Studies on Tiger (*Panthera tigris*)

Taxonomy and Identification.

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Tyger! Tyger! burning bright

In the forest of the night

What immortal hand or eye

Could frame thy fearful symmetry?

DECLARATION

I certify that this work does not incorporate without acknowledgment any material previously submitted for a degree or diploma in any university; and that to the best of my knowledge and belief it does not contain any material previously published or written by another person except where due reference is made in the text.

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Thitika Kitpipit

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Thitika Kitpipit

Studies on tiger (*Panthera tigris*) taxonomy and identification.

Abstract

All subspecies of tigers (*Panthera tigris*) are listed on Appendix 1 of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), affording them the highest international legal protection. The number of tigers has declined dramatically over the last 100 years and in particular in the last two decades with the main reason for the decline being illegal poaching for body parts. Enforcement of international and national legislation requires a reliable and robust forensic test to be established. The trade in tiger body parts is primarily in the form of powders and potions preventing any morphological examination and therefore requiring a molecular approach to identify the sample in question. The five extant subspecies are classified primarily on their phenotypic appearances, although there remains debate about this number of subspecies. Based on a combination of morphological and genetic data, proposals for the number of subspecies range from two to six. This study decoded the entire mitochondrial DNA sequence two individuals of four of the five subspecies of tiger to determine tiger taxonomic classification and to develop a DNA test for the unambiguous identification to the level subspecies. The analysis included a complete mitochondrial genome characterization, nucleotide composition and pattern and codon usage; with the aim to investigate tiger inter-, intra-species variation. The comparison of DNA sequences, which included these new sequences and all reliable sequence data on GenBank, revealed very limited subspecies diversity and questions the current classification. These studies indicated the presence of only 11 tiger species-, subspecies-specific variable sites found throughout the entire mitochondrial genome. A multiplex assay was developed to analyses polymorphic bases and was able to reliably identify 15 voucher tiger samples with 100% accuracy. The sensitivity of the test was down to a level of 15,000 mitochondrial DNA copies (approximately 0.26 pg), indicating that it will work on trace amounts of tissue, bone or hair. This simple and reliable technique can be applied by forensic science laboratories with the aim of enforcing legislation protecting the trade in the last remaining tiger.

Table of contents

Title **Page**

Acknowledgements ……i

Abstract……...ii

Table of contents……...…iii

Lists of table……..vii

Lists of figure……..….x

Lists of abbreviations……..……xxii

1 Introduction 1

1.1 The tiger (*Panthera tigris*) 1

1.1.1 General characteristics 1

1.1.2 Evolution of tigers 2

1.1.3 Taxonomy 2

1.1.4 Geography and distribution 10

1.1.5 Ecology and behaviour 11

1.1.6 Illegal trade of tiger and legislation 13

1.2 Mitochondrial DNA 15

1.2.1 Structure and its organization 15

1.2.2 Special features of mitochondrial genome 16

1.2.3 The use of mitochondrial DNA for forensic casework 18

1.3 Single nucleotide polymorphisms (SNPs) 20

1.3.1 Type of SNPs 20

1.3.2 The use of SNPs 21

1.3.3 SNP genotyping technologies 23

1.4 Molecular phylogenetics and tools 31

1.4.1 Phylogenetic tree and types 31

1.4.2 Molecular phylogenetic tree reconstruction 32

1.5 Aims of the project will be: 35

2 Materials and methods 36

2.1 Sample collection and DNA extraction 36

2.1.1 Sample collection 36

2.1.2 DNA extraction 37

Table of contents (Cont.)

2.2 The retrieval of the entire tiger mitochondrial genome.....37
2.2.1 Establishment of Panthera sequence alignment 37
2.2.2 Primer design.....38
2.2.3 The polymerase chain reaction (PCR).....40
2.2.4 DNA separation and detection 41
2.2.5 PCR product purification 41
2.2.6 DNA sequencing and post-sequencing method.....43
2.3 The analysis of the tiger mitochondrial genome.....46
2.3.1 Genome characterization and annotation 46
2.3.2 Nucleotide compositional pattern.....48
2.3.3 Codon usage 50
2.3.4 DNA sequence variation in the tiger mitochondrial genome 50
2.3.5 Tiger subspecies phylogeny 53
2.4 The development and validation for tiger species- and subspecies-specific SNPs identification 54
2.4.1 Tiger species and subspecies-specific SNP identification 54
2.4.2 The detection of tiger species and subspecies by SNaPshot® assay…….60
2.4.3 The validation of developed SNaPshot® multiplex assay 62
3 Results and discussions 66
3.1 The DNA sequencing of the entire mitochondrial genome of eight members of Panthera tiger species. 66
3.1.1 Primer design.....66
3.1.2 Primer test 67
3.1.3 The PCR amplifications of all tiger subspecies mitochondrial DNA… 70
3.1.4 PCR product purification and DNA sequencing 83
3.2 The analysis of the entire tiger mitochondrial genome.....87
3.2.1 Genome characterization.....87
3.2.2 Nucleotide compositional pattern.....98
3.2.3 Codon usage 104
3.2.4 DNA sequence variation in the tiger mitochondrial genome 105

Table of contents (Cont.)

3.2.5 Phylogeny in tiger subspecies 116

3.3 The development and validation of tiger species- and subspecies-specific SNP identification 126

3.3.1 Identification of tiger SNPs though the entire mitochondrial genome 126

3.3.2 The evaluation of a SNaPshot® assay developed for tiger species and subspecies identification 129

3.3.3 The validation of developed SNaPshot® multiplex assay 137

3.3.4 Unknown tiger sample identification 143

4 Conclusions 145

4.1 Novel scientific data derived from this thesis 145

4.2 Recent technological developments 146

4.3 Whole mitochondrial versus single mitochondrial genes 146

4.4 Analysis of the entire tiger mitochondrial genome and tiger subspecies phylogeny 147

4.5 The development and validation of tiger species- and subspecies-specific SNP identification 148

4.6 Future work 149

5 References 150

6 Appendix 172

6.1 Appendix 1: Publications for this thesis are shown below. 172

6.2 Appendix 2: The entire mitochondrial sequence alignment for all eight tiger samples. 207

6.3 Appendix 3: The alignment result of eight complete mitochondrial sequences from domestic cat (*Felis catus*) and five Panthera species (*Panthera uncia, Pantheara pardus, Panthera tigris, Neofelis nebulosa, Acinonyx jubatus*). The locations of the 26 Panthera-specific primer sets, amplified successfully the entire tiger mitochondrial genome, are shown on this alignment result. ..... CD

6.4 Appendix 4: The alignments of tiger sequences, obtained from the GenBank and this study, for each mitochondrial genes. ..... CD

Table of contents (Cont.)

6.5 Appendix 5: The cyt *b* sequence alignment of 349 mammalian sequences, 71 tiger sequences available on GenBank, and our tiger cyt *b* sequences. ..... CD

6.6 Appendix 6: The phylogenetic trees reconstructed from 37 tiger mitochondrial genes by using five different methods: neighbour-joining, minimum evolution, maximum parsimony, UPGMA, and Mr.Bayes method. ..... CD

LIST OF TABLES

Table 1: The details of collected tiger sample such as scientific name, number of samples, their label, type of samples, and from where they were obtained. 36

Table 2: Mitochondrial genome numbers for each *Panthera* species and their accession number 38

Table 3: Nucleotide sequences of twenty-six primer sets amplifying whole tiger mitochondrial DNA.....39

Table 4: The tiger sequence information used in this study, including: accession number; total number of DNA sequences used; and author of relevant paper and the year published. 52

Table 5: The mammalian sequence information used in this study, including: common name, scientific name, the total number of DNA sequences used, and the accession number obtained from GenBank. 54

Table 6: The expected and observed sizes of PCR products amplified by the twenty-six primer sets. 69

Table 7: The evaluation and scoring of PCR product yields obtained from the amplification of the 8 tiger samples using the twenty-six primers sets.....78

Table 8: Nucleotide sequences of twenty-six primer sets amplified successfully all tiger DNA samples and provided overlapping PCR fragments over the entire tiger mitochondrial genome. The full sequence of each primer is provided along with the calculated T_m and expected size of PCR product (nucleotide).....82

Table 9: Tiger genome organization: showing the locations and position of each gene, start and stop codon (for PCGs), anticodon (for tRNAs gene), gene size, and intergenic nucleotides. 89

LIST OF TABLES (Cont.)

Table 10: The percentage of nucleotide composition, GC-skew, AT-skew, and their skew standard deviation in the eight tiger mitochondrial genomes. 99

Table 11: The codon usage frequency and relative synonymous codon usage observed in the entire tiger mitochondrial genome. 105

Table 12: The DNA variable sites and their positions observed from the entire tiger mitochondrial genome. The 'N' represents a total number of variable site at a particular region; 'HN' represents Haplotype numbers; 'ATL' represents *P. t. altaica*; 'TIG' represents *P. t. tigris*; 'SUM' represents *P. t. sumatrae*; 'AMOY' represents *P. t. amoyensis*; 'COB' represents *P. t. corbetti*, 'Jack' represents *P. t. jacksoni*; '.' represents the same nucleotide base as the top haplotype sequences of *P. t. altaica* sample; '-' represents no sequence data at a particular site. Red fonts indicate tiger subspecies-specific SNP.....108

Table 13: Subspecies-specific SNPs for the tiger, with their position and location on the mitochondrial genome. 126

Table 14: Tiger species-specific SNPs and their position on the mitochondrial genome (bp), including a list of mammalian species with the same nucleotide bases for each SNP. The position was determined by aligning these sequences with the *Felis catus* sequences accession number U20753. The number inside the bracket is the number of sequences showing the same nucleotide base from the same species. Dot (.) represents a nucleotide position showing the same nucleotide base as tiger. 127

Table 15: Details of the three primer pairs being designed for SNaPshot® template amplification. These details are primer names, primer directions, primer sequences, melting temperature (T_m), primer sizes, their PCR product sizes, and the optimal primer concentration used in a multiplex SNaPshot® reaction. 129

LIST OF TABLES (Cont.)

Table 16: The location, direction and sequence of the SNaPshot® extension primer sequences used in this study. The size in bp and the optimal primer concentration in the SNaPshot® multiplex is also shown. Lower cases denote primer tail sequences. 132

Table 17: The expected and observed SNPs results obtained from singleplex SNaPshot® amplifications of P. t. sumatrae DNA using all single extension primers. 133

Table 18: The expected SNPs and their nucleotide base, dye colour and fragment sizes obtained by the amplifications of four tiger subspecies DNA using these extension primers. 136

Table 19: The statistic calculation for all tiger species- and subspecies-specific SNPs. This was run using 10 tiger voucher samples picked at random. Each tiger sample was used to prepare 10 PCR product aliquots of which all were injected to the capillary electrophoresis. 137

Table 20: The details of 14 mammalian samples used in the specificity test, including: scientific name, common name, type of sample, and where they were obtained from. 139

Table 21: The result of blind trial testing in 10 DNA samples picked at random. 143

LIST OF FIGURES

Figure 1: The morphology of the traditional eight tiger subspecies; *Panthera tigris sumatrae* (a), *Panthera tigris tigris* (b), *Panthera tigris corbetti* (c), *Panthera tigris altaica* (d), *Panthera tigris amoyensis* (e), *Panthera tigris virgata* (f), *Panthera tigris sondaica* (g), and *Panthera tigris balica* (h). All these eight pictures are cited from http://en.wikipedia.org/wiki/Tiger (accessed on 8 April 2011).....4

Figure 2: A strict consensus tree reproduced using the mitochondrial cyt b sequences for the 11 tiger haplotypes found by Cracraft et al., 1998. These 11 haplotypes were obtained by the analysis of 35 tiger samples from four tiger subspecies, *P. t. sumatrae, P. t. tigris, P. t. corbetti,* and *P. t. altaica*, which were abbreviated as 'Su', 'B', 'C', and 'S', respectively. The number given following these abbreviations indicates an individual tiger sample. The mitochondrial cytochrome *b* sequence of the lion was used to root the tree. A cladistic analysis yielded 25 equally parsimonious trees of 23 steps using the branch and bound option of PAUP 3.1 [23]. The numbers in brackets indicate the percentage of bootstrap support produced by 200 bootstrap replicates. Three haplotypes of *P. t. sumatrae* were clustered together whereas the rests of tiger subspecies haplotypes were either not clustered as a group or mixed with other subspecies (Cited from Cracraft *et al.* [19]).....6

Figure 3: A strict consensus tree reproduced using the combined data of mitochondrial cyt *b* sequences for the 11 tiger haplotypes, the two putative nuclear cyt *b* sequences, the published lion [24], and the lion sequence determined by [19]. The 11 haplotypes were obtained by the analysis of 35 tiger samples from four tiger subspecies, *P. t. sumatrae, P. t. tigris, P. t. corbetti*, and *P. t. altaica*, which were abbreviated as 'Su', 'B', 'C', and 'S', respectively. mitochondrial cyt *b* sequence of the domestic cat [25] was used to root the tree. A cladistic analysis yielded 70 equally parsimonious trees of 292 steps using the branch and bound option of PAUP 3.1 [23]. The numbers in brackets below the branches indicate the percentage of bootstrap support produced by 200 bootstrap replicates. The numbers above the branches indicate the range of branch lengths on the 70 equally parsimonious trees.

Likewise the phylogenetic result obtained from the analysis of tiger mitochondrial cyt *b* sequences, three haplotypes of *P. t. sumatrae* were clustered together and separate from all other tiger subspecies (Cited from Cracraft *et al*. [19]). 7

Figure 4: A phylogenetic tree reconstructed using the combined 4,078 bp mitochondrial sequence for the 25 tiger mtDNA haplotypes which were found among 100 tiger samples from the five living tiger subspecies, *P. t. sumatrae, P. t. tigris, P. t. corbetti, P. t. altaica, P. t. amoyensis*. Each tiger subspecies is represented by a different colour. The trees reconstructed using maximum parsimony (MP), maximum evolution (ME), and maximum likelihood (ML) approaches are identical; only the MP tree is shown here. The numbers above branches indicate the bootstrap support produced by 100 bootstrap replicates based on the MP method followed by bootstrap values of the ME-ML analyses (only those over 70% are indicated). Numbers below branches show number of MP steps per number of homoplasies from a strict consensus tree. Numbers in parentheses represent numbers of individuals sharing the same haplotype. MP analysis using heuristic search and tree-bisection-reconnection branch-swapping approach results in two equally most-parsimonious trees and the one resembling the ME and ML trees is shown here (tree length = 60 steps; CI = 0.900). The ME tree is constructed with PAUP using Kimura two-parameter distances (transition to transversion ratio = 2) and NJ algorithm followed by branch-swapping procedure (ME = 0.0142). The ML approach is performed using a TrN (Tamura-Nei) þI (with proportion of invariable sites) model, and all nodes of the ML tree were significant (a consensus of 100 trees, – Ln likelihood = 5987.09). Each of the subspecies *P. t. sumatrae* and *P. t. tigris* haplotypes formed a molophyletic group. The rest of the tiger subspecies haplotypes clustered together which was partitioned into three geographic groups, Amur tiger lineage (*P. t. altaica*), a northern Indochinese lineage (*P. t. corbetti*) included two haplotypes of the subspecies *P. t. amoyensis*, and a Malayan Peninsula tiger lineage (*P. t. jacksoni*) which was separated from the northern Indochinese tiger. *P. t. amoyensis* was found to have a unique group, forming a separate lineage from the other tiger

subspecies, but could only be confirmed with a larger sample size. The recognition of six tiger subspecies, *P. t. sumatrae, P. t. tigris, P. t. corbetti, P. t. altaica, P. t. amoyensis*, and *P. t. jacksoni*, were then proposed in this study (Cited from Luo *et al*. [22]).....8

Figure 5: The neighbor-joining phylogenetic tree reconstructed using the composite microsatellite genotypes of 30 loci obtained from 113 tiger samples. The tree topologies reconstructed based on the proportion of shared allele (Dps) and kinship coefficient (Dkf) genetic distance using the (1 – ps/kf) option in MICROSAT [26] was similar; only the Dps tree is shown here. The same colour branches represent the same tiger subspecies. Only the boostrap values over 50% are indicated on the divergence node. The result tends to support the recognition of six living tiger subspecies investigated by the phylogenetic analysis of 4kb mitochondrial DNA (Cited from Luo *et al*. [22]).....9

Figure 6: The geographical distribution of eight subspecies of tiger classified by Mazak (1981), 1) *P. t. virgata*, 2) *P. t. tigris*, 3) *P. t. corbetti*, 4) *P. t. sumatrae*, 5) *P. t. sondaica*, 6) *P. t. balica*, 7) *P. t. amoyensis*, 8) *P. t. altaica*. The colours indicate a historical and current geographical distribution of tiger; the yellow represents a geographical distribution of tiger in 1900 while current tiger geographical distribution is shown in red (modified from Seidensticker *et al*., 1999 and Kitchener and Dugmore, 2000).....11

Figure 7: The schematic view of mitochondrial genome. The D-loop is shown at the top (12 o'clock) where a base is numbered as 1, with bases numbered sequentially in a clockwise direction. The colours represent the average diversity within mammalian species. The diagram is reproduced from Linacre, 2009.....16

Figure 8: The synonymous, non-synonymous and frame shift mutational events. A synonymous mutation is the change of one DNA base to another that does not result in a change to the amino acid sequence of the resulting

protein. Conversely, the change of one base to another leading to a change of the amino acid sequence is called a non-synonymous mutation. Frameshift mutation is normally causes by insertion or deletion, which results in a disrupt to the reading frame, or the grouping of the codons, resulting in a completely different translation from the original. 19

Figure 9 The characteristics of bi-allelic SNP (A/C), tri-allelic SNP (A/C/G), and tetra-allelic SNP (A/C/G/T). The tri- and tetra-allelic SNP are rarely found in the genome. 21

Figure 10: The details for the three steps, allele discrimination, product separation, and product detection strategy, combined as a SNP genotyping technology. A list of the recent SNP genotyping commercial systems, including their platform patterns is also shown here. 23

Figure 11: The processes of the five SNP allelic discrimination methods; allele-specific oligonucleotide (ASO) (a), mininsequencing (c), oligonucleotide ligation (d), invasive cleavage (e), and enzymatic cleavge (f) [114]. 26

Figure 12: The example of how to call base 'N'. The X-axis represents nucleotide bases determined for each sequence positions; the Y-axis represents an adjustable vertical scale. One nucleotide base at the position 219 out of eight nucleotide bases, found in the DNA sequence of mtDNA fragment amplified by primer set 11, is ambiguous (a). This unclear base is edited to be base "G" base on the black colour (b). 43

Figure 13: The diagram showing how to make alignment for forward and reversed complementary sequencing strand. 44

Figure 14: The steps to extend sequences obtained from the same sample 45

Figure 15: An example of unsuitable 12S rRNA sequence obtained from GenBank (highlighted by yellow colour). A number of mismatch base ambiguities are found on the tiger sequence alignment, particularly at the

variable sites. This sequence is not used for tiger subspecies-specific SNP identification.....51

Figure 16: the positions of twenty-six primer sets on *Panthera tigris sp*. mtDNA map, which amplify and provide whole tiger mitochondrial genome sequence. The sizes of PCR fragment are in the rage of 700 – 900 bp. The next primer set amplifying adjacent region was designed to give overlapping DNA sequences of approximately 100 – 150 bp.....66

Figure 17**:** The results of amplification with twenty-six tiger specific primer sets using *P. t. sumatrae*. The PCR products (10µL/well) were separated on a 2% agarose gel and visualized with ethidium bromide staining. The 50 bp DNA ladder was used to determine the size of PCR products (lane 1). The Sumatran tiger DNA could be successfully amplified by all primer sets, except primer set 17 (Lane 3, bottom left). Two PCR fragments were observed from primer set 22.....68

Figure 18**:** a) The amplification of *P. t. sumatrae* DNA with the original primer set 17 performed by decreasing annealed temperature from 60 ^{o}C to 58 ^{o}C, 56 ^{o}C, and 54 ^{o}C. The 50 bp DNA ladder was used to determine the size of PCR products (lane 1). The result shows very faint bands at the expected size, indicating poor amplification at the annealing temperature at 56 ^{o}C (lane 3) and 54 ^{0}C (lane 4). b) The amplification of the same tiger DNA with the new primer set 17 (primer 17N). The result shows bands of higher intensity compared to the original primer set 17 at the annealing temperature of 60 ^{o}C. All PCR products (10µL/well) were separated on a 2% agarose gel and visualized with ethidium bromide staining. 70

Figure 19**:** The amplification results of all twenty-six primer sets. The PCR products (5µL/well) were electrophoresed on a 2% agarose gel and visualized with ethidium bromide staining. The 50 bp DNA ladder was used to determine the size of PCR products (lane 1). All tiger subspecies were successfully amplified by these primer sets. Two PCR frangments were

observed from all eight samples amplified by primer set 22 and one *P. t. corbetti* sample when amplified by primer set 5. High PCR product yields were obtained for both samples of *P. t. sumatrae* (SUM1/SUM2) and one sample of *P. t. altaica* (ALT4) while the remaining samples provided lower yields. 76

Figure 20: The amplifications of *P. t. corbetti* (COB1) with primer set 5 and 22 performed by increasing the annealing temperature from 60 ^{o}C to 63 ^{o}C, and 66 ^{o}C. The PCR products (10µL/well) were separated on a 2% agarose gel and visualized with ethidium bromide staining. The 50 bp DNA ladder was used to determine the size of PCR products (lane 1). The results showed that the amplifications with the annealing temperature of 60 ^{o}C and 63 ^{o}C still produced two products; at the approximate sizes of 650/850 bp for primer set 5 (lane 2 and 3), and 700/900 bp for primer set 22 (lane 4 and 5). No PCR product was observed at the annealing temperature of 66 ^{o}C. 77

Figure 21: The amplification of *P. t. tigris* (TIG2) and *P. t. corbetti* (COB1) DNA with the primer set 3 performed by decreasing the annealing temperature from 60 ^{o}C to 58 ^{o}C, 56 ^{o}C, and 54 ^{o}C. The PCR products (5µL/well) were separated on a 2% agarose gel and visualized with ethidium bromide staining. The 50 bp DNA ladder was used to determine the size of PCR products (lane 1). The result shows that expected bands have been amplified successfully from *P. t. corbetti* DNA, which were used as positive controls (lane 2 and 4). The amplification of TIG2 at the annealing temperature of 56 ^{o}C failed while a very faint band was observed using the annealing temperature of 54 ^{o}C (lane 5).....79

Figure 22: The positions of the old and re-designed primers for the entire tiger mitochondrial genome amplification. The new primer set 3 (new 3F and 3R) was re-designed from a position close to the prior one. 80

Figure 23: The results of 8 tiger samples amplified with the new primer set 3 (primer 3N). The PCR products (10 µL/well) were separated on a 2% agarose

gel and visualized with ethidium bromide staining. The 50 bp DNA ladder was used to determine the size of PCR products (lane 1). All tiger subspecies samples were amplified successfully by this primer set.....81

Figure 24: The example of good quality DNA sequence data of an mtDNA fragment amplified from Sum1 DNA sample with primer set 9 at the position 80 to 670. This PCR fragment was extracted from muscle sample and purified by the Exo-Sap method. 85

Figure 25: The example of bad quality DNA sequencing of mtDNA fragment amplified from Cob 1 DNA sample with primer set 8 at the position 80 to 660. This PCR fragment was extracted from hair sample and purified by the Exo-Sap method. There appears to be a secondary DNA sequence interfering with the main sequence. 85

Figure 26: The quality of DNA sequencing of mtDNA fragment amplified from Cob 1 DNA sample with primer set 8 at the position 170 to 630. This PCR fragment was extracted from hair sample and purified by gel extraction purification method. The quality of the data are improved obviously compared to Figure 25. 86

Figure 27: A mitochondrial genome map of *Panthera tigris*. Thirteen protein coding genes are in blue; 2 rRNA genes are in green; 22 tRNA genes are in yellow; and the D-loop region is in white. The inner circular is the light strand of mitochondrial DNA that contains a total of nine coding genes. The origin of replication of the both heavy and light strand are labelled and shown in red. 90

Figure 28: Putative secondary structures of the 22 tRNA genes identified in the entire mitochondrial genome of *Panthera tigris* using the tRNAscan-SE and RNAfold ($tRNA^{-Ser\ (AGY)}$). Dot colours indicate base-pairing probabilities; red represents strong base-paring probability, blue represents weak base-paring. The anticodon positions in all indentified tRNAs are marked with a black curve line. 94

LIST OF FIGURES (Cont.)

Figure 29: Putative minimum free energy (MFE) secondary structures of 12S and 16S rRNAs identified in the tiger mitochondrial genome. The structures are coloured by base-pairing probabilities; the colour ranges from red representing the highest base-paring probability to blue representing the lowest base-paring probability. 95

Figure 30: The tiger control region organization which consists of five parts: hypervariable region I (HV I), repeat sequence I (RS I), conserved control region (CCR), repeat sequence II (RS II), and hypervariable region II (HV II). 96

Figure 31: A characteristic of the length heteroplasmy found in the control region of tiger mitochondrial genome (TIG1) at the position 270-335. It was observed in the three tiger samples, COB1, COB2, and TIG1. 97

Figure 32: The nucleotide base composition in terms of AT% (in blue) and GC% (in red) observed in all 37 mitochondrial genes. The AT content is higher than the GC content in 36 mitochondrial genes, except in the region of the $tRNA^{-Ile}$ (t-Ile) gene where the GC content represented 69% and the AT content represents 15.9%.....102

Figure 33: The nucleotide compositional asymmetry in terms of AT- and GC-skew observed in all 37 mitochondrial genes. Overall, the value of AT-skew was mostly lower than an absolute GC-skew value; however, a high AT-Skew value was found in the ND6 (0.29) and $tRNA^{-Phe}$ (0.25) genes. The GC-skew showed a negative value in most of mitochondrial genes, except in three tRNA genes ($tRNA^{-Phe}$, $tRNA^{-Asp}$, and $tRNA^{-Leu}$ (CUN)). Negative AT-skews were found in five mitochondrial genes, $tRNA^{-Tyr}$, COI, ATP6, COII, and ND4L. Zero AT-skews were observed in $tRNA^{-Cys}$ and $tRNA^{-Asp}$.....103

Figure 34: Percentages of sequence variable site (VS), conserved site (CS) and inter-subspecies variable site (ISS) observed from each of the 37 tiger mitochondrial genes. The highest percentage of sequence variable sites was found in the cyt *b* gene (3.33%); high percentages of variable sites were

observed in the tRNA^{-Asn} (2.74%), COIII (1.91%), ATP6 (1.91%), and ND2 (1.73%) genes. Almost all the sequences were highly conserved in all the mitochondrial genes; the lowest percentage was as high as 96.6% found in the cyt b gene. The inter-tiger subspecies DNA variation were found only in the three mitochondrial genes (ND2, ND6, and cyt *b*).....115

Figure 35: Phylogenetic trees reconstructed using the entire tiger mitochondrial genomes of the five extant tiger subspecies, *P. t. tigris, P. t. sumatrae, P. t. altaica, P. t. corbetti, P. t. amoyensis,* using the five methods: neighbor-joining (a), maximum likelihood (b), parsimony method (c), UPGMA (d), and Mr.Bayes (e). The default phylogenetic parameters were used for all runs. Either bootstrap or interior branch test was set as 500 replicates; 64238 random seed was used to test the reliability of reconstructed phylogenetic trees. A complete deletion option for any gap or missing data, and the Maximum Composite Likelihood Model was used.....120

Figure 36: Phylogenetic trees reconstructed using the ND1 gene sequences of the five extant tiger subspecies, *P. t. tigris, P. t. sumatrae, P. t. altaica, P. t. corbetti, P. t. amoyensis*, using the five methods: neighbor-joining (a), maximum likelihood (b), parsimony method (c), UPGMA (d), and Mr.Bayes (e). The default phylogenetic parameters were used for all runs. Either bootstrap or interior branch test was set as 500 replicates; 64238 random seed was used to test the reliability of reconstructed phylogenetic trees. A complete deletion option for any gap or missing data, and the Maximum Composite Likelihood Model was used. 125

Figure 37: The position of all eleven tiger species and subspecies-specific SNPs on a mitochondrial map. Numbers represent the position of the SNPs on the mitochondrial DNA which are in the ND2, ND6 and cyt b genes. 128

Figure 38: The position of three primer pairs designed for SNaPshot® template amplification on mitochondrial map.....129

LIST OF FIGURES (Cont.)

Figure 39: The results of tiger DNA singleplex amplification with primer set P1, P2 and P3. The PCR products (10 µL/well) were separated on a 2% agarose gel and visualized with ethidium bromide staining. Lane 1 is a 100 bp DNA ladder; lane 2,3, and 4 is the PCR products of P1, P2, and P3, respectively.....130

Figure 40: The results of tiger DNA amplification with primer set P1, P2 and P3. The PCR products (20 µL/well) were separated on a 3% agarose gel and visualized with ethidium bromide staining. Lane 1 is a 100 bp DNA ladder; lane 2, 3, and 4 is the PCR products of *P. t. tigris, P. t. sumatrae, P. t. corbetti*, and *P. t. altaica*, respectively.....131

Figure 41: The amplification result of all 15 tiger voucher samples using primer set P1, P2 and P3. The PCR products (20 µL/well) were separated on a 3% agarose gel and visualized with ethidium bromide staining. 132

Figure 42: The electropherogram shows singleplex amplification of *P.t.sumatrae* using all single eleven-extension primers. 134

Figure 43: The electropherogram generated by SNP typing of four extant tiger subspecies (*P. t. tigris, P. t. sumatrae, P. t. corbetti,* and *P. t. altaica*) when analyzed with the SNaPshot® kit developed in this study for tiger species and subspecies identification.....136

Figure 44: The electropherogram shows SNP typing of *P. t. corbetti* at the concentration of 120,000, 60,000, 30,000, 15,000, and 7,500 mitochondrial copies. A product can be seen at all dilutions down to 15,000 mitochondrial copies. No product was recorded from 7,000 mitochondrial copies. 138

Figure 45: The amplification result of *P. t. corbetti* at the concentration 120,000, 60,000, 30,000, 15,000, and 7,500 mitochondrial copies. The PCR products (20 µL/well) were separated on a 3% agarose gel and visualized with ethidium bromide staining. A product can be seen in the lane of 15,000 copies but not visible when loading 7,500 copies. 139

LIST OF FIGURES (Cont.)

Figure 46: The electropherogram shows SNP typing of tiger and 14 other mammalian species when analyzed with the single SNaPshot® kit developed in this study for tiger species and subspecies identification. The expected product can be seen only in the tiger species. 140

Figure 47: The specificity test for the SNaPshot® multiplex assay for tiger species and subspecies identification. Lane 1 and 9 is a 100 bp DNA ladder (100 bp is the smallest fragment shown); lane 2 is tiger (*Panthera tigris*); lane 3 is cheetah (*Acinoyx jubatus*); lane 4 is jaguar (*Panthera onca*); lane 5 is lion (*Panthera leo*); lane 6 is snow leopard (*Panthera pardus*); lane 7 is clouded leopard (*Neofelis nebulosa*); lane 8 is puma (*Puma concolor*); lane 10 is domestic cat (*Felis catus*); lane 11 is bear (*Ursus thibetanus*); lane 12 is horse (*Equus caballus*); lane 13 is sika deer (*Cervus nippon*); lane 14 is domestic dog (*Canis familiaris*); lane 15 is cow (*Bos taurus*); lane 16 is goat (*Capra hircus*); and lane 17 is human (*Homo sapiens*). The PCR products (10 µL/well) were separated on a 3% agarose gel and visualized with ethidium bromide staining. 141

Figure 48: The amplification result of ten blind samples. The PCR products (20 µL/well) were separated on a 3% agarose gel and visualized with ethidium bromide staining. 142

Figure 49: The electropherogram showing SNP typing of ten blind samples when analyzed with the single SNaPshot® kit developed in this study for tiger species and subspecies identification. Sample 2, 5, 6, 8, and 10 were identified as being from a tiger sample. Sample 3, 4 were identified as being from a big cat samples. 142

Figure 50: The amplification result four unknown tiger subspecies samples. The PCR products (20 µL/well) were separated on a 3% agarose gel and visualized with ethidium bromide staining. 143

LIST OF FIGURES (Cont.)

Figure 51: The electropherogram shows SNP typing of four unknown tiger subspecies samples when analyzed with the single SNaPshot® kit developed in this study for tiger species and subspecies identification.....144

LIST OF ABBREVIATIONS

A	Adenine
bp	Base pair
cyt *b*	Cytochrome *b*
CO	Cytochrome Oxidase
C	Cytosine
°C	Degree Celsius
DNA	Deoxyribonucleic acid
dNTP	Deoxyribonucleotide triphosphate
g	Gram
G	Guanine
h	Hour
$MgCl_2$	Magnesium Chloride
T_m	Melting temperature
µL	Microliter
mg	Milligram
mL	Milliliter
mm	Millitmetre
min	Minute
mtDNA	Mitochondrial DNA
M	Molar
ND	NADH dehydrogenase
ng	Nanogram
ALT	*Panthera tigris altaica*
COB	*Panthera tigris corbetti*
SUM	*Panthera tigris sumatrae*
TIG	*Panthera tigris tigris*
%	Percentage
pM	Picomolar
pmole	Picomole
PCG	Protein-coding gene
RSCU	Relative synonymous codon usage

LIST OF ABBREVIATIONS (Cont.)

RFLP	Restriction fragment length polymorphism
rpm	Revolutions per minute
rRNA	Ribosomal RNA
s	Second
STR	Short tandem repeat
SNP	Single nucleotide polymorphisms
CITES	The convention on international trade in endangered wild fauna and flora
IUCN	The international union for conservation of nature
TRAFFIC	The wildlife trade monitoring network
T	Thymine
tRNA	Transfer RNA
TBE	Tris boric acid-ethylenediaminetetra acetic acid
V	Voltage
v/v	Volume per volume
w/v	Weight per volume
WWF	World wildlife fund

1 Introduction

1.1 The tiger (*Panthera tigris*)

1.1.1 General characteristics

Tiger (*Panthera tigris*) is the largest felid in the world today. It typically has muscular characteristics with powerful forequarters and a somewhat large head. Its face is surrounded with a white fringe and stripes that vary from brown or gray to pure black. The ground colouration of the tiger body varies from white to reddish orange, with many dark vertical stripes with various lengths, breadths, and/or form. The belly region of tiger is white or whitish. The ears are rounded and relatively small, with a black colour and white spot on their dorsal area. The length of tail is normally less than one half of the head and body length while hair length is variable geographically, in the range of 7 mm to 20 mm on the dorsal and 15 mm to 35 mm on the ventral [1]. Tiger's forefeet have five toes while the hind feet have just four toes; the hallux is absent. The pollex of forefeet is raised above the others and does not touch the ground. Tiger claws are retractable. The teeth of tigers are exceptionally stout. Canines are long and slightly curved; they are the longest among living felids. The height of crown of the upper canine is as much as 74.5 mm in *P t. altaica* [2].

As is the case with most animals in this Family, the males are usually larger than the females. The body length of tiger is in the range between 2200 mm and 3000 mm [1, 3]. The Indian and Siberian tiger are commonly larger than other subspecies. The largest Indian tiger "Bachelor of Powalgarh" measured 3228 mm within the "over curves" which is equal to about 3070 mm to 3100 mm measured "between pegs" [4]. The weight of tiger is up to 300 kilograms (660 pounds). The heaviest Indian and Siberian tiger weighted 258.2 kg and 306.5 kg, respectively [5, 6]. Male tigers also possess distinct characteristic of long hair whiskers on its face.

1.1.2 Evolution of tigers

The evolution of tiger is known from several evidences of fossil and phylogenetics analysis. The oldest fossil, called *Felis palaeosinensis*, was found in northern China and Java [7]. It is thought to date from the end of the Pliocene and the beginning of the Pleistocene, being more than two million years old [7, 8]. Early tiger fossils have also been excavated from Java. Their age is estimated to be between 1.66 and 1.81 million years, which is in the beginning of Pleistocene. Based on this evidence, it is believed that the tiger originated from eastern Asia and distributed broadly in this area during the beginning of Pleistocene, two million years ago [1, 7]. Collier and O'Brien [9] supported this hypothesis by showing that the tiger diverged from other Panthera species up to two million years ago before the divergence of lion, leopard and jaguar. The centre of evolution is thought to be in northern China [1, 7].

In spite of some uncertainty regarding from where the tiger first emerged, it is believed to have spread into northeast Asia, and south into the Sunda Islands and the subcontinent of India [7]. A certain group of authors, like Hemmer [7] and Mazak [1], proposed that tigers came into southwest Asia from northeast Asia via central Asia. While other authors, like Heptner and Sludskii [10], suggest that tigers came into South East Asian from northwest India.

1.1.3 Taxonomy

Tiger (*Panthera tigris*) is classified within Kingdom Animalia; Phylum Chordata; Class Mammalia; Order Carnivora; Family Felidae; and Genus Panthera. Historically, the subspecies of tiger were classified by their geography and morphological features such as body size, skull characters, striping pattern, and coloration of pelage, as defined by Mayr [11]. Based on this subspecies concept, a total of eight traditional subspecies of the tiger were recognized, as the following [1]:

1. ***Panthera tigris tigris*** [12] or Bengal Tiger, is found in parts of India, Bangladesh, Nepal, Bhutan, and Burma.

2. ***Panthera tigris virgata*** [13] or Caspian tiger, was found in range of Afghanistan, Iran, Turkey, Mongolia, and the Central Asiatic area of Russia.
3. ***Panthera tigris altaica*** [14] or Siberian tiger, Amur tiger, is found currently in Korea, east Russia.
4. ***Panthera tigris sondaica*** [14] or Javan tiger, was found in the Indonesian island of Java.
5. ***Panthera tigris amoyensis*** [15] or South China tiger, was native to south central China.
6. ***Panthera tigris balica*** [16] or Balinese tiger, was found in Bali.
7. ***Panthera tigris sumatrae*** [17] or Sumatran tiger, is found only on the Indonesian island of Sumatra.
8. ***Panthera tigris corbetti*** [18] or Indochinese tiger, is found in Cambodia, China, Laos, Burma, Thailand, and Vietnam.

Out of the above eight tiger subspecies *Panthera tigris virgata, Panthera tigris sondaica*, *and Panthera tigris balica* are already extinct, which leaves only five extant subspecies. It is noted that the subspecies *Panthera tigris amoyensis* no longer exists in the wild. The morphology of these eight tiger subspecies are shown in Figure 1.



a) Sumatran tiger



b) Bengal Tiger



c) Indochinese tiger



d) Siberian tiger



e) South China tiger



f) Caspian tiger



g) Java tiger



h) Balinese tiger

Figure 1: The morphology of the traditional eight tiger subspecies; *Panthera tigris sumatrae* (a), *Panthera tigris tigris* (b), *Panthera tigris corbetti* (c), *Panthera tigris altaica* (d), *Panthera tigris amoyensis* (e), *Panthera tigris virgata* (f), *Panthera tigris sondaica* (g), *and Panthera tigris balica* (h). All these eight pictures are cited from http://en.wikipedia.org/wiki/Tiger (accessed on 8 April 2011).

There are several researches that evaluated the numbers of tiger subspecies based on morphological, biochemical, and molecular genetic studies. Different authors have proposed diverse conclusions. Cracraft *et al*. [19] have proposed two subspecies of living tiger; the mainland tiger (*P. tigris*) and an island species (*P. sumatrae*), using phylogenetic analysis of the mitochondrial cytochrome *b* (cyt *b*) gene and nuclear cyt *b*-like sequence. In their study [19], the phylogenetic relationship among four subspecies of tiger, *P. t. sumatrae, P. t. tigris, P. t. corbetti, P. t. altaica,* have been investigated. The phylogenetic trees reconstructed from both the mitochondrial cyt *b* gene and nuclear cyt *b*-like gene showed that the *P. t. sumatrae* haplotypes were clustered together whereas the remainder of the recognized tiger subspecies haplotypes were either not clustered as a group or mixed with other subspecies (Figure 2 and Figure 3). The clustering of *P. t. sumatrae* haplotypes confirmed the distinctness of Sumatrans as a separate taxonomic unit. While Kitchener [3] suggests that it is difficult to prove subspeciation in the tiger based on morphological analysis and also shows strong evidence of clinal variation in tiger morphology over a geographical range. However three models of tiger subspecies are also proposed by Kitchener [3]. One of these models is supported by Mazak [20], who proposed two basic forms of modern tigers; mainland tiger and Sunda tiger, based on craniometric study and multivariate analysis. In this study [20], *P. t. sumatrae* showed evidence of hybrid characteristic of mainland and island tiger. Wentzel *et al*. [21] showed that the genetics of extant tiger subspecies are very similar and exhibit low diversity based on mtDNA sequence variation. While Luo *et at.* [22] proposed six extant subspecies of tiger (*P. t. sumatrae, P. t. tigris, P. t. corbetti, P. t. altaica, P. t. amoyensis,* and *P. t. jacksoni*) based on the analysis of three molecular markers; 4 kb of mitochondrial DNA, 30 loci composite nuclear microsatellite genotypes, and allele variation in the nuclear major histocompatibility complex class II DRB gene. According to their study of the phylogenetic relationship among living tiger subspecies, the two subspecies, *P. t. sumatrae* and *P. t. tigris* haplotypes, formed a monophyletic group while the rest of the tiger subspecies haplotypes clustered together (Figure 4). The clustered unit was partitioned into three geographic groups which are: an Amur tiger lineage (*P. t. altaica*); a northern Indochinese lineage (*P. t.*

corbetti), which included two haplotypes of the subspecies *P. t. amoyensis*; and a Malayan Peninsula tiger lineage (*P. t. jacksoni*) which was separated from the northern Indochinese tiger. By the need of larger sampling, the unique genetic haplotype of *P. t. amoyensis* was suggested which was found to form a separate lineage from the other tiger subspecies. This result was also supported by the statistical parsimony network analysis of the 4 kb tiger mitochondrial sequence (Figure 5).

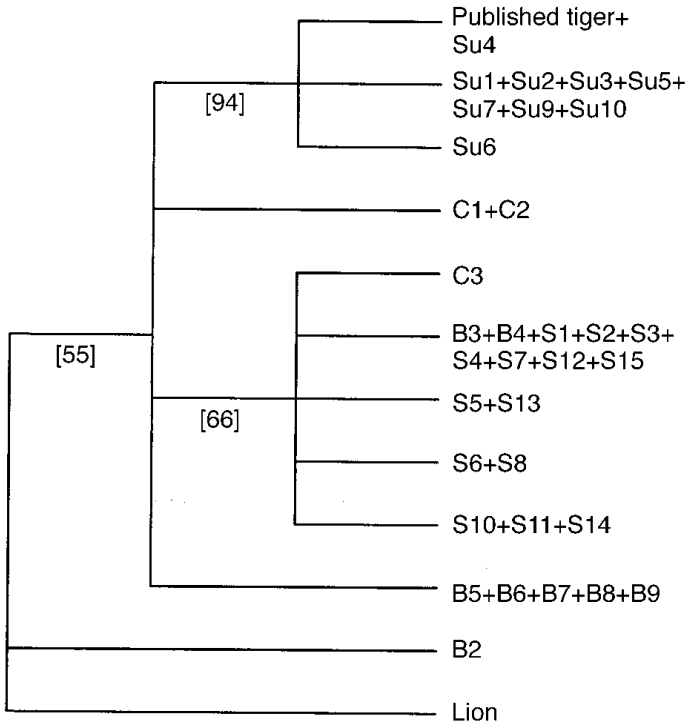


Figure 2: A strict consensus tree reproduced using the mitochondrial cyt *b* sequences for the 11 tiger haplotypes found by Cracraft *et al.*, 1998. These 11 haplotypes were obtained by the analysis of 35 tiger samples from four tiger subspecies, *P. t. sumatrae, P. t. tigris, P. t. corbetti,* and *P. t. altaica*, which were abbreviated as 'Su', 'B', 'C', and 'S', respectively. The number given following these abbreviations indicates an individual tiger sample. The mitochondrial cytochrome *b* sequence of the lion was used to root the tree. A cladistic analysis yielded 25 equally parsimonious trees of 23 steps using the branch and bound option of PAUP 3.1 [23]. The numbers in brackets indicate the percentage of bootstrap support produced by 200 bootstrap replicates. Three haplotypes of *P. t. sumatrae* were clustered together whereas the rests of tiger subspecies haplotypes were either not clustered as a group or mixed with other subspecies (Cited from Cracraft *et al.* [19]).

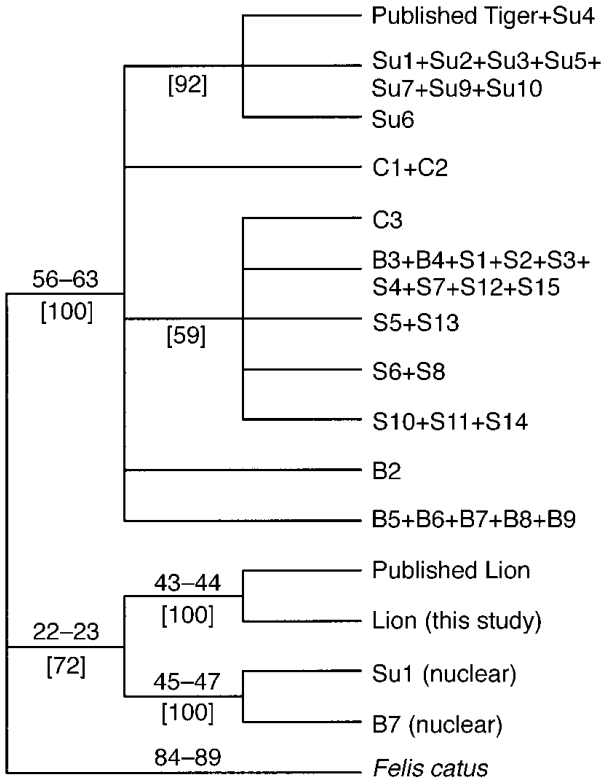


Figure 3: A strict consensus tree reproduced using the combined data of mitochondrial cyt *b* sequences for the 11 tiger haplotypes, the two putative nuclear cyt *b* sequences, the published lion [24], and the lion sequence determined by [19]. The 11 haplotypes were obtained by the analysis of 35 tiger samples from four tiger subspecies, *P. t. sumatrae, P. t. tigris, P. t. corbetti,* and *P. t. altaica*, which were abbreviated as 'Su', 'B', 'C', and 'S', respectively. mitochondrial cyt *b* sequence of the domestic cat [25] was used to root the tree. A cladistic analysis yielded 70 equally parsimonious trees of 292 steps using the branch and bound option of PAUP 3.1 [23]. The numbers in brackets below the branches indicate the percentage of bootstrap support produced by 200 bootstrap replicates. The numbers above the branches indicate the range of branch lengths on the 70 equally parsimonious trees. Likewise the phylogenetic result obtained from the analysis of tiger mitochondrial cyt *b* sequences, three haplotypes of *P. t. sumatrae* were clustered together and separate from all other tiger subspecies (Cited from Cracraft *et al*. [19]).

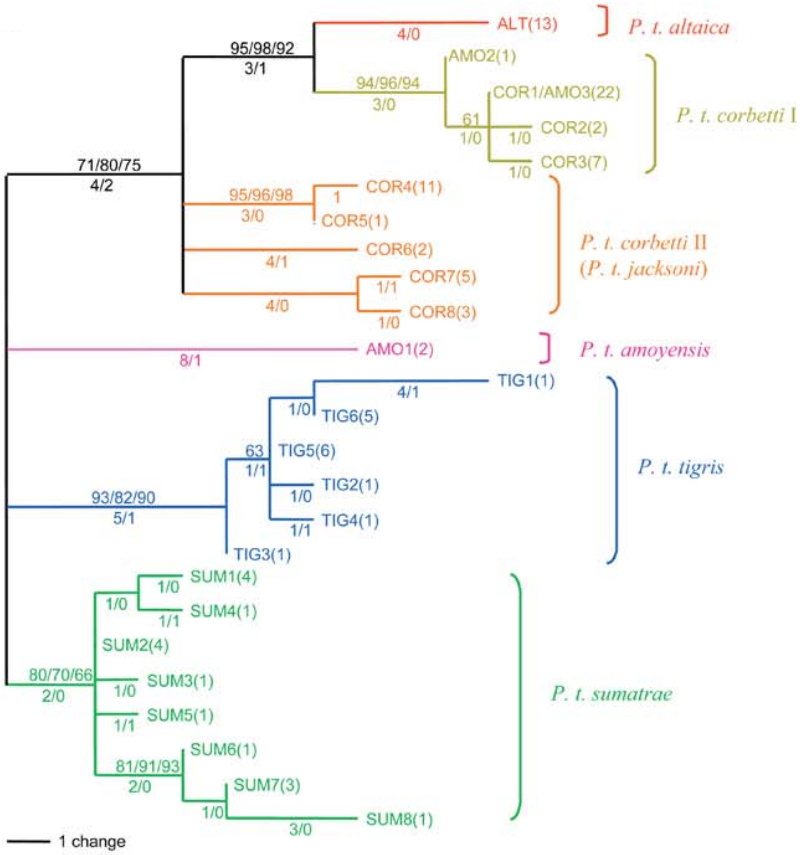


Figure 4: A phylogenetic tree reconstructed using the combined 4,078 bp mitochondrial sequence for the 25 tiger mtDNA haplotypes which were found among 100 tiger samples from the five living tiger subspecies, *P. t. sumatrae, P. t. tigris, P. t. corbetti, P. t. altaica*, *P. t. amoyensis*. Each tiger subspecies is represented by a different colour. The trees reconstructed using maximum parsimony (MP), maximum evolution (ME), and maximum likelihood (ML) approaches are identical; only the MP tree is shown here. The numbers above branches indicate the bootstrap support produced by 100 bootstrap replicates based on the MP method followed by bootstrap values of the ME-ML analyses (only those over 70% are indicated). Numbers below branches show number of MP steps per number of homoplasies from a strict consensus tree. Numbers in parentheses represent numbers of individuals sharing the same haplotype. MP analysis using heuristic search and tree-bisection-reconnection branch-swapping approach results in two equally most-parsimonious trees and the one resembling the ME and ML trees is shown here (tree length = 60 steps; CI = 0.900). The ME tree is constructed with PAUP using Kimura two-parameter distances (transition to transversion ratio = 2) and NJ algorithm followed by branch-swapping procedure (ME = 0.0142). The ML approach is performed using a TrN (Tamura-Nei) þI (with proportion of invariable sites) model, and all nodes of the ML tree were significant (a consensus of 100 trees, – Ln likelihood = 5987.09). Each of the subspecies *P. t. sumatrae* and *P. t. tigris* haplotypes formed a molophyletic group. The rest of the tiger subspecies haplotypes clustered together which was partitioned into three geographic groups, Amur tiger lineage (*P. t. altaica*), a northern Indochinese lineage (*P. t. corbetti*) included two haplotypes of the subspecies *P. t. amoyensis*, and a Malayan Peninsula tiger lineage (*P. t. jacksoni*) which was separated from the northern Indochinese tiger. *P. t. amoyensis* was found to have a unique group, forming a separate lineage from the other tiger subspecies, but could only be confirmed with a larger sample size. The recognition of six tiger subspecies, *P. t. sumatrae, P. t. tigris, P. t. corbetti, P. t. altaica, P. t. amoyensis,* and *P. t. jacksoni*, were then proposed in this study (Cited from Luo *et al.* [22]).

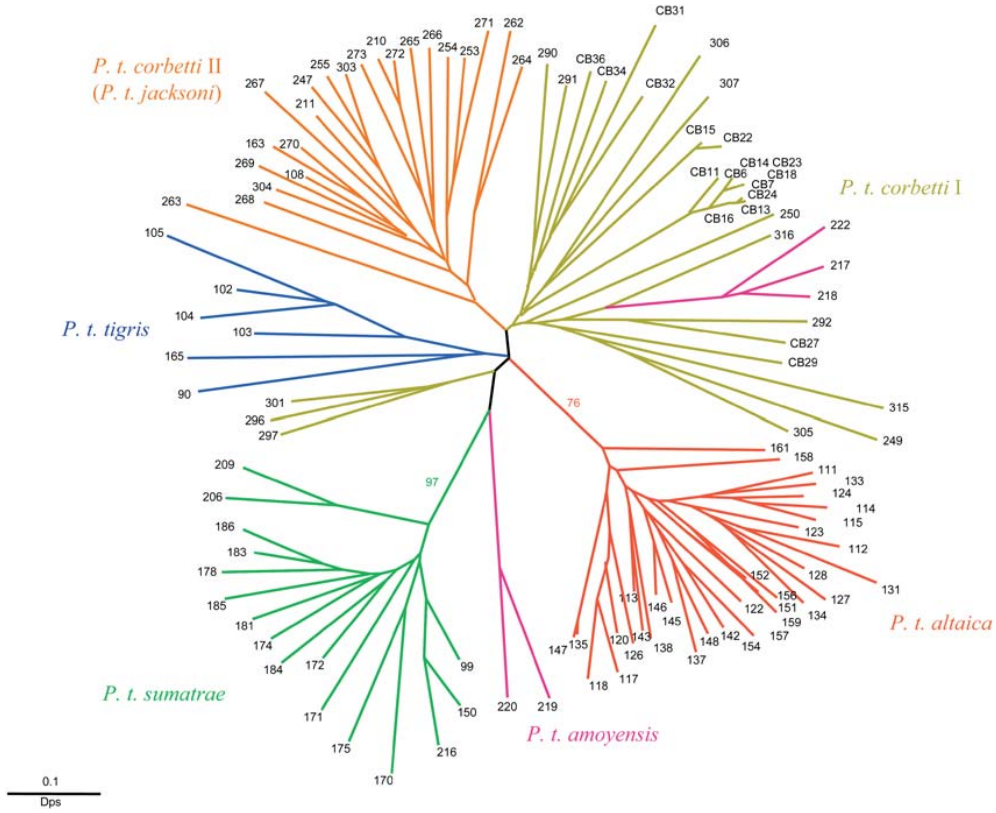


Figure 5: The neighbor-joining phylogenetic tree reconstructed using the composite microsatellite genotypes of 30 loci obtained from 113 tiger samples. The tree topologies reconstructed based on the proportion of shared allele (Dps) and kinship coefficient (Dkf) genetic distance using the (1 – ps/kf) option in MICROSAT [26] was similar; only the Dps tree is shown here. The same colour branches represent the same tiger subspecies. Only the boostrap values over 50% are indicated on the divergence node. The result tends to support the recognition of six living tiger subspecies investigated by the phylogenetic analysis of 4kb mitochondrial DNA (Cited from Luo *et al*. [22]).

1.1.4 Geography and distribution

Possibly owing to their adaptability to varied conditions, the tigers once had one of the widest geographical distribution of any cat, stretching originally from almost 10 latitudes south of the equator (Java and Bali) to more than 60 north (the Russian Far East) and through more than 100 longitudes [21]. Tigers were distributed as far north as Siberia, as far west as Turkey, to the east on the Island of Sakhalin, and down to the Southern islands of Indonesia [21, 27]. They were also found along the great rivers deep into central China to the coast of eastern China. The geographical distribution of each traditional eight subspecies of tiger is described in section 1.2.

Manchuria, Korea, and parts of south eastern Siberia formed the northern most limit of their distribution. Tigers never inhabited the Tibetan plateau, Iran south of the Elburz Mountains, southern Afghanistan, western and south western Baluchistan (Pakistan), lower Sind and Cutch, Sri Lanka, or other islands of the Malayan Archipelago (except Sumatra, Java and Bali). India, Nepal, and possibly Malaya have the largest extant population of tigers. Tigers are no longer remaining in south eastern Turkey and northern Afghanistan. Recently, tigers occupying the Caspian region, the islands of Java and Bali, and southern China have become extinct because of the loss of habitat and the persistent killing of tigers and their prey [28]. Presently, the number of tigers has dramatically decreased in many places, resulting in the extermination from most of their former geographic range. The historical and recent geographical distributions of the tigers are shown in Figure 6.

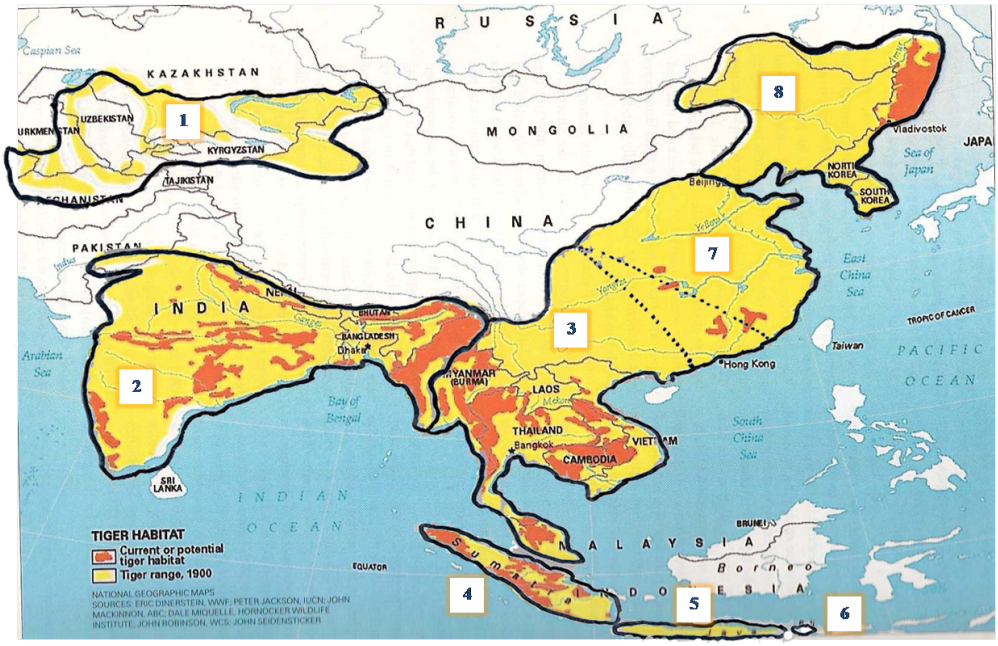


Figure 6: The geographical distribution of eight subspecies of tiger classified by Mazak (1981), 1) *P. t. virgata*, 2) *P. t. tigris*, 3) *P. t. corbetti*, 4) *P. t. sumatrae*, 5) *P. t. sondaica*, 6) *P. t. balica*, 7) *P. t. amoyensis*, 8) *P. t. altaica*. The colours indicate a historical and current geographical distribution of tiger; the yellow represents a geographical distribution of tiger in 1900 while current tiger geographical distribution is shown in red (modified from Seidensticker *et al*., 1999 and Kitchener and Dugmore, 2000).

1.1.5 Ecology and behaviour

Tigers are tolerant to a variety of environmental conditions, as evident from their relatively wide geographical distribution. The only apparent requisites for their survival being some form of plant cover, a water supply, and sufficient prey [29]. Tigers were found not only in tropical Asia's humid rain forests, but also in dry deciduous forests, savannahs, and tamarisk shrub lands. They were present in the hilly country of western parts of Asia with dense cover of trees and shrubs, while in Soviet Central Asia they preferred dense vegetation fringing riverbanks and floodplains; however, it is noted that the wild tiger no longer exist in this area. The tigers of Manchuria and the Amur-Ussuri region inhabit rocky, mountain slopes and river valleys. In eastern and south eastern China, tigers lived in oak and poplar forests, grass thickets, and jungles [29-31].

Tigers are essentially solitary and territorial animals. They primarily use scent and visual signals to mark their territories, for example, spraying urine, leaving their faeces in conspicuous piles [29]. Tiger gait is similar to other Panthera species; both legs of one side normally move together. The step length ranges from 500 mm to 650 mm in females and about 600 mm to 800 mm in males [2]. Because of somewhat long hind legs the tiger has very good jumping abilities.

Tigers are lone hunters and mostly track larger mammals like wild boar various types of deer, nilgai, black buck etc. [29, 30]. Humans are very rarely killed and eaten by certain aberrant tigers which are the so-called “man-eaters”. Several different techniques are used by tigers to attack their prey, to illustrate; its canines are rapidly used to grasp the victim’s throat with powerful impact. They will hold the target until it dies of strangulation to prevent it from moving again, or from using its horns, antlers, and/or hooves in defence. The amount of meat eaten in one meal ranges between about 18 kg and 40 kg [29], although in zoos tigers are usually fed 5 kg to 6 kg of meat per day.

Most of the tigers are nocturnal predators which hunt at night. The certain routes, or beats, to attack its territory are used in a range from several days to several months [4, 29, 32], depending on the territory size, prey density, and other factors. To locate their prey tigers mostly use their hearing and sight rather than olfaction [4, 29, 32]. They cover considerable distances to search for prey; in India, they may cover 16 km to 30 km in a single night [29]. In eastern Siberia and Manchuria, tigers may travel 50 km to 60 km in a day. Large connected habitats are therefore necessary for the survival of tiger populations.

1.1.6 Illegal trade of tiger and legislation

1.1.6.1 Illegal trade of tiger

The tiger population has declined heavily by the combination of habitat loss and extreme poaching of tigers for many reasons. These include for sport, commercial trade of its skin or body parts, medicine, and conflict with people and their livestock. Tiger skins are used for clothing and costume decoration in some countries like Tibet and China; this is in the absence of interference of government (http://www.wwfchina.org/english/loca.php?loca= 336). Tiger skin is also used for house decoration. Tiger body parts are used in oriental medicine without any scientific support for remedial effect. For instance, tiger bone is mainly used for either Asian folk remedies or Traditional Chinese Medicine (TCM), which prescribed as a general strengthening tonic. TCM is particularly popular in China, Japan, South Korea, Vietnam, parts of Southeast Asia, and even the United States [33]. While tiger's tail is claimed to cure skin disease; the eyeball is utilized for convulsions and cataract treatment; and the whiskers can retrieve pain from toothaches [34]. The result is that markets in many countries trade tiger's body parts and products. Moreover, some Asian people believe that intake of tiger penises can improve humans' aphrodisiac powers. These reasons drive illegal poaching of tigers to supply the commercial demand for several tiger's commodities. The first international investigation to stop tiger poaching was the seizure of 500 kg tiger bone seized in India in 1993 [34]. At nearly the same time, a similar situation happened in Siberia, where many Amur tigers were killed [34]. In addition, sales of tiger body parts and products began coming in from Vietnam, Cambodia, and North Korea as well [34].

1.1.6.2 Legislation

In 1993 when a huge amount of tiger bone were seized in India, non-government organizations like the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES), TRAFFIC (The wildlife trade monitoring network), IUCN/SSC Cat Specialist Group, started to take action to enforce tiger trade regulation [35]. CITES and the USA catalysed important legislative and enforcement change in several key East

Asian tiger consumer countries such as China, Taiwan, Hong Kong, and Korea by trade sanctions [35]. These actions aim to stop illegal trade in tigers and their body's parts and all medicine derivatives.

The international trade of tigers is regulated by CITES which forms a large multilateral agreement on species conservation of around 30,000 species of animals and plants and not just the tiger. They achieve this through a system of reciprocal permits and certificates and seek to control over-exploitation by listing species in one out of three Appendices which are subjected to different levels of regulation. All tiger subspecies are listed in Appendix I, and given the maximum level of protection as they are the most endangered among CITES-listed animals and plants and are threatened with extinction. International trade of specimens of these species are prohibited from commercial exploitation. For purposes such as scientific research special import and export permits are issued in a controlled environment.

TRAFFIC, which is a joint programme of WWF and IUCN - The World Conservation Union, monitors wildlife trade to ensure it does not pose a threat to the conservation of nature. The vision of the organization is to manage trade in wild plants and animals at sustainable levels without damaging the veracity of our ecological systems and also fulfilling human needs, supporting national economies and help to motivate human commitments toward the practice of conservation.

The upholding of the CITES agreement in Australia is covered under Part 13 of the 1999 Environment Protection and Biodiversity Conservation Act (EPBC Act), which is enforced by many organizations, such as the Sustainability, Environment, Water, Population and Communities (SEWPaC) and the Australian Federal Police. In addition to monitoring international trades, the Act covers threatened species and communities, migratory species, marine species, and protected areas.

1.2 Mitochondrial DNA

1.2.1 Structure and its organization

Mitochondria are a double membrane organelle, playing a crucial role for chemical energy production by the process of oxidative respiration [36]. They are located in the cytoplasm of nearly every somatic cell. Within this organelle there are many copies of genetic material called mitochondrial DNA (mtDNA), which have become valuable for species identification. The numbers of mitochondria in each cell are different depending on cell type and the number of mtDNA genome varies per mitochondrion [37].

Mitochondrial DNA is responsible for the encoding of RNA molecules and protein. Human and other non-human mammalian species have a circular mtDNA about 16,569 bp in length [36, 38, 39]. The mitochondrial genome possesses 37 genes, including 22 tRNA molecules, 2 rRNA molecules, and 13 proteins all involved in respiration [38]. A schematic view of mitochondrial genome is shown in Figure 7. The primary sequence of the human mitochondrial genome was first determined by Anderson *et al.* [40]. Two different base composition strands were found in the mitochondrial genome, a pyrimidine-rich strand called the light strand (L), and a purine-rich strand called the heavy strand (H). The heavy strand carries 28 genes, 14 genes encoding tRNA, both genes encoding rRNA, and 12 genes encoding proteins, while the light chain carries the remaining 9 genes. The only non-coding part of mtDNA genome is the control region (CR) or displacement loop (D-loop), which spans positions 1 to 576 and 16,024 to 16,569, approximately 1,125 base pairs in length for the human genome [36]. Within this region, there is an origin of DNA replication for the heavy strand and the promoters for the light and heavy strand transcription. The D-loop region is also highly variable among individuals because of the high substitution rate being in the range of 2.8 times [41] to 5 times [42] the rate of the remaining mtDNA in human. However mtDNA characteristics such as shape, length, and number of genes encoded, are different in other groups of organism [39]. For plants, the length varies in the range of 200 kb – 2,500 kb, which has a circular shape and varies

in size whereas *Paramecium,* a common prokaryotic cell, has a linear mtDNA, about 40 kb in length [39].

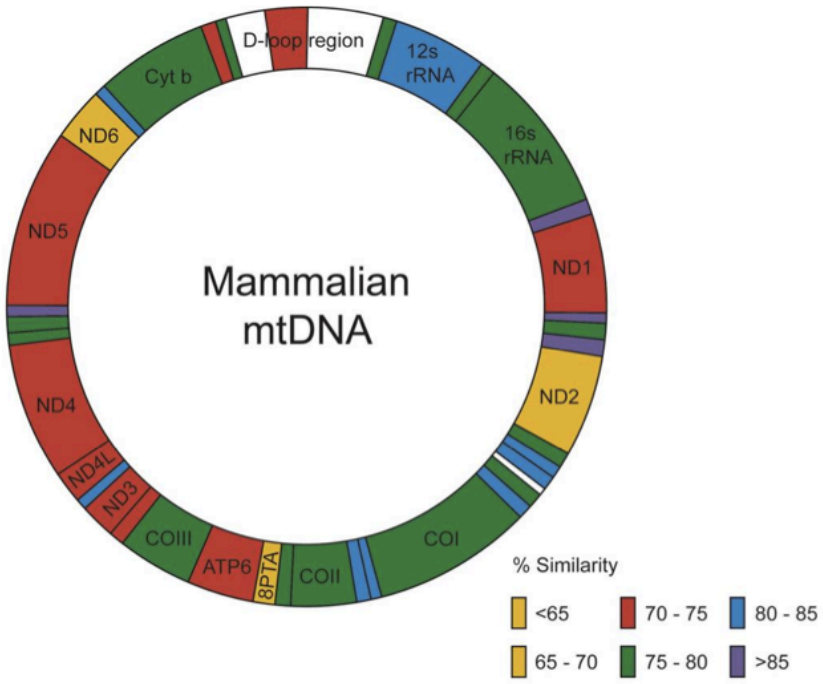


Figure 7: The schematic view of mitochondrial genome. The D-loop is shown at the top (12 o'clock) where a base is numbered as 1, with bases numbered sequentially in a clockwise direction. The colours represent the average diversity within mammalian species. The diagram is reproduced from Linacre, 2009.

1.2.2 Special features of mitochondrial genome

The mitochondrial genome has unique characteristics being useful for forensic casework. These attributes are numerous copy numbers and stability of mtDNA, maternal inheritance, and higher rate of evolution [43].

1.2.2.1 Numerous copy numbers

The number of mtDNA copies per cell ranges from hundreds to thousand depending on the type of cell [44]. For each mitochondrion, an average copy number of mitochondrial DNA is about 4-5 [44]. As each cell contains hundreds of mitochondria [45], the result is that mtDNA in each cell is mathematically equal to 400-500 (more) copy molecules, which corresponds

to the study of Satoh and Kuroiwa [46] where it was estimated that there were about 500 mtDNA molecules in most cells. However the virtual number of mitochondria in each cell is different depending on cell type and the number of mtDNA genome varies per mitochondrion [47]. The more tissue demands amount of oxygen, the larger amount of mtDNA copy found in the cell [48, 49]. To illustrate, a mature oocyte is estimated to have thousands of mitochondria and more than 100,000 copies of mtDNA [36]. Whereas in some somatic cells mtDNA is in the range of 200 copies -1700 copies [45]. Therefore, mtDNA analysis is often used in the case that degraded biological samples are the only type of DNA available for analysis [36, 50].

1.2.2.2 Stability of mtDNA

As each mitochondrion has an additional protective mitochondrial membrane, strong protein coat, and closed circular double strand DNA structure, the mtDNA within the cell is then protected from environmental factors, particularly bacterial enzymes [38, 43, 50]. It is possible to get successful mtDNA analysis from old samples; for instance Ovchinnikov *et al*. [51] reported a successful mtDNA analysis from Neanderthal remains.

1.2.2.3 Maternal Inheritance

Mitochondrial DNA is maternally inherited. Like the general cell, egg cytoplasm contains about 100,000 mtDNA molecules [44, 52]. During fertilization, only sperm heads can enter the egg cell membrane, leaving its mid section containing many thousand copies of mtDNA outside. Although sperm heads contain a few mtDNA copies, they are eliminated by a specific recognition mechanism either at, or soon after, fertilization [53]. Many researchers have confirmed the elimination of sperm-derived mitochondria [54, 55]. Only the maternal mtDNA being in the egg cytoplasm are directly passed to an offspring [43, 44]. However biparental inheritance of mtDNA is found in a variety of species as the exception, for example, mussels, parasitic trematode. [56, 57]. The explanation of this phenomenon is that the elimination of paternal mtDNA is less efficient in interspecific crosses but it is rare in nature [56].

1.2.2.4 Higher rate of mutation and evolution

Mitochondria lack a competent DNA repair system during the DNA replication process, resulting in an increased rate of mutation compared to nuclear DNA. The mutation rate in mtDNA is much higher than nuclear DNA [50]. In the hypervariable regions of mtDNA, the mutation rate is estimated to be about 5-10 times higher [58] and 10 – 17 times higher in the abnormal mitochondrial metabolism [59], probably due to an increased exposure to reactive oxygen species during oxidative phosphorylation [60]. This results in the single base polymorphisms that are commonly observed in this genetic material [43]. It is found that these single base mutations are rare but occurs once every 1,200 bases in the human genome [43]. This feature of mtDNA have made it a valuable tool for evolutionary study and species testing [43].

1.2.3 The use of mitochondrial DNA for forensic casework

In the forensic context, analysis of mitochondrial DNA (mtDNA) has commonly been used for species identification [38], or human identification when nuclear DNA typing is not possible due to sample degradation, or due to a low copy number of genomic DNA [61]. To accomplish these purposes the polymerase chain reaction (PCR) and subsequent sequencing of mitochondrial gene are employed.

The mitochondrial DNA has unique features supporting discrimination among species. The genome consists of 37 genes encoding particular proteins and RNA molecules. There is therefore a selection pressure against change in the DNA coding sequence in order to preserve structure and function of proteins expressed by mitochondrial genes [38]. However a few DNA alterations also occur in these coding regions. Subsequently little intra-species variation occurs within these regions. This variation is low enough to identify samples that come from the same species. There are also inter-species variations within protein encoding mitochondrial genes. But the change does not affect any roles of the genes because the DNA mutations do not result in a change to the final amino acid sequence of protein, which are called synonymous mutation. This type of mutation normally occurs at the third bases of codons

[38]. Synonymous, non-synonymous and frame shift mutations are shown in Figure 8.

The D-loop region of mtDNA is valuable for individual identification. Since it is the only area in mtDNA being non-coding, it does not affect any DNA roles once the DNA alterations occur [38]. The hypervariable regions located at each side of the D-loop region is found to have a high substitution rate, resulting in greater intra-species variation. They are then commonly used for human identification in the purpose of particular individual human identification [38]. Because of their high intra-species variation, it is not possible to use these regions for species identification.

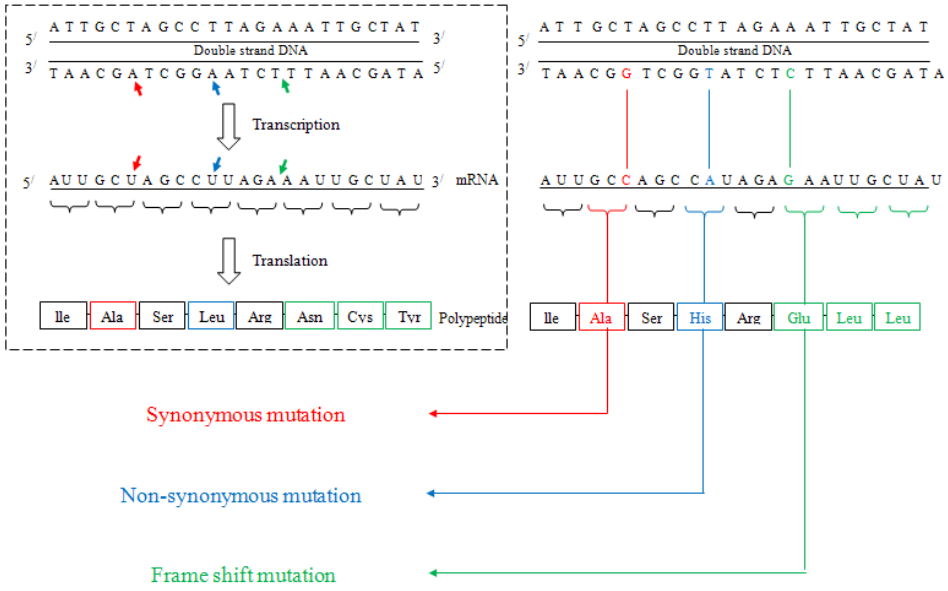


Figure 8: The synonymous, non-synonymous and frame shift mutational events. A synonymous mutation is the change of one DNA base to another that does not result in a change to the amino acid sequence of the resulting protein. Conversely, the change of one base to another leading to a change of the amino acid sequence is called a non-synonymous mutation. Frameshift mutation is normally causes by insertion or deletion, which results in a disrupt to the reading frame, or the grouping of the codons, resulting in a completely different translation from the original.

Heteroplasmy, the presence of more than one mtDNA type in an individual [62], have to be taken into account because it can complicate and strengthen forensic identity testing [36]. Nevertheless, heteroplasmy is a rare event occurring only in 2-8% of the population [36]. The frequency of heteroplasmy

is different across tissue types, being higher in muscle tissue and heteroplasmy increases with age [63].

1.3 Single nucleotide polymorphisms (SNPs)

In the past decade, the detection of genetic difference among individuals was a challenging issue for geneticists. A number of methods such as genotyping, protein sequence polymorphisms, restriction fragment polymorphism (RFLP), and short tandem repeat (STR) markers have been employed to achieve this purpose [64]. More recently, DNA sequencing and single base detection technology have been introduced, resulting in the discovery of differences in DNA nucleotide composition among individuals or between species. These nucleotide composition variations in a DNA sequence are mainly caused by incorrect nucleotide insertions by the DNA polymerase during the DNA replication process. A single base substitute variation that has an allele frequency of 1% or greater in any population is called single nucleotide polymorphisms, or SNPs [65, 66]. However, in practice, sequence variations caused by an insertion/deletion or mutation, which is less than 1% in abundance, are also classified as SNP loci [66, 67]. SNPs are normally found every 400-1500 base pairs [68-71]; they have been reported as the most abundant variation found in the human genome [72]. Recently, more than 10 million SNPs have been found by the human genome project (http://www.ncbi.nlm.nih.gov/projects/SNP/snp_summary.cgi). More than three million SNPs have been identified from a number of different ethnic groups through the international Hapmap project (http://www. hapmap.org/ index.html.en), being a database of common DNA variation across the whole human genome.

1.3.1 Type of SNPs

SNPs can be found in both the coding and non-coding regions of the genome [72]. The SNP in the coding region can be divided into two types; synonymous (sSNP) and non-synonymous SNP (nsSNP). The synonymous SNP is a variation site in which both alleles produce the same amino acid, leading to no change in a polypeptide sequence of the resulting protein [72]. This is due to the variation occurring at the third codon position, according to the degeneracy of the genetic code. Essentially, synonymous SNP can be

defined as the SNP that causes synonymous mutation. Alternatively, if there is a difference in the amino acid sequence produced, the mutation site can be defined as a non-synonymous SNP.

SNP can be categorized into three groups depending on the number of polymorphic alleles found at the variable site. If the number of polymorphic nucleotides observed at a variable site is two, three, and four, the SNP will be defined as bi-, tri-, and tetra-allelic SNP respectively. The characteristics of these three types of SNPs are shown in Figure 9. Among the three types, bi-allelic SNP is the most frequently found in a genome because of the bias in mutation and low occurrence in single nucleotide substitution, as estimated in mammalian genomes [65, 66].

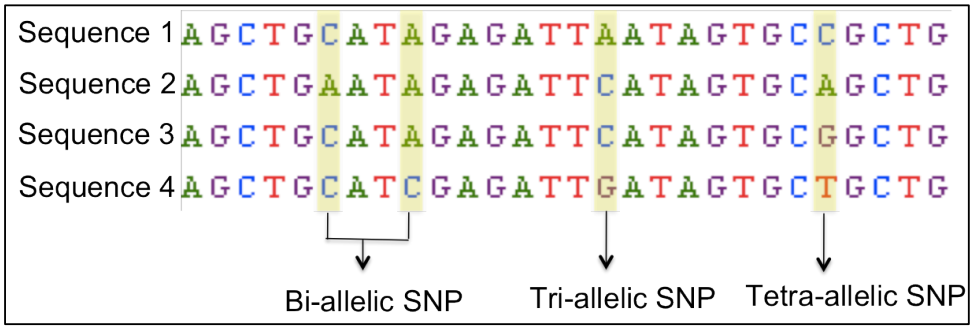


Figure 9 The characteristics of bi-allelic SNP (A/C), tri-allelic SNP (A/C/G), and tetra-allelic SNP (A/C/G/T). The tri- and tetra-allelic SNP are rarely found in the genome.

1.3.2 The use of SNPs

SNP markers have been increasingly used in various research fields such as medical diagnostic [73-75], population genetics [76, 77], ecology/evolution/conservation [78], behaviour studies [79], crop plant genetic studies [80, 81] and animal source identification [82] including forensic investigation [83-85]. The rise in the use of SNPs is for many reasons. Firstly they have a high abundance and availability in a genome. Secondly SNPs characterizations provide a better opportunity to obtain a result from a poor quality or historical samples. Lastly there are several molecular technologies developed to accurately obtain SNP genotypes and allele frequencies of one to hundreds of thousands of SNPs [86].

In the forensic community, SNPs have been used for both human and non-human identification [84, 85]. For human identification, SNPs can be used as a new type of DNA marker to achieve a result where insufficient DNA has been obtained for a STR analysis. As a SNP assay only requires short-sized amplicons, SNP genotyping can be more easily obtained from degraded samples or low amounts of DNA [84]. Approximately 50 SNP markers have been determined to have the equal discrimination power of the 10-15 multiple allele STRs typically used for forensic human identification [87]. Because of the possibility to replace the use of STRs with this biallelic marker in forensic investigation, there has been much interest in finding highly informative SNPs and improve the efficiency of SNPs multiplex amplifications [88-96]. However STRs are expected to remain the major method of human identity testing for the foreseeable future rather SNPs due to their higher power of discrimination, mixture analysis, and ability to be combined in a multiplex assay [97]. However the use of SNP is beneficial for a paternity and immigration testing as it has lower mutation rates than STRs and other variable number tandem repeat (VNTR) loci [64, 84].

SNPs have played an important role in the investigation of the alleged illegal trade in endangered species protected by national legislations. The seized materials normally found in these offence types are typically trace materials such as the body parts, derivatives, or powder from endangered species. The morphological features are frequently absent in these evidence forms, such that the traditional morphological examination is not applicable in subsequent investigations. SNP markers are then used as an efficient alternative to achieve the result from these types of samples. For example, informative SNPs have been successfully used to identify endanger species in the Traditional Chinese Medicine (TCM) [98, 99], derivatives of their body parts [100, 101], within foodstuff [102], and illegally traded wood [103]. In addition to all the advantages of SNP mentioned above, SNP can use to identify endangered species to subspecies level. This aid in the enforcement of legislation to protect the illegal trade of endanger species, as some countries require knowledge of the exact subspecies in order to prosecute anyone

alleged to be trading in seized products. It should be noted that the use of SNP markers in non-human forensic science is much less than their use in human forensic identity. This is probably due to the lack of endangered species' DNA sequence data available in a public source, resulting in difficulty in SNPs discovery for endangered faunas and floras. Furthermore, sequencing is still considered expensive.

1.3.3 SNP genotyping technologies

A numbers of molecular technologies have been developed to detect and discriminate SNPs for allele-genotyping [104-111]. The platform of these technologies is set up based on a combination of three steps: allele discrimination, allele separation, and allele detection strategy. Details for each steps and a list of the recent SNP genotyping commercial systems, including their platform patterns, are summarized in
Figure 10.

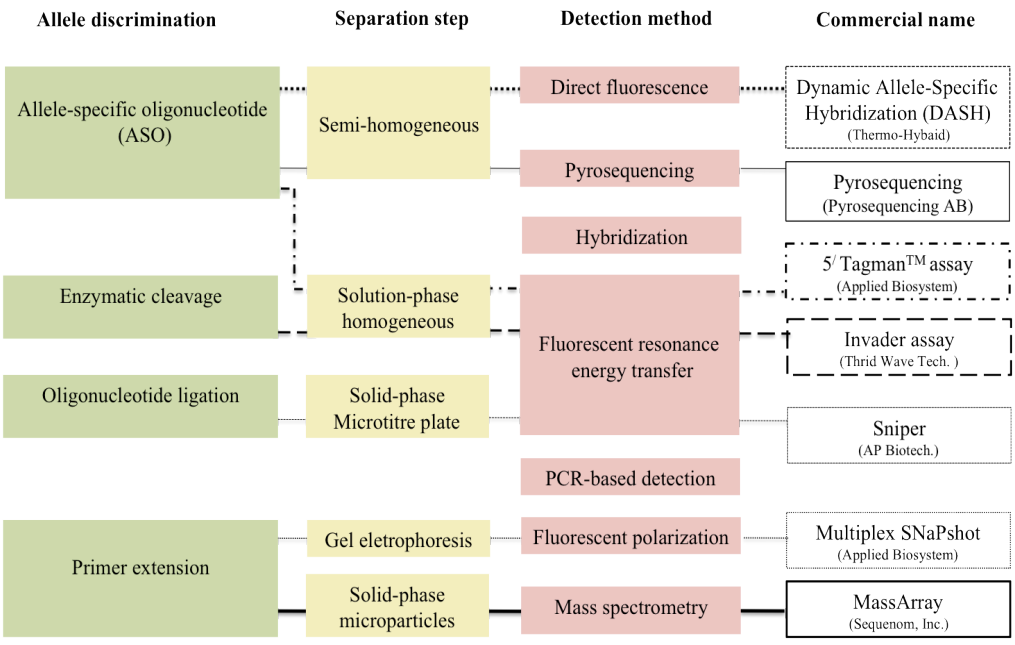


Figure 10: The details for the three steps, allele discrimination, product separation, and product detection strategy, combined as a SNP genotyping technology. A list of the recent SNP genotyping commercial systems, including their platform patterns is also shown here.

1.3.3.1 Reaction principle (Allele discrimination)

Four SNP allele discrimination methods, classified based on their molecular mechanism, have been used lately. These methods are the use of allele-specific oligonucleotide (ASO), primer extension, oligonucleotide ligation, and invasive cleavage. All these are explained in more details below.

Allele-specific oligonucleotide (ASO)

The allele-specific probe or allele-specific oligonuclotides (ASO) is the simplest tool for allele discrimination because there is no enzyme used in the reaction [112, 113]. To achieve allele detection, two ASO probes are required. Each probe is designed to contain nucleotides that are complementary to the target SNP allele; this SNP is in the middle of the probe sequence. Under the optimal assay conditions, only entirely matched probe-target hybrids are stable; the mismatch hybrids are unstable. This type of allelic discrimination process is shown in Figure 11a.

Primer extension

Primer extension is a robust allelic discrimination method. It requires a negligible number of primers or probes compared to the other methods (such as ASO probe) [112]. One of the well known primer extension based methods is that of allele specific nucleotide incorporation (minisequencing) [107]. This technique is used to determine a polymorphic base on the target DNA template. Only one primer is required for this assay and it is designed to anneal immediately 5' adjacent to the target SNP. Under normal PCR conditions, DNA polymerase will extend the primer by adding a dideoxy nucleotide triphosephate (ddNTP) at the 3' end of the chain. In minisequencing, only a single base that is complementary to the SNP site is extended from the primer; the SNP polymorphic base is then determined. The allelic discrimination reaction process of minisequencing approach is shown in Figure 11b.

Oligonucleotide ligation

The oligonucleotide ligation approach is the most specific and easiest method for allele discrimination; however, it is time-consuming and requires the highest number of probes for the investigation [112]. Two probes are required

for this assay. They are designed to bind to the target DNA sequence adjacent to each other. At the connection of the probes either 3' or 5' end is designed to contain a nucleotide that complementary to the SNP site. Once the probes are entirely matched with the target sequence, they will be united by a ligase enzyme being specific in repairing nick in the DNA strand Conversely, there will be no ligation in the case that one of the two probes are not completely matched with the target sequence. The allelic discrimination reaction process of the oligocucleotide ligation is shown in Figure 11c.

Enzymatic cleavage

Enzymatic cleavage based on the use of restriction fragment length polymorphism (RFLP) is the earliest and widely used method for allelic discrimination [112]. A restriction enzyme called flap endonuclease cleaving a specific recognition sequence is commonly used for this assay [108]. When a target SNP is within the recognition site of the enzyme, one sequence will be cleaved by the enzyme while another one will remain uncleaved. This results in a generation of RFLP bands. The allelic discrimination reaction process of the restriction enzymatic cleavage is shown in Figure 11d. A disadvantage with this method is that it is difficult to apply with the current high throughput automated genotyping techonologies. An alternative method called 'invasive cleavage' has been developed and used to accomplish this purpose. The invasive cleavage is based on the combination of enzyme cleavage and allelic-specific probes. An invader probe and two allele-specific probes, one for each allele, are required for this assay. The invader probe is designed to anneal to the 3' end of a target DNA template and contains unrelated complementary bases of the SNP at the 3' end of the probe. The two allelic-specific probes are designed to anneal the 5' end of the target template, one for each allele. At the 5'end of one probe has to contain a complementary base of the SNP. When the allele specific probe entirely matches the target DNA it will be displaced and overlapped by the invader probe at the SNP site. This will form a tripartite structure called 'flap' which is recognized by flap endonuclease enzyme. The 5' part of the probe will be cleaved from the structure. Conversely, if the probe does not entirely match with its target, the

probe will remain uncleaved. The allelic discrimination reaction process of invasive cleavage is shown in Figure 11e.

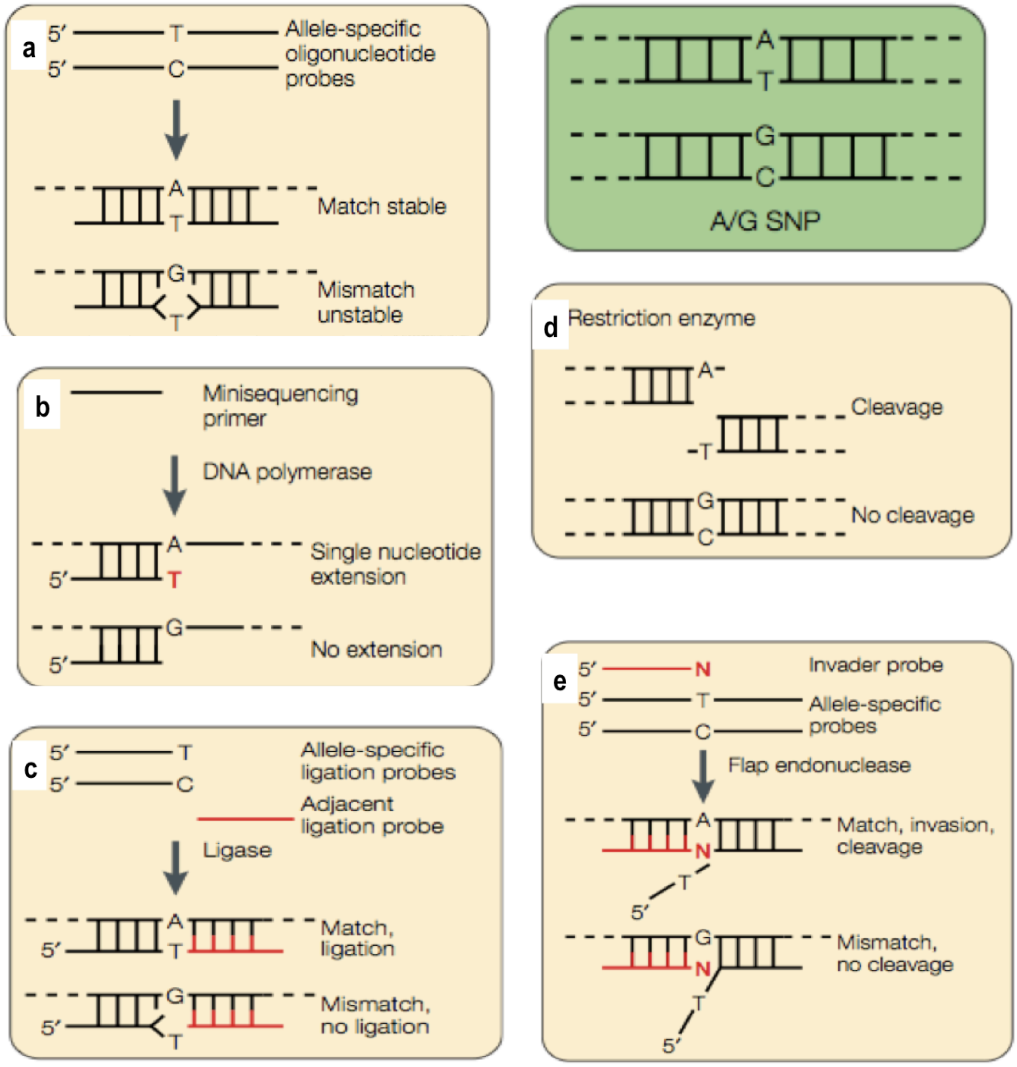


Figure 11: The processes of the five SNP allelic discrimination methods; allele-specific oligonucleotide (ASO) (a), mininsequencing (c), oligonucleotide ligation (d), invasive cleavage (e), and enzymatic cleavge (f) [114].

1.3.3.2 SNP detection method

There are several methods to detect allele-specific products obtained from the discrimination assay. Most of these methods are based on the detection of light/fluorescence emitted by a change in a labelled-dye properties, utilizing a PCR approach and hybridization, or measuring the product mass. The SNP detection methods used most commonly are hybridization, fluorescent-based methods (direct fluorescence detection, fluorescent resonance energy transfer, and fluorescent polarization), mass spectrometry, and pyrosequencing; these are described below.

Hybridization

The detection of allelic-specific products with this method is based on the hybridization of allele-specific oligonucleotide (ASO) on a target DNA template [115]. Two ASO probes are required; one is designed to specifically bind with each SNP allele. These probes are typically labeled with radioactive molecule such as ^{32}P [115] or a fluorescent molecule. Under an optimal hybridization, only the specific probe hybridizes entirely with its complementary sequence on the DNA template generates a signal. This signal can be detected by visualizing the hybridized ASO probe-DNA template via autoradiography or similar imaging techniques.

Amplification based method

There are several PCR-based methods for SNP allele detection [116, 117]. These methods are used commonly to detect allelic-specific products obtained from the two allelic discrimination methods, primer extension and ASO probes. The extension primer is designed to bind with a target sequence adjacent to the SNP and have a complementary base to the variant SNP at the 3' end of the primer. By the use of PCR and under the optimal assay conditions, the primer is amplified and extended only if the last base of the primer is complementary to the sequence on DNA template. If not, the PCR cannot continue. Another PCR-based method utilizes three ASOs, two forward oligonucleotides added with different-length tails and one common reverse oligonucleotides [117]. These two different length-ASOs produce different sizes of PCR amplicons that are later separated by gel electrophoresis.

Direct fluorescence detection

The detection of allele specific products is based on the use of allele-specific oligonucleotide (ASO) and intercalating dyes at which their products are monitored by a real-time PCR. One ASO is required for this purpose. It is mixed with PCR products and an intercalating dye such as ethidium bromide, SYBR Green I, or BEBO [118]. The structures of the dyes carrying a positive charge have been reported to play a crucial role for double stranded DNA-dye intercalation [118-120]. During the denaturation phase of real-time amplification, double stranded DNA is separated into two single strands of DNA by heat so the intercalating dye is released and floats free in the solution. In the case that the ASO perfectly anneals with DNA template and a new strand of DNA is extended from the ASO, the dye molecule will bind to the double-stranded DNA, resulting in a fluorescence of the dye. If there is a mismatch between ASO and the DNA template, the fluorescent will not present. The commercial genotyping system using this type of detection method is Dynamic Allele-Specific Hybridization (DASH) (Thermo-Hybaid, Middlesex, United Kingdom).

Fluorescent resonance energy transfer

Fluorescent Resonance Energy Transfer technology, or FRET, is a method of choice for the SNP allele-specific product detection. The principle of FRET is that when a high-energy dye or reporter is in close proximity to a low-energy dye or quencher, there will be a transfer of excitation energy from high to low [121]. This transformation of energy results in the reduction of the fluorescent quantum yield of the high-energy dye. The common quencher fluorophores are TAMRA, DABCYL, and BHQ while many reporter fluorohrores have been reported, such as FAM, VIC, and NED [120]. Recently, many chemistries have been reported as fluorescent probes (i.e., TaqMan, Molecular Beacons, Scorpions, hybridization probe or light-up probe, Lion probe, LNA, etc.) [109, 110, 118, 120] but only the two chemistries, TaqMan and Molecular Beacons, are popular. The TaqMan assay uses the 5’ exonuclease activity of *Taq* polymerase enzyme and FRET to generate fluorescence from a ASO probe. Two short ASO probes labelled with a reporter and quencher are required; one is specific for each allele. When the probe is not hybridized, the

close proximity between reporter and quencher prevent detection of fluorescence according to the principle of FRET. In the annealing phase of PCR, both probe and primers are annealed to the specific regions on the DNA template. The polymerization is then extended in extension phase. When the *Taq* polymerase approaches the probe, the 5' exonuclease activity of this enzyme starts to displace the probe. The reporter dye is then released away from the close proximity of the quencher, resulting in the fluorescent emission. For the molecular beacon assay, the structure of ASO probe is different from TaqMan at which it is single stranded hairpin shaped oligonucleotide and designed to remain intact during the amplification reaction, including rebind the complementary sequences for every cycle [109]. Similar to TaqMan, fluorescent reporter dye tagged at the 5' end is quenched by low-energy molecule tagged at another end in the absence of complementary target sequences. When it hybridizes with complementary target sequences, the beacons will become linear or unfold, resulting in separation of two different energy level dyes. The reporter dyes will then fluoresce, which can be detected by a real-time thermocycler.

Fluorescent polarization

Fluorescent polarization is applied to detect SNP allelic-specific products in solution [122]. In principle, a fluorescent dye excited by plane-polarized light emits the same plane of light if the dye remains stationary during the fluorophore's excitation. Alternatively, light will be emitted as a different plane if the dye rotates or tumbles in the solution [113]. For SNP detection, the fluorescent dyes are labelled with allelic-specific products, being changed in its molecular mass from the allele discrimination processes such as primer extension or invasive cleavage. The change in mass affects the degree of the dye's tumble during fluorophore's excitation phase. The smaller allelic products are, the faster the dye molecule tumbles resulting in more dissimilar in the light plane (more depolarized). This variation in amount of fluorescent polarization is then used to achieve the detection of processed SNP allelic products under a constant control of other conditions such as temperature and solvent viscosity [112, 113, 122]. The commercial genotyping system using

this type of detection method is Acycloprime (Perkin Elmer, Massachusetts, USA).

Mass spectrometry

Mass spectrometry is used as a method for SNP detection by measuring the molecular weight of DNA fragments such as SNP primer extension products; no dye label is required [104, 123, 124]. To achieve this purpose, matrix-assisted laser deporption/ionization time of flight (MALDI-TOF) is typically employed as a soft ionization. This plays a role in mixing a matrix compound and allele-specific products, obtained from the discrimination process, on a metal plate. This mixture is then heated and passed through the gas phase where its ionization is retrieved. The time that the ions take to reach the detector (time of flight) is measured and used to calculate mass/charge ratio. The different molecular weight of allele products will provide different the ratio values. Currently, a high-resolution mass spectrometry is able to discriminate alleles that differ by one base. A current form of this SNP detection method type uses DNA immobilized on a chip, which can serve as a direct MALDI plate. MALDI can be used to determine the molecular mass of allele products from the invasive cleavage and primer extension assay, including allele-specific hybridization probes. The DNA chip based on this type of SNP detection is known as MassArray (Sequenom, Inc.) and PinPoint (PerSeptive, Biosystems, Inc.).

Pyrosequencing

Pyrosequencing is a recent method of choice for SNP allele detection. It is a real-time sequencing method for a short strand of DNA based on the synthesis of its complementary strand [125]. The method is achieved by the combination of a sequencing primer, the four deoxynucleotide triphosphates (dNTPs), adenosine 5′ phosphosulfate (APS), luciferin, and four enzymes. These four enzymes are DNA polymerase, ATP sulfurylase, luciferase, and apyrase. Firstly, the four dNTPs are added into the reaction, one base at a time. The correct complementary dNTP is incorporated with the DNA template by the DNA polymerase and produces a pyrophosphase (PPi) as a by-product. In the presence of APS, the PPi is converted to ATP by the ATP sulfurylase. The ATP is then used to change the substrate luciferin to

oxyluciferin and this generates a chemiluminescent signal (visible light) in amounts that are proportional to the amount of ATP. The light is detected by a camera and interpreted as a peak on a pyrogram. Once all exceed dNTPs are degraded by the enzyme apyrase, the reaction can start with a new nucleotide. Therefore, it is possible to determine a SNP base on a target DNA template. The commercial trademarks for SNP genotyping based on pyrosequencing method is Biotage's pyrosequencing (Uppsala, Sweden)[105].

1.4 Molecular phylogenetics and tools

Molecular phylogenetics is a study of an evolutionary relationship among a group of organisms based on their molecular data. Basically, a genetic composition of any organism has the potential to change over times by the accumulation of mutations. This rate of change has been the focus of much recent interest to generate models to extrapolate back over time to depict these evolutionary relationships [126-128]. No one model can account for all the genetic variation observed, as the patterns of this change differ between diverse organisms or even different DNA regions located on the same DNA strand [129]; however, an evolutionary connection among genetically related organisms can be generated using a number of software programs.

1.4.1 Phylogenetic tree and types

A phylogenetic tree is a diagram representing inferred evolutionary relationship between various biological species, organisms, or genes. Trees have three main features: the tips of the branches are termed operational taxonomic unit (or OUTs and represents what currently exists), the length of the branch may indicate time (with the longer the branch indicating a longer period of time), and two or more branches will join at a node. Additionally, the types of trees can be divided into two forms – rooted and unrooted tree [129, 130]. Rooted tree shows lineage of various species and indicates its evolutionary path in which each node represents the inferred most recent common ancestor (RCA) of the descendants where the length of each branch depicts an evolutionary estimate time since the split from the RCA. An unrooted tree depicts the relationship between species without showing any evolutionary trail.

1.4.2 Molecular phylogenetic tree reconstruction

Assembling homologous DNA sequences of target species or loci is the first step in order to build an evolutionary phylogeny. The next step is alignment of these sequence using available computational algorithms and tools; this has been well documented in Edgar and Batzoglou [131]. The output is then used to reconstruct a phylogeny using several different methods. Most of the models use some criterion for evaluating the fit of a given dataset to the topology of the tree and then search for the tree that gives the best score in terms of their criterion. The adequate input and most realistic criterion would be the best to infer a phylogeny being as similar as the true phylogenetic relationship of the questioned species. Currently, there are five commonly used methods to reconstruct a molecular phylogeny; these methods are unweighted pair group method with arithmetic mean (UPGMA), neighbor joining (NJ), maximum parsimony (MP), maximum evolution (ME), and Mr.Bayes. The principle, criteria, and other details of these methods are described below.

1.4.2.1 Unweighted pair group method with arithmetic Mean (UPGMA)

UPGMA uses a simplest algorithm for building phylogenetic tree [129]. To infer an evolutionary relationship between species, a data mining technique called a clustering procedure is used and a constant rate of evolution among different lineages is assumed throughout the algorithm [130]. Based on this assumption, the number of nucleotide or amino acid substitutions can be directly used for the algorithm. The phylogenetic tree is built in a stepwise approach and is created based on the matrices; a new distance matrix is calculated at each step. A topology relationship is identified in order of similarity. Two OTUs showing the highest sequence similarity to each other are initially identified and formed as a composite OTU. These composites are the subsequently paired up based on similarity again until there are only two final ones left. The score for a change at any particular base is the same (unweighted) regardless of whether it is a transversion or a transition and whether coding or non-coding. Its benefit is that it is a simple model although

an incorrect topology is easily built by this method; for this is the reason the UPGMA clustering method is not used extensively today [130].

1.4.2.2 Neighbor joining (NJ)

Neighbor joining allows a phylogeny reconstruction of datasets with varying rates of evolution or branch lengths [132]. Similar to UPGMA, neighbor joining builds a phylogenetic tree based on a stepwise method; however, the distance matrix is obtained by directly calculating distance to internodes rather than clustering of OUTs [130]. The matrix distances of each OUT are used as a raw data, which are later used to calculate a net divergence for each OTU from all other OTU. By using these data, a modified distance matrix can be created for each pair of OUTs. The least-distant (closest) pair of OTUs (sometimes called neighbor) is formed as a new node in which a new distance from this new node and other terminal node are calculated and used to construct the tree. The step is repeated until only two nodes remain. The advantage of neighbor joining method is that it can apply for a large dataset varying evolutionary rate and can use a bootstrap analysis to test sequence information is reduced and the phylogeny is strongly depend on the model of evolution used in the process [129].

1.4.2.3 Minimum evolution (ME)

Minimum evolution is a commonly used method for generating phylogenetic trees. The ME tree is built by a matrix distance based algorithm, similarly to the UPGMA and almost identical to a neighbor joining. The difference is that this method uses the sum of the branch lengths to construct a phylogeny instead of using the internodes distance like in neighbor joining [133, 134]. The length of each branch is estimated by the ordinary least-squares method. The ME tree is built based on the assumption that the tree with the smallest sum of branch length estimates is most probably to be the true one [133, 134]. Thus, in order to reconstruct this tree, all possible trees are built and the one with the least sum of branch lengths is chosen as the best inferred topology. Similar to neighbor joining method, a large dataset makes it impossible to reconstruct this type of tree.

1.4.2.4 Maximum parisimony (MP)

Maximun Parsimony is commonly used and widely accepted as a reliable method for phylogeny reconstruction [129]. The tree is constructed based on a character-based algorithm, which is different from the UPGMA and neighbour joining approaches. The method does not build a tree by branch lengths but by minimizing the total overall length in terms of the number of changes. The assumption for parsimony is that the most probable tree is the one that requires the fewest number of changes to explain the data in the alignment [135]. To construct MP tree, all possible unrooted trees are built based on only informative sites – the site presenting at least two different kinds of nucleotides, each of which is represented in at least two of the sequences. For each of the possible trees, a number of substitutions or changes over all the informative sites are counted. The tree with a minimum number of changes is chosen and called maximum parsimonious tree. It should be noted that the method may results in more than one equally parsimonious tree, in which case a consensus tree should then be created. The limitation of this method is that it cannot be applied with a very large data set because of a rapid increase in number of possible trees.

1.4.2.5 Mr.Bayes

Mr.Bayes is a recently developed method, which applies Bayesian analysis to infer phylogenetic relationship [136, 137]. To obtain the most likely phylogenetic tree based on this method, all possible trees are constructed and given equal prior probability. The prior probability is then updated with data that has been collected in terms of sequence alignments, giving a posterior probability for each tree. The tree that has the highest posterior probability is the one that is most likely true based on the sequences obtained. There are various advantages of Mr.Bayes namely easy result interpretation, the ability to incorporate prior information, and some computational benefits [136, 137].

1.5 Aims of the project will be:

1. Design overlapping primer sets to amplify the entire tiger mitochondrial DNA genome.
2. Sequence the whole mtDNA of the four extant tiger subspecies.
3. Analyse the resulting tiger genomes for their genome characterization, nuclotide composition and pattern, and codon usage.
4. Compare the DNA sequence of each individual gene to determine which is the more informative for species identification.
5. Compare the resulting DNA sequences and those on GenBank to observe any intra and inter species variation.
6. Reconstruct a phylogenetic relationship among the four extant tiger subspecies based on the resulting entire mitochondrial genomes.
7. Comment on the genetic basis of sub speciation of *Panthera tigris*.
8. Develop and validate a single multiplex kit to identify simultaneously tiger species and subspecies for forensic purpose.

2 Materials and methods

2.1 Sample collection and DNA extraction

2.1.1 Sample collection

A total of 19 tiger samples, 15 voucher and four unknown samples, were obtained from various organizations described in Table 1. Voucher samples were essential as one must be certain of the sample's subspecies. As only a few of these samples existed in the UK and international transfer of tiger body parts would have violated CITES, the sample size in this study was limited. These 19 tiger samples comprised hair and tissues from different and unrelated individual tigers. Hair samples were plucked randomly from the individual's skin and then stored in a sterile bag. Sterile buccal swabs were used to collect forensically appropriate samples from muscle and other tissues. The hair was stored at room temperature and the swabs were stored at -20 ^{o}C until further analysis.

Table 1: The details of collected tiger sample such as scientific name, number of samples, their label, type of samples, and from where they were obtained.

Scientific name	Sample Number	Labelled	Type of samples	From where they were obtained
Panthera tigris tigris	4	Tigris1	Hairs	IWS
		Tigris2	Hairs	IWS
		Tigris3	Hairs	IWS
		Tigris4	Hairs	IWS
Panthera tigris sumatrae	4	Sumatrae 1	Tissues	NMS
		Sumatrae 2	Tissues	NMS
		Sumatrae 5	Tissues	NMS
		Sumatrae 8	Extracted DNA	NMS
Panthera tigris corbetti	2	Corbetti1	Hairs	CM
		Corbetti2	Hairs	SK
Panthera tigris altaica	5	Altaica	Extracted DNA	IWS
		Altaica 4	Tissues	NMS
		Altaica 6	Tissues	NMS
		Altaica 9	Tissues	NMS
		Altaica 29	Tissues	NMS

Unknown tiger	4	Tiger 8	Extracted DNA	NMS
		Tiger 13	Tissues	NMS
		Tiger 11	Tissues	NMS
		A.tiger	Tissues	NMS

*IWS is The Isle of Wight Tiger Sanctuary/ NMS is The National Museum of Scotland/ CM is The Chiang Mai zoo, Thailand/ SZ is The Songkhla zoo, Thailand

2.1.2 DNA extraction

Tiger DNA was isolated using the QIAamp DNA Mini Kit (QIAGEN, Crawley UK) following the manufacturer's protocol dependent on each sample type. Principally, the cellular membrane was firstly disrupted by either physical or detergent-based techniques such as sodium dodecyl sulphate (SDS). During this step, ethylenediaminetetraacetic acid (EDTA) or another chelating agent was added to the solution because it is a crucial reagent protecting any DNA released into solution. Protein denaturation and precipitation techniques were then required in order to remove protein from the solution. Regarding protein denaturation, some chemical substances have been reported to induce this process; these include urea salts and guanidine hydrochloride. Salting out was the method of choice for precipitation of cellular and histone protein bound DNA. Finally, extracted DNA was then separated from the denatured protein and other cellular components by a solid phase extraction technique where the DNA was bound to a positively charged membrane while denatured protein flowed through the column and was discarded.

2.2 The retrieval of the entire tiger mitochondrial genome

2.2.1 Establishment of Panthera sequence alignment

Panthera sequence alignments were firstly established to observe similarity and variation among Panthera mitochondrial sequences. To do this, as many as possible complete mitochondrial genomes from all *Panthera* species were searched from the GenBank database. A total of eight Panthera mitochondrial sequences were found, their information and accession number are shown in Table 2. These sequences were then aligned by Clustal X [138]. The Panthera alignment result was then kept for the further use in the design of Panthera universal primer sets.

Table 2: Mitochondrial genome numbers for each *Panthera* species and their accession number

Scientific name	Common name	Sequences number	Accession number in GenBank
Panthera tigris	Tiger	2	NC 010642, EF551003
Panthera pardus	Leopard	1	NC 010641
Uncia uncia	Snow Leopard	2	NC 010638, EF551004
Neofelis nebulosa	Clouded Leopard	1	NC 008450
Acinonyx jubatus	Cheetah	1	NC 005212
Felis catus	Cat	1	NC 001700

2.2.2 Primer design

Tiger primers were derived from conserved regions based on the Panthera sequence alignment, which were identified by an asterisk "*" to ensure that there was no sequence variation in the priming site; this should result in successful amplification for all tiger samples. The candidate primers were identified by eye. Each primer set was designed to provide a PCR fragment in the rage of 700 – 900 bp. The next primer set amplifying the adjacent region was designed to give overlapping PCR segments; overlapping by between 100 and 150 bp. The candidate primers were evaluated for their physical parameters such as annealing temperature (T_m), GC content, primer length, self complementary and secondary structure, using the DNA calculator website (http://www.sigma-genosys.com/calc/DNACalc.asp) and the Oligonucleotide Properties Calculator website (http://www.basic.north - western.edu/biotools/oligocalc.html). These primers were then either modified by increasing/decreasing base numbers in order to obtain the following properties:

- Primer length between 17-34 bases
- T_m between 55 ^oC – 65 ^oC
- No primer dimer potential
- No hairpin secondary structure

To avoid false positive results resulting from contamination with human DNA, all primer sets were also checked with the Basic Local Alignment

Search Tool (BLAST) from the NCBI website (http://blast.ncbi.nlm.nih.gov /Blast.cgi). This program is used to match selected sequences with the closest reported sequence uploaded to the DNA database. A total of twenty-six primer sets were designed, following the criteria and method mentioned above, for the entire tiger mitochondrial genome. These primers were synthesized by Sigma Genosys, UK. The nucleotide sequences are shown in Table 3. The panther sequence alignment showing all twenty six-primer sites is shown in Appendix 3.

Table 3: Nucleotide sequences of twenty-six primer sets amplifying whole tiger mitochondrial DNA. 'Y' represents pyrimidine bases (C/T); 'R' represents purine bases (G/A).

Primer set	Direction	Sequences (5'-3')	T_m (^oC)	Size of PCR product
1	Forward	CTCCCAGTACGAAAGGACAAG	62.52	788
	Reverse	GCTCGGTTGGTCTCTGCTAG	64.00	
2	Forward	TCAAAATAYGCYCTAATCGG	56.85	755
	Reverse	GGCCCGATAGCTTATTTAGC	61.40	
3	Forward	GTCTGACAAAAGAGTTACTTTGATAGAGT	61.21	730
	Reverse	GGGCGATTGAGGAGTATGCTA	65.05	
4	Forward	TACCCGAAGTTACACAAGGAAT	61.14	868
	Reverse	CCCACCAATCTAGTGAGGACTTAGC	66.18	
5	Forward	TAGACCAAGAGCCTTCAAAGC	62.33	803
	Reverse	GATGCTCCTGCATGAGC	60.71	
6	Forward	ATTGGAGGATTCGGAAACTG	62.72	854
	Reverse	GCTAGTACAATTCCTGTTAAGCC	59.72	
7	Forward	ACACGAGCATACTTTACGTCAGC	64.18	721
	Reverse	CTTCTTAATTGAGAAAGACATAGTGGT	60.75	
8	Forward	CCTCCGTATCACACATTTGAAGA	64.80	830
	Reverse	ACTAGTTCAAGGACAATGGG	58.04	
9	Forward	CTAAAAACTGACGCTATCCCAGG	64.55	811
	Reverse	GGTGTTCCTTGTGGTAGAAAGTG	63.46	
10	Forward	ACAAACYTGRGCCCTAATACT	62.33	803
	Reverse	AGGCTTGAGTGRTAGAAGGC	59.99	
11	Forward	GARAGCACATTCCAAGG	56.44	906
	Reverse	GTTTGTGAGGCYCAGGGAAG	63.73	
12	Forward	TATGAATGTGGATTTGACCC	59.60	894
	Reverse	AGTATTGTAATGTATAGTTTTTTTCG	55.70	
13	Forward	CACTCTCTGCACCCCTACTAGT	61.28	830
	Reverse	TCG TTCGTAGTTTGAGTTTG	57.94	

Primer set	Direction	Sequences (5'-3')	T_m (^{o}c)	Size of PCR product
14	Forward	TAATCGCATATTCATCCGTAAG	60.33	855
	Reverse	AAGGCGTAAGAGATTGTGGTT	61.43	
15	Forward	GGTGCAACTCCAAATAAAAG	58.65	888
	Reverse	GCTGTGAATAGGGTTGTGAT	58.99	
16	Forward	ATTTGGCCTACACCCATGA	62.74	831
	Reverse	TCTAATGCCAGGATAAAGCCT	61.46	
17	Forward	ATCAACTCCATTAAACGTCTCTT	63.70	915
	Reverse	TTTTCTTCAAAGCCTTCTCC	62.42	
18	Forward	TTATTAGATGTCCACGCCTC	59.13	876
	Reverse	GGAAGGCAAAGAATCGTGT	61.63	
19	Forward	CAGCCTTCATAGGATATGTCTTACC	62.61	854
	Reverse	GGCTATTGCTTCTTCCTTGA	60.88	
20	Forward	CAACTAGCCTCYATCCTATACTTCT	57.08	921
	Reverse	TTGAGAAAGTTGAAGGATTGG	60.62	
21	Forward	CGTGTACCTCTTCTCGCTC	60.16	886
	Reverse	ATAAATAAGATTAACGGGGGGT	60.17	
22	Forward	CCTATTGTTCCACAGGACAC	59.41	915
	Reverse	TGATTTAGAGGGCATTTTCA	59.64	
23	Forward	AAAGCAAGGCACTGAAAATG	61.74	813
	Reverse	TAAGGATTTTCGTGGATGTTCTA	61.19	
24	Forward	ATATACCGCCATCTTCAGC	59.09	773
	Reverse	CAGCTATCACCAGGCTCGT	63.03	
25	Forward	CCGAAACCAGACGAGCTA	61.58	793
	Reverse	GGAAGGTCAATTTCACGGAT	62.61	
26	Forward	CAAAAACATCACCTCTAGCATT	59.65	801
	Reverse	TGAACCTCTGATAGTAAAAGCTTAAG	59.89	

2.2.3 The polymerase chain reaction (PCR)

PCR amplifications were performed in a total volume of 20 µL containing, 200 µM of each dNTP, 1X PCR buffer (10 mM Tris HCl, pH 8.3, 50 mM KCl), 2.0 mM $MgCl_2$, 1.5 units Platinum *Taq* polymerase (Invitrogen, Paisley, UK), 0.5 pmol of each primer, and sterile water. The PCRs were conducted in a 2720 Applied Biosystems thermal cycler. Thermocycling conditions for tiger primers were as follows; 35 cycles of denaturation at 95 ^{o}C for 45 s, annealing at 60 ^{o}C for 45 s, extension at 72 ^{o}C for 1.30 min, and a final extension at 72 ^{o}C for 20 min. The reactions were then held at 4 ^{o}C.

2.2.4 DNA separation and detection

The PCR products were separated by agarose gel electrophoresis. First, a 2% (w/v) gel solution was made by adding the correct amount of agarose powder to 1 X TBE buffer (89 mM Tris base, 89 mM boric acid, 2 mM EDTA, pH 8.0), and then the slurry was heated in a microwave oven until the agarose was completely dissolved. The gel was allowed to cool down before 2µL of 10 mg/mL ethidium bromide was added. The warm gel solution was then poured into a gel tray which was fitted with a well-casting comb. Once the gel had solidified, the comb was removed and placed in the electrophoresis tank. In the next step, 1 X TBE buffer was added to cover the gel. To load the DNA samples, 5 µL of PCR product was mixed with 2 µL of 5 X loading dye. The 500 bp DNA ladder (Bioline) was used as a DNA size marker. The DNA migrated towards the anode. Electrophoresis was developed at 100 V for 20 min or until the dyes (bromophenol blue and xylene cyanol FF) migrated to a sufficient distance for separation of the fragments. The gel was examined under a UV transluminator and photographed in a Gel documentation station (Stratagene, USA).

2.2.5 PCR product purification

Three methods of PCR purification were used in this study. These methods are gel extraction purification, Microcon®, and ExoSAP-IT®.

2.2.5.1 Gel extraction purification method

PCR products were purified using the QIAquick® PCR Purification Kit by QIAGEN following the manufacturer's protocol. Firstly, a DNA fragment was separated from an agarose gel and then removed with a clean razor blade. The gel slice was place in 1.5 mL microcentrifuge tube. Three volumes of Buffer QG were added to one volume of gel in microcentrifuge tube and incubated at 50 ^{o}C for 10 min (or until the gel slice dissolved). After the gel slice has dissolved completely, the colour of the mixture was then checked so see if it was yellow. If the colour was violet or orange, 3M sodium acetate at pH 5.0 was be added. Afterwards, one gel volume of isopropanol was added to the sample. The mixture was then transferred to a QIAquick® spin column with 2 mL collection tube at the base and centrifuged for 1 min at 13,000 rpm.

The flow-through was discarded and 500 µL of yellow Buffer QG was added to the spin column and centrifuged for 1 min at 13,000 rpm to remove the last traces of agarose gel. Then, 750 µL of Buffer PE was added to the spin column and centrifuged for 1 min at 13,000 rpm. The flow-through was then discarded and the spin column was centrifuged for an additional 1 min at 13,000 rpm to remove any residual ethanol. Then, the spin column was placed into a new 1.5 mL microcentrifuge tube and DNA was eluted by adding 30 µL distilled water or Buffer EB to the centre of the spin column membrane. It was then left at room temperature for 5 min and the DNA was then removed from the column down to the tube by centrifugation at 13,000 rpm for 1 min.

2.2.5.2 Microcon®

PCR products were also purified using Microcon® Centrifugal Filter Units (Millipore Crawley, UK) following the manufacturer's protocol. First of all, a Microcon® sample reservoir was inserted into a 1.5 mL vial. Then, a DNA solution was prepared by mixing 485 µL sterile water and 15 µL PCR products. The solution was then pipetted to the sample reservoir without touching the membrane with the pipette tip. The assembly was placed in a centrifuge and spun at 500 rpm for 12 min. During this process, DNA was retained at the membrane while other smaller PCR mixtures passed through the membrane filter to the vial. After that, the assembly was removed from the centrifuge. Sterile water (20 µL) was added to the centre of the membrane before the sample reservoir was then placed upside down in a new vial. It was then spun at 1,000 rpm for 3 min to transfer the concentrate to new tube.

2.2.5.3 ExoSAP-IT®

PCR products were also purified using ExoSAP-IT® (USB, Crawley UK) following the manufacturer's protocol. Firstly, a working solution was prepared by mixing 5 µL of PCR products with 2 µL ExoSAP-IT® reagents. For treating 10 µL or more of PCR products, the amount of ExoSAP-IT® reagents was increased proportionally. The solution was then mixed and incubated at 37 ^{o}C for 15 min to let two hydrolytic enzymes (Exonuclease I and Shrimp Alkaline Phosphatase) function. Exonuclease I removes residual single strand primers and any extraneous single-strand DNA produced in PCR. Shrimp Alkaline Phosphatase removes the remaining dNTPs from the

PCR mixture. The solution was incubated at 80 ^{o}C for 15 minute to inactivate these enzymes. The treated PCR products were stored at -20 ^{o}C.

2.2.6 DNA sequencing and post-sequencing method

2.2.6.1 DNA sequencing and ambiguous base correction

All purified PCR products were sequenced by ABI 3100XL genetic analyser (Applied Biosystems, CA, USA) in both the forward and reverse direction. Once the tiger DNA sequence data were received, they were then edited, using the FINCH TV Version 1.4.0 (Geospiza Inc, WA) to remove any 'N' bases and ambiguities. Firstly, these sequence chromatograms were opened for examination. The bases 'N', being not called from the instrument caller, are called manually by the inspection of sequence traces as much as possible. The example of how to call bases N is shown in Figure 12. Any ambiguous bases which could not be decide which nucleotide base should be put at the particular position, were left as 'N' and will be edited as described in the next section.

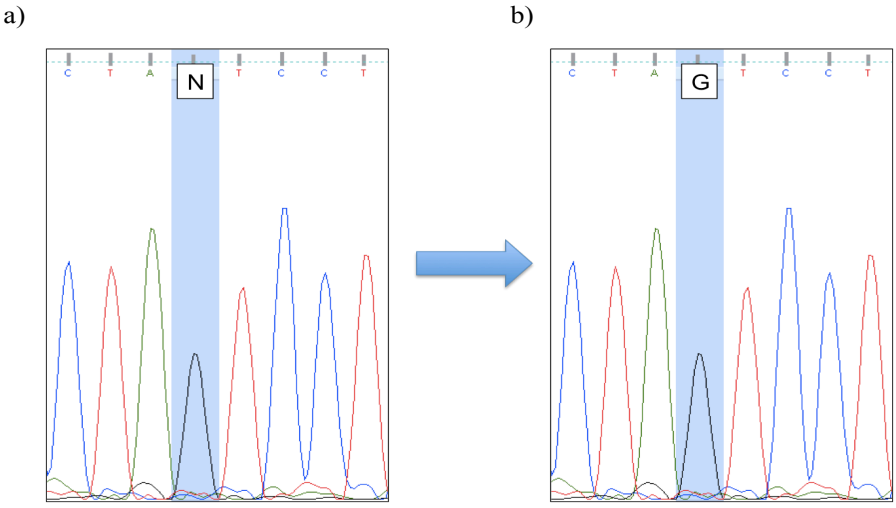


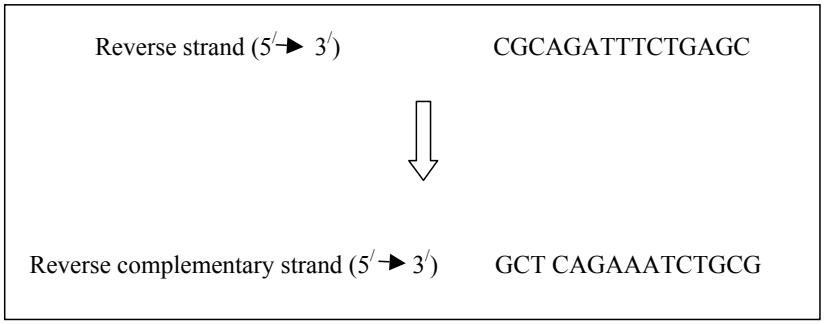
Figure 12: The example of how to call base 'N'. The X-axis represents nucleotide bases determined for each sequence positions; the Y-axis represents an adjustable vertical scale. One nucleotide base at the position 219 out of eight nucleotide bases, found in the DNA sequence of mtDNA fragment amplified by primer set 11, is ambiguous (a). This unclear base is edited to be base "G" base on the black colour (b).

A DNA sequence with no ambiguities and clear base calling was identified and cropped to remove poor quality DNA, which are normally present at the beginning and at the end of the nucleotide sequences.

2.2.6.2 The comparison of forward and reverse complementary sequences

The forward and reverse complementary sequences for each sample were compared using Clustal W. As the forward and reverse complementary strand of the same sample must be identical, doing this could confirm the correct sequences and determine if there are differences or mismatches. The reverse sequences were reverse complemented using OligoCalc (http://www.basic.northwestern.edu/biotools/oligocalc.html). This process is shown in Figure 13.

1) Converse reversed strand to reversed complementary strand



2) Make an alignment between forward and reverse complementary strand by Clustal W

Forward	GCTCAGAAATCTGAG	15
Reverse complementary	GCTCAGAAATCTGCG	15
	********** *	

3) Analyse the alignment result. If there are any mismatches, the sequence waveform file will be opened and checked for the correction again.

Mismatch

Forward	GCTCAGAAATCTGAG	15
Reverse complementary	GCTCAGAAATCTGCG	15
	********** *	

Figure 13: The diagram showing how to make alignment for forward and reversed complementary sequencing strand.

2.2.6.3 The extension of edited DNA sequences

Once the DNA sequences have been edited and corrected as mentioned above, the DNA sequences obtained from the same sample were then grouped and manually made an extension for whole tiger mitochondrial genomes as shown in Figure 14.

1) Put the DNA sequences in order according to primer set number

```
>SUMATRA1_PRIMER1
CTTCAAGCCGTAGCCCAAACAATCTCATATGAAGTCACATTAGCTATCATTCTCTTATCAG
TACACTAATAAATGGATCCTTCACATTAGCTGCACTAATTACCACCCAAGAATACATCTGG

>SUMATRA1_PRIMER2
TTACCACCCAAGAATACATCTGGCTCATCATCCCTGCATGACCCCTAGCCATAATATGATT
CATCTCCTCTCTGACAAAAGAATAAACATAGAGGTTTACTAATCCTAAGAATCCAAAAAT

>SUMATRA1_PRIMER3
TAATCCTAAGAATCCAAAAATCTTCGTGCTACCAATACTACACCACATTCTAAGTAAGGTC
AGCTAAATAAGCTATCGGGCCCATACCCCGAAACCCCTATCCTCACCATCATTATACTAAC
```

2) Search for the overlapping sequences of each primer set and an adjacent one.

```
>SUMATRA1_PRIMER1
CTTCAAGCCGTAGCCCAAACAATCTCATATGAAGTCACATTAGCTATCATTCTCTTATCAG
TACACTAATAAATGGATCCTTCACATTAGCTGCACTAATTACCACCCAAGAATACATCTGG

>SUMATRA1_PRIMER2
TTACCACCCAAGAATACATCTGGCTCATCATCCCTGCATGACCCCTAGCCATAATATGATT
CATCTCCTCTCTGACAAAAGAATAAACATAGAGGTTTACTAATCCTAAGAATCCAAAAAT

>SUMATRA1_PRIMER3
TAATCCTAAGAATCCAAAAATCTTCGTGCTACCAATACTACACCACATTCTAAGTAAGGTC
AGCTAAATAAGCTATCGGGCCCATACCCCGAAACCCCTATCCTCACCATCATTATACTAAC
```

3) Combine the sequences between the primer set and an adjacent one to make a whole mitochondrial genome

```
>SUMATRA1
CTTCAAGCCGTAGCCCAAACAATCTCATATGAAGTCACATTAGCTATCATTCTCTTATCAG
TACACTAATAAATGGATCCTTCACATTAGCTGCACTAATTACCACCCAAGAATACATCTGG
CTCATCATCCCTGCATGACCCCTAGCCATAATATGATTCATCTCCTCTCTGACAAAAGAAT
AAACATAGAGGTTTACTAATCCTAAGAATCCAAAAATCTTCGTGCTACCAATACTACACC
ACATTCTAAGTAAGGTCAGCTAAATAAGCTATCGGGCCCATACCCCGAAACCCCTATCCTC
ACCATCATTATACTAAC
```

Figure 14: The steps to extend sequences obtained from the same sample

2.3 The analysis of the tiger mitochondrial genome

A genome analysis was performed for the eight tiger mitochondrial genomes obtained in section 2.2. This analysis included an investigation of tiger genome characterization, nucleotide compositional pattern, codon usage, and DNA sequence variations. These are beneficial to get more understanding in tiger mitochondrial genome and can be used to determine a similarity/difference among the four extant tiger subspecies.

2.3.1 Genome characterization and annotation

The DNA sequence data for the eight entire tiger mitochondrial genomes, obtained in section 2.2, were used to identify the locations of 13 protein-coding genes (PCGs), 22 transfer RNA (tRNA), and 2 ribosomal RNA (rRNA) using several bioinformatics tools. The eight characterised tiger genomes were also annotated and submit to the GenBank database.

2.3.1.1 Protein coding genes (PCGs) identification

The 13 protein coding genes (PCGs) were identified using the Open Reading Frame Finder or ORF Finder (http://www.ncbi.nlm.nih.gov/ projects/gorf). This web-based server was used to find open reading frames or portions of the tiger genome that contains protein-encoding sequences, by searching for DNA sequences with a start codon and stop codon. The tiger DNA sequences were converted into the FASTA format and were analyzed by the ORF-finder one at a time. The minimum size of a selectable open reading frame was set as 100 nucleotides. A vertebrate mitochondrial genetic code was selected as a tool to compare and identify the PCGs in the tiger genomes. Once possible open reading frames were predicted, these data were analyzed by the Basic Local Alignment Tool (BLAST) and compared against the GenBank sequence database to identify possible matches.

2.3.1.2 transfer RNA gene (tRNA) identification

The software tRNAscan-SE, version 1.21, web-based server (http://lowelab. ucsc.edu/tRNAscan-SE/) was used to identify tRNA genes within the entire tiger genomes. Basically, this software employed two algorithms (optimized version of tRNA 1.3 and implementation of the Pavesi search algorithm called EufindRNA) to identify candidate tRNAs. The combination use of these two

algorithms can significantly improve the sensitivity and selectivity of tRNA gene identification [139]. The tRNA 1.3 algorithm used a hierarchical and rule-based system in which each potential tRNA must exceed empirically determined similarity thresholds for two intragenic promotors, plus have the ability to form base pairings present in tRNA stem-loop structure. While the Pavesi algorithm searched for a linear signals in the form of Eukaryotic RNA polymerase III promotors and terminators. The candidate tRNAs were structurally aligned with 1415 tRNAs in Sprinzl database by *covels* program [140]. They are then passed through the covariance model analysis yielding Cove score, which indicates a specificity and reliability of tRNA gene identification [139]. This process allows accurate secondary structure prediction [139]. To run the software, FASTA format sequences were used for this purpose. The 'tRNA only' and 'Mito/Chloroplast' options were selected as a search mode and source function, respectively. The Genetic Code for tRNA isotype prediction was set as 'Vertebrate Mito'. The default "EufindtRNA" search parameter was selected. Outputs such as a 'location' and 'sequence of an identified tRNA', 'tRNA gene size', 'predicted anticodon', and 'cove scores for tRNA identification' were obtained.

2.3.1.3 Ribosomal RNA gene (rRNA) identification

For rRNA gene identification, the new tiger mitochondrial genome sequences were aligned and compared with the complete tiger mitochondrial genomes available on the GenBank database using the NCBI Sequin software. This was performed using the sequin software for Macintosh version 10.3 which was downloaded from the website http://www.ncbi.nlm.nih.gov/Sequin/download/seq_download.html. Once the software was installed, FASTA format tiger sequences were uploaded to Sequin by the tool "Read existing record". The network configuration was set as "normal" to allow the information exchange between the downloaded Sequin and GenBank over the Internet. Three complete tiger mitochondrial genomes (NC_010642, NC_014770, and HM589214) were found in the GenBank database; no other complete tiger genomes were registered. These three tiger complete genomes were then downloaded to the software Sequin by the tool 'Update sequence' using the edit menu bar and then were aligned with the new tiger DNA

sequences. The options ‘no change’ and ‘import all features except duplicates’ were selected before updating the sequences. By using the software Sequin, all the identified PCGs and tRNA genes predicted by the ORF-finder and tRNAscan-SE would be checked and confirmed. Outputs such as locations and position of each genes, start and stop codon, gene size, intergenic nucleotide size, were recorded.

2.3.1.4 Secondary structure prediction

Secondary structures of tRNA and rRNA genes were predicted using the RNAfold web server (http://rna.tbi.univie.ac.at/cgi-bin/RNAfold.cgi). This software is based on dynamic programming algorithms that predict the secondary structure of RNA by minimizing free energy [141]. To run the software, the ‘minimum free energy’ (MFE) and ‘partition function’ were selected as a fold algorithms and basic options. According to this option, the RNAfold calculated the partition function and the base pairing probability matrix in addition to the minimum free energy (MFE) structure.

2.3.1.5 Genome annotation

The eight new tiger mitochondrial genomes were validated and prepared for submission to the GenBank database using the software Sequin, following the instruction available on the NCBI website. The sequence validation was performed using the tool ‘Validate’ to check for a missing organism information, incorrect coding region lengths, internal stop codons in coding regions, inconsistent genetic codes, mismatched amino acids, and non-consensus splice sites. The validated tiger genomes were saved as a required final submission file (.sqn file) using the tool ‘Prepare submission’. These final submission files were then submitted to the GenBank database using the tool ‘SequinMacroSend’ available on the NCBI website.

2.3.2 Nucleotide compositional pattern

The nucleotide compositional pattern in term of a nucleotide composition base frequency and asymmetry (GC- and AT- skews) was investigated in the eight tiger mitochondrial genomes using Mega 4 [142]. The nucleotide composition was calculated from the light strand (L-strand) of the mitochondrial DNA for the entire tiger mitochondrial genome and each of the 37 mitochondrial genes.

To do this, the tool "nucleotide composition" in the "statistics" menu bar provided in Mega 4 was employed. The nucleotide base frequencies, A%, T%, G%, C%, and the average frequencies in percentage were obtained. The average nucleotide base frequency was calculated using only complete mitochondrial genomes or genes. AT% and GC% were manually calculated using an Excel file. To do this, the formula "= (the cell containing A% + the cell containing T%)/2" and "= (the cell containing G% + the cell containing C%)/2" were created in the provided function space to calculate AT% and GC%, respectively.

The nucleotide compositional asymmetry in terms of GC- and AT- skews was used to indicate compositional difference within one strand and between the two strands of mitochondrial DNA. These parameters and their standard deviation were measured following the formulae:

$$\text{AT-skew} = \frac{A - T}{A + T} \qquad [143]$$

$$\text{GC-skew} = \frac{G - C}{G + C} \qquad [143]$$

$$\text{SD (GC-skew)} = \frac{2}{G + C}\sqrt{\frac{G.C}{G + C}} \qquad [144]$$

$$\text{SD (AT-skew)} = \frac{2}{A + T}\sqrt{\frac{A.T}{A + T}} \qquad [144]$$

Where G, C, A, and T are the frequency of the four nucleotides found in the observed sequence. The absolute value of GC- or AT-skew is within the range from 0 where there is no strand bias condition to 1 where a strong compositional asymmetry occurs.

2.3.3 Codon usage

Codon usage in the coding region of the entire tiger mitochondrial genome and each 37 mitochondrial genes was examined using Mega 4 [142]. Only complete mitochondrial genes or genomes were used for this purpose. The analysis was run clockwise in the direction of transcription for the entire mitochondrial genome and for each of 37 mitochondrial genes (28 genes encoded by the heavy strand and nine genes encoded by the light strand). Our tiger sequences were those on the light strand of mitochondrial DNA and served as the mRNA strand of the heavy strand-encoded template. Hence if using the light strand-encoded genes, the reverse complement is needed to be made before the analysis. To do this, the nine genes transcribed from the light strand, ND6, $tRNA^{-Gln}$, $tRNA^{-Ala}$ $tRNA^{-Asn}$ $tRNA^{-Cys}$ $tRNA^{-Tyr}$ $tRNA^{-Ser}$ $tRNA^{-Glu}$ $tRNA^{-Pro}$, were converted to their complementary sequences using the tool 'reverse complement' in Mega 4. These complementary sequences were then used to replace their opposite strands in the entire tiger mitochondrial genome and were used in the analysis of codon usage. To analyze the codon usage using Mega 4, the tool 'codon usage' in the statistics menu bar was selected. The 'vertebrate mitochondrial' was selected as a genetic code. The outputs obtained from this study were an average vertebrate codon frequency and a relative synonymous codon usage (RSCU); i.e. the a number of times a particular codon is observed relative to a number of times that the codon would be observed in the absence of any codon usage bias. In the case that a particular codon is used less frequently than expected, the RSCU value would be less than 1.00; on the other hand, the RSCU value that is higher than 1.00 indicates a more frequent use than expected.

2.3.4 DNA sequence variation in the tiger mitochondrial genome

DNA sequence variation throughout the entire tiger mitochondrial genome was investigated. To do this, mitochondrial DNA sequences from *Panthera tigris* available on GenBank (www.ncbi.nih.gov) were included in this study. From a search through the GenBank database, a total of 544 putative tiger sequences from the five extant tiger subspecies were found. These sequences and the tiger sequences from this study from each mitochondrial gene were combined and aligned by Mega 4. The reason for this alignment was to check

if the registered DNA sequences available on GenBank were genuine tiger DNA sequences and that no sequencing errors had occurred. The alignment result reported 52 sequences being incomplete or unsuitable for the further use as they showed a number of mismatch base ambiguities (Figure 15). From the original 544 DNA sequences, 492 DNA sequences were selected; the sequence accession number and other details for these data are shown in Table 4. These sequences and the tiger sequences from this study from each mitochondrial gene were then re-aligned using Mega 4. The tiger sequence alignments for each mitochondrial genes are shown in Appendix 4. All sequence alignments were assessed and DNA variations were manually searched to determine the DNA similarity, inter- and intra- DNA variation among tiger subspecies. The DNA variation sites observed from the entire tiger mitochondrial genomes and their position on the genome were examined and recorded. Moreover, a nucleotide substitution pattern was also examined in the entire tiger mitochondrial genome. To do this, the transition/transversion bias (R), transition/transversion rate ratio for purine and pyrimidine (k1 and k2) were calculated using Mega 4.

Position	1104	1420	1577	1649	1651	1655	1663	1671	1677	1687	1712	1751
P. tigris altaica 1	T	T	A	G	G	T	A	C	G	G	A	G
P. tigris altaica 2	C	.	.	.	.	.	.	T	.	.	.	.
P. tigris altaica 3	-	.	.	.	.	.	.	T	.	.	.	.
P. tigris altaica 4	-	.	.	A	C	G	T	T	A	T	.	A
P. tigris tigris 1	.	.	.	.	.	.	.	.	.	.	.	.
P. tigris tigris 2	.	.	.	.	.	.	.	.	.	.	.	.
P. tigris tigris 3	-	.	.	.	.	.	.	.	.	.	.	.
P. tigris tigris 4	-	.	.	.	.	.	.	.	.	.	.	.
P. tigris sumatrae 1	.	.	.	.	.	.	.	.	.	.	.	.
P. tigris sumatrae 2	.	.	.	.	.	.	.	.	.	.	.	.
P. tigris sumatrae 3	-	C	G	.	.	.	.	.	.	.	.	.
P. tigris sumatrae 4	-	.	.	.	.	.	.	.	.	.	.	.
P. tigris amoyensis 1	-	.	.	.	.	.	.	.	.	.	.	.
P. tigris amoyensis 2	-	.	.	.	.	.	.	T	.	.	.	.
P. tigris corbetti 1	C	.	.	.	.	.	.	T	.	.	.	.
P. tigris corbetti 2	C	.	.	.	.	.	.	T	.	.	.	.
P. tigris corbetti 3	-	.	.	.	.	.	.	T	.	.	.	.
P. tigris corbetti 4	-	.	.	.	.	.	.	T	.	.	.	.

Figure 15: An example of unsuitable 12S rRNA sequence obtained from GenBank (highlighted by yellow colour). A number of mismatch base ambiguities are found on the tiger sequence alignment, particularly at the variable sites. This sequence is not used for tiger subspecies-specific SNP identification.

Table 4: The tiger sequence information used in this study, including: accession number; total number of DNA sequences used; and author of relevant paper and the year published.

Accession number	No of samples	Author, Year	MtGene
EU661609-EU661691, FJ228452	84	Mondol, 2009	ND2, ND5, cyt *b*, CR
EU527874-EU527859	16	Sharma, 2009	12S rRNA, ND2, ND5, cyt *b*
FJ403464.1-67.1	4	Matrai, 2009	cyt *b*, CR
FJ895266.1	1	Yoo, 2009	cyt *b*
FN257739.1, FM999724.1	2	Doung/Din, 2009	ND2, cyt *b*
FJ469625.2, FJ694967.1-972.1, FJ461529.2-534.2, FJ608583.1-585.1	16	Shi&Zhang, 2009	COI, COIII, ND4
EU395630.1-645.1	16	Khan *et al.,* 2009	ND5
EU184702-EU184691	12	Ryan, 2008	cyt *b*
FJ422145.1, FJ465508.1-511.1, FJ478155.1-158.1, FJ455122.1-125.1	13	Shi&Zhang, 2008	COI, COIII, CR
FM179470-71.1	2	Nagappa *et al.*, 2008	12S rRNA
FJ185309.1	1	Ghosh *et al.*, 2008	COI
EF375881.1	1	Rajput&Goyal, 2007	ND1
AB211408-11	4	Sugimoto *et al*., 2006	cyt *b*
EF179376-EF179357	20	Ryan, 2006	cyt *b*
AB193164.1	1	Nagata, 2006	cyt *b*
AY452097-99.1, AY452101, AY452111.1, 112.1,114.1-119.1	12	Zhang *et al.*, 2006	ND5, CR
DQ111950-51.1	2	Wei *et al.*, 2005	ND5
AY736559–AY736808	250	Luo *et al.*, 2004	12S rRNA, ND1, ND2, COI, ND5, ND6, cyt *b*, CR
AY452110.1	1	Zhang *et al.*, 2003	16S rRNA
AF053018-AF053051	34	Cracraft, 1998	cyt *b*
Total tiger sequences	**492**		

2.3.5 Tiger subspecies phylogeny

The phylogenetic relationship among the five extant tiger subspecies was examined based on the entire tiger mitochondrial genomes and for each of the mitochondrial genes. The eight new tiger mitochondrial genomes were used to reconstruct a phylogenetic tree based on the entire genome. For the reconstruction of phylogenetic tree based on each mitochondrial gene, the 492 tiger sequences obtained from GenBank were included in this study. The control region was excluded in this study because of the occurrence of ambiguous bases in this region. The tree topologies were reconstructed using three methods being available on Mega 4 (parsimony, neighbor-joining, and maximum likelihood methods) and Mr.Bayes [145]. To reconstruct the phylogenetics tree using the tree methods on Mega 4, the default phylogenetic parameters were used for all runs. Either bootstrap or interior branch test was set as 500 replicates; 64238 random seed was used to test the reliability of reconstructed phylogenetic trees. All trees were calculated using complete deletion option for any gap or missing data, and the Maximum Composite Likelihood Model was used. The reconstructions included all codon positions, including transitions and transversions.

2.4 The development and validation for tiger species- and subspecies-specific SNPs identification

2.4.1 Tiger species and subspecies-specific SNP identification

The identification method for tiger subspecies-specific SNP is described in section 2.3.4. To examine tiger species-specific SNPs, 349 sequences from mammalian species spanning a range of taxonomic groups were aligned with 71 tiger sequences. The cyt *b* gene had the greatest number of mammalian sequences available online compared to other mitochondrial gene loci. The mammalian sequences used in this study were collected only from this locus. A total of 349 mammalian sequences from 169 mammalian species were collected. A list of mammalian species and their accession numbers are shown in Table 5. These 349 mammalian sequences, 71 tiger cyt *b* sequences available on GenBank, and our tiger cyt *b* sequences were then aligned using Mega 4. The cyt *b* sequence alignment of all these samples are shown in appendix 5. The SNPs being specific only to tiger species, or where a base is rarely present the same base as tiger in other mammalian species, were then manually identified.

Table 5: The mammalian sequence information used in this study, including: common name, scientific name, the total number of DNA sequences used, and the accession number obtained from GenBank.

Scientific name	Common name	GenBank accession number	No.
Acinonyx jubatus	Cheetah	AY463959.1, NC_005212.1, AF344830.1	3
Ailuropoda melanoleuca	Giant panda	AY390360.1, U23552.1, X94918.1	3
Ailurus fulgens	Red panda	X94919.1	1
Alces alces	Moose	AJ000026.1	1
Alouatta caraya	Black howler monkey	AY374378.2	1
Amblonyx cinereus	Small-clawed otter	AF057119.1	1
Aonyx capensis	African clawless otter	AF057118.1	1
Arctocephalus australis	South American fur seal	AY377329.1	1
Arctocephalus forsteri	New Zealand fur seal	NC_004023.1	1
Arctocephalus gazella	Antarctic fur seal	X82292.1	1
Arctogalidia trivirgata	Small-toothed palm civet	AF125140.2	1

Scientific name	Common name	GenBank accession number	No.
Arctonyx collaris	Hog badger	AB049810.1, AF498157.1	2
Atilax paludinosus	Marsh mongoose	AF522325.1, AF522324.1, NC_008417.1, AM181018.1	4
Bassaricyon alleni	Allen's olingo	DQ660299.1	1
Bassaricyon gabbii	Olingo	DQ660300.1, X94931.1	2
Bdeogale crassicauda	Bushy-tailed mongoose	AY950654.1	1
Bdeogale nigripes	Black-footed mongoose	AY950655.1	1
Bradypus tridactylus	Pale-throated three-toed sloth	NC_006923.1	1
Callorhinus ursinus	Northern fur seal	NC_008415.3, AY424647.1	2
Callosciurus nigrovittatus	Black-striped squirrel	AB043882.1	1
Canis aureus	Golden jackal	AY291433.1	1
Canis latrans	Coyote	DQ480511.1, EU789789.1	2
Canis lupus	Gray wolf	AB499825.1, AB499823.1, EU789737.1, EU789739.1, EU789762.1, EU352854.1	6
Canis (lupus) himalayensis	Himalayan wolf	AY291431.1	1
Canis (lupus) pallipes	Indian gray wolf	AY291432.1	1
Castor fiber	Eurasian beaver	DQ088706.1, DQ088705.1, DQ088707.1	3
Catopuma temminckii	Asian golden cat	FJ594957.1	1
Cephalorhynchus eutropia	Black dolphin	AF084072.1	1
Ceratotherium simum	White rhinoceros	NC_001808.1, Y07726.1	2
Cervus elaphus	Red deer	AB245427.2, EU878392.1	2
Cervus eldii	Eld's deer	EU878390.1	1
Civettictis civetta	African civet	AY170105.1, AF511043.1	2
Crocuta crocuta	Spotted hyaena	AF511064.1, AY048786.1	2
Crossarchus alexandri	Alexander's cusimanse	AF522326.1	1
Crossarchus obscurus	Long-nosed cusimanse	AF522327.1, AY170101.1	2
Cryptomys hottentotus	Common mole rat	AF012240.1	1
Cynopterus brachyotis	Lesser short-nosed fruit bat	GQ410210.1	1
Dasypus novemcinctus	Nine-banded armadillo	AF493839.1	1
Dendrogale melanura	Bornean smooth-tailed treeshrew	AY321634.1	1
Dicerorhinus sumatrensis	Sumatran rhinoceros	AJ245723.1, NC_012684.1	2
Diceros bicornis	Black rhinoceros	X56283.1	1
Dicrostonyx groenlandicus	Northern collared lemming	AJ238426.1, AJ238429.1, AY159000.1	3
Dolichotis patagonum,	Mara	AY382787.1	1
Dremomys pyrrhomerus	Red-hipped squirrel	EF539342.1	1
Elephantulus rupestris	Western rock elephant shrew	EF141696.1	1
Enhydra lutris	Sea otter	AF057120.1, DQ533942.1	2

Scientific name	Common name	GenBank accession number	No.
Equus asinus	Donkey	NC_001788.1	1
Equus caballus	Horse	EU433686.1, EU433679.1, EU433684.1	3
Equus grevyi	Grevy's zebra	X56282.1	1
Erethizon dorsatum	North American porcupine	FJ357428.1	1
Erignathus barbatus	Bearded seal	AY170104.1, AY140982.1, X82295.1	3
Eubalaena australis	Southern right whale	DQ095153.1	1
Eulemur mongoz	Mongoose lemur	NC_010300.1	1
Eumetopias jubatus	Steller's sealion	FJ948490.1, FJ948489.1, FJ948487.1	3
Felis catus	Domestic cat	AB194814.1, AB194815.1, U20753.1	3
Felis silvestris	Wildcat	AY170102.1, EF689046.1	2
Fossa fossana	Malagasy civet	AF511062.1, AY170097.1	2
Galerella pulverulenta	Cape gray mongoose	AF522329.1, AF522330.1	2
Galerella sanguinea	Slender mongoose	AF522332.1, AF522331.1	2
Galictis cuja	Lesser grison	EF987754.1	1
Galidictis fasciata	Broad-striped mongoose	AY170100.1	1
Genetta genetta	Common genet	AF511054.1	1
Glaucomys sabrinus griseifrons	Prince of Wales' flying squirrel	AF359238.1	1
Gulo gulo	Wolverine	AM711901.1, DQ206370.1, DQ206366.1, DQ206361.1, AB051245.1	5
Helarctos malayanus	Sun bear	EF196664.1, FM177765.1	2
Helogale hirtula	Desert dwarf mongoose	AF522335.1	1
Helogale parvula	Dwarf mongoose	AF522334.1, AF522333.1	2
Herpestes brachyurus	Short-tailed mongoose	FJ391225.1, FJ391211.1	2
Herpestes ichneumon	Egyptian mongoose	AF511059.1, EF689050.1	2
Herpestes naso	Long-nosed mongoose	AF522340.1, AF522339.1	2
Hipposideros rotalis	Laotian leaf-nosed bat	DQ054814.1	1
Homo sapiens	Human	J01415.2	1
Hyaena hyaena	Striped hyaena	AY048788.1, AY048787.1	2
Hydrictis maculicollis	Spotted-necked otter	AF057125.1	1
Ichneumia albicauda	White-tailed mongoose	AF511058.1, AF522341.1	2
Ictonyx libyca	Saharan striped Polecat	EF987739.1	1
Ictonyx striatus	Striped polecat	AF498156.1	1
Lemmus trimucronatus	Lemming	AY219157.1, AY219159.1, AY219154.1	3
Lepus europaeus	European hare	AF157460.1	1

Scientific name	Common name	GenBank accession number	No.
Lepus granatensis	Granada hare	AF157460.1	1
Lepus othus	Alaskan hare	AF010154.1	1
Lepus timidus	Mountain hare	AF157466.1	1
Lontra felina	Marine otter	AF057122.1	1
Lontra longicaudis	Neotropical river otter	AF057123.1	1
Loxodonta africana	African savanna elephant	NC_000934.1	1
Lynx canadensis	Canada lynx	AY928671.1, AF057121.1, AF057121.1, AY598475.1	4
Lynx rufus	Bobcat	GU175436.1, GQ979707.2	2
Manis pentadactyla	African pangolin	EU057626.1, EU057631.1	2
Manis tetradactyla	Long-tailed pangolin	NC_004027.1	1
Marmota broweri	Alaska marmot	FJ438936.1, FJ438934.1, FJ438933.1, FJ438931.1	4
Marmota caligata	Hoary marmot	FJ438941.1, FJ438938.1, FJ438939.1	3
Martes americana	American marten	AF154973.1, AF154971.1, AF057130.1, AF154965.1	4
Martes flavigula	Yellow-throated marten	EF987749.1	1
Martes melampus	Japanese marten	AB455639.1, AB455635.1	2
Martes zibellina	Sable	GU935933.1, AB455641.1	2
Meles meles	European badger	AB049807.1, AB049808.1	2
Melogale moschata	Chinese ferret-badger	AF498158.1	1
Melogale personata	Burmese ferret-badger	EF987756.1	1
Melursus ursinus	Sloth bear	U23560.1, U23562.1	2
Mephitis mephitis	Striped skunk	GU175440.1	1
Microtus arvalis	Common vole	EU439954.1, EU439957.1	2
Microtus californicus	California vole	GQ168688.1, GQ168689.1	2
Microtus longicaudus	Long-tailed vole	AF119267.1	1
Microtus maximowiczii	Maximowicz's vole	FJ986303.1	1
Microtus mongolicus	Mongolian vole	FJ986304.1	1
Microtus oeconomus	Root vole	AY220045.1, AY220044.1, AY220017.1	3
Microtus subterraneus	European pine vole	GU291956.1	1
Mungos mungo	Banded mongoose	AF522347.1, AY928674.1	2
Mustela erminea	Stoat or ermine	EF089133.1, EF689078.1, EF689078.1	3
Mustela eversmanii	Steppe polecat	EF987741.1	1
Mustela lutreola	European mink	EF987742.1, EF689085.1, EF689084.1	3
Mustela nigripes	Black-footed ferret	EF987743.1	1

Scientific name	Common name	GenBank accession number	No.
Mustela nivalis	Least weasel	EF689080.1, EF987744.1, EF987744.1	3
Mustela nudipes	Malayan weasel	EF987745.1	1
Mustela putorius	European polecat	EF987746.1	1
Mustela sibirica	Siberian weasel	EF987747.1, EF987747.1	2
Mustela strigidorsa	Back-striped weasel	EF987748.1	1
Myodes glareolus	Bank vole	EU439964.1, EU439967.1, EU483594.1	3
Mystacina tuberculata	New Zealand lesser short-tailed bat	AY960981.1	1
Nasua narica	White-nosed coati	DQ533940.1, DQ660302.1	2
Nasua nasua	South American coati	DQ660303.1	1
Neofelis nebulosa	Clouded leopard	DQ257669.1, NC_008450.1	2
Neovison vison	American mink	AF057129.1, GQ153577.1, AB026109.1	3
Nyctereutes procyonoides	Raccoon dog	NC_013700.1, GU256221.1	2
Ochotona collaris	Collared pika	EU549743.1, EU549742.1, EU549740.1, EU549739.1	4
Orcinus orca	Killer whale	GU187211.2	1
Orycteropus afer	Aardvark	NC_002078.1	1
Oryctolagus cuniculus	European rabbit	U07566.1	1
Ovibos moschatus	Muskox	U90300.1, U90301.1, U90302.1, U90303.1	4
Ovis aries	Domestic sheep	AF010406.1	1
Ovis dalli	Dall's sheep	U17860.1, AF034728.1, EU365992.1, FJ936184.1	4
Panthera uncia	Snow leopard	NC_010638.1, EF551004.1	2
Panthera leo	Lion	AF384813.1, AF384815.1, AF384814.1, AY928670.1, EF437586.1, AF053052.1, AF384811.1, AF384812.1, AF384816.1, AY297939.1, AY297940.1, AY297941.1, AF384810.1, AF384817.1, AF384809.1, AF384818.1	16
Panthera onca	Jaguar	GU175435.1, EF437582.1, HM107682.1	3

Scientific name	Common name	GenBank accession number	No.
Panthera pardus	Leopard	AY297925.1, EF056505.1, AY297926.1, EF056506.1, AY297927.1, EF056507.1, AY297928.1, EF063721.1, NC_010641.1, EF551002.1, EF437590.1, EF199742.1, AB211407.1, AB193168.1, AB193169.1, AB193170.1, AB193171.1, AB211401.1, AB211406.1, AB211405.1, AB211404.1, AB211403.1, AB211402.1, AB193165.1, AB193166.1, AB193167.1	26
Paradoxurus hermaphroditus	Plam civette	AF511056.1, AY170113.1	2
Parahyaena brunnea	Brown hyaena	AY048790.1, AY048789.1	2
Phoca largha	Spotted seal	AY140979.1, AB510432.1, AB510438.1, AB510443.1	4
Platanista minor	Indus river dolphin	NC_005275.1	1
Prionailurus bengalensis	Leopard cat	AB210237.1, AB210233.1, AB210238.1, FJ788107.1	4
Prionailurus bengalensis iriomotensis	Iriomote cat	AB210228.1	1
Prionailurus planiceps	Flat-headed cat	FJ594958.1	1
Prionailurus viverrinus	Fishing cat	FJ594959.1, AB210240.1	2
Procyon cancrivorus	Crab-eating raccoon	DQ660305.1	1
Procyon lotor	Raccoon	GU175439.1, DQ660306.1, X94930.1	3
Proteles cristatus	Aardwolf	AY048792.1	1
Puma concolor couguar	Puma	GU175442.1, AY598487.1	2
Rangifer tarandus	Reindeer	AB245426.1, DQ673127.1, DQ673130.1, DQ673135.1	4
Rhinolophus formosae	Formosan woolly horseshoe bat	EU166918.1	1
Rhynchogale melleri	Meller's mongoose	AF522344.1	1
Salanoia concolor	Brown-tailed mongoose	AY187007.1	1
Spermophilus parryii	Ground squirrel	AF157931.1, AY428024.1, AY428019.1, AY428008.1, AF157927.1,	5
Suricata suricatta	Meerkat	AY170111.1, AF522346.1	2
Talpa stankovici	Balkan mole	FJ688098.1	1

Scientific name	Common name	GenBank accession number	No.
Tamias sibiricus	Siberian chipmunk	EU754787.1	1
Tamiasciurus hudsonicus	American red squirrel	AF322957.1, AF322956.1, AF322949.1, AF322946.1, AF322945.1, GU175443.1	6
Tapirus indicus	Malayan tapir	AF145734.1	1
Tremarctos ornatus	Spectacled bear	U23554.1	1
Ursus americanus	American black bear	AF303109.1, U23556.1, AF268265.1, AF268259.1, AF268270.1	5
Ursus arctos	Brown bear	EU567095.1, EU567092.1, EU567090.1, AF303110.1	4
Ursus maritimus	Polar bear	U18898.1	1
Ursus thibetanus	Asian black bear	U23558.1, AY522430.2	2
Viverra megaspila	Large-spotted civet	AF511046.1	1
Viverra tangalunga	Malayan civet	AF511045.1	1
Viverra zibetha	Large Indian civet	AF511047.1	1
Vulpes vulpes	Red fox	AM181037.1, AY928669.1, EF689058.1, EF689060.1	4
Zalophus californianus	Californian sealion	X82310.1	1
Zapus hudsonius	Meadow jumping mouse	DQ665009.1, DQ665207.1, DQ665213.1, DQ665218.1, DQ665220.1,	5
Zapus princeps	Western jumping mouse	DQ665221.1	1
Total			**349**

2.4.2 The detection of tiger species and subspecies by SNaPshot® assay.

The tiger species and subspecies-specific SNPs identified through the alignment of tiger and other mammalian sequences as described in section 2.4.1 were detected by SNaPshot® multiplex assay. The methods for achieving this assay are described below.

2.4.2.1 The multiplex of SNaPshot® template amplification

After the tiger species- and subspecies-specific SNPs were identified, a set of primer pairs were designed to amplify mitochondrial regions that included these SNPs. The physical parameters and secondary structure of the primers were checked using the same tools as primers for the amplification of an entire tiger mitochondrial genome as described previously in the method 2.2.2. A primer cross reactivity was also checked using the online software

called Auto-dimer (http://www.cstl.nist.gov/strbase/AutoDimerHomepage/ - AutoDimerProgramHomepage.htm). The singleplex and multiplex PCR amplifications of these primers were performed in a total volume of 20 µL. The PCRs contained 200 µM of each dNTP, 1X PCR buffer (10 mM Tris HCl, pH 8.3, 50 mM KCl), 2.0 mM $MgCl_2$, 2.0 units Platinum *Taq* polymerase (Invitrogen, Paisley, UK), 1 µM of each primer, and sterile water. For the multiplex amplification, optimal concentrations of each primer were examined. To do this, the primer concentrations were adjusted as proportional to their PCR product band intensities. The PCRs were conducted using a 2720 Applied Biosystems thermal cycler. Amplification conditions for these primers were as follows; 35 cycles of denaturation at 95 ^{o}C for 45 s, annealing at 60 ^{o}C for 45 s, extension at 72 ^{o}C for 1 min 30 s, and a final extension at 72 ^{o}C for 20 min. The reaction was then held at 4 ^{o}C. From the final PCR, 2 µL were run on a 3 % agarose gel to ensure that the amplifications were successful and provided all the expected fragments.

2.4.2.2 SNaPshot® template purification

The remainders of the PCR products were purified by QIAquick® PCR purification kit (Qiagen) in order to remove unincorporated ddNTPs and exceed primers. The PCR products were purified following their manufacturer's protocol described in the method 2.2.5. The purified PCR products were stored at -20 ^{o}C until further analysis.

2.4.2.3 SNaPshot® reaction

A total of 11 SNaPshot® extension primers were designed to bind adjacent to the SNPs either in the forward or reverse direction. The SNaPshot® primers were examined for their physical parameters and secondary structure as described previously in the method 2.2.2. Different-length tails (poly GACT) were added to the 5' end of the primers to vary the PCR product sizes from 20 to 70 bp. The primer sequences and their sizes are shown in Table 7**.** The singleplex and multiplex SNaPshot® reactions were performed using the SNaPshot® multiplex kit (Applied Biosystems, Foster City, CA, USA) in a total volume of 10 µL, containing 5 µL reaction mix, 3 µL multiplex template, 1 µL sterile water, and 1 µL extension primer mix. The extension primer mix for the singleplex reaction was prepared by adding 0.2 µM of each extension

primers. For the multiplex reaction, optimal concentrations of each primer were examined by adjusting primer concentrations as proportional to their SNP peak height. The SNaPshot® PCRs were amplified in a 2720 Applied Biosystems thermal cycler using the following the condition: 25 cycles of 96 ^{o}C for 10 s, 50 ^{o}C for 5 s, and 60 ^{o}C for 30 s. The reaction was then held at 4 ^{o}C.

2.4.2.4 Post-extension purification

SNaPshot® PCR products were purified by the Shrimp Alkaline Phosphatase or SAP (USB, Crawley, UK) in order to remove unincorporated fluorescent ddNTPs and exceed extension primers. This method was performed following its manufacturer's protocol. Firstly, the SNaPshot® product mixture was added with 1 unit of SAP. The SNaPshot®-SAP mixture was then incubated at 37 ^{o}C for 60 min and then 75 ^{o}C for 15 min. The purified SNaPshot® product was stored at 4 ^{o}C until a further analysis.

2.4.2.5 SNaPshot® product analysis

SNaPshot®-purified product of 2 ul was mixed with 15.5 µL formamide and 0.5 µL of GeneScan-120 LIZ size standard (Applied Biosystems). The SNaPshot®-formamide mixture was heated at 95 ^{o}C for 3 min and stored at 4 ^{o}C until further analysis. The extended products were separated by capillary electrophoresis using the ABIPrism 310 Genetic Analyzer (Applied Biosystems), with a 36-cm length capillary and POP-4 polymer. The SNP typing results were analyzed using GeneMapper version 3.2.1.

2.4.3 The validation of developed SNaPshot® multiplex assay

The SNaPshot® multiplex assay for tiger species and subspecies identification was validated for its accuracy, sensitivity, specificity, and blind-trial tests. The methods for these validation tests are described below.

2.4.3.1 Accuracy test

The assay was used to analyze 15 voucher tiger samples described in the sample collection method. Ten out of fifteen voucher tiger samples were picked at random and then analyzed by the developed assay following the method described above. Data were collected after the sample was injected onto the capillary 10 times for each sample. The reasons of doing this were to

determine if there was any run variation, to create bin set and statistical calculation. The average range and size of the fragments, and their standard deviation were calculated for all SNP peaks as the formulas below:

- The average fragment size (mean) is given by

$$\overline{X} = \sum Xi / n$$

Where $\overline{X}$ = mean of fragment size, Xi = the *ith* value of fragment size, n = number of samples/values

- Standard deviation is given by

$$s = \sqrt{\sum Xi2 - ((\sum Xi)2 / n)/n-1}$$

Where s = standard deviation of fragment size, Xi = the *ith* value of fragment size

2.4.3.2 Sensitivity test

To test the assay's sensitivity or a minimum amount of tiger DNA detected by the assay, a quantified tiger DNA is needed. The DNA sample of *P. t. corbetti* was then quantified following the method described in [37]. To do this, the tiger sample and dilution series of quantified mitochondrial sample were simultaneously run by real-time PCR. The quantified mitochondrial sample was prepared by amplifying a fragment of the 12S ribosomal RNA gene from *Panthera leo* DNA with the universal primers; forward primer (5-3): GCCACCGCGGTCATACGATT, and reverse primer (5-3): GGGTATCTAATCCCAGTTTGGGTCTTAGC. The PCR was perform in a total volume of 50 µL containing: GeneAmp® 1× PCR Gold Buffer (100 mM Tris–HCl, 15 mM $MgCl_2$, pH 8.0), 200 µM dNTPs, 3.5 units AmpliTaq Gold® (Applied Biosystems, Foster City, CA), 0.5 µM forward and reverse primers, sterile H_2O, and 2.5 µL of DNA extract. The PCRs were conducted in a 2720 Applied Biosystems thermal cycler. Thermocycling condition for these primers was as follows; 40 cycles of denaturation at 95 ^oC for 45 s, annealing

at 64 ^{o}C for 45 s, extension at 72 ^{o}C for 1 min, and a final extension at 72 ^{o}C for 20 min. The mitochondrial PCR product was then run with a 10 bp ladder on a 2.5% agarose gel at 100 V for about 30 min. The gel was observed under UV light and ethidium bromide and the expected PCR band at the size of approximately 200 bp was then excised and kept in a sterile 1.5 mL eppendorf. The PCR product was then purified by QIAquick® PCR purification kit (Qiagen) and quantified using a UV spectrophotometer at the absorbance at 260 nm. The mitochondrial copy number of the *Panthera leo* sample was then calculated by the formula:

$[(A\times[5.0\times10^{-7}]$ g/mL×dilution)/(mol weight per copy)]×$[6.02\times10^{23}]$=fragment copy/mL

This known amount sample was used to make a ten-fold series dilution to range the mitochondrial copy number amount from 100 copies – 1,000,000 copies. These dilution series and tiger DNA sample was then amplified by qPCR. A standard curve between mitochondrial copy number and a threshold cycle (Ct) of known amount sample was then established. By using this standard curve, the mitochondrial copy number of any tiger DNA sample was determined by comparing its observed Ct value in the curve.

When the quantified tiger DNA was determined, it was used to prepare five DNA concentrations from a two-fold serial dilution. These samples were then analysed by the developed assay in order to test the assay's sensitivity. The minimum amount of detectable DNA giving a full tiger SNP profile was examined.

2.4.3.3 Specificity test

Fourteen other mammalian species were used to test the specificity of the assay. These mammalian species were cheetah (*Acinonyx jubatus*), jaguar, (*Panthera onca*), lion (*Panthera leo*), leopard (*Panthera pardus*), clouded leopard (*Neofelis nebulosa*), puma (*Puma concolor*), domestic cat (*Felis catus*), brown bear (*Ursus thibetanus*), horse (*Equus caballus*), sika deer (*Cervus nippon*), domestic dog (*Canis familiaris*), cow (*Bos taurus*), goat

(*Caprus hircus*), and human (*Homo sapiens*). All these samples were analyzed by the developed assay to check if the assay can result in a cross reactivity with some other mammalian species.

2.4.3.4 Blind-trial test

A total of 10 tiger and other mammalian samples were picked randomly from a total of 294 samples. Of these 294 samples, 250 samples were voucher non-panthera mammalian DNA from 20 mammalian species, 15 samples were one of four tiger subspecies DNA, and 28 samples were one of voucher big cat DNA from 7 big cat species which were cheetah (*Acinonyx jubatus*), jaguar, (*Panthera onca*), lion (*Panthera leo*), leopard (*Panthera pardus*), clouded leopard (*Neofelis nebulosa*), snow leopard (*Panthera uncia*) puma (*Puma concolor*). The 10 blind samples were then analyzed by the developed SNaPshot® assay.

3 Results and discussions

3.1 The DNA sequencing of the entire mitochondrial genome of eight members of Panthera tiger species.

3.1.1 Primer design

Twenty-six primer sets were designed to specifically amplify overlapping sections of the tiger mitochondrial genome. They were derived from conserved regions identified by the alignment of eight Panthera sequences to ensure that there is no sequence variation within the priming site; this should result in successful amplification for all tiger samples regardless of subspecies. The candidate primers were identified by eye. Each primer set was designed to provide a PCR fragment in the rage of 700 – 900 bp, which is within the length suitable for DNA sequencing. The next primer set amplifying the adjacent region was designed to give an overlapping sequence of approximately 100 – 150 bp to accommodate poor sequence data at the start of each PCR product. The positions of each primer set on mtDNA map are shown in Figure 16.

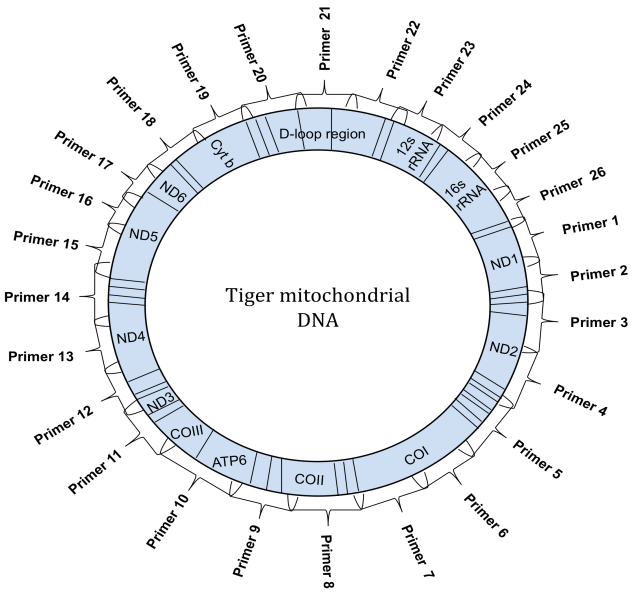


Figure 16: the positions of twenty-six primer sets on *Panthera tigris sp*. mtDNA map, which amplify and provide whole tiger mitochondrial genome sequence. The sizes of PCR fragment are in the rage of 700 – 900 bp. The next primer set amplifying adjacent region was designed to give overlapping DNA sequences of approximately 100 – 150 bp.

3.1.2 Primer test

To test the twenty-six primer sets, the PCR amplifications with all these single primer sets were carried out in a total reaction volume of 20 µL which contained the required PCR components, such as PCR buffer, dNTPs, DNA polymerase, primers and tiger DNA template (*Panthera tigris sumatrae*). The annealing temperature at 60 ^{o}C was used for the PCR condition as described in Chapter 2.

The result showed that the *P. t. sumatrae* DNA could be successfully amplified by 25 of the 26 primer sets. The exception was primer set 17 (Figure 17, Lane 3, bottom left). The unsuccessful amplification of the tiger DNA by this primer set may probably be caused from a mutation in the primer-binding site; most likely occurring nearby the 3' end of the primer. This results in the failure in a new DNA strand elongation by a DNA polymerase.

Twenty-two primer sets gave one distinct PCR product except primer set 2, 3 and 22 where more than one PCR fragments were observed. These unexpected fragments could be either non-specific products or primer dimers that were amplified unintentionally in the PCR. The results of these 26 amplification and the sizes of the amplified PCR products are shown in Figure 17 and Table 6 respectively. In addition, there were no PCR products observed in the negative control when amplified by all primer sets, indicating that there were no DNA contaminations in the PCR components.

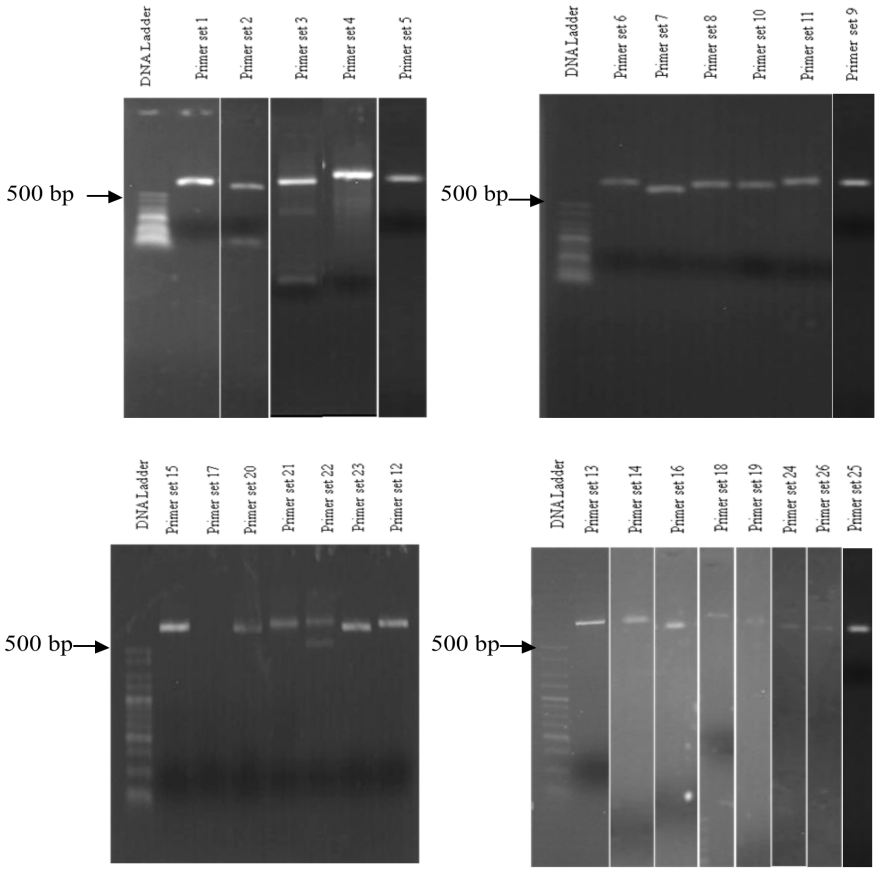


Figure 17: The results of amplification with twenty-six tiger specific primer sets using *P. t. sumatrae*. The PCR products (10µL/well) were separated on a 2% agarose gel and visualized with ethidium bromide staining. The 50 bp DNA ladder was used to determine the size of PCR products (lane 1). The Sumatran tiger DNA could be successfully amplified by all primer sets, except primer set 17 (Lane 3, bottom left). Two PCR fragments were observed from primer set 22.

Table 6: The expected and observed sizes of PCR products amplified by the twenty-six primer sets.

Primer set	Size of PCR product (bp)		Primer set	Size of PCR product (bp)	
	Expected size	Observed size		Expected size	Observed size
1	788	>500	14	855	>500
2	755	>500, 50	15	888	>500
3	730	>500, 300, <25	16	831	>500
4	868	>500	17	820	-
5	803	>500	18	876	>500
6	854	>500	19	854	>500
7	721	>500	20	921	>500
8	830	>500	21	886	>500
9	811	>500	22	915	>500/>500
10	803	>500	23	813	>500
11	906	>500	24	773	>500
12	894	>500	25	793	>500
13	830	>500	26	801	>500

*The expected size is based on the DNA sequences taken from GenBank and the observed size is an estimate from the agarose gel.

For the primer set 17, the amplification was performed again by decreasing the annealing temperature from 60 ^{o}C to 58 ^{o}C, 56 ^{o}C, and 54 ^{o}C in three separate reactions. The results showed that tiger DNA was successfully amplified by this primer set with the annealing temperature at 56 ^{o}C and 54 ^{o}C as lower annealing temperature often result in higher PCR product yield and increase a chance in amplification efficiency [146]. However a very faint PCR product bands were observed from both annealing temperatures as shown in Figure 18a. To obtain more PCR product yield and decrease a chance in observation of non-specific product caused from low annealing temperature, both forward and reverse primer set 17 (primer set 17N) were then re-designed following the criteria and method described in Chapter 2. The new primer sequences (5'-3') are ATCAACTCCATTAAACGTCTCTT for the forward primer and TTTTCTTCAAAGCCTTCTCC for the reverse primer.

The amplification of *P. t. sumatrae* DNA with this primer set was performed as the same method as mentioned before. The result showed that the new primer set 17 amplified successfully the tiger DNA and provided a higher yield of PCR product compared to the original primers at the annealing temperature of 60 ^{o}C. The result of this amplification is shown in Figure 18b. This primer replaced the original one and used in further analysis.

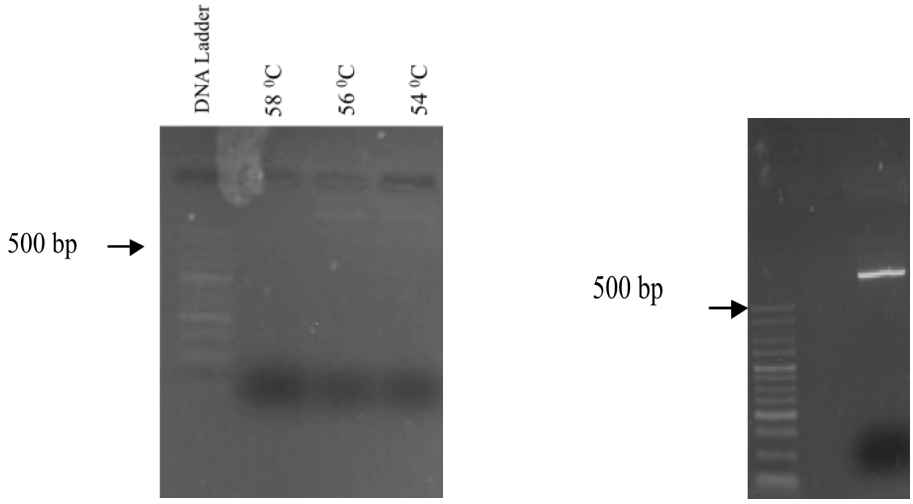


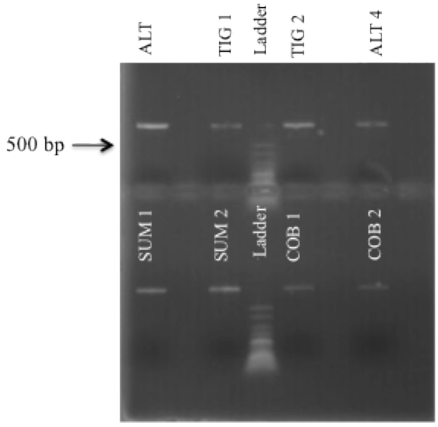
Figure 18: a) The amplification of *P. t. sumatrae* DNA with the original primer set 17 performed by decreasing annealed temperature from 60 ^{o}C to 58 ^{o}C, 56 ^{o}C, and 54 ^{o}C. The 50 bp DNA ladder was used to determine the size of PCR products (lane 1). The result shows very faint bands at the expected size, indicating poor amplification at the annealing temperature at 56 ^{o}C (lane 3) and 54 ^{0}C (lane 4). b) The amplification of the same tiger DNA with the new primer set 17 (primer 17N). The result shows bands of higher intensity compared to the original primer set 17 at the annealing temperature of 60 ^{o}C. All PCR products (10µL/well) were separated on a 2% agarose gel and visualized with ethidium bromide staining.

3.1.3 The PCR amplifications of all tiger subspecies mitochondrial DNA

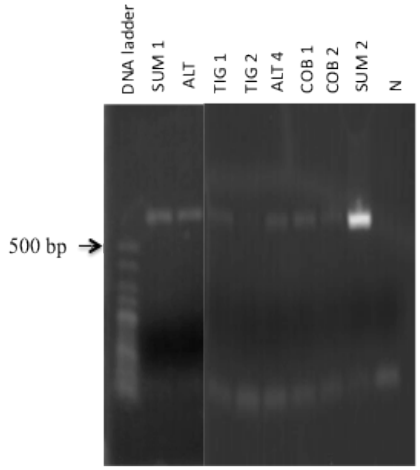
Once all twenty-six primer sets produced products at the expected sizes and to similar quantities, the DNA samples of four tiger subspecies, *Panthera tigris tigris*, *Panthera tigris sumatrae*, *Panthera tigris corbetti, and Panthera tigris altaica,* were amplified with these primers. A total of eight DNA samples, two individual DNA samples for each of the four tiger subspecies, were examined following the method described in section 2.2.3 and 2.2.4. A total of 208 PCRs (26 primer sets x 4 tiger subspecies x 2 samples per subspecies) were

therefore performed in order to obtain overlapping PCR fragments over the entire mitochondrial genome for all eight tiger samples. The amplification results of all PCRs were also scored according to their observed PCR band intensities. To do this, PCR band intensities produced from all PCRs were evaluated and given the symbols "++++", "+++", "++", "+", and " – " to record excellent, good, faint, very faint, and no band intensities, respectively.

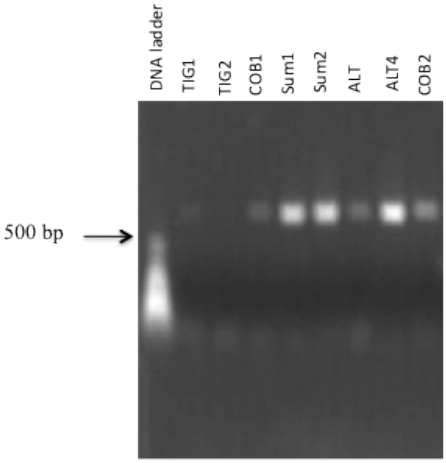
The gel amplification results of all twenty-six primer sets are shown in Figure 19. Of these 208 PCRs, 197 produced PCR products at the approximate expected sizes. There was no PCR product observed from 11 reactions. Nine of 11 failed to amplify *P. t. tigris* DNA; five failed to amplify one sample of *P. t. tigris* DNA using the primer set 3, 6, 14, 15, 21; and four failed to amplify both *P. t. tigris* DNAs using primer set 20 and 24. There were two unsuccessful amplifications using *P. t. corbetti* and *P. t. altaica* DNA samples amplified by the primer set 6 and 20, respectively. There are two possible causes for the failure amplifications, a poor quality of DNA template and PCR inhibitor contamination in the samples. The tiger DNA used in all 11 failed reactions were extracted from hair samples. Hair cells are reported to contain many substances such as eumelanin or pheomelanin granule and also have a complex distribution of high sulphur and nitrogen proteins in different regions [147]. These particular compositions may be difficult to remove and may decrease the efficiency in DNA extraction by QIAamp DNA Mini Kit (QIAGEN). It contributes to a recovery of a poor quality of DNA template from this type of sample and result in the failed amplifications in the 11 reactions. Another reason is that the 11 tiger samples being failed to amplify contaminated with PCR inhibitors such as organic and inorganic compounds; polysaccharides, polyphenolics, flavones, urea, humic acids, hemoglobin, or high bacteria concentrations [148-150].



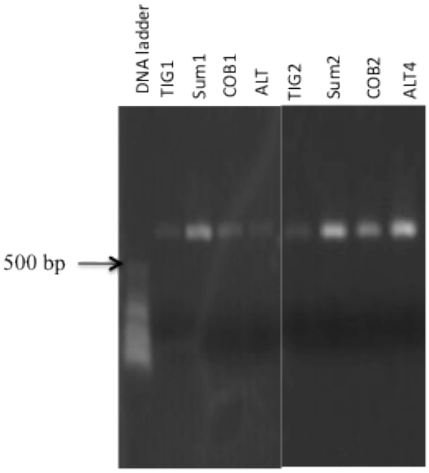
Primer set 1



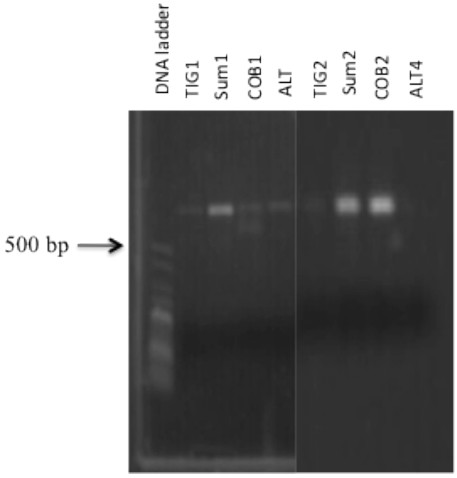
Primer set 2



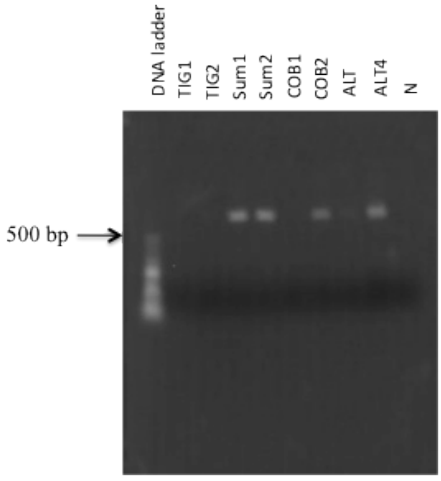
Primer set 3



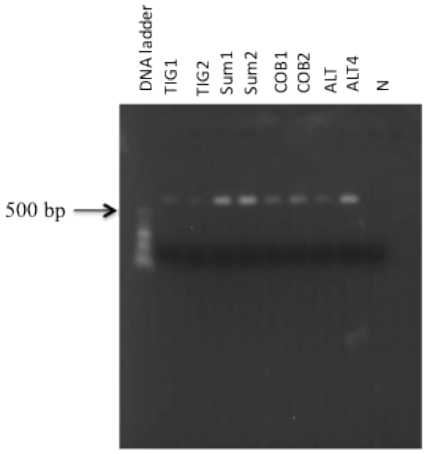
Primer set 4



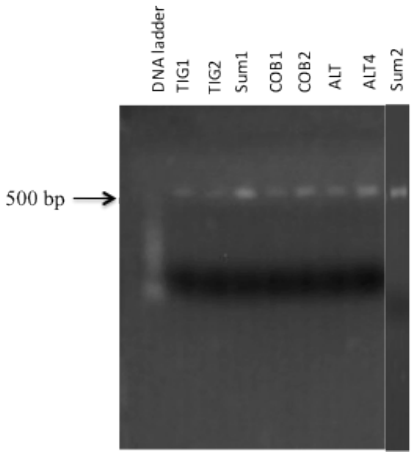
Primer set 5



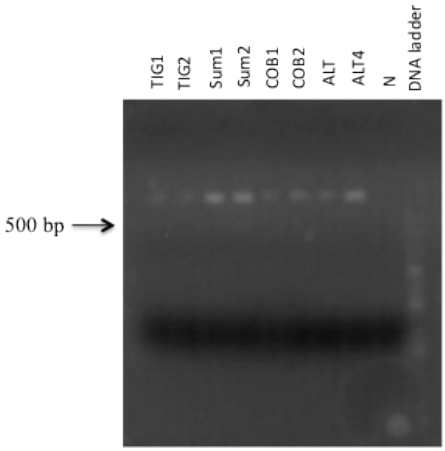
Primer set 6



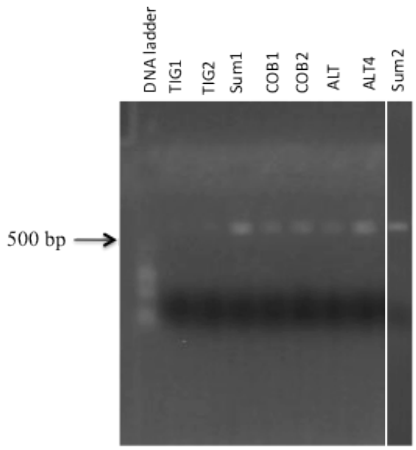
Primer set 7



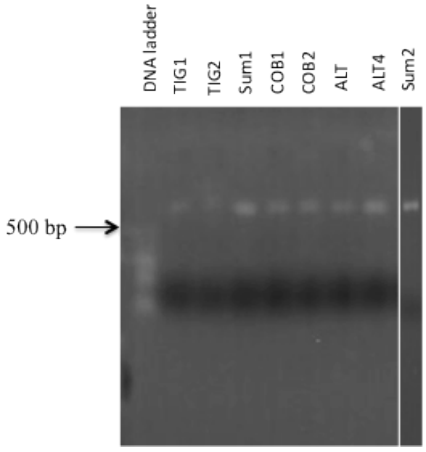
Primer set 8



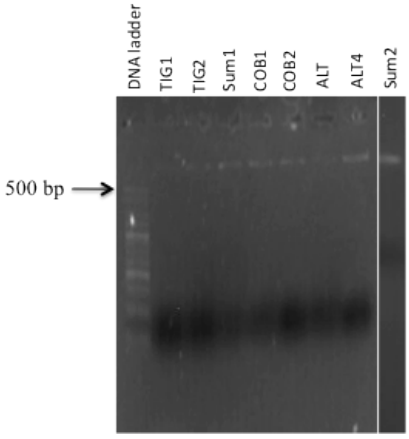
Primer set 9



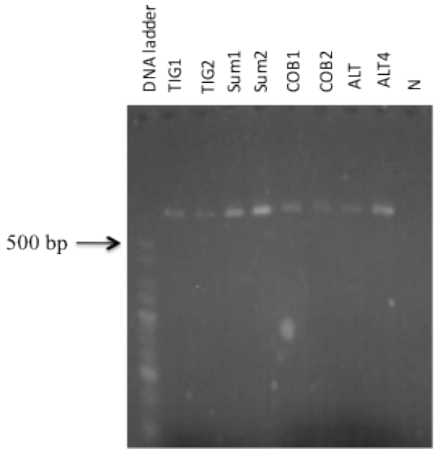
Primer set 10



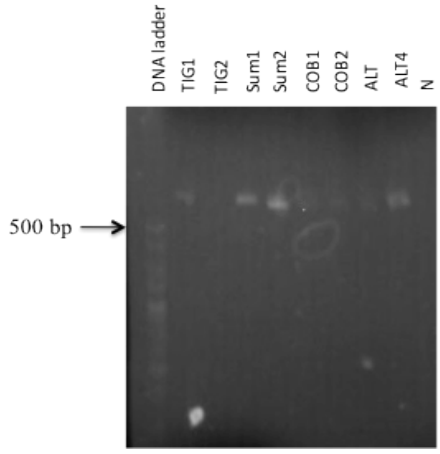
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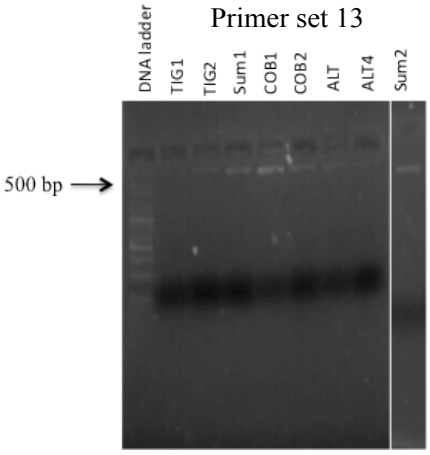
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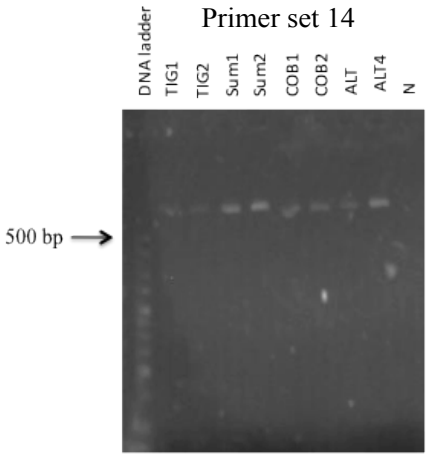
Primer set 13



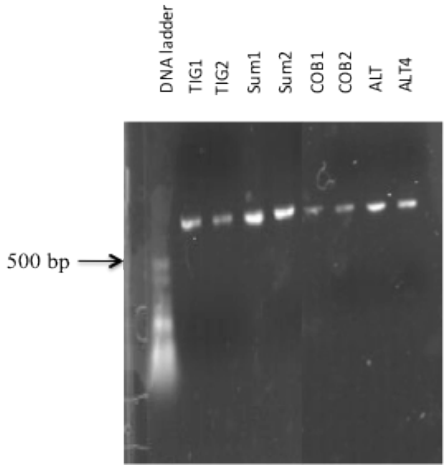
Primer set 14



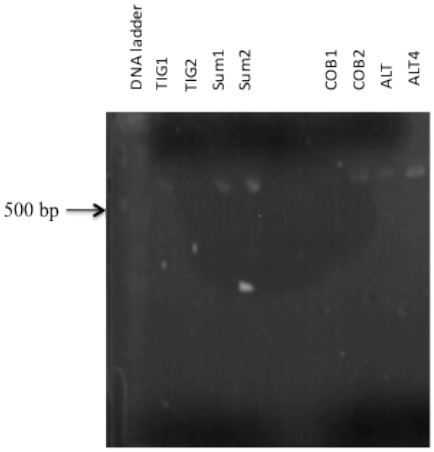
Primer set 15



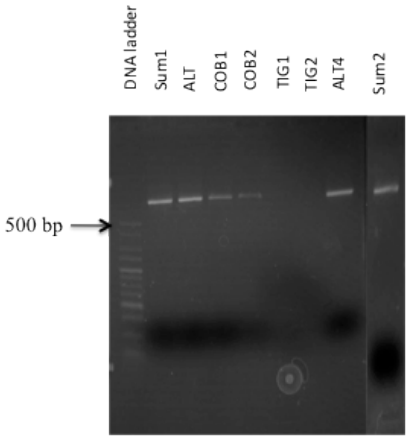
Primer set 16



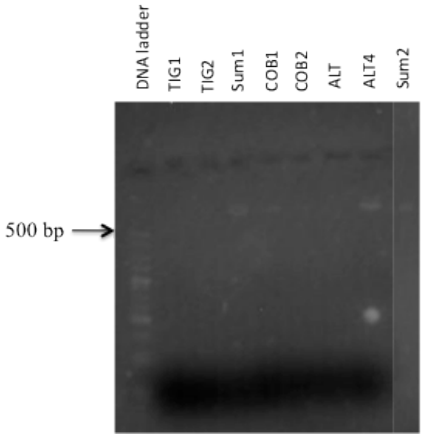
Primer set 17N



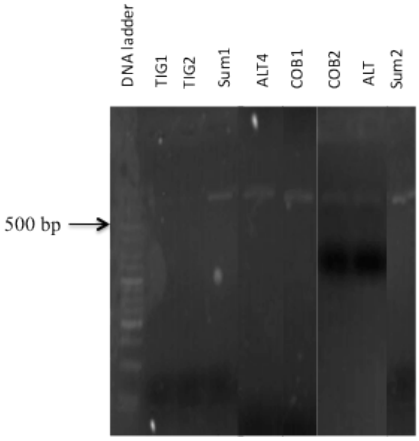
Primer set 18



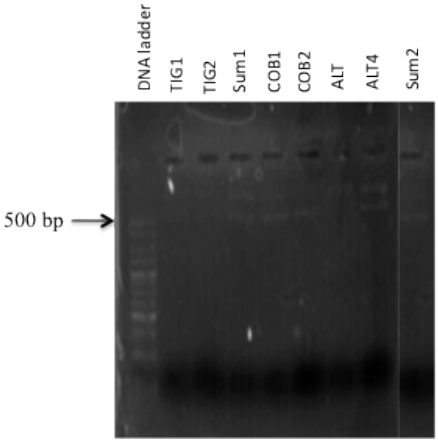
Primer set 19



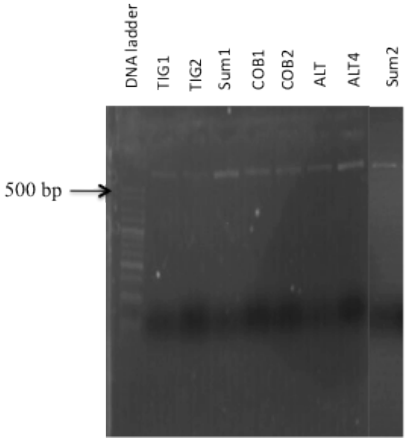
Primer set 20



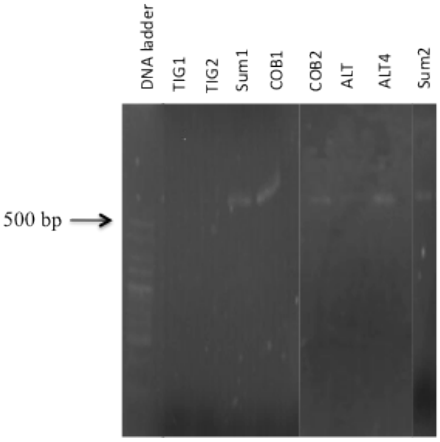
Primer set 21



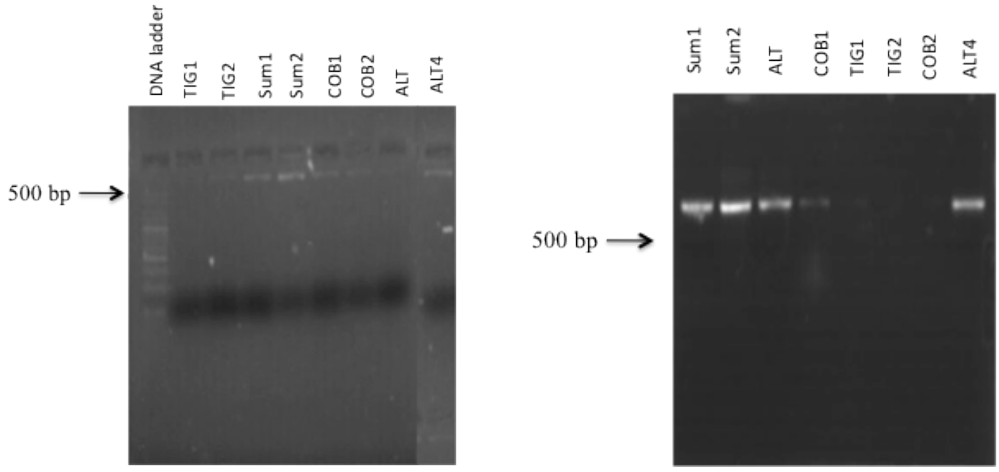
Primer set 22



Primer set 23



Primer set 24



Primer set 25 Primer set 26

Figure 19: The amplification results of all twenty-six primer sets. The PCR products (5µL/well) were electrophoresed on a 2% agarose gel and visualized with ethidium bromide staining. The 50 bp DNA ladder was used to determine the size of PCR products (lane 1). All tiger subspecies were successfully amplified by these primer sets. Two PCR frangments were observed from all eight samples amplified by primer set 22 and one *P. t. corbetti* sample when amplified by primer set 5. High PCR product yields were obtained for both samples of *P. t. sumatrae* (SUM1/SUM2) and one sample of *P. t. altaica* (ALT4) while the remaining samples provided lower yields.

Two PCR product bands were observed in the same individual DNA samples amplified by the primer set 5 and 22. The primer set 22 produced two PCR fragments in all eight samples; at the approximate sizes of 700/900 bp (Figure 19 lane 2-9). While the approximate fragment sizes of 650/850 bp were generated by the primer set 5 in one of the *P.t.corbetti* DNA samples (Figure 19 lane 4). As higher annealing temperature would decrease a chance in an amplification of non-specific products, the sample producing two PCR fragment bands were then re-amplified using a higher annealing temperature of 60 ^{o}C, 63 ^{o}C and 66 ^{o}C. In this experiment, the *P. t. corbetti* DNA (COB1) was used as a representative template for all tiger samples. These amplification results are shown in Figure 20. The results showed that the amplifications with the annealing temperature at 60 ^{o}C and 63 ^{o}C still produced two products; at the same sizes for the both primer sets. No PCR product was observed at the annealing temperature of 66 ^{o}C. This result corresponds to the studies by Cracraft *et. al*. [19], Zhang *et. al*. [151], and

Kim *et. al*. [152] which reported the observation of two PCR products, being about 200 bp in size difference, on the tiger mitochondrial genome. Based on the fragment sizes, the larger PCR fragment should be the expected product while another smaller fragment is possibly a mitochondrial pseudogene, which is also known as numt. The numt is the nuclear DNA sequence that is homologous to mitochondrial DNA sequence. These numt loci are due to the translocation of cytoplasmic mitochondrial DNA (cymtDNA) into the nuclear DNA [19]. Two pathways in transfer of numt to nuclear DNA have been proposed by Campbell and Thorsness [153] and Woischnik and Moraes [154]. The first authors proposed that nucleic acid fragments released during destruction of mitochondria by lysosomes could act as intermediates to transfer to nuclear DNA. While another author believes that numt causes from the combination between mtDNA of sperm with nuclear DNA of the egg cell during fertilization [154]. In addition, numt observations have been reported in about 60 animal and plant species [155], including Felids [25] and closely related tiger species [152].

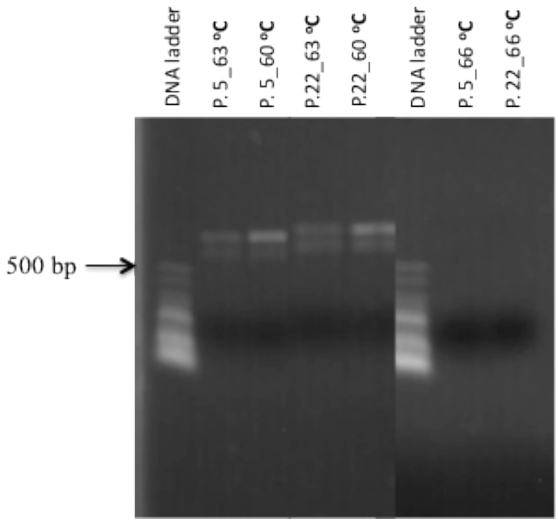


Figure 20: The amplifications of *P. t. corbetti* (COB1) with primer set 5 and 22 performed by increasing the annealing temperature from 60 ^{o}C to 63 ^{o}C, and 66 ^{o}C. The PCR products (10µL/well) were separated on a 2% agarose gel and visualized with ethidium bromide staining. The 50 bp DNA ladder was used to determine the size of PCR products (lane 1). The results showed that the amplifications with the annealing temperature of 60 ^{o}C and 63 ^{o}C still produced two products; at the approximate sizes of 650/850 bp for primer set 5 (lane 2 and 3), and 700/900 bp for primer set 22 (lane 4 and 5). No PCR product was observed at the annealing temperature of 66 ^{o}C.

The PCR product yields obtained from the amplification of the eight tiger samples using the twenty-six primers sets were evaluated and scored, as shown in Table 7. These PCR product yields were different depending on the DNA quality and types of sample. High PCR product yields were obtained from both samples of *P.t.sumatrae,* and one sample of *P.t.altaica.* The DNA samples of these samples were extracted from muscle samples collected using a buccal swab. Whereas the remaining DNA samples that were extracted from hairs provided lower yields of PCR products. This may be mainly due to the fact that muscle samples contain numerous copies of mtDNA. As the primary function of muscle cell is in energy production, and this requires a lot of oxygen, so a larger mtDNA copy number would be expected to be found in these cells compared to other somatic cells. The more tissue demands oxygen, the larger amount of mtDNA copy found in the cell [48, 49]. The results in Table 7 indicate that a muscle sample will provide better quality of DNA rather than hair samples.

Table 7: The evaluation and scoring of PCR product yields obtained from the amplification of the 8 tiger samples using the twenty-six primers sets.

Tiger sample Primer	TIG1	TIG2	SUM1	SUM2	COB1	COB2	ALT	ALT4
Primer set 1	+++	++++	++++	++++	+++	+++	++++	+++
Primer set 2	++	+	+++	++++	++	++	++	++
Primer set 3	+	-	++++	++++	++	+++	+++	++++
Primer set 4	++	++	++++	++++	++	++++	++	++++
Primer set 5	++	+	++++	++++	++*	++++	++	+
Primer set 6	-	+	++++	++++	-	++++	+	++++
Primer set 7	++	++	++++	++++	++	+++	++	++++
Primer set 8	++	++	+++	+++	++	+++	++	+++
Primer set 9	+	+	+++	+++	++	++	++	+++
Primer set 10	+	+	+++	+++	++	++	+++	+++
Primer set 11	+	+	+++	+++	++	++	++	+++
Primer set 12	+	+	++	++	++	+	+++	+++
Primer set 13	++	++	++++	++++	+++	++	++	++++
Primer set 14	+	-	+++	++++	+	+	+	+++
Primer set 15	-	+	++	++	+++	++	+	+++
Primer set 16	+	+	+++	+++	++	++	++	+++
Primer set 17	++++	+++	++++	++++	+++	+++	++++	++++
Primer set 18	+	+	++	++	++	++	+	++
Primer set 19	+	+	++++	++++	++	++	++++	++++
Primer set 20	-	-	++	+	+	+	-	++
Primer set 21	-	+	++	++	++	++	++	++
Primer set 22	+*	+*	++*	++*	++*	++*	++*	++*
Primer set 23	+	+	+++	+++	++	++	++	+++
Primer set 24	-	-	++	++	++	++	+	+++
Primer set 25	+	++	+++	+++	++	+	+	+++
Primer set 26	+	+	++++	++++	++	+	++++	++++

* Two PCR product bands were observed, ++++: Very high band intensity, +++: High band intensity, ++: Faint band intensity, +: Very faint band intensity, -: No band was observed.

The results in Table 7 show that a total of 49 reactions resulted in either no (-) or very faint PCR product intensities (+). These were re-amplified using the lower annealing temperature (T_m) at 58 ^oC. Higher PCR product yields were obtained successfully from 48 of 49 reactions under this new condition. The exception was the sample TIG 2 amplified by the primer set 3. This sample was re-amplified in two separate reactions using reduced annealing of 56 ^oC and 54 ^oC. The sample COB2 was used as a positive control for both annealing temperatures for this experiment. The result showed that the positive control was successfully amplified at the both annealing temperatures and generated the approximate fragment size. However the amplification of TIG2 sample using the annealing temperature of 56 ^oC failed while a very faint band was observed at approximately the expected size for the lower annealing temperature of 54 ^oC (Figure 21). The reason for the failed amplification could be an occurrence of a mutation at the primer-franking region on this particular sample DNA template.

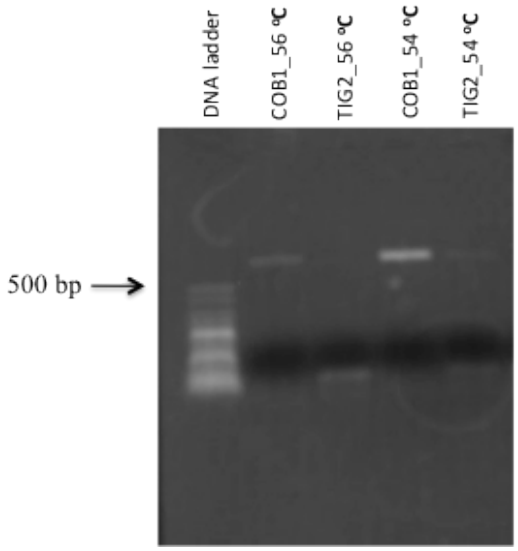


Figure 21: The amplification of *P. t. tigris* (TIG2) and *P. t. corbetti* (COB1) DNA with the primer set 3 performed by decreasing the annealing temperature from 60 ^oC to 58 ^oC, 56 ^oC, and 54 ^oC. The PCR products (5µL/well) were separated on a 2% agarose gel and visualized with ethidium bromide staining. The 50 bp DNA ladder was used to determine the size of PCR products (lane 1). The result shows that expected bands have been amplified successfully from *P. t. corbetti* DNA, which were used as positive controls (lane 2 and 4). The amplification of TIG2 at the annealing temperature of 56 ^oC failed while a very faint band was observed using the annealing temperature of 54 ^oC (lane 5).

A new primer set 3 (primer set 3N) was then re-designed by selecting new primer position that was close to the previous one in order to obtain approximately the same size of PCR product. The criteria for doing this were followed using the method described in section 2.2.2. The positions of the old and new primer set 3 on the *Panthera* sequence alignment are shown in Figure 22. The new primer sequences (5'-3') are ACAGCAAGCATTCCACC for the forward primer and TATGATGGCTGTTATTCAACCTAT for the reverse direction. The amplifications of all 8 tiger subspecies samples were performed with these new primers using the same method as described in section 2.2.3. The result showed that the new primer set 3 amplified successfully all eight tiger samples and provided the expected fragment size of approximately 800 bp (Figure 23). Also, a high yield of PCR product was observed in all tiger samples.

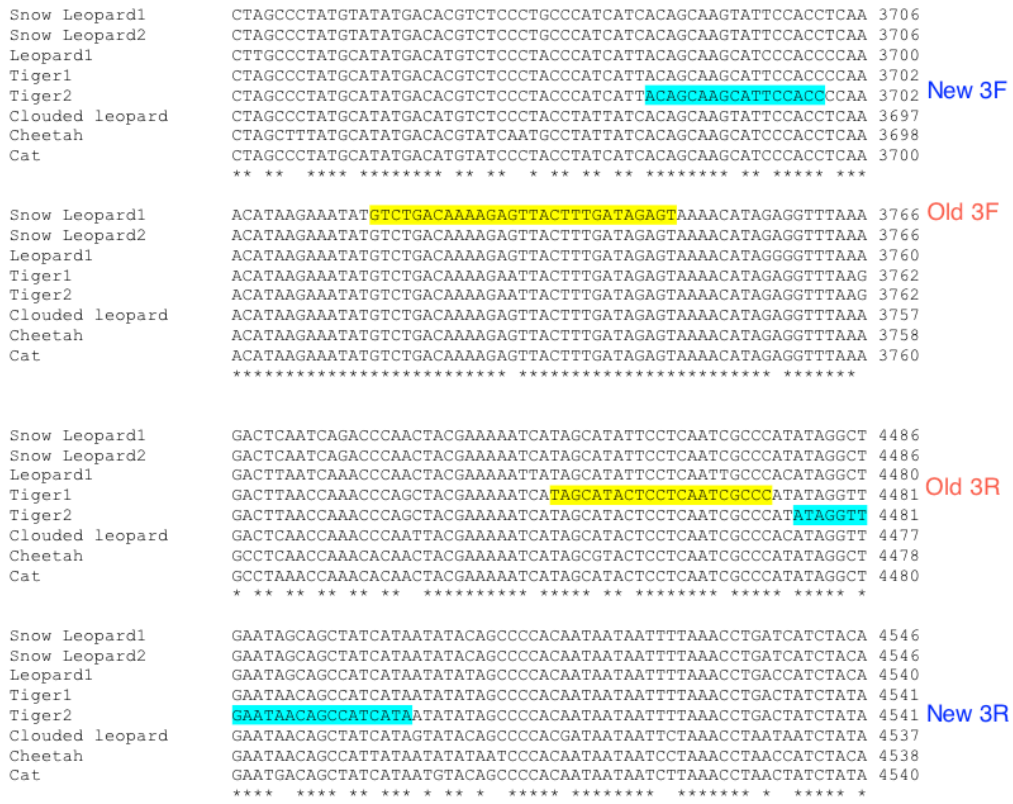


Figure 22: The positions of the old and re-designed primers for the entire tiger mitochondrial genome amplification. The new primer set 3 (new 3F and 3R) was re-designed from a position close to the prior one.

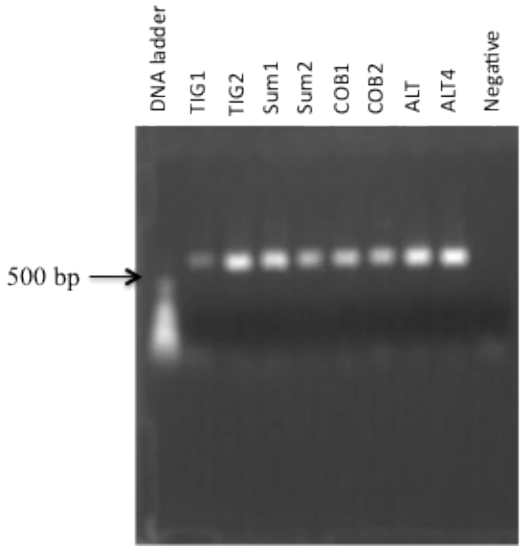


Figure 23: The results of 8 tiger samples amplified with the new primer set 3 (primer 3N). The PCR products (10 µL/well) were separated on a 2% agarose gel and visualized with ethidium bromide staining. The 50 bp DNA ladder was used to determine the size of PCR products (lane 1). All tiger subspecies samples were amplified successfully by this primer set.

The conclusion was that 24 of 26 primer sets amplified successfully all tiger subspecies samples with either an annealing temperature of 60 ^{o}C or 58 ^{o}C. Two primer sets, the primer sets 3 and 17, were re-designed at about the same position in the mitochondrial genome as they failed to amplify all tiger samples previously. The twenty-four and two new primer sets, amplified successfully all eight tiger DNA samples and provided overlapping PCR fragments over the entire tiger mitochondrial genome. These details are shown in Table 8. The primer set 5 produced two PCR product bands in one of *P. t. corbetti* sample while these two PCR product bands were present in all tiger samples amplified by the primer set 22. PCR product yields obtained from the amplification of eight tiger DNA samples showed much variation.

Table 8: Nucleotide sequences of twenty-six primer sets amplified successfully from all tiger DNA samples and provided overlapping PCR fragments over the entire tiger mitochondrial genome. The full sequence of each primer is provided along with the calculated T_m and expected size of PCR product (nucleotide). 'Y' represents pyrimidine bases (C/T); 'R' represents purine bases (G/A).

Primer set	Direction	Sequences (5'-3')	T_m (^oC)	Size of PCR product
1	Forward	CTCCCAGTACGAAAGGACAAG	62.52	788
	Reverse	GCTCGGTTGGTCTCTGCTAG	64.00	
2	Forward	TCAAAATAYGCYCTAATCGG	56.85	755
	Reverse	GGCCCGATAGCTTATTTAGC	61.40	
3N	Forward	ACAGCAAGCATTCCACC	59.77	818
	Reverse	TATGATGGCTGTTATTCAACCTAT	60.13	
4	Forward	TACCCGAAGTTACACAAGGAAT	61.14	868
	Reverse	CCCACCAATCTAGTGAGGACTTAGC	66.18	
5	Forward	TAGACCAAGAGCCTTCAAAGC	62.33	803
	Reverse	GATGCTCCTGCATGAGC	60.71	
6	Forward	ATTGGAGGATTCGGAAACTG	62.72	854
	Reverse	GCTAGTACAATTCCTGTTAAGCC	59.72	
7	Forward	ACACGAGCATACTTTACGTCAGC	64.18	721
	Reverse	CTTCTTAATTGAGAAAGACATAGTGGT	60.75	
8	Forward	CCTCCGTATCACACATTTGAAGA	64.80	830
	Reverse	ACTAGTTCAAGGACAATGGG	58.04	
9	Forward	CTAAAAACTGACGCTATCCCAGG	64.55	811
	Reverse	GGTGTTCCTTGTGGTAGAAAGTG	63.46	
10	Forward	ACAAACYTGRGCCCTAATACT	62.33	803
	Reverse	AGGCTTGAGTGRTAGAAGGC	59.99	
11	Forward	GARAGCACATTCCAAGG	56.44	906
	Reverse	GTTTGTGAGGCYCAGGGAAG	63.73	
12	Forward	TATGAATGTGGATTTGACCC	59.60	894
	Reverse	AGTATTGTAATGTATAGTTTTTTTCG	55.70	
13	Forward	CACTCTCTGCACCCCTACTAGT	61.28	830
	Reverse	TCG TTCGTAGTTTGAGTTTG	57.94	
14	Forward	TAATCGCATATTCATCCGTAAG	60.33	855
	Reverse	AAGGCGTAAGAGATTGTGGTT	61.43	
15	Forward	GGTGCAACTCCAAATAAAAG	58.65	888
	Reverse	GCTGTGAATAGGGTTGTGAT	58.99	
16	Forward	ATTTGGCCTACACCCATGA	62.74	831
	Reverse	TCTAATGCCAGGATAAAGCCT	61.46	

Primer set	Direction	Sequences (5'-3')	T_m (^oC)	Size of PCR product
17N	Forward	ATCAACTCCATTAAACGTCTCTT	59.55	925
	Reverse	TTTTCTTCAAAGCCTTCTCC	59.94	
18	Forward	TTATTAGATGTCCACGCCTC	59.13	876
	Reverse	GGAAGGCAAAGAATCGTGT	61.63	
19	Forward	CAGCCTTCATAGGATATGTCTTACC	62.61	854
	Reverse	GGCTATTGCTTCTTCCTTGA	60.88	
20	Forward	CAACTAGCCTCYATCCTATACTTCT	57.08	921
	Reverse	TTGAGAAAGTTGAAGGATTGG	60.62	
21	Forward	CGTGTACCTCTTCTCGCTC	60.16	886
	Reverse	ATAAATAAGATTAACGGGGGGT	60.17	
22	Forward	CCTATTGTTCCACAGGACAC	59.41	915
	Reverse	TGATTTAGAGGGCATTTTCA	59.64	
23	Forward	AAAGCAAGGCACTGAAAATG	61.74	813
	Reverse	TAAGGATTTTCGTGGATGTTCTA	61.19	
24	Forward	ATATACCGCCATCTTCAGC	59.09	773
	Reverse	CAGCTATCACCAGGCTCGT	63.03	
25	Forward	CCGAAACCAGACGAGCTA	61.58	793
	Reverse	GGAAGGTCAATTTCACGGAT	62.61	
26	Forward	CAAAAACATCACCTCTAGCATT	59.65	801
	Reverse	TGAACCTCTGATAGTAAAAGCTTAAG	59.89	

3.1.4 PCR product purification and DNA sequencing

The PCR products produced by the twenty-six primer sets were purified and then sequenced in both the forward and reverse directions. A total of 416 DNA sequences (26 primer sets x 4 tiger subspecies x 2 samples per subspecies x 2 sequenced direction) were sequenced to create one whole mitochondrial genome for each of the four tiger subspecies.

All PCR products were firstly purified by the ExoSAP-IT® process, following the manufacturer's protocol. The results showed that all DNA samples extracted from muscle samples, which are SUM1, SUM2, ALT4, provide good quality DNA sequence data (Figure 24) while DNA obtained from hair samples, which are Corbetti 1, Corbetti 2, Tigris 1, Tigris 2, and Altica,

provide DNA sequence data with a number of ambiguities (Figure 25). This result corresponds to the PCR product yield results explained above; muscle samples were found to provide a high yield of PCR fragment compared to hair samples. Hair sample was found also to provide poor quality DNA; hair contains many substances such as melanin pigments which could not be removed by Exo-sap purification method. These substances may interfere with the initial PCR for sequencing by inhibiting the *Taq* polymerase or compromising the subsequent electrophoresis, resulting in poor sequencing quality from this type of sample. In addition, it might be due to low template molecules were added in the reaction as evident by only a short fragment of good quality sequences followed by failed sequencing (Figure 25). Bad primer quality could be one of the factors affecting sequencing quality as well.

To address the problem of poor quality DNA sequencing, a gel extract purification method was used to purify the PCR products. PCR amplifications of these samples were re-performed in the total volume of 40 μL, all of which was then loaded on a 2% agarose gel. The fragment bands at the expected product sizes were excised from the gel and stored in a 1.5 mL eppendorf for gel extraction purification. DNA sequence data from these samples was improved such that every ambiguous base can be called with confidence (Figure 26). The improvement in sequencing quality may be due to this purification method as it can eliminate melanin pigments or other contaminants in PCR product mixture and only targeted amplicons were selected by cutting from the gel.

In addition, there may be the presence of more than one nucleotide sequence at the same mitochondrial position, which is known as a heteroplasmy. The observation of the heteroplasmy frequently presents in hair sample rather muscle cell. This result agrees with the study of Paneto *et al*. [156] reporting a higher heteroplasmy incidence in hair cells rather than the other cells such as blood cell. Therefore, the analysis of sequencing results should be done with caution when hair samples are used.

Once good quality DNA sequence data from all PCR fragments were received, they were then edited to remove any 'N' bases and ambiguities and compared for sequence confirmation. A good quality data is indicated by well-defined peaks with high signal-to-noise ratios, as exemplified in Figure 24. The overlapping sequence data could be used to create whole tiger mitochondrial genomes as described in section 2.2.6.3. The entire sequence data for all eight tiger samples can be seen in Appendix 2.

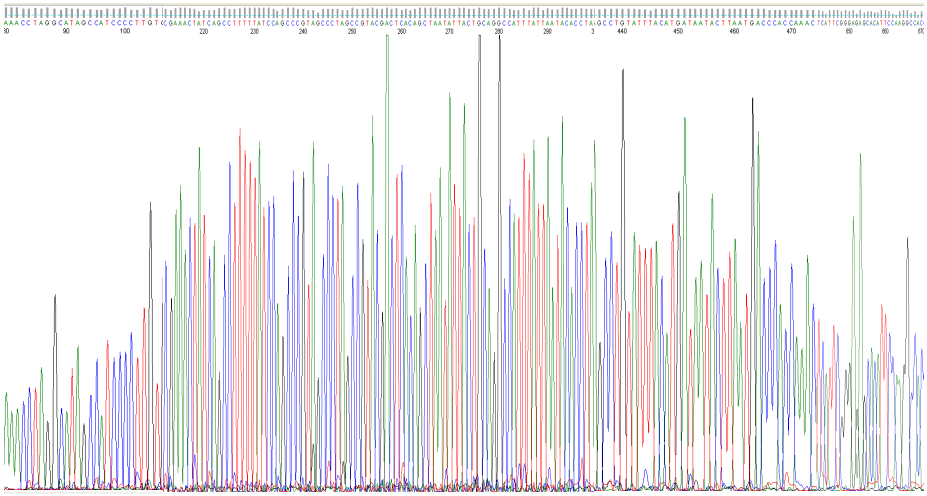


Figure 24: The example of good quality DNA sequence data of an mtDNA fragment amplified from Sum1DNA sample with primer set 9 at the position 80 to 670. This PCR fragment was extracted from muscle sample and purified by the Exo-Sap method.

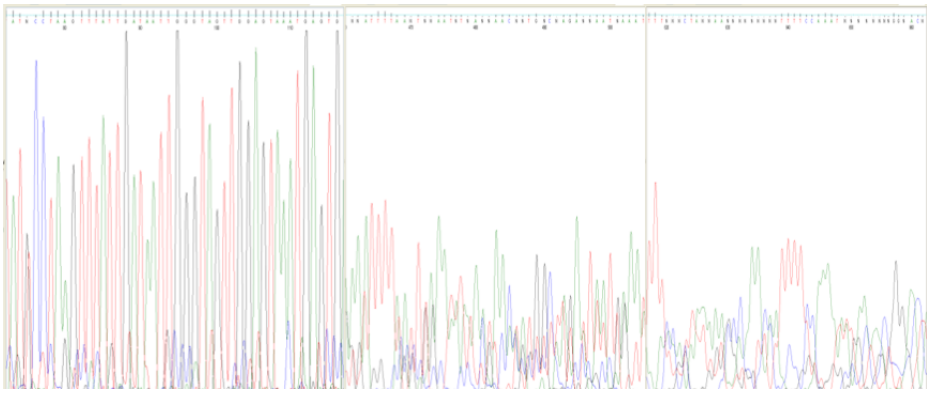


Figure 25: The example of bad quality DNA sequencing of mtDNA fragment amplified from Cob 1 DNA sample with primer set 8 at the position 80 to 660. This PCR fragment was extracted from hair sample and purified by the Exo-Sap method. There appears to be a secondary DNA sequence interfering with the main sequence.

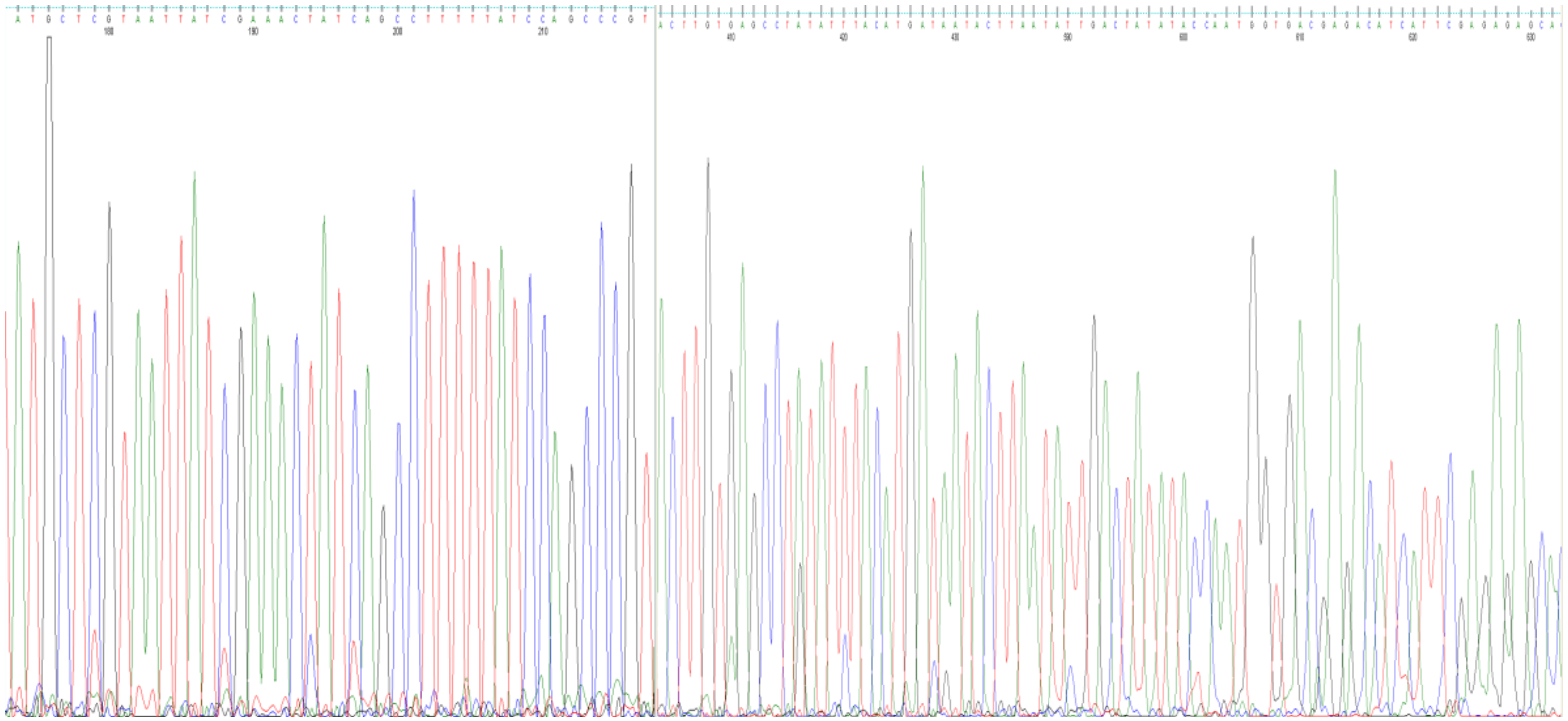


Figure 26: The quality of DNA sequencing of mtDNA fragment amplified from Cob 1 DNA sample with primer set 8 at the position 170 to 630. This PCR fragment was extracted from hair sample and purified by gel extraction purification method. The quality of the data are improved obviously compared to Figure 25.

3.2 The analysis of the entire tiger mitochondrial genome

3.2.1 Genome characterization

The overlapping mitochondrial fragments amplified by the twenty-six primer sets were sequenced and manually edited to create the entire mitochondrial genomes. These new data are the eight tiger DNA sequences to which reference will be made later. Once the final sequences of the eight tiger samples were generated, all 37 mitochondrial genes, 13 protein-coding genes (PCGs), 22 transfer RNA (tRNA) genes, and 2 ribosomal RNA (rRNA) genes, were identified by the Open Reading Frame Finder, tRNAscan-SE, and Sequin as described in the method section 2.3.1. The other details of tiger genome organization, such as locations and positions of each genes, start and stop codon (for PCGs), anticodon (for tRNA genes), gene size, intergenic nucleotide size, were identified and examined. The secondary structure of RNA genes were also predicted based on a minimum free energy (MFE) using RNAfold web server.

Five out of eight tiger entire mitochondrial genomes were completely sequenced. The exceptions were the two of the *P. t. corbetti* samples and the sample TIG1, which presented sequence gaps in their mitochondrial genomes. A genome organization of these tiger samples, including the gap locations for the two *P. t. corbetti* and one *P. t. tigris* samples are shown in Table 9. The complete mitochondrial genome sizes of the sample TIG2, SUM1, SUM2, ALT, and ALT4 were 16,976, 16,998, 17,001, 17015, and 16,980 bp in length respectively. The length of these tiger genomes varied due to variability at the tandem repeated region in D-loop while the coding gene sizes are the same in all tiger genomes. The average size in length of these tiger mitochondrial genomes was 16,994 bp which is smaller than the mitochondrial genome of the domestic cat (*Felis catus*) (17,009 bp) [25] and Cheetah (*Acinonyx jubatus*) (17,011 bp) [157] but larger than those of clouded leopard (*Neofelis nebulosa*) (16,844 bp) [158] and snow leopard (*Panthera uncia*) (16,773 bp) [159]. Similar to other mammalian species, the complete tiger mitochondrial genomes joined to create circular shape, which contains D-loop region and 37 genes in total. Of these 37 genes, 13 code respiration-related proteins; 22 code

tRNA molecule; and 2 code rRNA molecules (Figure 27). Nine genes, ND6, $tRNA^{-Gln}$, $tRNA^{-Ala}$ $tRNA^{-Asn}$ $tRNA^{-Cys}$ $tRNA^{-Tyr}$ $tRNA^{-Ser}$ $tRNA^{-Glu}$ $tRNA^{-Pro}$, encoded from the light strand of mitochondrial DNA. The arrangement of all 37 coding genes is the same as other mammalians or common vertebrates [160]. The origin of replication of both heavy and light strands are also noted in Figure 27.

The sequence gaps found in the three tiger samples, COB1, COB2, and TIG1, consisted of several ambiguous DNA bases that could not be successfully called by both the automated sequencer and manual sequence base correction. Even though a gel extraction purification method proved to improve the quality of DNA sequencing data obtained from tiger hair samples, as described in section 3.1.4, the sequence ambiguities at these particular segments were not removed by the method. The bad quality of DNA sequence obtained from these fragments could be due to: the fragment templates were not sufficiently purified for the sequencing reaction; the quantities of the sequencing templates were not in an appropriate range; primer efficiencies in binding to the templates were poor; or there was a contamination of other organism's DNA or DNA sequencing inhibitors were in the template. The ambiguous bases were found at overlapping regions of two adjacent PCR products, contributing to the failure in extension of these two fragment sequences. This resulted in the retrieval of incomplete mitochondrial genomes of the three tiger samples. However the five complete and three incomplete tiger mitochondrial genome sequences were annotated and published in the GenBank database. The accession numbers of the eight tiger samples were JF357967-JF357974.

Table 9: Tiger genome organization: showing the locations and position of each gene, start and stop codon (for PCGs), anticodon (for tRNAs gene), gene size, and intergenic nucleotides.

Gene	St[a]	Position[b]	Size (bp)	In[c]	Codon		Anticodon[d]			Note[f]
					Start	Stop	Base	Position	Cove score[e]	
$tRNA^{-Phe}$	+	1-71	71	0			GAA	36-38	27.4	P (COB2) C (COB1)
12S rRNA	+	72-1031	960	0						P (COB1)
$tRNA^{-Val}$	+	1032-1099	68	0			TAC	1062-1064	27.88	-
16S rRNA	+	1100-2674	1575	0						P (COB2)
$tRNA^{-Leu}$	+	2675-2749	75	0			TAA	2710-2712	56.37	-
ND1	+	2752-3707	956	2	ATG	TA*				-
$tRNA^{-Ile}$	+	3708-3776	69	0			GAT	3737-3739	38.59	-
$tRNA^{-Gln}$	-	3774-3847	74	-3			TTG	3812-3810	40.16	-
$tRNA^{-Met}$	+	3848-3916	69	0			CAT	3878-3880	20.96	-
ND2	+	3917-4958	1042	0	ATC	T*				-
$tRNA^{-Trp}$	+	4959-5026	68	0			TCA	4990-4992	25.31	-
$tRNA^{-Ala}$	-	5042-5110	69	15			TGC	5080-5078	41.79	-
$tRNA^{-Asn}$	-	5112-5184	73	1			GTT	5151-5149	26.61	-
$tRNA^{-Cys}$	-	5218-5282	65	0			GCA	5254-5252	17.88	-
$tRNA^{-Tyr}$	-	5283-5349	67	0			GTA	5321-5319	61.35	-
COI	+	5351-6895	1545	1	ATG	TAA				A (COB2)
$tRNA^{-Ser}$	-	6893-6961	69	-3			TGA	6931-6929	35.67	-
$tRNA^{-Asp}$	+	6968-7036	69	6			GTC	6998-7000	35.84	-
COII	+	7037-7720	684	0	ATG	TAA				A (COB2)
$tRNA^{-Lys}$	+	7724-7791	68	3			TTT	7752-7754	47.86	A (COB2)
ATP8	+	7793-7996	204	1	ATG	TAA				A (COB2)
ATP6	+	7954-8634	681	-43	ATG	TAA				A (COB2)
COIII	+	8634-9417	784	-1	ATG	T*				A (COB2)
$tRNA^{-Gly}$	+	9418-9486	69	0			TCC	9449-9451	31.4	-
ND3	+	9487-9833	347	0	ATA	TA*				-
$tRNA^{-Arg}$	+	9834-9902	69	0			TCG	9865-9867	32.97	-
ND4L	+	9903-10199	297	0	ATG	TAA				-
ND4	+	10193-11570	1378	-7	ATG	T*				A (COB2)
$tRNA^{-His}$	+	11571-11639	69	0			GTG	11601-11603	48.36	-
$tRNA^{-Ser}$	+	11640-11698	59	0			GCT	11659-11661	NA	-
$tRNA^{-Leu}$	+	11699-11768	70	0			TAG	11731-11733	46.65	-
ND5	+	11769-13589	1821	0	ATA	TAA				P (COB2)
ND6	-	13573-14100	528	-17	ATG	TAA				-
$tRNA^{-Glu}$	-	14101-14169	69	0			TTC	14139-14137	41.22	-
Cytb	+	14173-15312	1140	3	ATG	AGA				A (COB2)
$tRNA^{-Thr}$	+	15313-15382	70	0			TGT	15343-15345	15.3	P (COB2)
$tRNA^{-Pro}$	-	15383-15449	67	0			TGG	15418-15416	22.66	
CR	+	TIG2: 15450-16976	1527	0						P (TIG1) P (COB1) C (COB2)
		SUM1:15450-16998	1549							
		SUM2:15450-17001	1552							
		ALT: 15450-17015	1566							
		ALT4: 15450-16980	1531							

[a] St denotes " Mitochondrial strand"; + Heavy strand, - Light strand.

[b] The first base position of all tiger mitochondrial genomes start from the first base of the $tRNA^{-Phe}$ gene

[c] In denotes an intergenic space between a particular gene and the adjacent gene upstream.

[d] Anticodon refers to three base-sequences on a strand of tRNA coding to an amino acid.

[e] Cove score indicates a specificity and reliability of tRNA gene identification [139].

[f] P denotes partial gene sequence gap; C denotes complete gene sequence gap; A denotes ambiguous bases found

*Incomplete stop codons thought to be completed by a post-transcriptional addition of polyadenylation (poly A).

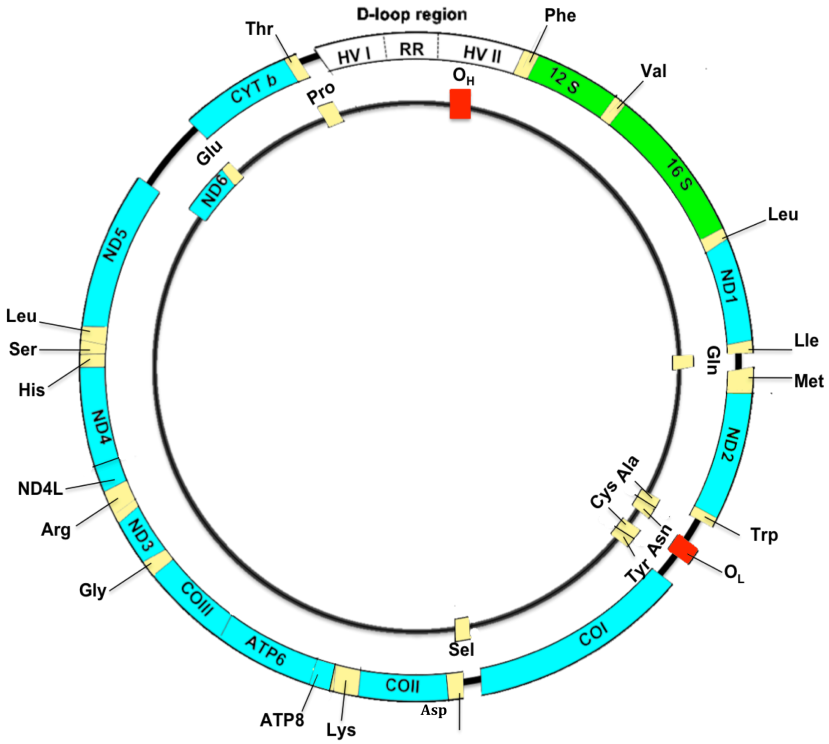


Figure 27: A mitochondrial genome map of *Panthera tigris.* Thirteen protein coding genes are in blue; 2 rRNA genes are in green; 22 tRNA genes are in yellow; and the D-loop region is in white. The inner circular is the light strand of mitochondrial DNA that contains a total of nine coding genes. The origin of replication of the both heavy and light strand are labelled and shown in red.

3.2.1.1 Protein coding genes (PCGs)

Thirteen protein coding genes, NADH dehydrogenase (ND) subunit 1-6, Cytochrome Oxidase (CO) subunits 1-3, ATP8, ATP6, ND4L, and cyt *b* gene in the eight tiger mitochondrial genomes were successfully identified by the ORF-finder and Sequin. These 13 complete protein-coding genes were obtained from seven tiger mitochondrial genomes. The exception was the COB2 genome which contained a partial sequence of the ND5 gene and ambiguous bases in the region of COI, COII, ATP8, ATP6, COIII, ND4, and cyt *b* gene. This could be due to a contamination of other organism's DNA or DNA sequencing inhibitors in this sample, resulting in a retrieval of bad quality DNA sequences containing a number of ambiguous bases in several mitochondrial regions.

The organization and arrangement of the 13 PCGs observed from the eight tiger samples are identical, as shown in Table 9. The arrangement of the 13 tiger's PCGs in a mitochondrial genome are similar to those of other vertebrate species [161-165], including the tiger's closely related species such as the clouded leopard (*Neofelis nebulosa*), snow leopard (*Panthera uncia*), or cheetah (*Acinonyx jubatus*) [157-159]. Among the tigers' 13 PCGs, the ND5 gene was the longest PCG, which had a size of 1,821 bp in length; on the other hand the ATP8 was the smallest PCGs having a size of 204 bp. The ND5 and ATP8 loci were found to be the longest and smallest PCGs in almost vertebrate species [161-165]; however the tiger's ND5 gene was slightly larger than those of some species such as pig (*Sus scrofa*) (1,820 bp) [162] and rabbit (*Oryctolagus cuniculus*) (1,812 bp) [163] while the same size of the ATP8 locus was found in all observed species. Seven PCGs were found to share their nucleotide compositional base with the adjacent gene. Of these seven, six of three protein-coding gene pairs, ATP6-ATP8, ND5-ND6, and ND4L-ND4 were found to overlap each other by 43, 17, and 7 bp respectively. Whereas COI shared its nucleotide base with the $tRNA^{-Ser}$ by 3 bp. Similar to other tiger's PCG characteristics, the observation of overlapping and separated nucleotide bases in some adjacent PCGs were also reported in several species, most likely in all metazoan mitochondrial genomes [165].

The methionine codon (ATG and ATA) was the most common start codon used by the newly characterised tiger PCGs. The codon 'ATG' was used by the 10 PCGs while two PCGs, ND3 and ND5, used the start codon 'ATA'. These two start codons were commonly used and homologous to a vast number of mammalian species [25, 157, 158, 161-165]. The ND2 gene used the start codon of isoluecine (ATC) which is commonly found in some mammalian species: including horse (*Equus ferus*) [166], and tiger's closest genetic relation the snow leopard (*Panthera uncia*) [159]. A different isoleucine start codon (ATT) was also used by cat (*Felis catus*), cheetah (*Acinonyx jubatus*) [157], clouded leopard (*Neofelis nebulosa*) [158], harbor seal (*Phoca vitulina)* and grey seal (*Halichoerus grypus*) [166].

The stop codons used in the PCGs were TAA, TA, T, AGA. The stop codon TAA was used by: COI, COIII, ATP8, ATP6, ND4L, ND5, and ND6. TA was used by ND1 and ND3; T was used by ND2, COIII, and ND4; AGA was used only in cyt *b* gene. The stop codons observed from the tiger genomes were similar to those of most mammals, except the ND1 gene where the stop codon TAA was used instead of a single T [158, 159]. Termination with the incomplete stop codon is a common characteristic found in most mammalian PCGs [167]. These incomplete stop codons, such as TA and T, are thought to be completed by a post-transcriptional addition of polyadenylation (poly A) during the mRNA maturation process [168].

3.2.1.2 Tranfer RNAs (tRNAs)

Twenty-one tRNAs genes, $tRNA^{-Phe}$ $tRNA^{-Val}$, 2 $tRNA^{-Leu\ (UUR\ and\ CUN)}$, $tRNA^{-Ile}$, $tRNA^{-Gln}$, $tRNA^{-Met}$, $tRNA^{-Trp}$, $tRNA^{-Ala}$, $tRNA^{-Asn}$, $tRNA^{-Cys}$, $tRNA^{-Tyr}$, $tRNA^{-Ser\ (UCN)}$, $tRNA^{-Asp}$, $tRNA^{-Lys}$, $tRNA^{-Gly}$, $tRNA^{-Arg}$, $tRNA^{-His}$, $tRNA^{-Glu}$, $tRNA^{-Thr}$, and $tRNA^{-Pro}$ in the eight tiger mitochondrial genomes, were successfully identified by tRNAscan-SE. The obtained Cove scores for the tRNA identification were between 15.30-48.36 (Table 9), indicating a high specificity and reliability of the identification. The exception was the $tRNA^{-Ser\ (AGY)}$ that could not be detected by tRNAscane-SE. This tRNA gene was successfully identified by comparing these sequences with the tiger genome sequences available on GenBank using the program Sequin. Of these 22 tRNA genes, 19 complete tRNA genes were obtained from all the new tiger samples. Two tRNA genes, $tRNA^{-Lys}$ and $tRNA^{-Thr}$, were incomplete in the COB2 mitochondrial genome while the $tRNA^{-Phe}$ was incomplete in both the COB1 and COB2 mitochondrial genomes.

The sizes of tRNA genes were in the range of 59 bp -75 bp. The longest tRNA gene was $tRNA^{-Leu\ (UUR)}$ and the shortest was $tRNA^{-Ser}$. This characteristic of the tiger's tRNA genes were similar to other vertebrates [25, 152, 157-159]; however, in the snow leopard (*Panthera uncia*) mitochondrial genome, the longest tRNA gene was the $tRNA^{-Asn}$ which was slightly shorter than that of the tiger for 2 bp [159]. Three tRNA genes ($tRNA^{-Ile}$, $tRNA^{-Gln}$ and $tRNA^{-Ser}$)

were found to share their nucleotide base with the adjacent gene. Each of the gene pair $tRNA^{-Ile}$/$tRNA^{-Gln}$ and COI/$tRNA^{-Ser}$ was found to overlap each other by 3 bp.

Twenty-one of the 22 tRNA genes were successfully folded into a cloverleaf secondary structure using the tRNAscan-SE program. The exception was the shortest $tRNA^{-Ser\ (AGY)}$ gene which was successfully folded by the RNAfold web server. The secondary structures of these 22 tRNA genes are shown in Figure 28. With the exception of the $tRNA^{-Ser\ (AGY)}$, the secondary structures of all identified tRNAs are similar, mainly comprising of the amino acid acceptor stem (AA stem), TΨC stem (T stem), anticodon stem (AC stem), and dihydrouridine (D stem). The D stem was absent in the $tRNA^{-Ser\ (AGY)}$ (Figure 28). These characteristics of the observed tRNA secondary structures were homologous to most other vertebrates [157-159, 166, 169].

3.2.1.3 Ribosomal RNA (rRNA)

Two ribosomal RNA genes, 12S rRNA and 16S rRNA, in the eight tiger mitochondrial genomes were successfully identified by comparing with the tiger mitochondrial genomes available on GenBank using the program Sequin. Complete 12S and 16S rRNA genes were obtained from six tiger samples, the exceptions being the two *P. t. corbetti* samples. Partial sequences of 12S and 16S rRNA were observed in the sample COB1 and COB 2, respectively. Likewise other mitochondrial regions mentioned above, poor quality DNA templates obtained from the *P. t. corbetti* samples could be responsible for a retrieval of incomplete sequences in the two RNA genes.

The size of the 12S rRNA gene was 960 bp, which is similar to those of the domestic cat (*Felis catus*) and cheetah (*Acinonyx jubatus*) but larger than that of clouded leopard (*Neofelis nebulosa*) by 2 bp. The size of the 16S rRNA gene was 1,575 bp which is a few base pairs larger than those of other big cat species [157-159]. These rRNA genes did not overlap with any other genes in the mitochondrial genome. The MFE secondary structures of 12S and 16S rRNA genes were predicted as shown in Figure 29.

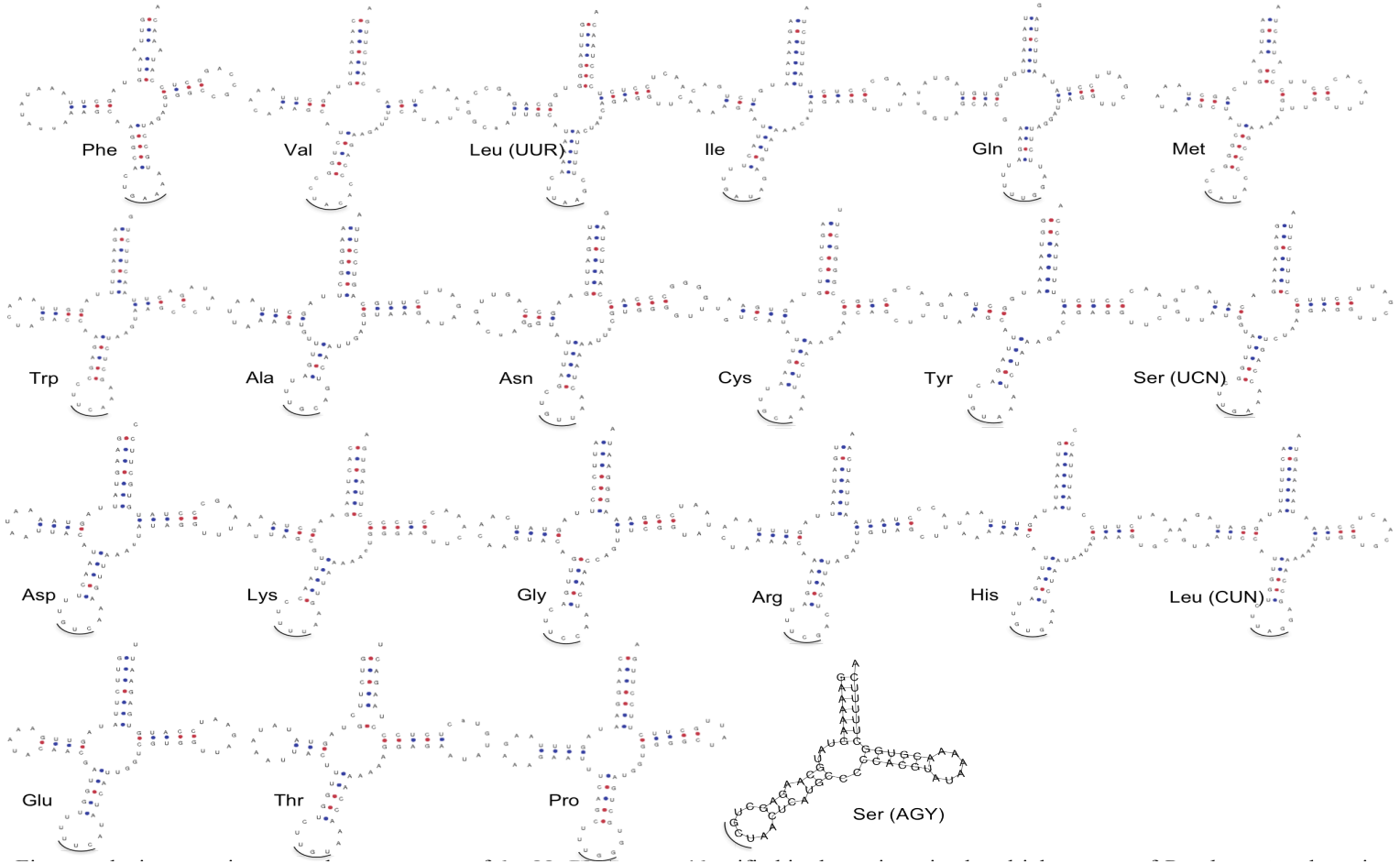
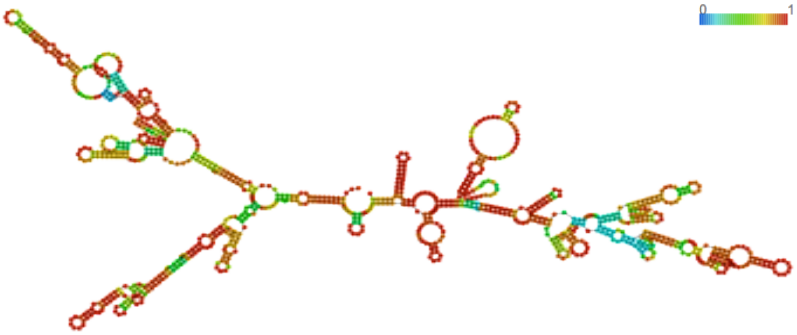


Figure 28: Putative secondary structures of the 22 tRNA genes identified in the entire mitochondrial genome of *Panthera tigris* using the tRNAscan-SE and RNAfold ($tRNA^{Ser\ (AGY)}$). Dot colours indicate base-pairing probabilities; red represents strong base-paring probability, blue represents weak base-paring. The anticodon positions in all indentified tRNAs are marked with a black curve line.

a) MFE secondary structure of 12S rRNA



b) MFE secondary structure of 16S rRNA

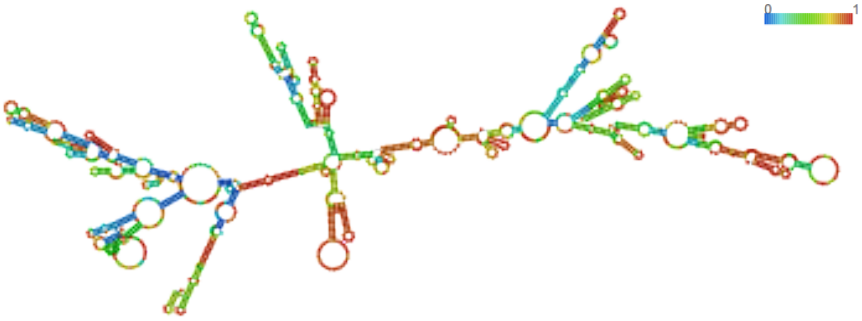


Figure 29: Putative minimum free energy (MFE) secondary structures of 12S and 16S rRNAs identified in the tiger mitochondrial genome. The structures are coloured by base-pairing probabilities; the colour ranges from red representing the highest base-paring probability to blue representing the lowest base-paring probability.

3.2.1.4 Control region (CR)

The control regions (CR) of the eight tiger mitochondrial genomes were successfully identified by comparing with the tiger mitochondrial genome available on GenBank and using the software Sequin. Of these eight genomes, five contained a complete CR, two contained a partial CR, and one contained no CR (Table 9).

The sizes of the CR in the five tiger mitochondrial genome varied from 1,527 to 1,566 bp, leading to a variation in size of the resulting tiger mitochondrial genomes. According to the alignment result of the complete CR obtained from the five tiger samples, the CR was divided into five parts. These were hypervariable region I (HV I), repeat sequence I (RS I), conserved control region (CCR), repeat sequence II (RS II), and hypervariable region II (HV II).

The locations and sizes of these five CR parts are shown in Figure 30. Sequence variable sites were commonly found in the HVI and HVII loci compared to the other region in the mitochondrial genome. Two tandem repeat sites (RS I and RS II) were observed at the two ends of the high conserved core of the control region (CCR). The RS I locus, located at the 5' end of the light strand, contained two repeat units of 80 bp and the first 15 bp of what would be the third repeat motif. These complete two repeat units had 89-93% similarity, meaning that the sequences from these two units were highly conserved to each other but now evolving separately. The RS II contained 47-50 repeat motifs of a shorter 8 bp $(ACGTAYAC)_n$.

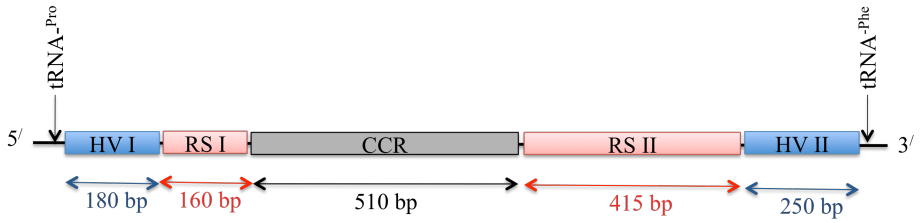


Figure 30: The tiger control region organization which consists of five parts: hypervariable region I (HV I), repeat sequence I (RS I), conserved control region (CCR), repeat sequence II (RS II), and hypervariable region II (HV II).

Repetitive sequences in the CR have been reported in several species and classified into 5 array types (RS1-RS5) based on their location in the CR [170]. According to this study, the observed tiger repetitive sequences (RSI and RSII) were identified as the type RS2 and RS3, respectively. Both of these two repetitive sequence types have been documented in some felid species such as domestic cat and cheetah species [170, 171], while either one of these types were found in several mammalian species such as the evening bat (*Nycticeius humeralis*), pig (*Sus scrofa*), rabbit (*Oryctolagus cuniculus*), harbour seal (*Phoca vitulina*), elephant seals (*Mirounga angustirostris* and *M. leonine*), and 18 other carnivore species [24, 170, 172-175]. The tiger's RS2 motif length is the same as those of cat, cheetah and evening bat species but differ in the number of repeat units; cat and cheetah CR loci were found to contain two and four repeat units, respectively, while the number of repeats is higher in the evening bat [25, 173, 176]. It is noted that there was no RS2 sequence found in the clouded leopard CR [158]. Similar to the RS2 array

type, the tiger's RS3 array sequence (ACGTAYAC) is homologous to a cat species; however, the repeated unit number of this array type observed in the tiger's CR is 10-13 times higher than another species. This array is also found to share a core motif 'ACGT' with 18 carnivore species even though the array sequence pattern among these species are different [170].

There is an observation of a length heteroplasmy in this study; this is where two or more mitochondrial types with a different length were found with in an individual, a cell, or a mitochondrion of tiger [36, 177]. The observed length heteroplasmy was a polycytocine (poly-C) stretch which was observed at the end of the HVI locus in all tiger samples. This result corresponded to the study of Bendall and Sykes [178] who reported that the poly-C stretch is a common length heteroplasmy found at the same location in the human mitochondrial genome. Even though the pattern of length heteroplasmy is highly variable among individuals or species, it is not recommended to use this locus as an additional polymorphic markers for a forensic purpose because it provides inconsistent results under various amplification conditions [177]. The occurrence of length heteroplasmy in the tiger mitochondrial CR resulted in a mixture of DNA sequence bases from the particular position where the length polymorphism was found (Figure 31). This was most likely the cause of unsuccessful recovery of the mitochondrial sequences at this particular region.

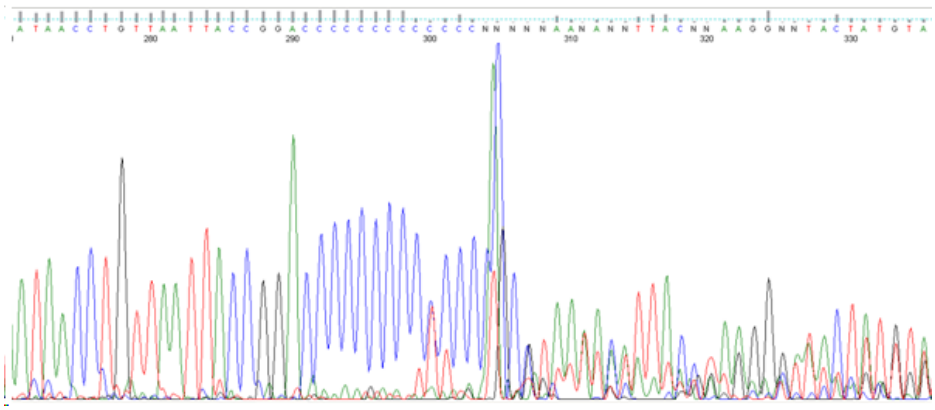


Figure 31: A characteristic of the length heteroplasmy found in the control region of tiger mitochondrial genome (TIG1) at the position 270-335. It was observed in the three tiger samples, COB1, COB2, and TIG1.

3.2.2 Nucleotide compositional pattern

The nucleotide base frequency and compositional asymmetry in terms of GC- and AT-skews were calculated to investigate nucleotide compositional patterns in the eight tiger mitochondrial genomes using Mega 4 and the formulae described in section 2.3.2. This analysis was calculated from the light strand (L-strand) of the mitochondrial DNA and was examined throughout the entire tiger mitochondrial genome and for each 37 mitochondrial genes using data from the eight tiger genome sequences. All average parameters were calculated using the five complete tiger genomes or complete gene sequences only.

Based on the analysis of the entire tiger mitochondrial genome, the nucleotide compositional patterns of the eight tiger genome sequences were similar to each other (Table 10). The nucleotide base A was the most represented base, which showed the highest average frequency of 31.8%. The lowest nucleotide base frequency was observed for the base G which represented 14.6% on average; as would be expected of the data were obtained from the light strand (L-strand) of a mitochondrial DNA. The T% and C% were represented equally at approximate 27%. The percentages of all nucleotide bases represented in tiger mitochondrial genome were homologous to those of other big cats species [157-159]. The average value of AT% was higher than GC% by 17.6%; this higher AT content was found in all the tiger mitochondrial genes, except in the region of the $tRNA^{-Ile}$ where GC content represented 69% of the content and 15.9% was AT content (Figure 32). This result indicated that the tiger mitochondrial genome is AT-rich (GC poor) which is common with all organism's mitochondrial genomes sequenced up to date [179]. The bias of nucleotide composition along the same mitochondrial strand would be explained by a bias in dNTP pool or strand-specific misparing rate of the DNA polymerase during DNA replication [180, 181]. Moreover, the resulting tiger average percentage of GC content (41.2 %) corresponded to the study of Saccone *et. al.* [165] who reported the GC% range of all mammals as 37.20% to 43.36% and carnivores between 39.84% to 41.86%. Based on these reports, the tigers' GC% value was found to nearly reach the highest GC% value of the carnivores and other mammalian species [165].

Table 10: The percentage of nucleotide composition, GC-skew, AT-skew, and their skew standard deviation in the eight tiger mitochondrial genomes.

Tiger subsp	Total	T%	C%	A%	G%	AT%	GC%	AT-skew		GC-skew	
								Value	SD	Value	SD
TIGRIS1	16634	26.9	26.7	31.9	14.5	58.8	41.2	0.085	0.130	-0.296	0.149
TIGRIS2	16975	27.0	26.6	31.8	14.6	58.8	41.2	0.082	0.130	-0.291	0.149
SUMATRA1	16998	27.0	26.6	31.8	14.7	58.8	41.3	0.082	0.130	-0.288	0.149
SUMATRA2	17001	26.9	26.6	31.8	14.7	58.7	41.3	0.083	0.130	-0.288	0.149
CORBETTI1	16601	26.9	26.6	31.9	14.6	58.8	41.2	0.085	0.130	-0.291	0.149
CORBETTI2	14103	27.3	26.8	31.6	14.3	58.9	41.1	0.073	0.130	-0.304	0.149
ALTAICA4	16980	27.0	26.6	31.8	14.6	58.8	41.2	0.082	0.130	-0.291	0.149
ALTAICA	17012	26.9	26.7	31.8	14.6	58.7	41.3	0.083	0.130	-0.293	0.149
Avg.	16538	27.0	26.6	31.8	14.6	58.8	41.2	0.082	0.130	-0.291	0.149

By the analysis of the entire tiger mitochondrial genome, the average GC-skew and AT-skew values were – 0.291 ±0.13 and 0.082 ±0.15, respectively (Table 10). These values indicated an existence of nucleotide compositional asymmetry in the tiger mitochondrial genome as well as other animal species [182, 183], including human [184]. The negative value of GC-skew indicated that the investigated tiger mitochondrial strand contained a high C% or low G%, confirming that the data were obtained from the light strand (L-strand) of a mitochondrial DNA. These two observed values corresponded to the GC- and AT-skew value determined from various mammalian species that have an average negative (value of) GC-skew (-0.41±0.05) and positive value of AT-skew (0.05±0.04) [164]. However the opposite pattern of the nucleotide composition asymmetry (positive GC-skew and negative AT-skew value) is found in some invertebrate species such as arthropods, insects [185], flatworms [166, 167], echinoderms [186], and fish [187]. The absolute value of GC-skew is much higher than the AT-skew, meaning that there is a considerable asymmetry of the base G and C between the two strands of the tiger mitochondrial genome; this characteristic is found in all mammalian species studied [183]. However the strength of GC-skew slightly varied among different mammalian species [128], while AT-skew value was similar among these mammalian species [164]. The uneven significant asymmetry in the nucleotide composition of the two mitochondrial strands could be explained by an irregularity mechanism of mitochondrial DNA replication - the parental H-strand remained single-stranded for a much longer time compared to the L-strand during the replication process so that it would be

affected more by hydrolylic and oxidative damage. This would lead to a preferential mutation in the H-strand [180, 188]. Moreover, a nucleotide substitution is bias toward γ-base (G and C), and least for an α-base (A and T) [183], probably leading to a significant asymmetry of base G and C between the two strands.

To study the skew characteristics for a particular region on the mitochondrial genome, the GC- and AT-skew parameters were determined for each of the 37 mitochondrial genes. The GC-skew showed a negative value in most of the mitochondrial genes, except in four tRNA genes ($tRNA^{-Phe}$, $tRNA^{-Ile}$, $tRNA^{-Asp}$, and $tRNA^{-Leu\ (CUN)}$) (Figure 33). While the AT-skew showed a positive value in most mitochondrial genes, except in five genes ($tRNA^{-Tyr}$, COI, ATP6, COII, and ND4L). Absolute values of GC-skew were higher than the AT-skew value in all 13 PCGs but lower in the two rRNA genes and the five tRNA genes ($tRNA^{-Phe}$, $tRNA^{-Val}$, $tRNA^{-Tyr}$, $tRNA^{-Ser}$, and $tRNA^{-Leu\ (CUN)}$). By disregarding minor reverse values of AT-skew found in the five PCGs mentioned above, the key skew characteristics observed from the PCGs were mostly similar to those obtained from the entire tiger mitochondrial genome. This would suggest that the overall skew values obtained from the entire tiger mitochondrial genome were particularly influenced by the PCGs rather than rRNA genes.

The skew strength was found to vary among tiger mitochondrial genes. The asymmetry in nucleotide base GC between the two strands of mitochondrial genome is greatest in the ND2 gene, which presented the lowest GC-skew value (– 0.50). This was also noted in the regions of the ATP8, $tRNA^{-Gln}$, ND1, ND3, ND4, ND6, and cyt *b* genes which showed a lower GC-skew of 0.35-0.4. Moreover, the COI gene showed the lowest GC-skew value when compared to all the PCGs. The results indicated a significant difference of the bases GC between the two strands in the most of the ND family, ATP8, $tRNA^{-Gln}$, and cyt *b* genes; and least difference in the COI gene. The variation of the GC-skew strength observed in this study supported the theory noted previously of a correlation between the skew strength and gene position in the mitochondrial genome [189]. According to the asymmetrical mechanism of

mitochondrial DNA replication, high skew strengths are expected from the corresponding genes observed in this study as they are close to the origin of H-strand replication (O_H) (such as cyt *b*, ND6, and ND5) or located between the two origins of replication (such as ND1 and ND2). These loci would spend a longer time in the mutagenic single-strand state during replication [183, 184], whereas the COI gene spends the shortest time in the single-strand state [183, 184] and showed the lowest GC-skew value.

High AT-skew values were found in the ND6 (0.29) and $tRNA^{-Phe}$ (0.25) genes, meaning that a significant difference of the base AT between the two strands was particularly present in these two genes. Low absolute AT-skew values were found in the $tRNA^{-Thr}$, COIII, ATP6, and $tRNA^{-Leu\ (UUR)}$ genes, while an even distribution of the nucleotide base AT was observed in the $tRNA^{-Cys}$ and $tRNA^{-Asp}$ genes which therefore showed a zero AT-skew value. These results showed that the AT-skew strength varied undirectionally among mitochondrial genes. A reason for this incident is still ambiguous.

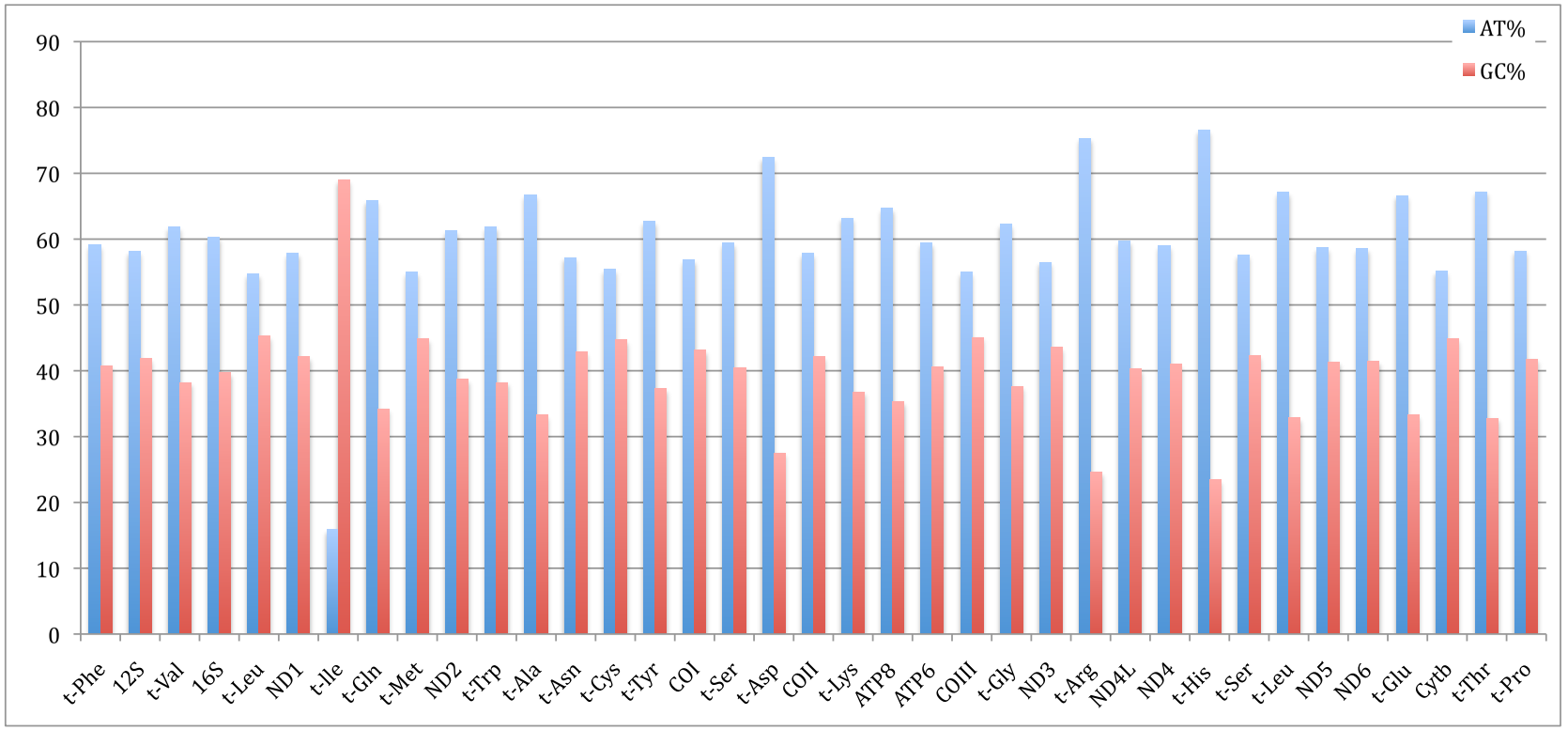


Figure 32: The nucleotide base composition in terms of AT% (in blue) and GC% (in red) observed in all 37 mitochondrial genes. The AT content is higher than the GC content in 36 mitochondrial genes, except in the region of the $tRNA^{-Ile}$ (t-Ile) gene where the GC content represented 69% and the AT content represents 15.9%.

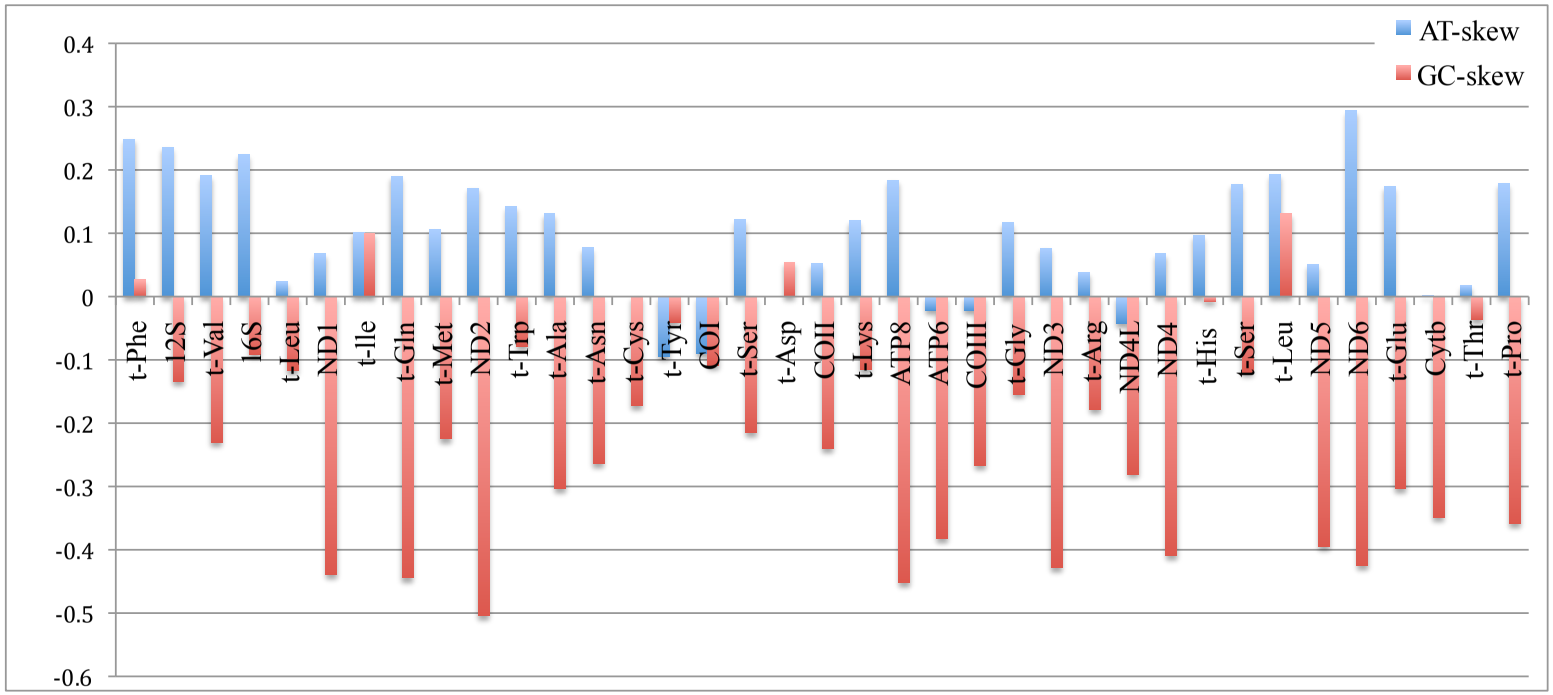


Figure 33: The nucleotide compositional asymmetry in terms of AT- and GC-skew observed in all 37 mitochondrial genes. Overall, the value of AT-skew was mostly lower than an absolute GC-skew value; however, a high AT-Skew value was found in the ND6 (0.29) and tRNA^{-Phe} (0.25) genes. The GC-skew showed a negative value in most of mitochondrial genes, except in three tRNA genes (tRNA^{-Phe}, tRNA^{-Asp}, and tRNA^{-Leu} (CUN)). Negative AT-skews were found in five mitochondrial genes, tRNA^{-Tyr}, COI, ATP6, COII, and ND4L. Zero AT-skews were observed in tRNA^{-Cys} and tRNA^{-Asp}.

3.2.3 Codon usage

Codon usage was examined in the coding regions of the five completed tiger mitochondrial genomes using Mega 4. The light strand (L-strand) of a mitochondrial genome was used as a template to examine the codon usage of the 28 heavy strand-encoded genes. The remaining nine light strand-encoded genes were analyzed using their complementary heavy strand sequences; being identical to their transcribed mRNAs. The average codon frequency and the relative synonymous codon usage (RSCU) were calculated from the entire tiger genomes.

The average codon frequency and relative synonymous codon usage for the entire tiger mitochondrial genome are shown in Table 11. The codon UAU (Tyr), AAU (Asn), and GAU (Asp) were used the most; being 199, 191.2, and 178.8 times on average. The lowest used-codon frequency was 9.8 times, as found for the codon CGC (Arg). Different codons coding for the same amino acid (synonymous codons) provided different codon frequencies (Table 11); the most frequently used codon for an amino acid (e.g. UCA for serine) matched the corresponding prominent anticodon predicted using the tRNAscan-SE software (Table 9). This incident is commonly found in vertebrate mitochondrial genomes [190], unlike insect mitochondrial genomes where the association between the most used-codon and complementary anticodon was not observed [191]. The codons AGU (Ser) and GUU (Val) represented the highest RSCU values, which were 1.49 and 1.41 respectively. While the lowest RSCU of 0.35 and 0.37 were found in the codons GCG (Ala) and CCG (Pro) respectively. With the exception of the amino acid aspartic acid, RSCU values of all codons were above or under 1.00. These results indicated that codon usage bias occurred in the tiger mitochondrial genome. The occurrence of bias is most likely due to a codon usage optimization for amino acid translation efficiency of protein coding genes [192, 193], or mutation pressure biased toward base pair GC, particularly at the third codon position [183, 194]. In addition, other factors such as transcription efficiency, mRNA secondary structure, and protein structure could effect the selection pressure in codon usage [195-197].

Table 11: The codon usage frequency and relative synonymous codon usage observed in the entire tiger mitochondrial genome.

Amino acid	Codon	N[a]	RSCU[b]	Amino acid	Codon	N[a]	RSCU[b]
Phenylalanine	UUU	88.20	1.02	Tyrosine	UAU	160.50	1.22
Phenylalanine	UUC	84.30	0.98	Tyrosine	UAC	102.70	0.78
Leucine	UUA	128.70	1.35	Stop codon	UAA	121.20	1.48
Leucine	UUG	40.00	0.42	Stop codon	UAG	61.70	0.75
Leucine	CUU	92.50	0.97	Histidine	CAU	119.80	1.09
Leucine	CUC	107.20	1.13	Histidine	CAC	100.70	0.91
Leucine	CUA	151.50	1.59	Glutamine	CAA	112.80	1.44
Leucine	CUG	51.30	0.54	Glutamine	CAG	44.00	0.56
Isoleucine	AUU	119.50	0.99	Asparagine	AAU	191.20	1.19
Isoleucine	AUC	122.70	1.01	Asparagine	AAC	130.00	0.81
Methionine	AUA	115.00	1.30	Lysine	AAA	194.20	1.47
Methionine	AUG	62.00	0.70	Lysine	AAG	70.00	0.53
Valine	GUU	58.30	1.30	Aspartic acid	GAU	51.20	1.00
Valine	GUC	40.70	0.90	Aspartic acid	GAC	51.70	1.00
Valine	GUA	55.80	1.24	Glutamic acid	GAA	69.50	1.35
Valine	GUG	25.00	0.56	Glutamic acid	GAG	33.70	0.65
Serine	UCU	94.30	1.14	Cysteine	UGU	37.00	0.84
Serine	UCC	96.70	1.16	Cysteine	UGC	51.00	1.16
Serine	UCA	112.80	1.37	Tryptophan	UGA	68.70	1.14
Serine	UCG	29.30	0.36	Tryptophan	UGG	52.20	0.86
Proline	CCU	136.50	1.33	Arginine	CGU	33.00	0.99
Proline	CCC	132.20	1.28	Arginine	CGC	33.70	1.01
Proline	CCA	107.30	1.04	Arginine	CGA	43.70	1.31
Proline	CCG	35.80	0.35	Arginine	CGG	23.00	0.69
Threonine	ACU	138.70	1.36	Serine	AGU	75.70	0.92
Threonine	ACC	125.00	1.23	Serine	AGC	87.00	1.05
Threonine	ACA	107.20	1.05	Stop codon	AGA	80.00	0.98
Threonine	ACG	37.00	0.36	Stop codon	AGG	64.00	0.78
Alanine	GCU	72.50	1.27	Glycine	GGU	30.30	0.75
Alanine	GCC	87.20	1.52	Glycine	GGC	46.00	1.14
Alanine	GCA	59.30	1.04	Glycine	GGA	48.80	1.21
Alanine	GCG	10.20	0.18	Glycine	GGG	36.30	0.90

N[a] represents a codon usage frequency
RSCU[b] represents relative synonymous codon usage
Yellow highlights represent the most frequent-used synonymous codon for all single amino acids.

3.2.4 DNA sequence variation in the tiger mitochondrial genome

A total of 492 verified tiger DNA sequences, being from six tiger subspecies (*P. t. tigris, P. t. sumatrae. P. t. altaica, P. t. corbetti, P. t. amoyensis, and P. t. jacksoni*), were obtained from GenBank. These DNA sequences were combined with the eight new tiger sequences and then aligned by Mega 4. DNA variations among these tiger sequences were searched throughout the

entire tiger mitochondrial genome. The nucleotide substitution pattern in the tiger mitochondrial genome was also examined for nucleotide diversity, the ratio of transition/transversion for purine and pyrimidine bases and transition/transversion bias.

From a search through the alignment result of the eight entire tiger mitochondrial genomes, a total of 191 variable base positions were observed, as shown in Table 12. This number of variable sites equates to 1.12% of total mitochondrial DNA, meaning that a variable site would be found every 89 bp on average. The average nucleotide diversity for the entire tiger mitochondrial genome (π) was 0.002, indicating a moderate degree of sequence variation within tiger populations [142]. These results correspond to the study of Luo *et. al*. [22] who reported a similar quantity of mitochondrial sequence variation in tiger. According to this study, moderate sequence diversity was reported such that a variable site was found every 75 and 112 bp in the tiger mitochondrial genome. This was based on 4 kb and 6 kb of 34 individual tiger mitochondrial sequences. However this value is much higher than that reported by Zhang *et. al*. [198], who observed sequence variation at about one every 288 bp in tiger mitochondrial genomes. These observations are based on from two entire *P. t. amoyensis* mitochondrial genomes. A difference in the DNA variation quantity mentioned above could be affected by a difference in numbers of tiger samples used for the analysis. By comparing the mitochondrial DNA diversity to other Felid species, the value observed from tiger was slightly less than that of puma (*Puma concolor*) (0.003) and tiger cat (*Leopardus tigrina*) (0.0022) but much less than those of leopard (*Panthera pardus*) (0.012) and Geoffroy's cat (*Oncifelis geoffroyi*) (0.012) [199-201].

The overall transition/transversion bias in the tiger mitochondrial genome is 9.66, meaning that the nucleotide substitutions occurred in the tiger mitochondrial genome biased toward a transition rather than transversion with the ratio of 9.66:1. This ratio was in the range of those determined across 70 species from various taxonomic groups in which it varied from 1.00:1 in the chinstrap penguin (*Pygoscelis antartica*), to 20.00:1 in the long-clawed shrew

(*Sorex unguiculatus*) [202]. However the transition bias is assumed to vary broadly among genes and lineages [203-205].

Table 12: The DNA variable sites and their positions observed from the entire tiger mitochondrial genome. The 'N' represents a total number of variable site at a particular region; 'HN' represents Haplotype numbers; 'ATL' represents *P. t. altaica*; 'TIG' represents *P. t. tigris*; 'SUM' represents *P. t. sumatrae*; 'AMOY' represents *P. t. amoyensis*; 'COB' represents *P. t. corbetti*, 'Jack' represents *P. t. jacksoni*; '.' represents the same nucleotide base as the top haplotype sequences of *P. t. altaica* sample; '-' represents no sequence data at a particular site. Red fonts indicate tiger subspecies-specific SNP.

12S rRNA

Position	N	HN	1104	1423	1580	1676	1718
			220	554	771	806	847
ALT	3	1	T	T	A	C	A
		1	C	.	.	T	.
		1	-	.	.	T	.
TIG	13	2	-	.	.	T	.
SUM	10	1	-	C	G	.	.
		1	-	.	G	.	.
AMOY	1	1	-	.	.	.	.
COB	6	4	-	.	.	T	.
		2	C	.	.	T	.
Jack	5	2	-	.	.	.	G

16s rRNA

Position	N	HN	2392	2571	2690	2710	3166	3252
			1528	1707	1827	1847	2304	2388
ALT	2	1	T	T	T	G	G	T
		1	.	.	.	.	A	.
TIG	3	2	.	C	.	.	A	.
		1	-	-	-	-	A	C
SUM	2	2	C	.	C	.	A	.
AMOY	0							
COB	1	1	.	.	.	A	A	.
Jack	0							

ND1

Position	N	HN	3851	3901	4212	4226	4228	4333	4357	4406	4442
			2988	3038	3349	3363	3365	3470	3494	3543	3579
ALT	3	1	T	T	C	A	C	T	A	A	T
		1	C	.	.	.	.	.	.	.	C
		1	-	-	T	.	.	.	.	.	.
TIG	9	2	C	.	.	.	.	.	.	.	C
		1	-	-	T	.	.	.	.	.	.
		5	-	-	T	.	.	.	.	.	C
		1	C	C	T	C	G	.	.	.	.
SUM	10	2	.	.	.	.	.	.	.	.	C
		6	-	-	T	.	.	.	.	.	C
		2	-	-	T	.	.	.	.	G	C
AMOY	1	1	-	-	T	.	.	.	G	.	.
COB	6	3	-	-	T	.	.	.	.	.	.
		1	-	-	T	.	.	C	.	.	.
Jack	5	5	-	-	T	.	.	.	.	.	.

Gn

Position	N	HN	4696
			3833
ALT	2	1	T
		1	.
TIG	2	2	.
SUM	2	2	C
AMOY			
COB	2	2	.
Jack	0		

ND2

Position	N	HN	4930	4940	4949	4963	5037	5044	5050	5155	5186	5332	5349	5515	5518	5533	5608	5674	5728	5737
			4066	4076	4085	4099	4173	4180	4186	4291	4322	4468	4485	4651	4654	4669	4744	4810	4864	4873
ALT	3	3	A	G	A	G	T	A	C	T	A	C	T	A	G	G	C	T	G	C
TIG	33	1	.	.	.	.	.	.	T	C	.	T	.	.	.	A	.	.	.	T
		1	.	A	.	.	.	.	T	C	.	T	.	.	.	A	.	.	.	
		1	.	.	.	A	.	.	T	C	.	T	.	.	.	A	-	.	.	T
		5	.	.	.	.	.	.	T	C	.	T	.	.	.	A	-	.	.	
		1	-	-	-	A	-	-	-	-	-	-	-	-	-	-	-	-	-	
		1	.	.	.	.	G	T	T	-	-	-	-	-	-	-	-	-	-	
		18	.	.	.	.	.	.	T	-	-	-	-	-	-	-	-	-	-	
		1	T	.	G	.	.	.	T	-	-	-	-	-	-	-	-	-	-	
		1	.	.	.	A	.	.	T	-	-	-	-	-	-	-	-	-	-	
		3	-	-	-	.	-	-	-	-	-	-	-	-	-	-	-	-	-	
SUM	10	10	.	.	.	.	.	.	.	C	.	T	.	.	.	.	T	.	.	.
AMOY	1	1	.	.	.	.	.	.	.	C	.	T	C	.	A	.	.	C	A	.
COB	6	4	.	.	.	.	.	.	.	.	.	T	.	.	.	.	.	.	.	.
		1	.	.	.	.	.	.	.	.	G	T	.	.	.	.	.	.	.	.
Jack	5	2	.	.	.	.	.	.	.	.	.	T	.	.	.	.	.	.	.	.
		3	.	.	.	.	.	.	.	.	.	T	.	G	.	.	.	.	.	.

Position	N	HN	tAsn 5993	tAsn 6031
			5128	5166
ALT	2	1	T	A
		1	C	.
TIG	2	2	C	G
SUM	2	2	C	G
AMOY	0			
COB	2	1	C	.
		1	T	.
Jack	0			

Position	N	HN	COI 6284	6299	6332	6351	6383	6446	6456	6479	6571	6584	6758	6764	6781	6786	6860	6884	6959	6965	7188	7287	7304	7382	7440	7505	7629	7753
			5419	5434	5467	5486	5518	5581	5591	5614	5706	5719	5893	5899	5916	5921	5995	6019	6094	6100	6323	6422	6439	6517	6575	6640	6764	6888
ALT	5	1	C	A	C	A	A	A	T	A	A	A	A	G	T	A	A	C	G	G	G	C	G	T	T	C	A	T
		1	.	G	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	T	.	C	G	.	G	.
		1	.	.	.	.	.	.	C	.	G	.	.	.	.	G	G	.	A	T	-	-	-	-	-	-	-	-
		1	.	G	.	.	.	.	C	.	G	.	.	.	.	G	G	.	A	T	-	-	-	-	-	-	-	-
		1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.	.	.	.	.	-	-	-	-	-
TIG	13	1	.	G	.	.	.	.	.	.	.	.	G	.	.	.	.	.	.	.	.	T	.	C	.	.	G	.
		1	.	G	.	.	.	.	.	.	.	.	G	.	.	.	.	.	.	.	A	T	.	C	.	.	G	.
		6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.	.	.	T	.	-	-	-	-	-
		3	.	G	.	.	.	.	.	.	.	.	.	.	.	.	.	.	A	T	-	-	-	-	-	-	-	-
		1	.	G	.	.	.	.	.	.	.	.	.	.	C	.	.	.	A	T	-	-	-	-	-	-	-	-
		1	.	G	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	-	-	-	-	-	-	-
SUM	10	2	.	G	.	.	G	.	.	.	.	G	.	.	.	.	.	.	.	.	.	T	.	C	.	.	G	.
		5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.	.	.	T	.	-	-	-	-	-
		3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.	.	.	T	A	-	-	-	-	-
AMOY	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.	.	.	T	.	-	-	-	-	-
		1	.	G	.	G	G	G	.	G	.	.	.	A	.	.	.	T	A	T	-	-	-	-	-	-	-	-
COB	6	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.	.	.	T	.	-	-	-	-	-
		1	T	G	T	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	T	.	C	.	.	G	.
		1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	R	.	.	.	.	.	.	.	.	T	.	G
Jack	5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.	.	.	T	.	-	-	-	-	-

Position	N	HN	COII 7919	8072	8087	8103	8228	8268	8288	8361	8399	N	HN	A8 8720
			7054	7207	7222	7238	7363	7403	7423	7496	7534			7855
ALT	2	1	A	T	A	T	G	A	G	G	A	2	1	C
		1	.	T	.	C	A	.	A	.	.		1	.
TIG	2	2	G	C	.	.	.	.	.	.	G	2	2	.
SUM	2	2	.	T	.	.	.	G	.	.	.	2	2	.
AMOY	0											0		
COB	2	1	.	T	G	.	.	.	.	.	.	2	1	.
		1	.	T	.	.	.	.	.	A	.		1	T
Jack	-											0		

Position	N	HN	ATP6														N	HN	COIII																				N	HN	ND3		N	HN	4L
			8917	8963	8968	8994	8995	8997	8998	9076	9191	9340	9415	9430	9478				9456	9466	9478	9687	9718	9786	9882	9897	10041	10104	10152	10190	10203	10227	10239			10447	10495			10864
			8052	8098	8103	8129	8130	8132	8133	8211	8326	8475	8550	8565	8613				8591	8601	8613	8822	8853	8921	9017	9032	9176	9239	9287	9325	9338	9362	9374			9582	9630			9999
ALT	2	1	G	T	A	T	T	C	C	T	T	C	G	C	G	5	1	T	A	G	G	G	T	A	T	C	G	T	A	C	T	G	2	2	A	C	2	2	C
		1	.	.	G	.	.	.	.	C	C	.	.	.	.		1	.	.	.	.	A	.	.	.	.	.	.	.	.	.	.	2				2		
																	3	-	-	-	.	.	.	.	.	.	.	.	T	.	C	A							
TIG	2	2	A	.	.	.	.	.	.	.	C	T	A	.	A	6	2	.	.	A	A	A	A	.	.	.	.	.	.	.	.	.	2	2	.	.	2	2	T
																	3	.	G	.	.	A	.	.	.	.	.	.	.	.	C	A	2				2		
																	1	G	G	.	.	A	.	.	.	.	.	.	.	.	C	A							
SUM	2	2	A	.	.	.	.	.	.	.	C	T	.	T	.	2	2	.	.	.	.	A	.	.	C	T	.	C	.	.	.	.	2	2	G	.	2	2	.
AMOY	0															1	1	-	-	-	.	A	.	G	.	.	.	.	.	T	C	-	0				0		
COB	2	1	.	C	.	.	.	.	.	.	C	.	.	.	.	2	1	.	.	.	.	A	.	.	.	.	.	.	.	.	.	.	2	1	.	T	2	1	.
		1	A	.	.	C	C	T	T	.	.	Y	.	.	.		1	.	.	.	.	A	.	.	.	.	A	.	.	.	.	.							
Jack	0															0																	0				0		

Position	N	HN	ND4											N	HN	H	N	HN	ND6				N	HN	Pro		N	HN	CR				
			11356	11646	11741	11744	11756	11777	11825	11951	12371			12464				14591	14618	14711	14780			16262	16271			15450	15454	15493	15526	15533
			10491	10781	10876	10879	10891	10912	10960	11086	11506			11599				13726	13753	13846	13915			15398	15407			16315	16319	16358	16391	16399
ALT	5	1	T	C	A	A	T	A	A	C	A	2	1	T	3	2	T	C	A	C	4	3	T	C	5	4	C	T	T	C	.
		1	.	T	.	.	.	.	.	.	C		1	.		1	.	.	G	T		1	C	T		1	.	C	.	.	.
		3	-	.	.	.	.	.	.	.	-																				
TIG	7	2	.	.	.	.	.	.	.	.	C	2	2	.	8	8	.	T	G	.	27	2	C	T	27	1	.	.	A	A	.
		2	-	T	.	.	.	.	.	.	-															1	.	.	.	A	.
		1	-	.	G	.	.	.	.	.	-															1	.	C	.	.	.
		2	-	.	.	.	.	.	.	.	-															1	T	.	.	.	.
																										1	T	.	.	.	.
SUM	2	2	.	.	.	G	.	.	T	.	C	2	2	.	10	10	.	.	G	.	10				10						
AMOY	1	1	-	.	.	.	C	.	.	T	-	0			1	1	C	.	G	.	2	1	C	T	2		.	.	.	.	.
COB	2	1	C	.	.	.	.	G	.	.	C	2	1	C	6	5	.	.	G	.	5	5	.	.	5	5	T	.	.	.	.
Jack	0											0			5	3	.	.	G	.	5	5	.	.	5	2	.	.	.	.	T
																2	.	.	G	T						3	.	C	.	.	.

Position	N	HN	ND5																														
			12666	12785	12951	12957	13029	13138	13140	13173	13332	13369	13377	13417	13447	13460	13494	13527	13537	13611	13722	13908	13971	13983	13986	14046	14088	14118	14211	14295	14406		
			11801	11920	12086	12092	12164	12273	12275	12308	12467	12504	12512	12552	12582	12595	12629	12662	12672	12746	12857	13043	13106	13118	13121	13181	13223	13253	13346	13430	13541		
ALT	4	1	G	T	A	A	A	C	G	G	G	C	C	C	G	T	C	T	G	T	C	A	C	C	C	C	C	T	C	T	C		
		1	.	.	.	.	G	.	.	.	.	.	.	.	.	.	.	.	.	C	.	T	.	.	.	.	.	C	.	.	.		
		1	.	C	G	G	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
		1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	T	.	.	.	.	.	.	C	.	.	.		
TIG	51	2	A	.	.	.	G	.	A	.	.	.	.	.	.	.	.	.	.	C	.	.	.	.	.	.	.	C	.	.	.		
		17	-	-	-	-	G	.	.	.	.	.	.	.	.	.	.	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
		2	-	-	-	-	G	.	A	.	.	.	.	.	.	.	.	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
		1	-	-	-	-	G	.	.	.	.	.	.	.	.	.	T	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
		2	-	-	-	-	G	.	.	.	.	.	.	.	.	A	.	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
		1	-	-	-	-	G	.	.	.	A	.	.	.	.	.	.	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
		5	-	-	-	-	G	.	.	.	.	.	.	.	A	.	.	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
		2	-	-	-	-	G	.	.	.	.	.	T	.	A	.	.	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
		1	-	-	-	-	G	.	.	.	.	.	.	A	.	.	.	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
		1	-	-	-	-	G	.	.	.	.	T	.	.	.	.	.	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
		3	-	-	-	-	G	.	.	.	.	.	.	.	.	.	.	A	-	-	-	-	-	-	-	-	-	-	-	-	-		
		1	-	-	-	-	G	.	A	.	.	.	.	.	.	.	.	A	-	-	-	-	-	-	-	-	-	-	-	-	-		
		1	-	-	-	-	G	.	.	.	.	.	.	.	A	.	.	A	-	-	-	-	-	-	-	-	-	-	-	-	-		
		2	.	.	G	G	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
		1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.	.	.	.	T	.	.	C	-	-	-		
		5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.	.	.	.	.	.	.	C	-	-	-		
		3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.	.	.	-	-	-	-	-	-	-		
		1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.	.	T	-	-	-	-	-	-	-		
SUM	10	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	T		
		1	.	C	.	.	G	.	.	.	.	.	.	.	.	.	.	.	.	C	T	.	.	.	.	.	.	C	.	.	T		
		1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.	.	T	.	.	T	T	.	-	-	-		
		7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.	.	.	.	.	.	.	.	-	-	-		
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			14217	14239	14241	14250	14253	14293	14313	14344	14346	14358	14400	14415	14491	14514	14525	14532	14538	14541	14580	14586	14589	14592	14637	14658	14723	14730	14737	14745	14772	14775	14808	14826	14878	14891	15080	15129	15171	15261
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Out of 191 variable sites, only six points, at positions 5050, 5533, 5608, 14618, 15223, 15743 were classified as an inter-subspecies variation or subspecies-specific sites. Three out of the six variable sites, position 5050, 5533, and 5608 were specific to *P. t. tigris* and the rest were specific to *P. t. sumatrae*. Two of the tiger subspecies, *P. t. corbetti* and *P. t. altaica*, did not show any variation between each other and could not be distinguished from the other tiger subspecies based on the 16,694 bp entire mitochondrial genome. With the exception of the SNP at position 15223, the tiger subspecies-specific SNPs are transition variants, which is consistent with nucleotide base substitutions biased in favour of transitions rather than transversions [206, 207]. Five of six SNPs, at positions 5050, 5533, 5608, 14618, and 15743, correspond to the only previously reported tiger subspecies-specific study [22]. In this previous report a further six subspecies specific SNPs were recorded for the four tiger subspecies that from part of this study, however these were not confirmed as subspecies-specific in this study as they were found in more than one subspecies.

By investigating DNA sequence variation in each of the mitochondrial genes, the highest number of DNA variable sites was found in the cyt *b* gene, where 38 variable bases were recorded. High numbers of DNA variable sites were also observed in the ND5 (29), COI (26), and ND2 (18) genes (Table 12). The percentages of sequence variable site, conserved site and inter-subspecies variable site observed from the 37 tiger mitochondrial genes are shown in Figure 34. In this Figure, mitochondrial sequence variations were found to be unequal among all the 37 mitochondrial genes. The highest percentage of sequence variable sites was also found in the cyt *b* gene (3.33%); high percentages of variable sites were observed in the $tRNA^{-Asn}$ (2.74%), COIII (1.91%), ATP6 (1.91%), and ND2 (1.73%) genes. This suggested that nucleotide substitutions were occurring preferably in these mitochondrial genes. Almost all the sequences were highly conserved in all the mitochondrial genes; the lowest percentage was as high as 96.6% found in the cyt *b* gene. This result indicated an extremely high similarity of the entire mitochondrial sequences among the four extant tiger subspecies. Moreover, a total of only six variable sites, located in cyt *b*, ND2, and ND6, were found to

be variable to allow differentiation between the different tiger subspecies. On the basis of these results cyt *b*, ND2, and ND6 gene would be the most informative mitochondrial genes for tiger subspecies identification. The suggestion of using cyt *b* gene as an informative site corresponded to the study of Tobe *et. al*. [208] who reported that this gene provided an accurate phylogenetic reconstruction and mammalian species identification when compared to the COI gene. In addition, these data highlight the use of other informative mitochondrial genes such as ND2 or ND6 for the purpose of species identification and enforcement of allegation of wildlife crime.

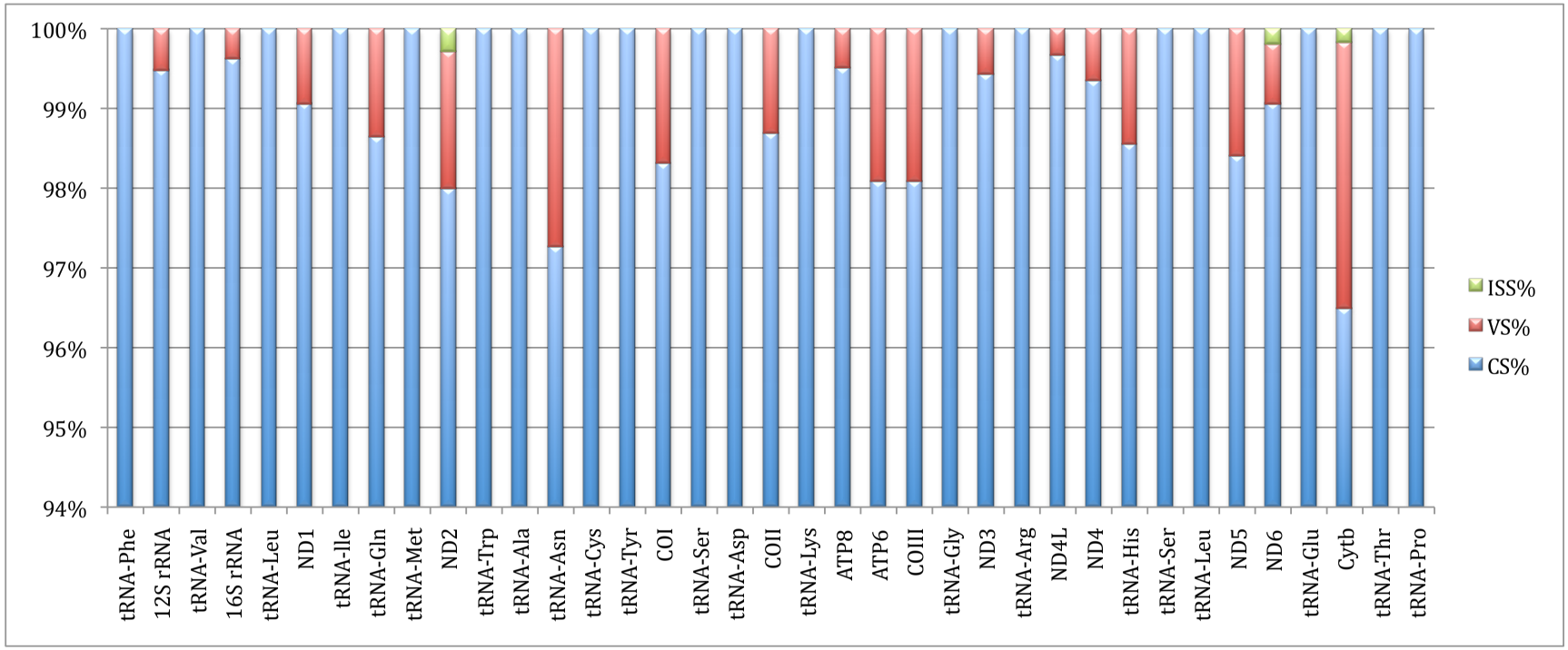


Figure 34: Percentages of sequence variable site (VS), conserved site (CS) and inter-subspecies variable site (ISS) observed from each of the 37 tiger mitochondrial genes. The highest percentage of sequence variable sites was found in the cyt *b* gene (3.33%); high percentages of variable sites were observed in the tRNA^{-Asn} (2.74%), COIII (1.91%), ATP6 (1.91%), and ND2 (1.73%) genes. Almost all the sequences were highly conserved in all the mitochondrial genes; the lowest percentage was as high as 96.6% found in the cyt *b* gene. The inter-tiger subspecies DNA variation were found only in the three mitochondrial genes (ND2, ND6, and cyt *b*).

3.2.5 Phylogeny in tiger subspecies

The phylogenetic relationship among the five extant tiger subspecies (*P. t. tigris, P. t. sumatrae, P. t. altaica, P. t. corbetti, P. t. amoyensis*) was examined based on the entire tiger mitochondrial genomes and for each of the mitochondrial genes individually. The tiger mitochondrial sequences available on GenBank were included in this study. For the tiger phylogenetic analysis based on the entire mitochondrial genome, a total of three tiger complete mitochondrial genomes available on GenBank, two from *P. t. amoyensis* (accession number HM589214-5) and one from an unknown tiger (accession number NC010642), were combined with the new eight tiger mitochondrial genomes. As the phylogenetic structure of tiger subspecies is still debatable and were reconstructed by different mitochondrial fragments using various approaches; therefore, the phylogenetic trees were reconstructed using five commonly used methods – neighbour-joining (a), minimum evolution (b), maximum parsimony (c), UPGMA (d), and Mr.Bayes (e) method – to evaluate the possible genetic relationships between the different subspecies.

According to the tiger phylogenetic analysis based on the entire mitochondrial genomes, the result showed similar topologies reconstructed by the three methods, neighbour-joining, minimum evolution, and UPGMA (Figure 35 a, b, and d). The snow leopard sequence was used to root the tree as this was separated clearly from the tiger species. Eleven individual tiger mitochondrial genomes were grouped into two monophyletic groups with a high bootstrap support. The first group consisted of two Amoy tiger (*P. t. amoyensis*) samples that would have a more distant-recent common ancestor compared to the other tiger subspecies. Another group consisted of mixed individuals from the rest of tiger subspecies, suggesting a low genetic diversity among these subspecies. The Amoy tiger is no longer in the wild since the early 1970's; this could limit a genetic flow between populations of Amoy subspecies and other current wild-living subspecies, resulting in the significant difference in a genetic component of these two monophyletic groups. Based on these data, a first hypothesis in regard to tiger sub-speciation is that the tiger species could be classified into two subspecies, *P. t. amoyensis* and *P. t. tigris* (represented a

group of traditional *P. t. tigris, P. t. sumatrae, P. t. altaica, P. t. corbetti*), based on the entire tiger mitochondrial genome analysis.

However within the mixed tiger subspecies monophyletic group mentioned above, it could be partitioned into two distinct sub-groups of the subspecies *P. t tigris* and *P. t. sumatrae*. Similar to the topology reconstructed by the MP, members of the Amoy tiger (*P. t. amoyensis*) subspecies were clustered together and separated from the other tiger subspecies as the first divergent subspecies; the monophyletic group of *P. t. sumatrae* and *P. t. tigris* was observed as the second and third divergent subspecies respectively; samples from the same subspecies of *P. t. altaica* and *P. t. corbetti* were not clustered together. Based on these results, the second hypothesis is that tiger species can be classified as four subspecies - *P. t. tigris, P. t. sumatrae, P. t. amoyensis*, and a single group combining *P. t. altaica* and *P. t. corbetti*. By considering the MP tree study, the unknown tiger mitochondrial genome obtained from the GenBank was grouped with the sample 'Corbetti 2', suggesting that this GenBank sequence sample was taken from either the subspecies *P. t. corbetti* or *P. t.* altaica, as there is no evidence discriminating these two subspecies based on this study.

The phylogenetic tree reconstructed by Mr.Bayes resulted in monophyletic groups of *P. t. tigris* and mixed individuals from the subspecies *P. t. altaica* or *P. t. corbetti* (Figure 35e). However this tree was not taken into account for the comment on tiger sub-speciation because of two unreliable points. Firstly, two of the *P. t. amoyensis* samples were clustered together with snow leopard sample. Another issue is that each *P. t. sumatrae* samples provided each monophyletic branch, which doesn't correspond to the rest of phylogenetic trees.

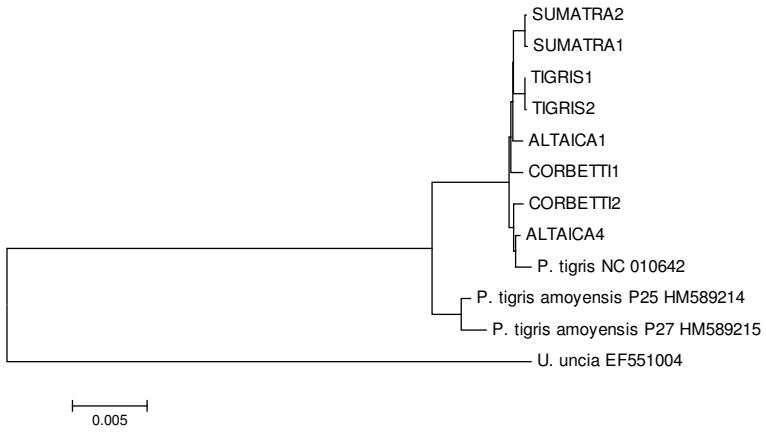
For the tiger phylogenetic analysis based on each mitochondrial gene, the new eight tiger sequences and those available on GenBank were combined for the analysis. Similar to the tiger phylogenetic analysis based on the entire mitochondrial genome, these mitochondrial gene sequences were used to reconstruct phylogenetic trees using five different methods. The examples of

phylogenetic trees reconstructed based on the ND1 gene using the five methods are shown in Figure 36; all phylogenetic trees reconstructed by the 37 mitochondrial genes are shown in Appendix 6. Overall, the trees were constructed using individual mitochondrial genes. These were different from those obtained from the entire mitochondrial genomes, except for the ND2 and cyt *b* gene. With the exception of these two mitochondrial genes, tiger sequences from the same subspecies were not clustered together; they were mixed with other tiger subspecies sequences in the same tree branch. These results showed a low genetic diversity in these mitochondrial regions at which sequence variations occurred in these genes were not sufficiently high to discriminate one subspecies from the others. However the cyt *b* gene provided a monophyletic group containing subspecies *P. t. sumatrae*; this corresponds to the study of Cracraft *et. al.* [19] who reported that *P. t. sumatrae* was the only tiger subspecies showing a genetic distinctness based on the analysis of the complete cyt *b* gene. Similar to the phylogenetic trees reconstructed by the entire mitochondrial genome, the partial sequences of the ND2 gene provided a monophyletic group of the subspecies *P. t. tigris* and *P. t. sumatrae* while the remainder were grouped together. This result suggested that the ND2 gene would be used as a gene representative for the tiger phylogenetic analysis as it provided a similar phylogenetic result to trees reconstructed by the entire mitochondrial genome.

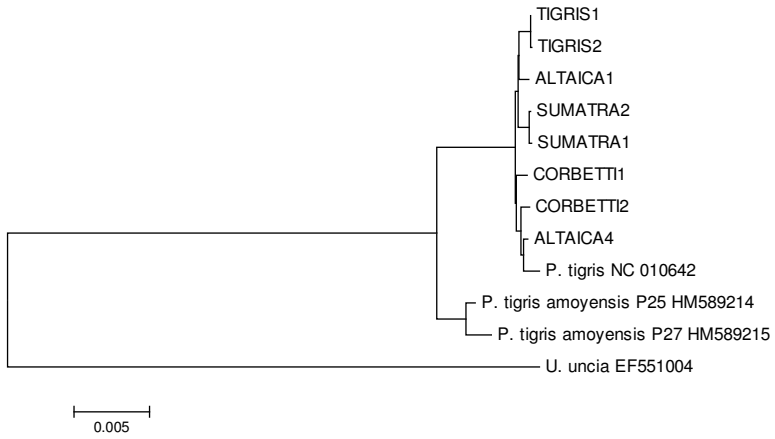
Previous studies have attempted to determine the number of tiger sub-species, with different authors proposing several conclusions [3, 19, 20, 22]; none of these researchers proposed exactly the same conclusion as either one of the two hypotheses proposed in this study. However our results on tiger sub-speciation correspond to the studies of Cracraft *et. al*. [19], Mazak [20], and Kitchener [3] in the point that the extant tiger subspecies genetics are very similar and exhibit low diversity, leading to only a few tiger sub-speciation events. Nonetheless our result did not correspond with the recent publication of Luo *et. al*. [22] in which six extant subspecies of tiger (*P. t. sumatrae, P. t. tigris, P. t. corbetti, P. t. altaica, P. t. amoyensis,* and *P. t. jacksoni*) were proposed based on the analysis of three molecular markers; being 4 kb of mitochondrial DNA, 30 loci composite nuclear microsatellite genotypes, and

allele variation in the nuclear major histocompatibility complex class II DRB gene. As mentioned above, the phylogenetic analysis based on the entire and partial mitochondrial sequenced provided different results. This could explain why our comments on tiger sub-speciation based on the entire mitochondrial genome are different from those of previous reports which were based only on partial mitochondrial sequences. The conclusions raised in this study could lead to a re-consideration in tiger subspecies classification in order to be beneficial for tiger conservation and forensic purpose.

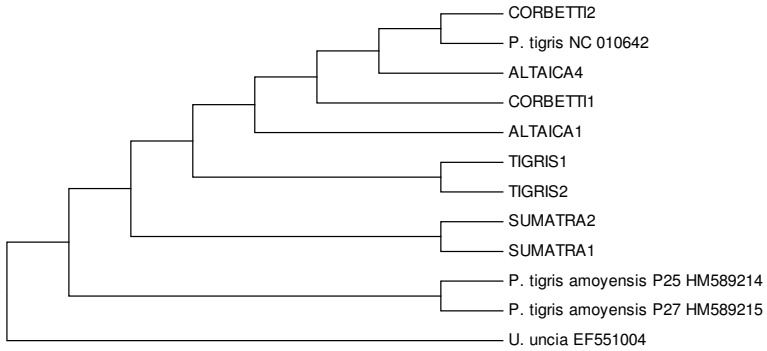
a) Neighbour-joining



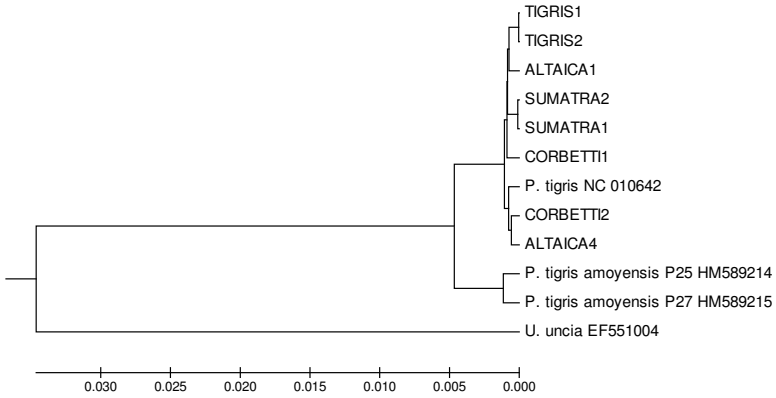
b) Minimum evolution



c) Maximum Parsimony



d) UPGMA



e) Mr.Bayes

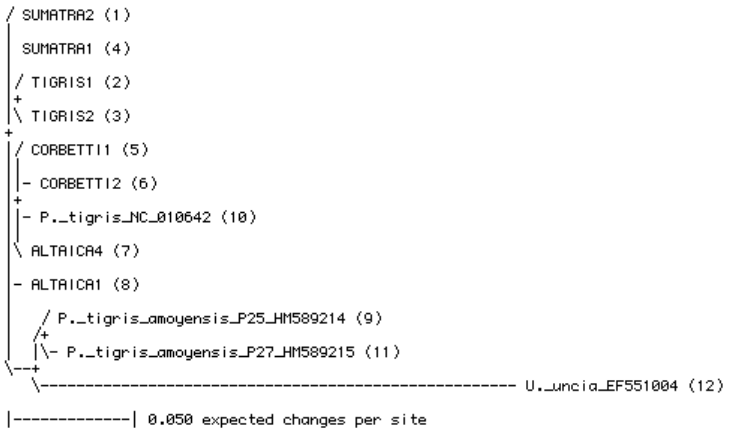
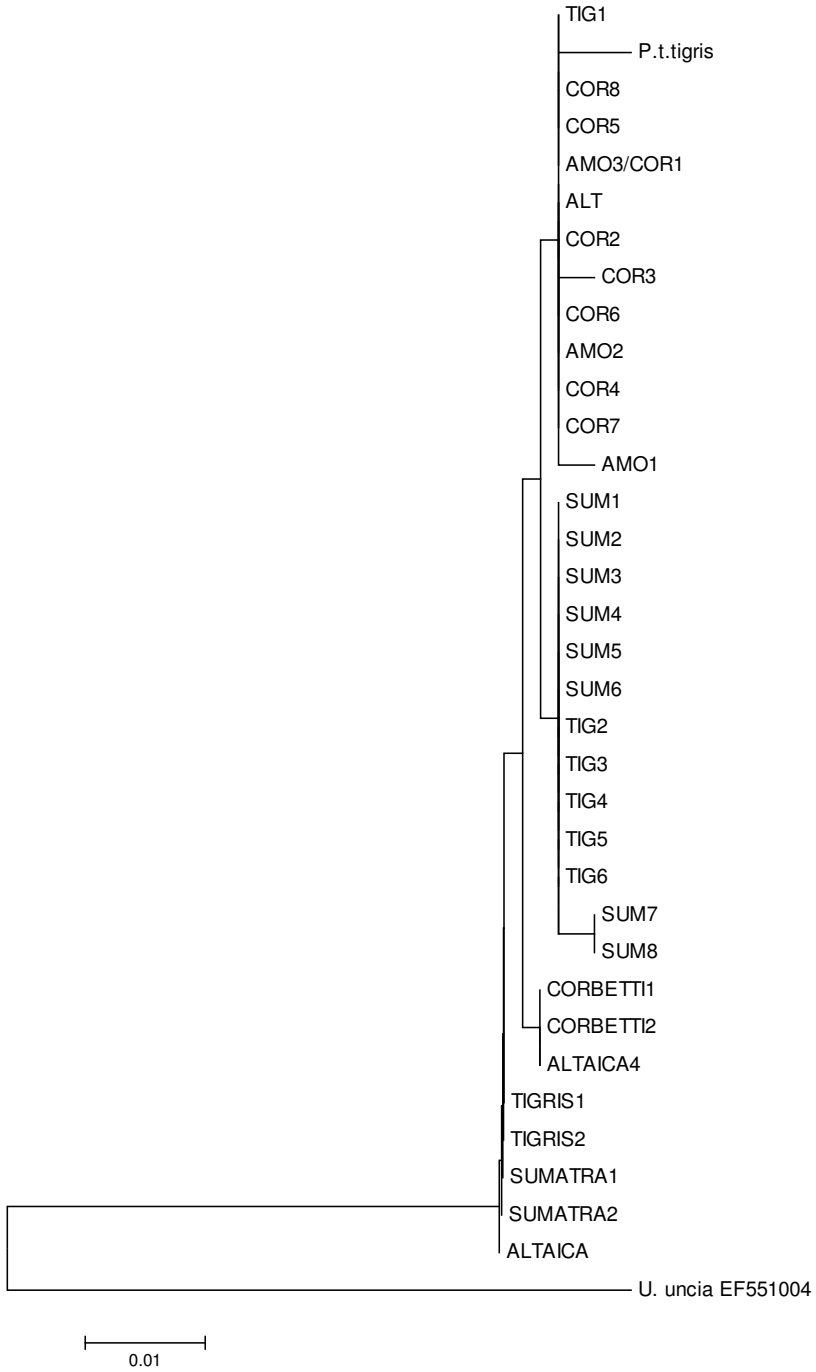
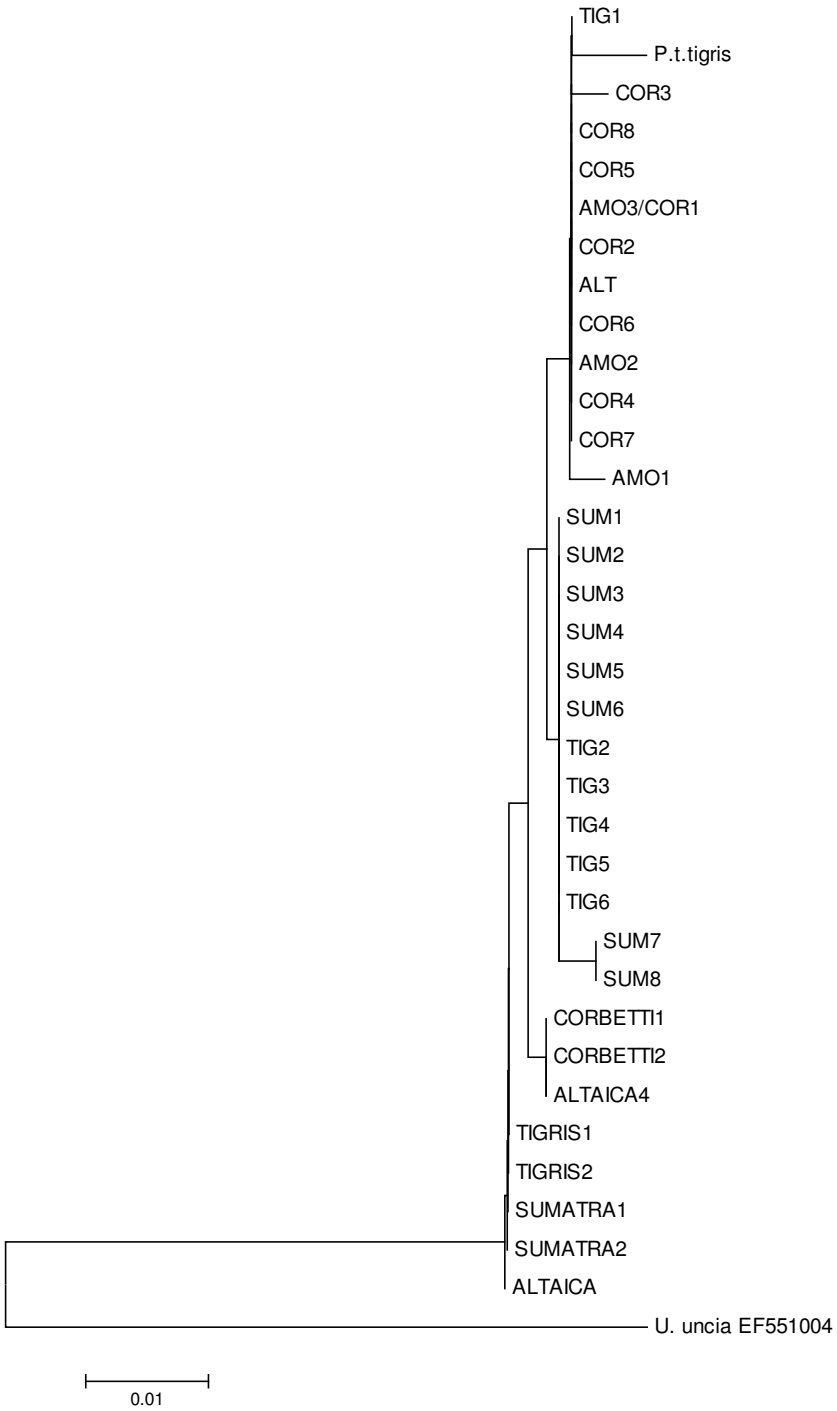


Figure 35: Phylogenetic trees reconstructed using the entire tiger mitochondrial genomes of the five extant tiger subspecies, *P. t. tigris, P. t. sumatrae, P. t. altaica, P. t. corbetti, P. t. amoyensis*, using the five methods: neighbor-joining (a), maximum likelihood (b), parsimony method (c), UPGMA (d), and Mr.Bayes (e). The default phylogenetic parameters were used for all runs. Either bootstrap or interior branch test was set as 500 replicates; 64238 random seed was used to test the reliability of reconstructed phylogenetic trees. A complete deletion option for any gap or missing data, and the Maximum Composite Likelihood Model was used.

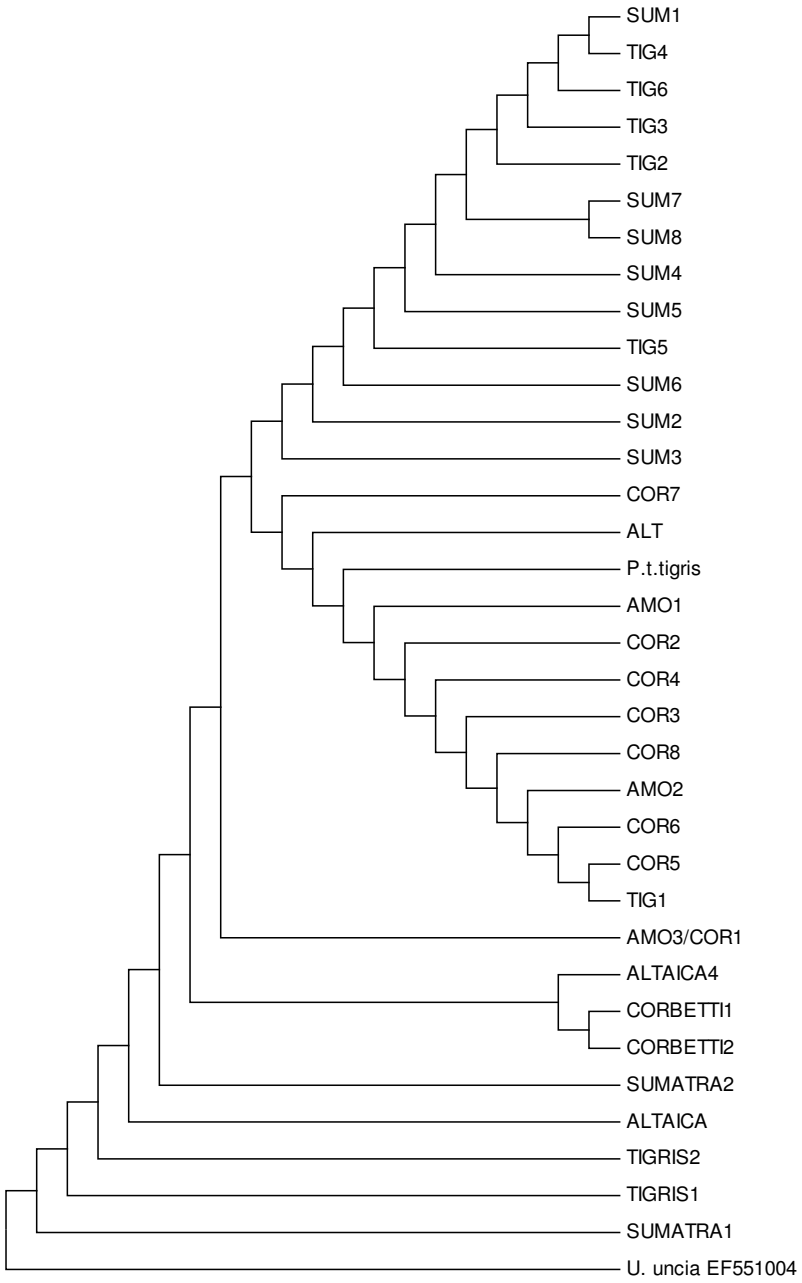
a) ND1_Neighbour-joining



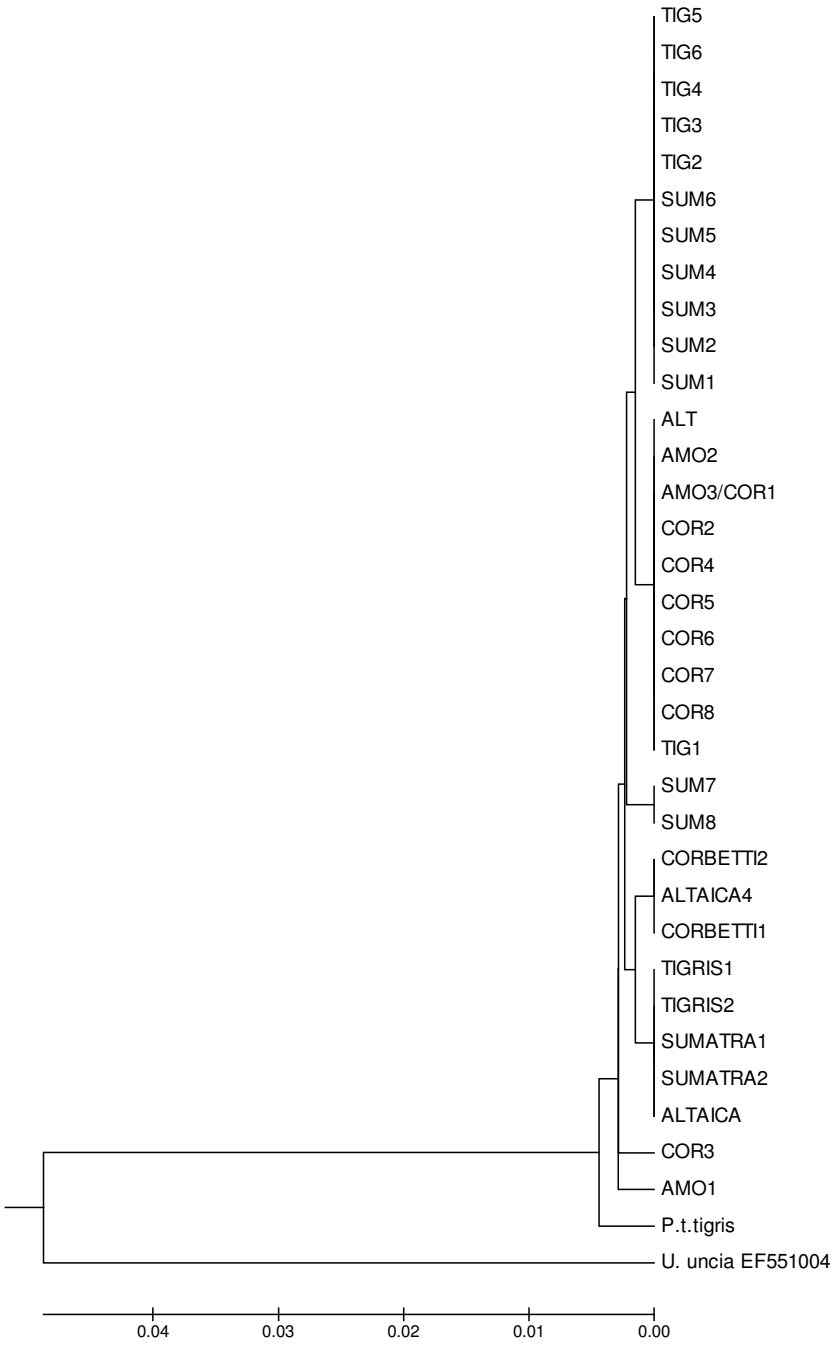
b) ND1_Minimum evolution



c) ND1_Parsimony



d) ND1_UPGMA


TIG5
TIG6
TIG4
TIG3
TIG2
SUM6
SUM5
SUM4
SUM3
SUM2
SUM1
ALT
AMO2
AMO3/COR1
COR2
COR4
COR5
COR6
COR7
COR8
TIG1
SUM7
SUM8
CORBETTI2
ALTAICA4
CORBETTI1
TIGRIS1
TIGRIS2
SUMATRA1
SUMATRA2
ALTAICA
COR3
AMO1
P.t.tigris
U. uncia EF551004
0.04
0.03
0.02
0.01
0.00

e) ND1_Mr.Bayes

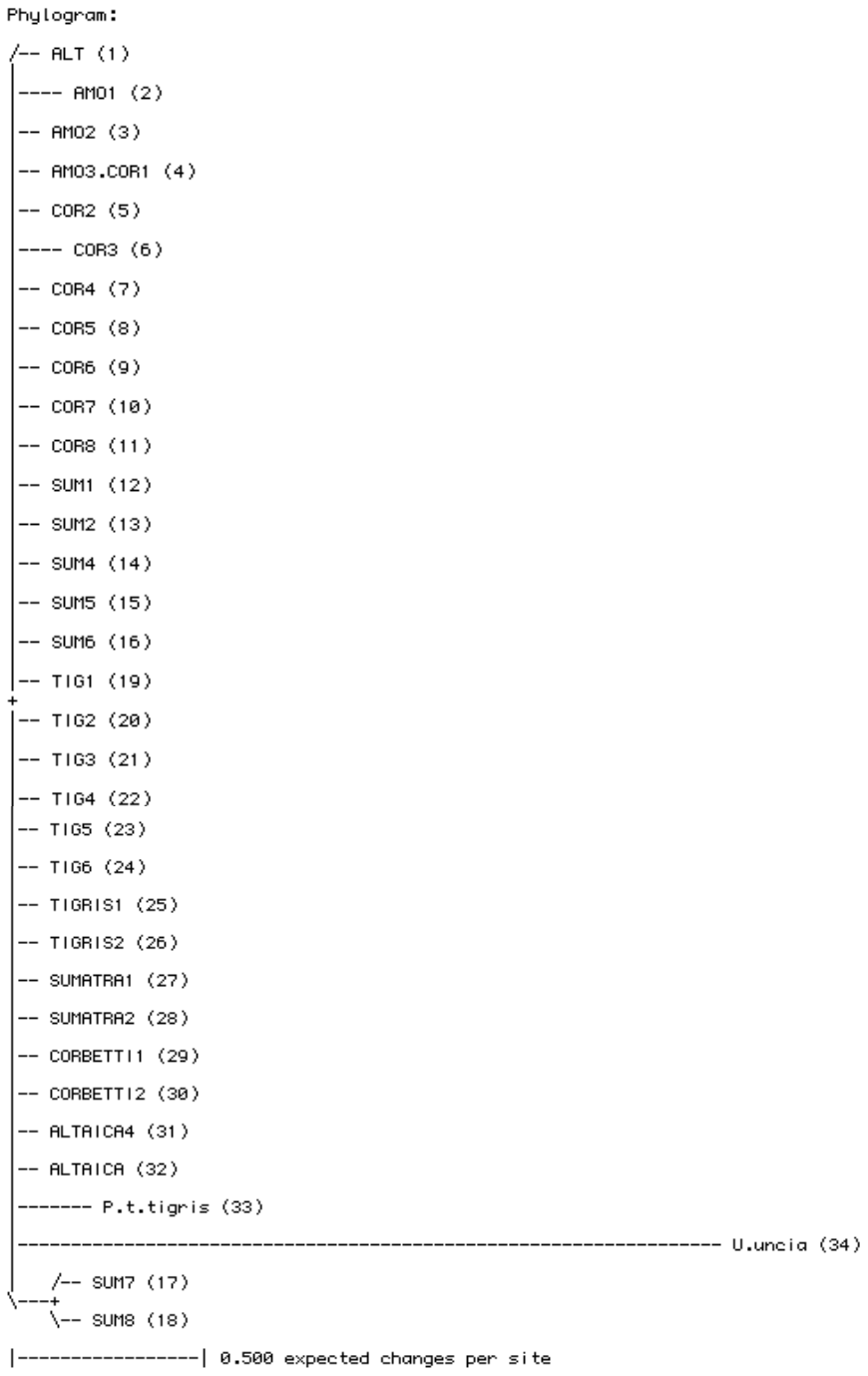


Figure 36: Phylogenetic trees reconstructed using the ND1 gene sequences of the five extant tiger subspecies, *P. t. tigris, P. t. sumatrae, P. t. altaica, P. t. corbetti, P. t. amoyensis*, using the five methods: neighbor-joining (a), maximum likelihood (b), parsimony method (c), UPGMA (d), and Mr.Bayes (e). The default phylogenetic parameters were used for all runs. Either bootstrap or interior branch test was set as 500 replicates; 64238 random seed was used to test the reliability of reconstructed phylogenetic trees. A complete deletion option for any gap or missing data, and the Maximum Composite Likelihood Model was used.

3.3 The development and validation of tiger species- and subspecies-specific SNP identification

3.3.1 Identification of tiger SNPs though the entire mitochondrial genome

3.3.1.1 Tiger subspecies-specific SNP

The aim of this experiment is to develop a DNA test that will unambiguously identify any one of the four extant tiger subspecies (*P. t. tigris, P. t. sumatrae. P. t. altaica, P. t. corbetti*). To achieve this, SNPs shared by all members of the same tiger subspecies but not shared with other member of different subspecies (tiger subspecies-specific SNPs) are required.

From the previous data on DNA sequence variation in tiger, a total of six tiger subspecies-specific SNPs (at the position 5050, 5533, 5608, 14618, 15223, and15743) were identified in three mitochondrial gene loci; these were ND2, ND6, and cyt *b*. Three out of the six SNPs (at the position 5050, 5533, and 14618) are specific to *P. t. tigris* and the rest are specific to *P. t. sumatrae*. SNPs specific to *P. t. altaica* or *P. t. corbetti* could not be identified over the entire mitochondrial genome. All the other SNPs were not found to be inter-subspecies specific or not shared by all members of the same subspecies. The position and location of these SNPs on the mitochondrial genome were assembled and is shown in Table 13.

Table 13: Subspecies-specific SNPs for the tiger, with their position and location on the mitochondrial genome.

mtlocus	**ND2**			**ND6**	**cyt *b***	
Position/17009*	**5050**	**5533**	**5608**	**14618**	**15223**	**15743**
P.t.altaica	C (3)	G (3)	C (3)	C (3)	T (20)	A (17)
P.t.tigris	**T** (29)	**A** (8)	C (8)	**T** (8)	T (10)	A (38)
P.t.sumatrae	C (10)	G (10)	**T** (10)	C (10)	**A** (11)	**G** (19)
P.t.amoy	C (1)	G (1)	C (1)	C (1)	T (1)	A (1)
P.t.corbetti	C (11)	G (12)	C (12)	C (11)	T (38)	A (15)

* The position (bp) was determined by aligning tiger sequences with the *Felis catus* sequence accession number U20753

**The number inside bracket is a number of tiger sequences used for the alignment.

3.3.1.2 Tiger species-specific SNP

Three hundred and forty-nine complete mammalian cyt *b* sequences from 169 mammalian species were aligned using the software Mega 4 with 71 tiger sequences using Mega 4. The reason of this alignment was to search for SNPs that are specific for all tiger subspecies. SNPs that were specific only to tiger species, or rarely present at the same base as tiger in other mammalian species, were then manually identified. A total of five sites were selected as being a potential tiger species-specific SNP haplotype. Four of these SNPs, at positions 1514, 15385, 15391, and 15673, are multi-allelic markers where all nucleotide bases were observed from the aligned sequences. The SNP at position 15268 was a bi-allelic transition as the observed data were either base G or A in all sequences. Even though some mammalian species exhibit the same nucleotide base as the tiger species at one particular SNP, the tiger sequences can be distinguished by the remaining four SNPs. The SNPs and their position on the mitochondrial genome, including the lists of mammalian species providing the same nucleotide base as tiger species for each SNP, are shown in Table 14. The position of all eleven tiger species- and subspecies-specific SNPs is shown on a mitochondrial map (Figure 37).

Table 14: Tiger species-specific SNPs and their position on the mitochondrial genome (bp), including a list of mammalian species with the same nucleotide bases for each SNP. The position was determined by aligning these sequences with the *Felis catus* sequences accession number U20753. The number inside the bracket is the number of sequences showing the same nucleotide base from the same species. Dot (.) represents a nucleotide position showing the same nucleotide base as tiger.

Position/17009*	**15154**	**15268**	**15385**	**15391**	**15673**
Panthera tigris (Tiger)	G (43)	G (44)	G (69)	G (69)	G (70)
Melursus ursinus (Sloth bear)	. (2)	A (2)	C (2)	T (2)	A (2)
Ursus maritimus (Polar bear)	. (1)	A (1)	C (1)	T (1)	A (1)
*Ursus arctos (*Brown bear*)*	. (3)	A (3)	C (3)	T (3)	A (3)
Crossarchus obscurus (Long-nosed cusimanse)	. (2)	A (2)	A (2)	A (2)	A (2)
Panthera onca (Jaguar)	. (2)	A (2)	A (2)	A (2)	A (2)
Panthera onca (Jaguar)	. (1)	A (1)	-	-	-
Ovibos moschatus (Muskox)	C (4)	A (4)	. (4)	T (4)	A (4)
Tremarctos ornatus (Spectacled bear)	. (1)	A (1)	A (1)	T (1)	A (1)
Ailuropoda melanoleuca (Giant panda)	. (3)	A (3)	A (3)	T (3)	A (3)
Marmota caligata (Hoary marmot)	A (3)	A (3)	. (3)	T (3)	C (3)

Position/17009*	15154	15268	15385	15391	15673
Erignathus barbatus (Bearded seal)	C (3)	A (3)	C (3)	C (3)	. (3)
Fossa fossana (Malagasy civet)	A (2)	A (2)	. (2)	T (2)	A (2)
Herpestes naso (Long-nosed mongoose)	A (2)	A (2)	A (2)	C (2)	. (2)
Mungos mungo (Banded mongoose)	A (2)	A (2)	. (2)	C (2)	A (2)
Civettictis civetta (African civet)	C (2)	A (2)	A (2)	A (2)	. (2)
Martes zibellina (Sable)	C (2)	. (2)	T (2)	C (2)	C (2)
Microtus maximowiczii (Maximowicz's vole)	C (1)	A (1)	. (1)	C (1)	T (1)
Microtus arvalis (common vole)	T (2)	A (2)	. (2)	C (2)	C (2)
Lemmus trimucronatus (lemming)	T (1)	A (1)	. (1)	C (1)	C (1)
Crossarchus alexandri (Alexander's cusimanse)	A (1)	A (1)	A (1)	A (1)	. (1)
Prionailurus bengalensis (leopard cat)	A (1)	A (1)	A (1)	. (1)	A (1)
Meles meles (European badger)	C (1)	. (1)	C (1)	C (1)	C (1)
Proteles cristatus (Aardwolf)	C (1)	A (1)	. (1)	A (1)	A (1)
Tapirus indicus (Malayan tapir)	C (1)	A (1)	A (1)	C (1)	. (1)
Cynopterus brachyotis (Lesser short-nosed fruit bat)	C (1)	A (1)	. (1)	C (1)	A (1)
Talpa stankovici (Balkan mole)	C (1)	A (1)	. (1)	A (1)	A (1)
Dasypus novemcinctus (Nine-banded armadillo)	C (1)	A (1)	. (1)	C (1)	. (1)
Mystacina tuberculata (New Zealand lesser short-tailed bat)	C (1)	. (1)	A (1)	C (1)	C (1)
Oryctolagus cuniculus (European rabbit)	. (1)	A (1)	C (1)	C (1)	T (1)
Arctogalidia trivirgata (Small-toothed palm civet)	T (1)	A (1)	. (1)	A (1)	A (1)
Other mammals	A/C/T (281)	A (283)	A/C/T (280)	A/C/T (282)	A/C/T (283)

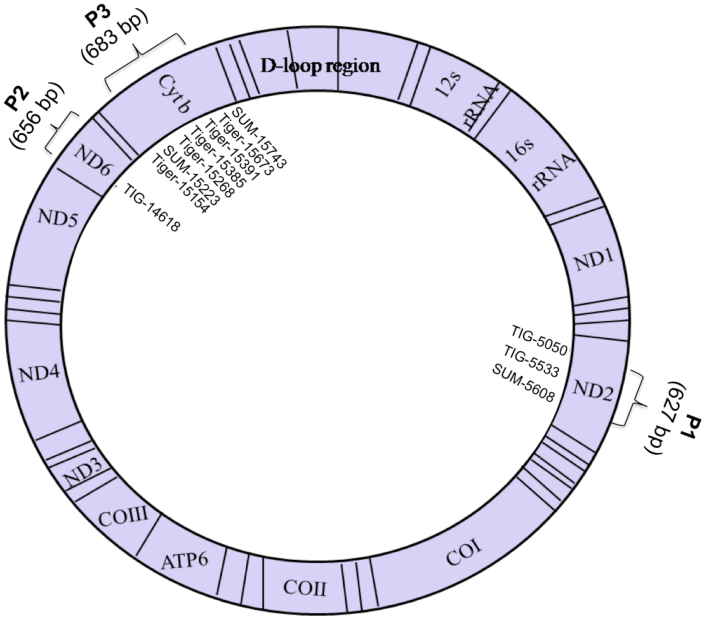


Figure 37: The position of all eleven tiger species and subspecies-specific SNPs on a mitochondrial map. Numbers represent the position of the SNPs on the mitochondrial DNA which are in the ND2, ND6 and cyt *b* genes.

3.3.2 The evaluation of a SNaPshot® assay developed for tiger species and subspecies identification

3.3.2.1 Primers for multiplex SNaPshot® template amplification

Once the tiger species- and subspecies-specific SNPs were identified, three primer pairs (P1, P2, and P3) were designed to amplify the three separate mitochondrial regions that included all these SNPs. These primers were evaluated for their physical parameters, secondary structures, including primer cross reactivity as described in Chapter 2. There was no report of any hairpin formation, 3' complementarity, self-annealing site within the primer, or cross reaction among these primers. The primer sequences and their other details are shown in Table 15 and their location on mitochondrial map is shown in Figure 38.

Table 15: Details of the three primer pairs being designed for SNaPshot® template amplification. These details are primer names, primer directions, primer sequences, melting temperature (T_m), primer sizes, their PCR product sizes, and the optimal primer concentration used in a multiplex SNaPshot® reaction.

Primer pair	Primer name	Direction	Sequences (5'-3')	Tm (°C)	size (bp)	Size of product (bp)	[µM]
1	3FP1	Forward	ACTCAGGACAATGAACCGT	59.54	19	627	0.5
	3RP2	Reverse	TAAGTAGTGCTGTTATGGCTAGTAGTG	60.63	27		
2	17FF	Forward	ATCAACTCCATTAAACGTCTCTT	59.55	23	656	1
	P3R	Reverse	GGAAGATGAGGTTGAGGTTG	61.08	20		
3	Tiger15154	Forward	TTTGGCTCCTTACTAGGGGT	61.38	20	683	0.5
	19NRRR	Reverse	TTGGCGGGGATGTAGTT	61.52	17		

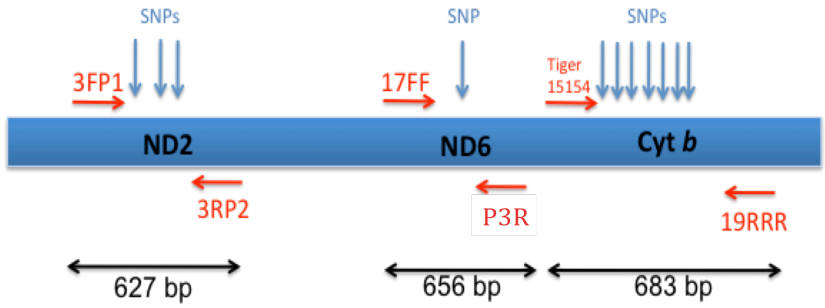


Figure 38: The position of three primer pairs designed for SNaPshot® template amplification on mitochondrial map.

To test the primers, amplifications of DNA from *P. t. sumatrae* using all single primer pairs were performed. The singleplex amplification result showed a single PCR product band at the expected size of approximately 620, 650, and 680 bp for each of the primers P1, P2, and P3 (Figure 39).

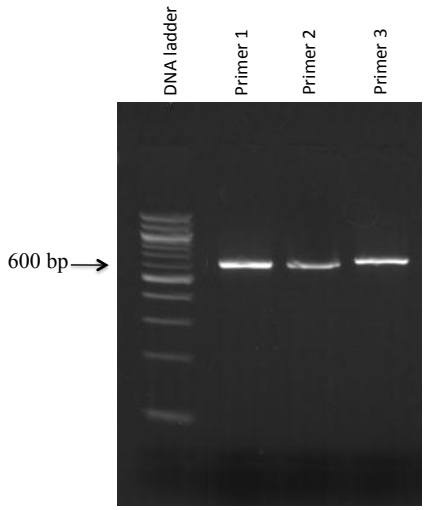


Figure 39: The results of tiger DNA singleplex amplification with primer set P1, P2 and P3. The PCR products (10 µL/well) were separated on a 2% agarose gel and visualized with ethidium bromide staining. Lane 1 is a 100 bp DNA ladder; lane 2,3, and 4 is the PCR products of P1, P2, and P3, respectively.

A multiplex amplification of *P. t. sumatrae*, using the three primer pairs, was then performed. The result was compared to the singleplex amplification result, which had provided the expected PCR product of approximately 627, 656, and 683 bp in size. To increase a higher resolution for PCR product band separation, the multiplex PCR products were separated on a 3% agarose gel, however the PCR product amplified by the primer P2 (primer 17FF and P3R) produced a faint band compared to the other two bands. This could be due to the properties of this primer pair (such as GC content) if it is favoured less in the amplification of the same target compared to the rest of primer pairs, resulting in the preferential amplification in the multiplex reaction [209]. The multiplex primer optimization were then performed by increasing the amount of the primer P2 and decreasing the amount of the primer P1 and P3, carried out in separate reactions. The optimal concentrations for the three primer pairs that provided an equivalent product yield were successfully obtained.

The amplifications of the four tiger subspecies DNA using the three optimal primer concentrations were performed. The result showed that the DNA from all tiger subspecies were amplified successfully and produced the three expected PCR products with an equal intensity. The amplification result of all tiger subspecies is shown in Figure 40.

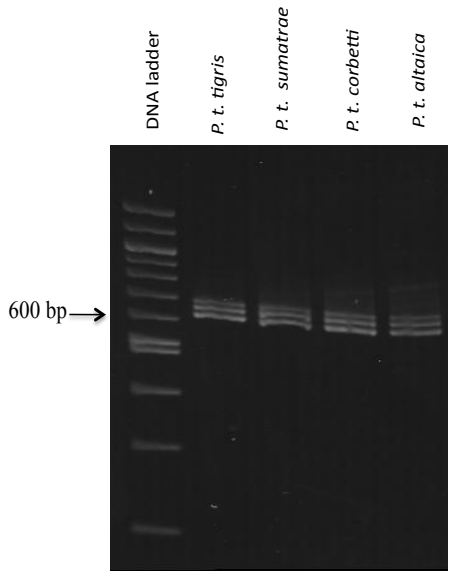


Figure 40: The results of tiger DNA amplification with primer set P1, P2 and P3. The PCR products (20 µL/well) were separated on a 3% agarose gel and visualized with ethidium bromide staining. Lane 1 is a 100 bp DNA ladder; lane 2, 3, and 4 is the PCR products of *P. t. tigris*, *P. t. sumatrae, P. t. corbetti, and P. t. altaica,* respectively.

A total of 15 DNA samples from tiger voucher samples were amplified by the three primer pairs. All these samples were successfully amplified and produced the three expected PCR products as the previous result. The multiplex amplification result of these 15 tiger samples is shown in Figure 41. The multiplex PCR products of these 15 voucher tiger samples were then purified by the gel extraction purification method, following the manufacturer's protocol as described in section 2.2.5.1. The purified multiplex PCR products of these samples were used as a SNaPshot® template in further analysis.

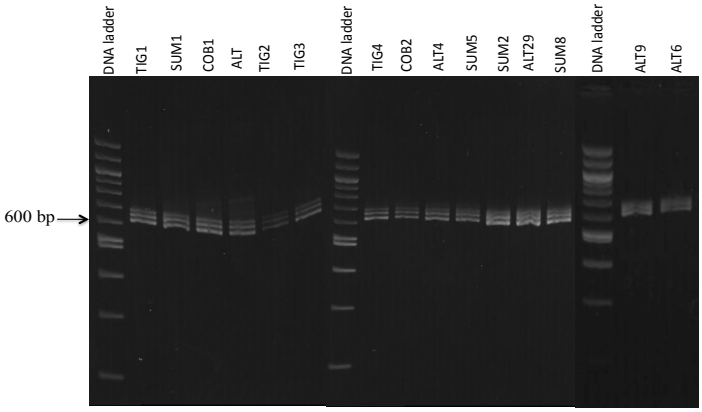


Figure 41: The amplification result of all 15 tiger voucher samples using primer set P1, P2 and P3. The PCR products (20 µL/well) were separated on a 3% agarose gel and visualized with ethidium bromide staining.

SNaPshot® extension primer and multiplex reaction

Eleven extension primers were designed to amplify all eleven tiger species and subspecies-specific SNPs by one base, using the SNaPshot® reaction, using the purified multiplex PCR products as the SNaPshot® template, as described in section 2.4.2. The cross-reactivity among these extension primers was tested by Auto-dimer [210]. The result showed no primer self-compatibility at the score as high as 7, indicating a high potential amplification in a multiplex PCR [210]. This suggested that the multiplex PCR using the three primer pairs would work well. The eleven extension primer sequences and their other details are shown in Table 16. The expected SNPs and their details, nucleotide base, dye colour and fragment sizes, obtained by the amplifications of four tiger subspecies DNA using these extension primers are shown in Table 17.

Table 16: The location, direction and sequence of the SNaPshot® extension primer sequences used in this study. The size in bp and the optimal primer concentration in the SNaPshot® multiplex are also shown. Lower cases denote primer tail sequences.

Position	Strand direction	Single based extension primer sequence (5-3)	Primer size (nucleotides)	[Opt.] (µM)
Tiger-15154	Forward	TTTGGCTCCTTACTAGGGGT	20	0.10
Tiger-15268	Reverse	gaTTGGCATGTAGATATCGGATAAT	25	0.50
Tiger-15385	Reverse	tgactgacTGACCGTAAACAATAGCACAAT	30	0.50
Tiger-15391	Forward	tgactgactgactAAACATGAAATATCGGGATTGT	35	0.20
Tiger-15673	Forward	gactgactgactgactAATAACCCCTCAGGAATGGT	40	0.15
TIG-5050	Forward	actgactgactgactgactAATGAACCGTATCAAAAGACCT	45	0.20
TIG-5533	Forward	actgactgactgactgactgacTATCCTACTGCTAATAATATCTCT	50	0.20
TIG-14618	Reverse	ctgactgactgactgactgactgactgactACCCGCACCATTAAACTTAAA	55	0.30
SUM-5608	Reverse	tgactgactgactgactgactgactgactTGTTATGGCTAGTAGTGTGGGTATTAT	60	0.12
SUM-15223	Forward	tgactgactgactgactgactgactgactgactgactgactACATCAGACACAATAACCGC	65	0.40
SUM-15743	Reverse	actgactgactgactgactgactgactgactgactgactgactGACGAGTAGTRTGAGGGTTAGGA	70	1.00

To test the extension primers, singleplex SNaPshot® amplifications with all single extension primers were performed from the purified SNaPshot® templates of *P. t. sumatrae*. The results showed a single peak for each amplification, shown in Figure 42, indicating that the designed extension primers amplified successfully and specifically to the target SNPs. The expected and observed tiger species and subspecies SNP results for this experiment is shown in Table 17.

Table 17: The expected and observed SNPs results obtained from singleplex SNaPshot® amplifications of *P. t. sumatrae* DNA using all single extension primers.

Tiger subspecies	Tiger 15154		Tiger 15268		Tiger 15385		Tiger 15391		Tiger 15673		TIG 5050		TIG 5533		TIG 14618		SUM 5608		SUM 15223		SUM 15743	
	B	C	B	C	B	C	B	C	B	C	B	C	B	C	B	C	B	C	B	C	B	C
Expected base/color	G		C		C		G		G		C		G		C		A		A		C	
Observed base/color	G		C		C		G		G		C		G		C		A		A		C	
Expected peak size	20		25		30		35		40		45		50		55		60		65		70	
Observed peak size	30.45		32.24		34.13		38.65		44.47		47.63		53.66		57.37		64.25		67.92		74.68	

B is nucleotide base/ C is colour

According to Table 17, the observed nucleotide base and dye colour corresponded to the expected SNP result. It was noted that the observed fragment sizes amplified by the primer Tiger15154 and 15268 were obviously larger in mass than the actual sizes while the rest of primers presented a small shift in the product size. This was most likely due to the influence of the dye attached to the ddNTPs, thus increasing their mass and affecting fragment mobility in the capillary electrophoresis. The other factors causing mobility shift of SNaPshot® products are the nucleotide composition and fragment size; the shorter the fragment size, the greater the impact of the fluorescent dye that occurs [211].

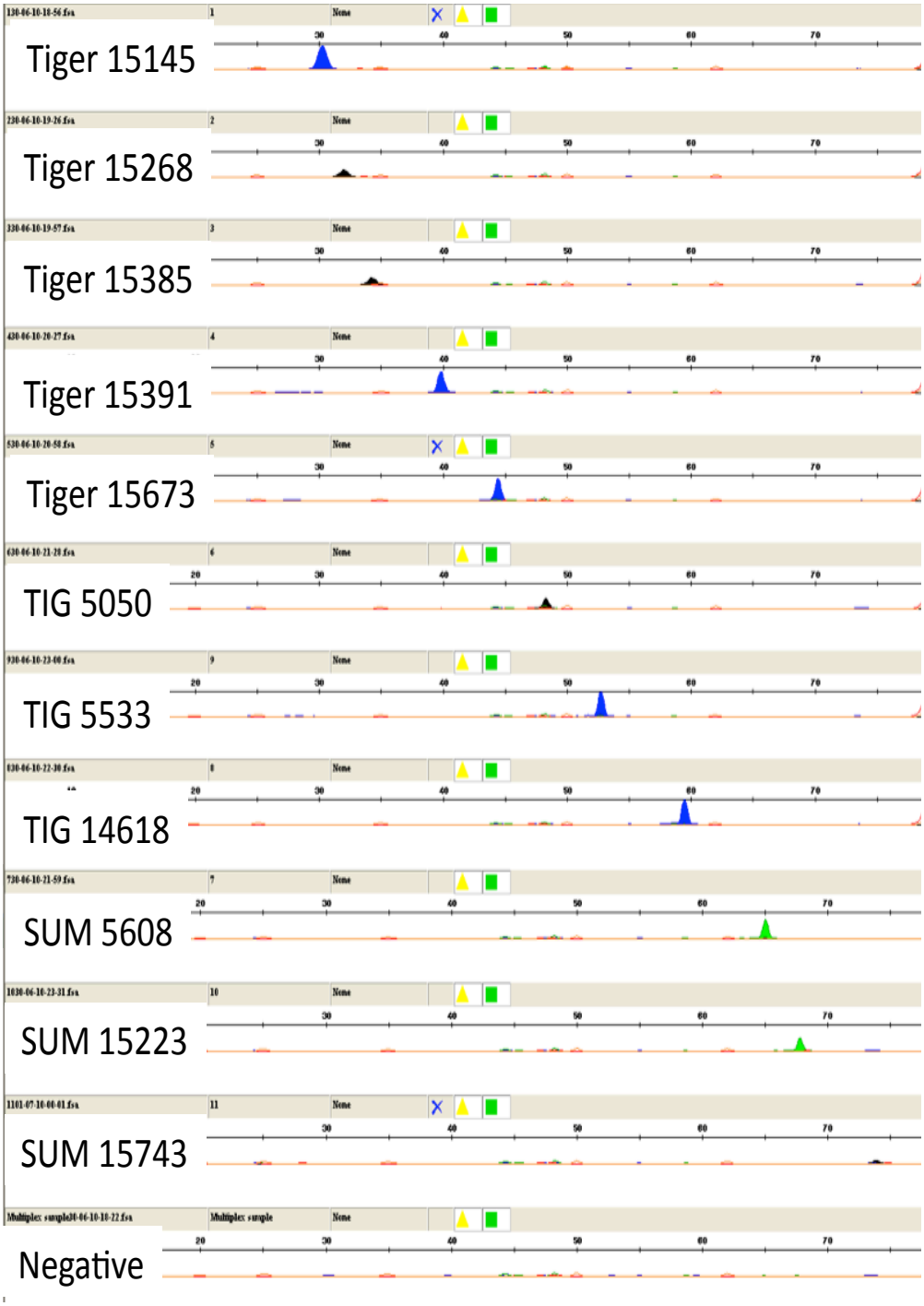


Figure 42: The electropherogram shows singleplex amplification of *P.t.sumatrae* using all single eleven-extension primers.

Multiplex SNaPshot® amplifications using the eleven extension primers were performed from the purified SNaPshot® templates of four tiger subspecies DNA. All eleven SNPs were successfully multiplexed and the expected PCR products were present for DNA samples from all tiger subspecies samples. It was noted that the obtained peak heights of these SNPs were unbalanced (not shown in a figure), indicating different amount of PCR products amplified by the eleven extension primers. This could be due to different amplification efficiencies of these extension primers. Extension primer concentrations were then adjusted as proportional to their SNP peak height. This SNP peak height optimization was successful in creating SNP products of similar amplitude. The optimal extension primer concentrations are shown in Table 16.

Multiplex SNaPshot® amplifications using the optimized primer concentrations was re-performed for four tiger subspecies DNA. The expected nucleotide base, dye colour and fragment sizes for all eleven tiger species- and subspecies-specific SNPs for the four tiger subspecies are shown in Table 18. The SNP typing for four tiger subspecies corresponded to the expected result, as shown in Figure 43. Similar to the singleplex amplification, the observed peak sizes were slightly larger in mass than the actual size for all SNPs; must likely for the reasons explained previously.

As can be seen in Figure 43, the fluorescent signals, or peak height, obtained from the 11 SNP fragments remain slightly different. The highest signal was recorded for SNP SUM-5608 and the lowest signal was found in the SNP Tiger-15391. The fluorescent signal difference among the obtained SNPs might be due to efficiencies of the binding between extension primer and SNaPshot® template. The extension primer SUM-5608 might bind most efficiently to the template, resulting in the highest peak height observed. Conversely, the lowest peak height of the SNP Tiger-15391 may be caused by the poorest efficiency and high competition in binding to the template when compared to the other extension primers. An alternative may be the dye chemistry of the inserted ddNTP. An example is when guanine is labelled with dR100, it normally generates a higher signal than the other ddNTPs [211]. A red dye blob is detected at the smallest fragment size position for all

tiger samples, which is probably due to an incomplete SAP-treatment reaction during the process of post-extension purification [44]. If the SNaPshot® product mixture was inefficiently treated by the SAP reagent, incorporated ddNTPs would not be removed from the solution.

Table 18: The expected SNPs and their nucleotide base, dye colour and fragment sizes obtained by the amplifications of four tiger subspecies DNA using these extension primers.

Tiger subspecies	Tiger 15154		Tiger 15268		Tiger 15385		Tiger 15391		Tiger 15673		TIG 5050		TIG 5533		TIG 14618		SUM 5608		SUM 15223		SUM 15743	
	B	C	B	C	B	C	B	C	B	C	B	C	B	C	B	C	B	C	B	C	B	C
P.t.tigris	G		C		C		G		G		T		A		T		G		T		T	
P.t.sumatrae	G		C		C		G		G		C		G		C		A		A		C	
P.t.corbetti	G		C		C		G		G		C		G		C		G		T		T	
P.t.altaica	G		C		C		G		G		C		G		C		G		T		T	
Expected peak size	20		25		30		35		40		45		50		55		60		65		70	

B is nucleotide base/ C is colour

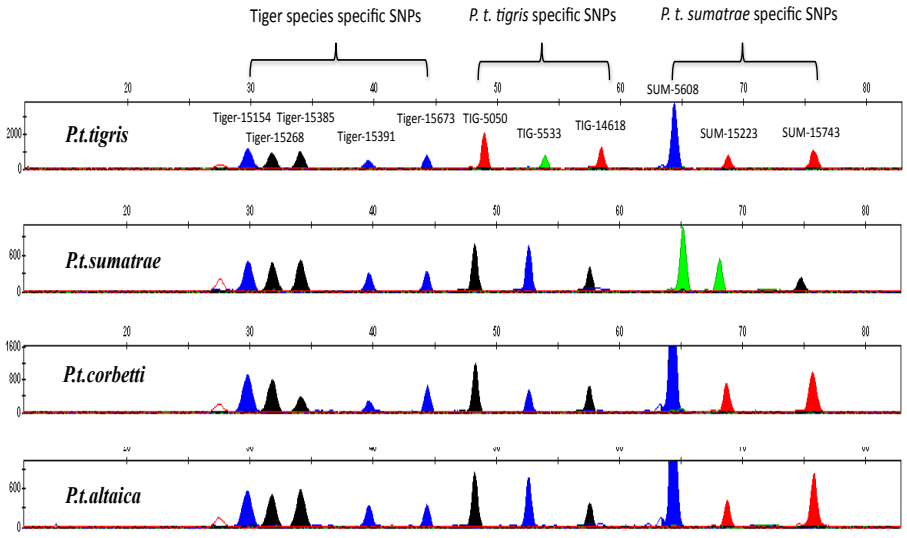


Figure 43: The electropherogram generated by SNP typing of four extant tiger subspecies (*P. t. tigris*, *P. t. sumatrae*, *P. t. corbetti*, and *P. t. altaica*) when analyzed with the SNaPshot® kit developed in this study for tiger species and subspecies identification.

3.3.3 The validation of developed SNaPshot® multiplex assay

3.3.3.1 Accuracy test

The precision of the assay was tested with 15 voucher tiger DNA samples. The result obtained from this SNP multiplex test either from known or unknown *P. t. tigris* can be compared to the data in Table 18. A level of accuracy of 100% was recorded for all 15 samples, as all showed the expected SNP typing as predicted for its reported subspecies. For all single SNPs the observed peak size average, observed range of peak sizes, and standard deviations were calculated and are shown in Table 19. The standard deviations of the observed fragment size are very small, being in the range of 0.18-0.55. These data allow a confident identification of the targeted SNPs when this assay is employed.

Table 19: The statistic calculation for all tiger species- and subspecies-specific SNPs. This was run using 10 tiger voucher samples picked at random. Each tiger sample was used to prepare 10 PCR product aliquots of which all were injected to the capillary electrophoresis.

Parameter	**Tiger 15154**	**Tiger 15268**	**Tiger 15385**	**Tiger 15391**	**Tiger 15673**	**TIG 5050**	**TIG 5533**	**TIG 14618**	**SUM 5608**	**SUM 15223**	**SUM 15743**
Expected peak size	20	25	30	35	40	45	50	55	60	65	70
Observed peak size average (n=10)	30.11	32.04	34.27	39.78	44.52	48.58	53.06	57.87	64.72	68.66	75.54
Observed peak size-range (n=10)	29.53-30.81	31.57-32.66	33.91-34.64	39.51-40.13	44.27-44.87	47.97-49.62	52.22-54.50	57.46-58.83	64.23-65.57	68.04-69.11	73.58-76.23
STD (n=10)	0.39	0.31	0.22	0.19	0.18	0.37	0.55	0.38	0.40	0.31	0.54

Sensitivity test

The sensitivity of the test was determined as the minimum quantity of tiger DNA required to generate a result. To do this, an accurate quantification of tiger DNA sample is needed. The DNA sample of *P. t. corbetti* was quantified following the method described in section 2.4.3.2. The mitochondrial DNA

concentration of this sample was determined to be 2.08 pg/μL; this equates to approximately 120,000 mitochondrial copies/μL.

The sensitivity of the assay was determined by preparing five DNA concentrations from a two-fold serial dilution containing quantified tiger DNA. The starting concentration was approximately 120,000 mitochondrial copies so the five concentrations used in this study were 120,000, 60,000, 30,000, 15,000, and 7,500 copies. A SNP test was performed on each dilution. The result showed that full SNP profiles could be obtained from the sample containing at least 15,000 copies of mitochondrial DNA. This amount of mitochondrial DNA equates to 0.26 pg, indicating that the test will work on trace amounts of tissue or hair samples. The electropherogram for the sensitivity test is shown in Figure 44. The PCR product amplified from this sample was also the lowest concentration observed on the agarose gel when stained with ethidium bromide, as shown in Figure 45. The presence of an amplification product acted as a rapid screening test to indicate the potential success in obtaining a full SNP profile.

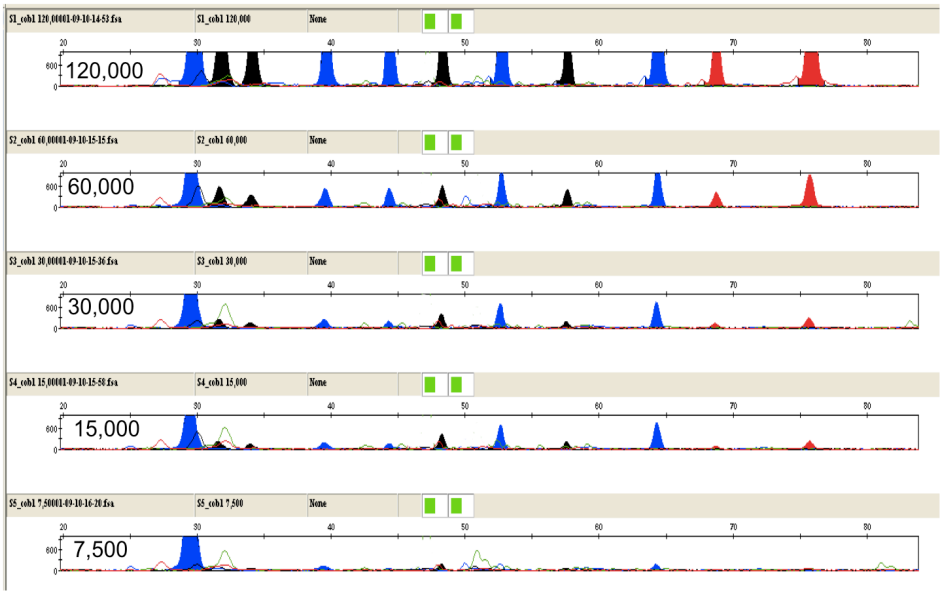


Figure 44: The electropherogram shows SNP typing of *P. t. corbetti* at the concentration of 120,000, 60,000, 30,000, 15,000, and 7,500 mitochondrial copies. A product can be seen at all dilutions down to 15,000 mitochondrial copies. No product was recorded from 7,000 mitochondrial copies.

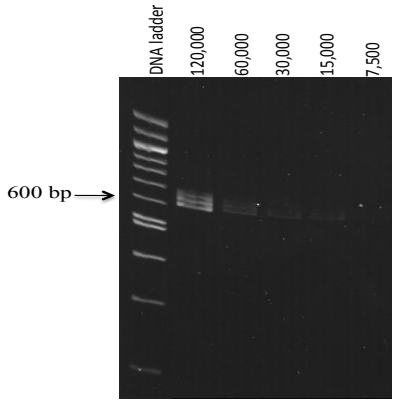


Figure 45: The amplification result of *P. t. corbetti* at the concentration 120,000, 60,000, 30,000, 15,000, and 7,500 mitochondrial copies. The PCR products (20 µL/well) were separated on a 3% agarose gel and visualized with ethidium bromide staining. A product can be seen in the lane of 15,000 copies but not visible when loading 7,500 copies.

3.3.3.2 Specificity test

One tiger and fourteen other mammalian samples, including one species closely related *Panthera* species, were tested to determine the specificity of the assay. Details of the fourteen mammalian samples (such as scientific name, common name, type of sample, and where they were obtained from) are shown in Table 20.

Table 20: The details of 14 mammalian samples used in the specificity test, including: scientific name, common name, type of sample, and where they were obtained from.

No.	Scientific name	Common name	Type of samples	From where they were obtained
1	*Acinoyx jubatus*	Cheetah	Tissue	NMS
2	*Panthera onca*	Jaguar	Tissue	NMS
3	*Panthera leo*	Lion	Tissue	NMS
4	*Panthera pardus*	Snow leopard	Tissue	NMS
5	*Neofelis nebulosa*	Clouded leopard	Tissue	NMS
6	*Puma concolor*	Puma	Tissue	NMS
7	*Felis catus*	Domestic cat	Hair	PD
8	*Ursus thibetanus*	Bear	Hair	EZ
9	*Equus caballus*	Horse	Hair	EZ
10	*Cervus nippon*	Sika deer	Hair	EZ
11	*Canis familiaris*	Domestic dog	Hair	PD
12	*Bos taurus*	Cow	Tissue	PD
13	*Capra hircus*	Goat	Tissue	PD
14	*Homo sapiens*	Human	Buccal swab	PD

* NMS is abbreviated from the national museum of Scotland; EZ is abbreviated from the Edinburgh zoo; PD is abbreviated from personal donation.

A full SNP profile was retrieved only for the sample from *P. tigris*, as shown in Figure 46. This indicates that the developed assay is specific for tiger species and subspecies identification. However DNA from other cat species were also amplified successfully by the three primer pairs, including cheetah, jaguar, lion, leopard, snow leopard, clouded leopard, puma and domestic cat. But none of which produced products at the same positions as tiger SNPs, demonstrating that this new SNP test has the potential to identify other big cat species. All three expected multiplex PCR fragments were generated by the tiger sample as predicted. The band patterns and the intensities obtained for the cat species were different to those for the tiger samples as shown in Figure 47.

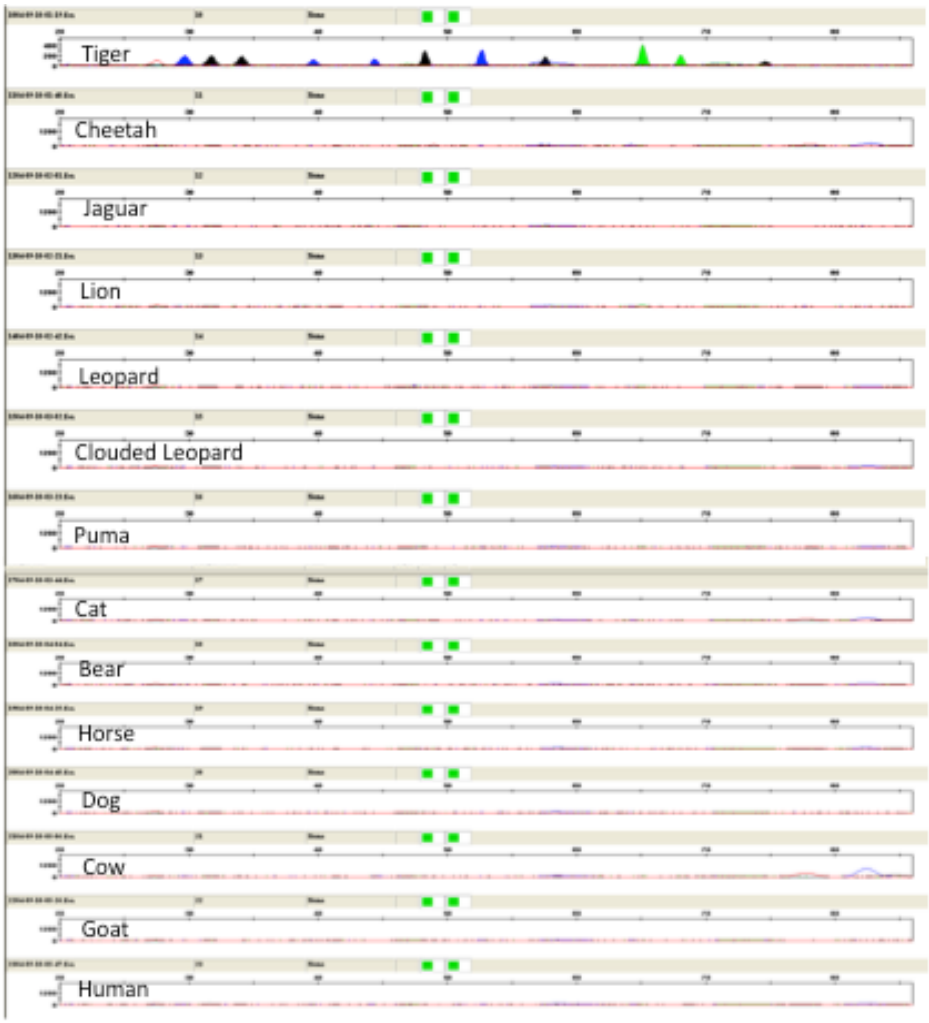


Figure 46: The electropherogram shows SNP typing of tiger and 14 other mammalian species when analyzed with the single SNaPshot® kit developed in this study for tiger species and subspecies identification. The expected product can be seen only in the tiger species.

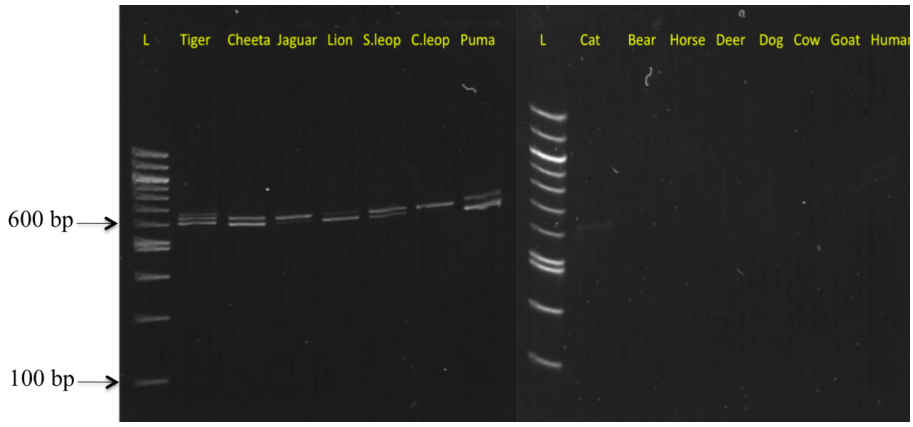


Figure 47: The specificity test for the SNaPshot® multiplex assay for tiger species and subspecies identification. Lane 1 and 9 is a 100 bp DNA ladder (100 bp is the smallest fragment shown); lane 2 is tiger (*Panthera tigris*); lane 3 is cheetah (*Acinoyx jubatus*); lane 4 is jaguar (*Panthera onca*); lane 5 is lion (*Panthera leo*); lane 6 is snow leopard (*Panthera pardus*); lane 7 is clouded leopard (*Neofelis nebulosa*); lane 8 is puma (*Puma concolor*); lane 10 is domestic cat (*Felis catus*); lane 11 is bear (*Ursus thibetanus*); lane 12 is horse (*Equus caballus*); lane 13 is sika deer (*Cervus nippon*); lane 14 is domestic dog (*Canis familiaris*); lane 15 is cow (*Bos taurus*); lane 16 is goat (*Capra hircus*); and lane 17 is human (*Homo sapiens*). The PCR products (10 µL/well) were separated on a 3% agarose gel and visualized with ethidium bromide staining.

3.3.3.3 Blind-trial test

Random single blind trials were performed to examine the SNaPshot® multiplex effectiveness of the assay. Ten DNA samples from tiger or other mammalian species reference samples previously kept were picked at random by a volunteer and amplified by the multiplex primers being specific to *Panthera* species and run on a 3% agarose gel. Seven out of ten samples (sample numbers 2, 3, 4, 5, 6, 8, 10) were amplified successfully and produced fragments in a range of approximately 600 bp -700 bp, as shown in Figure 48. However only sample number 2 and 6 provided a high intensity PCR band. The three samples (number 1, 7, and 9) that were not successfully amplified were identified as samples from other mammalian species, none of which were tiger nor another big cat species. The seven samples that were amplified successfully were then analyzed by the SNaPshot® multiplex assay. Of these samples, five generated full SNP typing as predicted (Figure 49) if they were one of the tiger subspecies; this was later confirmed. The samples that showed no SNP peaks were later identified as a big cat species, other than tiger; again as predicted by the SNP testing. The blind-trial results for all samples revealed 100% accuracy for these 10 samples, when categorizing unknown samples into one of the three categorizes; tiger, other big cat, and

other mammalian species; as shown in Table 21. This suggests that the developed assay is practical to employ in a real forensic wildlife crime investigation; a reliable and accurate identification result will be obtained using the assay.

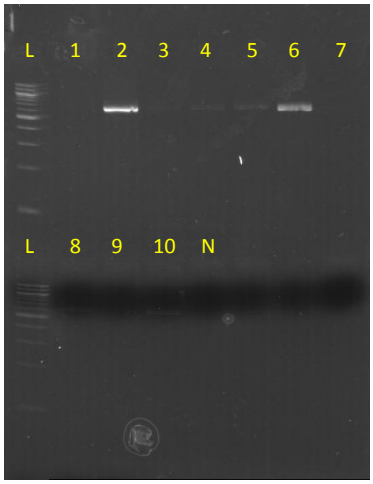


Figure 48: The amplification result of ten blind samples. The PCR products (20 µL/well) were separated on a 3% agarose gel and visualized with ethidium bromide staining.

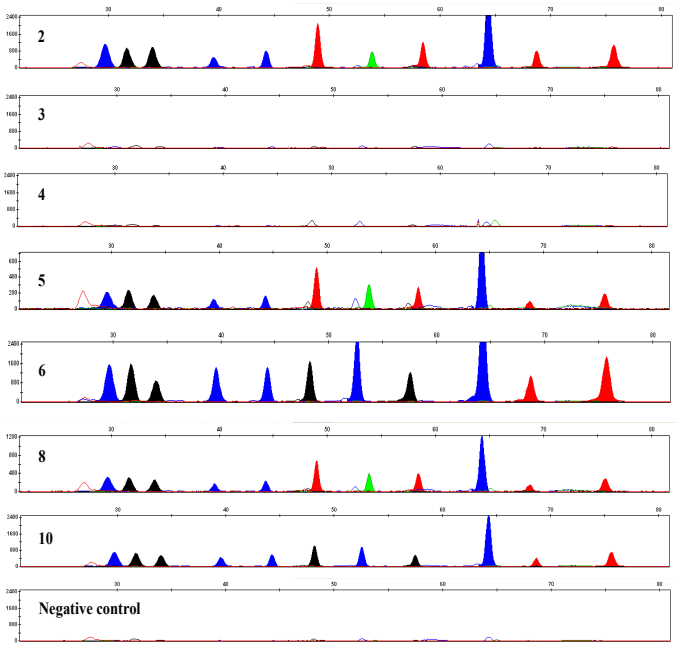


Figure 49: The electropherogram showing SNP typing of ten blind samples when analyzed with the single SNaPshot® kit developed in this study for tiger species and subspecies identification. Sample 2, 5, 6, 8, and 10 were identified as being from a tiger sample. Sample 3, 4 were identified as being from a big cat samples.

Table 21: The result of blind trial testing in 10 DNA samples picked at random.

Sample no. / Result	1	2	3	4	5	6	7	8	9	10
Observed result	Other	Tiger *P.t.tigris*	Big cat	Big cat	Tiger *P.t.tigris*	Tiger *P.t.corbetti*	Other	Tiger *P.t.tigris*	Other	Tiger *P.t.altaica*
DNA source	Sheep	Tiger *P.t.tigris*	Jaguar	Puma	Tiger *P.t.tigris*	Tiger *P.t.corbetti*	Horse	Tiger *P.t.tigris*	Fox	Tiger *P.t.altaica*
Correct	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

3.3.4 Unknown tiger sample identification

A total of 4 unknown tiger samples were analyzed by the developed assay. All these tiger DNA samples were successfully amplified and produced the expected PCR product sizes in the range of 600 bp -700 bp. The amplification result is shown in Figure 50. A full SNP profiles were also retrieved from all samples, which showed the same SNP typing as a reported subspecies of *P. t. corbetti* and *P. t. altaica* (Figure 51).

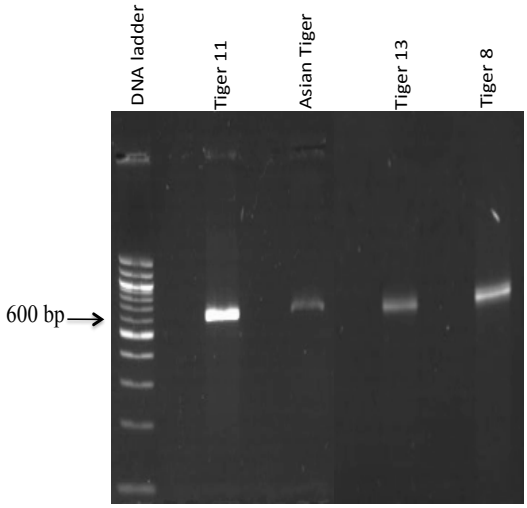


Figure 50: The amplification result four unknown tiger subspecies samples. The PCR products (20 µL/well) were separated on a 3% agarose gel and visualized with ethidium bromide staining.

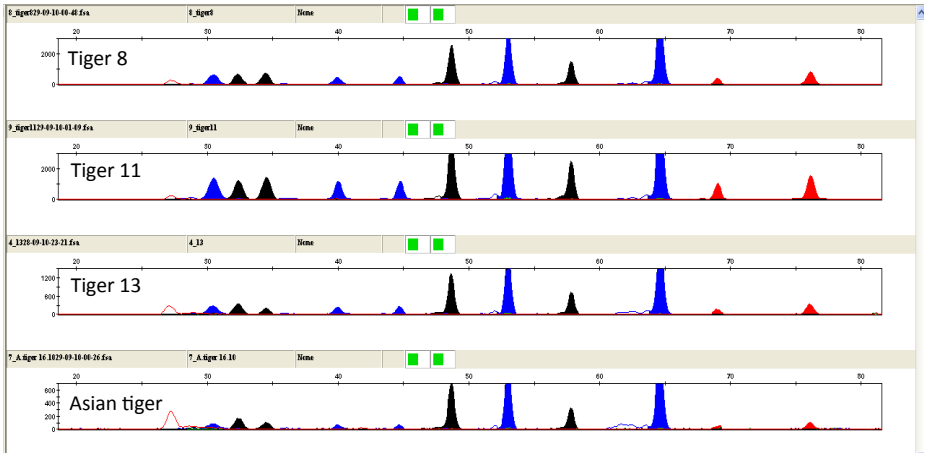


Figure 51: The electropherogram shows SNP typing of four unknown tiger subspecies samples when analyzed with the single SNaPshot® kit developed in this study for tiger species and subspecies identification.

4 Conclusions

4.1 Novel scientific data derived from this thesis

There were two main aspects to this study of *Panthera tigris* subspecies as part of forensic science investigations. The aim from the outset was to develop a species and subspecies specific DNA-based test to identify tiger from trace amounts and in complex mixtures containing other biological material. A consequence of identifying subspecies specific DNA sequence was likely to be an opportunity to comment on the phylogenetics of this species. At the start of the project little DNA sequence data was available on GenBank which could be used to develop subspecies specific tests. What DNA sequences were available were partial DNA sequences of the cyt *b* and COI genes but little else. The first part of the project was therefore to sequence in full the mitochondrial genomes of members of the tiger subspecies. This initially depended on obtaining voucher specimens. From the National Museum Scotland (NMS) in Edinburgh, and Belfast and Isle of Wight Zoos in the UK, samples of known subspecies were provided for the four extant tiger subspecies, *Panthera tigris tigris*, *Panthera tigris sumatrae*, *Panthera tigris corbetti, and Panthera tigris altaica*. Muscle samples were provided by the NMS and hair samples from the zoos. From these samples two members of each of the four extant subspecies were identified and their complete mitochondrial genomes decoded.

The outcome of sequencing eight tiger mitochondrial genomes was that it was possible to 1) examine the tiger mitochondrial genome characterization; 2) identify intra subspecies variation although this was only based on two samples; 3) identify inter subspecies variation between the four extant subspecies from which a SNP test could be developed; 4) identify variation at each of the 37 genes; and 5) reconstruct tiger subspecies phylogenies based on mitochondrial DNA to determine whether this genetic data supports conflicting hypotheses for the number of subspecies.

4.2 Recent technological developments

The DNA sequences have been successfully registered with GenBank. At the time of writing there remain only three other individual complete mitochondrial sequences from any tiger subspecies. Further, in some cases it is not clear from which subspecies the DNA data were derived.

All the sequencing performed in this thesis was by Sanger sequencing using standard fluorescent dyes. During the course of this thesis mass parallel sequencing techniques such as 454 DNA sequencing became more available and affordable [212]. There is little doubt that this novel technology has very many advantages and would have reduced the time required to make 26 primer sets and sequence separately each amplicon. Conversely it is worth noting that the technology used in this thesis allowed accurate base calling, particularly when ambiguities were encountered with possible heteroplasmy (see Chapter 3.2.1), and more importantly there were no issues with putative identification of mitochondrial pseudogenes. The problem of pseudogene detection when sequencing mitochondrial genomes has been noted in other felids [25, 152].

4.3 Whole mitochondrial versus single mitochondrial genes

Much of the mitochondrial genome of other mammalian species is highly conserved; this is particularly the case for the tRNA and rRNA genes. It may have been logical to have focused on the key mitochondrial genes used in taxonomy and species identification; being cyt *b* and COI. However much was gained by sequencing the entire mitochondrial genomes, particularly for large scale phylogenetic analysis to compare the effect of using the entire genome compared to individual genes; this was evident in Chapter 3.2.5. Comparison of the entire coding region of the mitochondrial genomes only highlighted the large scale conservation of sequence between all the subspecies. Additionally it was only by sequencing ND6 that additional inter subspecies SNPs were discovered.

4.4 Analysis of the entire tiger mitochondrial genome and tiger subspecies phylogeny

For the first time there has been a detailed examination nucleotide compositional pattern, codon usage and DNA sequence variations. Similarities were observed with other felidae and mammalian species. This aspect of the thesis has been submitted for publication and a copy of the submission can be seen in Appendix 1.

The phylogenetics of tigers remains a contentious issue with models based on sections of genes, a combination of mitochondrial genes and nuclear loci. This has led to a number of models with the latest model suggesting that there are six distinct subspecies [22]. This thesis has added to this debate by comparing the entire mitochondrial sequences of these four tiger subspecies to each other, to other *Panthera tigris* sequences and to the DNA sequences of other *Panthera* species. The main conclusion from this work is that there is extensive sequence conservation between the four extant subspecies, that there is greater intra subspecies variation than inter subspecies variation at many mitochondrial loci, and that in most phylogenetic models the four extant subspecies show separation to *P. t. amoyensis*. The data using all the mitochondrial loci does not support the concept of six distinct subspecies [22] rather the data supports the concept of two subspecies.

This conclusion, if supported by others in the field of tiger conservation has a major impact on breeding programs. A previous report [213] showed that the extinct Caspian tiger (*Panthera tigris virgata*) had greater genetic similarity to the Siberian tiger and if habitat became available any reintroduction should come from this extant subspecies. This datum shows that the Siberian tiger shows genetic similarity with other subspecies and hence reintroduction might be possible from other remaining subspecies. There is a major problem with this in that the morphology of the Sumatran tiger is hardly adapted to the Siberian winter for instance and hence this type of movement of individual animals to assist with gene flow is unlikely to be successful.

It should be noted that in other endangered big cats there have been experiments to assist with gene flow and reintroduction. The most recent being the North American Panther where there were previously two subspecies living in Texas and in Florida [214]. These two putative subspecies were kept separate to respect the taxonomic distinction but recent genetic analysis has shown that they exhibit no separation; this has allowed the capture of individuals in Texas to be released into the Florida Everglades.

4.5 The development and validation of tiger species- and subspecies-specific SNP identification

The eleven tiger species- and subspecies-specific SNPs, spanning the entire tiger mitochondrial genome were validated and used to develop a single SNaPshot® multiplex assay for tiger species and subspecies identification [215]. This assay was shown to be reliable, accurate, specific, sensitive and robust which is useful in forensic applications as it is able to detect and identify tiger species and subspecies in trace or degraded biological evidence.

The benefit of this test is that it is developed only to detect genetic variation that has been identified as part of this study. It is standard otherwise in species testing to amplify and sequence a section of the mitochondrial genome such as part of COI of the cyt *b* gene, however this work has shown that this type of test would identify much redundant and conserved sequence if the aim is to identify the subspecies present. The sensitivity of the test is comparable or greater than other tests [99] and as the primers have been published it is anticipated that the test will be adopted by those enforcing legislation protecting tigers.

A disadvantage of the test is that is it based on mitochondrial loci only and hence there will always be the issue with hybrids. This issue should not be relevant for wild species as by definition these subspecies are supposed to be from different populations that do not have overlapping geographical ranges.

4.6 Future work

It is anticipated that this research will continue while the plight of tigers remains so critical. There are a number of follow on projects that should be considered.

With respect to the SNP multiplex this test should be conducted on traditional medicines shown previously to contain tiger DNA, to further validate the use of the test. It may require spiking the medicine samples with known amounts of DNA first to demonstrate the sensitivity of the tests. It may be that the original primer sets are redesigned to make shorter amplicons, thus allowing more degraded DNA to be detected. Further *Panthera* species and other CITES listed species may be added to the multiplex if need dictates.

Two complete mitochondrial genomes from members of each of the four extant subspecies were sequenced. To discover more comprehensively intra subspecies variation it would be valuable to sequence an additional two members of each subspecies. Additionally much more information on tiger evolution will be gained from sequencing the mitochondrial genomes of the three recently extinct tigers; the Javan, Balinese and Caspian.

If this research assists in the conservation of *Panthera tigris sp*. in any way at all then it would be a success.

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6 Appendix

6.1 Appendix 1: Publications for this thesis are shown below.

6.1.1 Research article on the title of 'The development and validation for tiger species and subspecies identification-implication for forensic purposes' published in the Journal of Forensic Science International: Genetics in July 2011.

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The development and validation of a single SNaPshot multiplex for tiger species and subspecies identification—Implications for forensic purposes

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ABSTRACT

The tiger (*Panthera tigris*) is currently listed on Appendix I of the Convention on the International Trade in Endangered Species of Wild Fauna and Flora; this affords it the highest level of international protection. To aid in the investigation of alleged illegal trade in tiger body parts and derivatives, molecular approaches have been developed to identify biological material as being of tiger in origin. Some countries also require knowledge of the exact tiger subspecies present in order to prosecute anyone alleged to be trading in tiger products. In this study we aimed to develop and validate a reliable single assay to identify tiger species and subspecies simultaneously; this test is based on identification of single nucleotide polymorphisms (SNPs) within the tiger mitochondrial genome. The mitochondrial DNA sequence from four of the five extant putative tiger subspecies that currently exist in the wild were obtained and combined with DNA sequence data from 492 tiger and 349 other mammalian species available on GenBank. From the sequence data a total of 11 SNP loci were identified as suitable for further analyses. Five SNPs were species-specific for tiger and six amplify one of the tiger subspecies-specific SNPs, three of which were specific to *P. t. sumatrae* and the other three were specific to *P. t. tigris*. The multiplex assay was able to reliably identify 15 voucher tiger samples. The sensitivity of the test was 15,000 mitochondrial DNA copies (approximately 0.26 pg), indicating that it will work on trace amounts of tissue, bone or hair samples. This simple test will add to the DNA-based methods currently being used to identify the presence of tiger within mixed samples.

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1. Introduction

Tigers once had a widespread geographical distribution, including southern and eastern Asia, ranging as far north as the Russian Far East to as far south as the Sunda Islands [1,2], and had an estimated population size of 100,000 in 1900 [2,3]. Owing to habitat loss and hunting/poaching, tiger populations are presently only a fraction of their previous size; recent estimates suggest there are only approximately 3200 wild tigers [4–8]. Up to nine subspecies of tiger are currently recognized: *Panthera tigris altica*, *P. t. amoyensis*, *P. t. tigris*, *P. t. corbetti*, *P. t. sumatrae*, *P. t. virgata*, *P. t. sondaica*, *P. t. balica* and *P. t. "jacksoni"* (N.B. This taxon is a *nomen nudum*, and if valid awaits a formal scientific description) [9]. Three of these putative subspecies are now extinct (*P. t. virgata*, *P. t. sondaica*, and *P. t. balica*) and *P. t. amoyensis* is no longer present in the wild and exists only in captivity [10], although it has been suggested recently that even these are subspecific hybrids with *P. t. corbetti* [11]. The remaining five extant tiger subspecies are critically endangered [5]; however there is a continuing discussion as to how many tiger subspecies can be recognized based on morphological, biochemical, and molecular genetic studies with different authors proposing diverse conclusions [11–14]. For the purposes of this study we assume that five existing tiger subspecies survive, with no further judgment on their taxonomic validity. As the subspecies *P. t. amoyensis* is no longer present in the wild, only the remaining four subspecies are likely to be poached from wild populations and are the focus of this report.

There are several governmental and charitable organizations that regularly produce reports on illegal wildlife trade [15–17]. Extreme poaching and the illegal trade in tiger skins and body parts are important factors in these reports and significantly contribute to the decline in the number of wild tigers [18] and is evident in surveys carried out by organizations such as TRAFFIC [19]. This has escalated to such an extent that tiger 'farms' have been proposed to breed tigers for commercial use of their parts [20]. Tiger parts are used in traditional Oriental medicine without any scientific

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support for a therapeutic effect. For example, tiger bone is used in Asian folk remedies or Traditional Chinese Medicine (TCM), and is normally mixed with materials derived from other animal species or herbal material for a compound recipe [21]. Tiger body parts, such as tail, whisker and eyeball, are also claimed to have medicinal properties [22]. Tiger skins are highly sought after as house and costume decoration in some countries such as Tibet [23]. All of these uses of tiger parts have resulted in a highly profitable market in many countries.

All five extant tiger subspecies are listed currently on CITES (Convention on International Trade in Endangered Species) Appendix I, which affords them protection at the highest level from international trade. All are on the International Union for the Conservation of Nature's Red List as Critically Endangered. International trade in tigers and tiger body parts is prohibited by signatories to CITES and many countries have national legislation preventing the ownership of tiger body parts. The role of a forensic science laboratory is to determine if seized material contains even traces of species for which trade is prohibited by CITES agreements or national legislation. Morphological features may aid in the identification of tiger skins and bones, but not their subspecies [24]. Recognizable parts are not present in many commercially available medicines and other products derived from the tiger. To aid in the prevention of trade in tigers and their parts, a molecular approach may be used to ensure whether or not examined samples contain tiger DNA. Owing to the potential for degradation of samples found in a forensic context, nuclear DNA is unlikely to yield results and, therefore, mitochondrial DNA may be used as an alternative means of species identification.

The use of genetic markers for tiger species identification has been previously reported using a number of different detection methods. These approaches employ traditional PCR amplification, using tiger species-specific primers designed for mitochondrial loci such as: cytochrome *b* (cyt *b*); NADH; cytochrome oxidase I (COI) and II (COII); 12s rRNA; and the control region [11,25–27]; RFLP-PCR [28]; and real-time PCR, using species-specific ARMs [29]. However, none of these techniques is able to distinguish between subspecies, and neither can they accurately assign an individual to a particular population. The use of single nucleotide polymorphisms (SNPs) has been used to try and separate tiger subspecies, but was never developed into a full functional or validated forensic test [11]. SNPs have been used in forensic wildlife investigations to identify a number of other protected or endangered wildlife species [30,31], including plants [32]. One of the major challenges of determining the presence of tiger in medicines is their very small quantities, which may have been pre-treated by various methods thus yielding trace quantities of potentially highly degraded DNA.

In this study we report on the identification of tiger-specific SNP haplotypes within the tiger mitochondrial genome, which can also be used to distinguish between two particular tiger subspecies. These SNP loci are the basis for a single multiplex SNaPshot assay. The development and validation of the assay is also demonstrated.

2. Materials and methods

2.1. Sample collection

Fifteen voucher tiger samples were obtained from the National Museums Scotland, Edinburgh Zoo, Dudley Zoo, Isle of Wight Zoo, and Auchingarrich Wildlife Park, all in the UK. These samples comprised hair and tissues from different and unrelated individual tigers. Of these samples, four samples were identified previously as *P. t. sumatrae*, four were from *P. t. tigris*, five samples were from *P. t. altaica*, and two samples were from *P. t. corbetti*. Hair samples were plucked randomly from the individual's body skin and then stored in a sterile bag. Sterile buccal swabs were used to collect forensically appropriate samples from muscle and other tissues. The hair was stored at room temperature and the swabs were stored at −20 °C until extraction.

2.2. DNA extraction

DNA was extracted using QIAamp DNA Mini Kit (QIAGEN, Crawley, UK), according to the manufacturer's protocols for the relevant sample type. The DNA extracts were stored at −20 °C for further analysis.

2.3. The identification of tiger species- and subspecies-specific SNPs

2.3.1. Tiger subspecies-specific SNP identification

The mitochondrial genome was sequenced for 8 tiger samples, comprising two from each of four subspecies. These new data were combined with 492 registered *P. tigris* sequences available on GenBank (www.ncbi.nih.gov). Five hundred and forty-four putative tiger DNA sequences were available although 52 sequences were not used as these data were incomplete or otherwise unsuitable. The remaining 492 DNA sequences were aligned using Clustal X2 [33] to confirm the authenticity of the tiger DNA sequences and minimize the potential for errors in the DNA sequence. The accession numbers, and other relevant information, for these eight new DNA sequences and the 492 DNA tiger sequences retrieved from GenBank data are shown in Table 1. DNA-sequence variability between tiger subspecies over the entire mitochondrial genome was determined. Any SNPs that were specific to a particular tiger subspecies were identified and recorded.

2.3.2. Tiger species-specific SNP identification

To examine tiger-species specific SNPs, 349 DNA sequences of the cyt *b* gene from mammalian species spanning a wide range of taxonomic groups were aligned with 71 tiger sequences, which included all five extant tiger subspecies. A list of mammalian species and their GenBank accession numbers are shown in the supplementary Table S1. These 420 DNA sequences were aligned using Clustal X2. A haplotype of the five SNPs was identified that is specific for all tiger subspecies and not present in other mammalian species. Within the haplotype it should be noted that other mammalian species share one or more of the SNPs with tiger subspecies, but no other species had all five.

2.4. Detection of tiger species and subspecies by SNaPshot assay

2.4.1. The multiplex of SNaPshot template amplification

After the tiger species- and subspecies-specific SNPs were identified, three primer pairs (P1, P2 and P3) were designed to amplify mitochondrial regions that included these SNPs. The physical parameters and secondary structure of the primers were checked using the same tools as primers for the amplification of an entire tiger mitochondrial genome as described previously [34]. The sequences of these three primer sets from 5′ to 3′ are: P1F ACTCAGGACAATGAACCGT; P1R TAAGTAGTGCTGTTATGGCTAG-TAG-TG; P2F ATCAACTCCATTAAACGTCTCTT; P2R GGAAGAT-GAGGTTGAGGTTG; P3F TTTGGCTCCTTACTAGGGGT; and P3R TTGGCGGGGATGTAGTT. The multiplex PCR amplifications were performed in a total volume of 20 μL, containing 200 μM of each dNTP, 1× PCR buffer (10 mM Tris–HCl, pH 8.3, 50 mM KCl), 2.0 mM $MgCl_2$, 2.0 units Platinum *Taq* polymerase (Invitrogen, Paisley, UK), 0.5 μM of primer P1 and P3, 1 μM of primer P2, and sterile water. The PCRs were conducted using a 2720 Applied Biosystems thermal cycler. Amplification conditions for these primers were as follows: 35 cycles of denaturation at 95 °C for 45 s, annealing at

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Table 1
Tiger DNA sequence information used in this study, including: accession number, total number of DNA sequences used, author of relevant paper, the year published.

Accession number	No.	Author, year	MtGene
JF357967–JF357974	8	Kitpipit et al., 2011	Complete mitochondrial genomes
EU661609–EU661691, FJ228452	84	Mondol, 2009	ND2, ND5, cyt *b*, CR
EU527874–EU527859	16	Sharma, 2009	12S rRNA, ND2, ND5, cyt *b*
FJ403464.1-67.1	4	Matrai, 2009	cyt *b*, CR
FJ895266.1	1	Yoo, 2009	cyt *b*
FN257739.1, FM999724.1	2	Doung/Din, 2009	ND2, cyt *b*
FJ469625.2, FJ694967.1-972.1, FJ461529.2-534.2, FJ608583.1-585.1	16	Shi and Zhang, 2009	COI, COIII, ND4
EU395630.1-645.1	16	Khan et al., 2009	ND5
EU184702–EU184691	12	Ryan, 2008	cyt *b*
FJ422145.1, FJ465508.1-511.1, FJ478155.1-158.1, FJ455122.1-125.1	13	Shi and Zhang, 2008	COI, COIII, CR
FM179470-71.1	2	Nagappa et al., 2008	12S rRNA
FJ185309.1	1	Ghosh et al., 2008	COI
EF375881.1	1	Rajput and Goyal, 2007	ND1
AB211408-11	4	Sugimoto et al., 2006	cyt *b*
EF179376–EF179357	20	Ryan, 2006	cyt *b*
AB193164.1	1	Nagata, 2006	cyt *b*
AY452097-99.1, AY452101, AY452111.1, 112.1,114.1-119.1	12	Zhang et al., 2006	ND5, CR
DQ111950-51.1	2	Wei et al., 2005	ND5
AY736559–AY736808	250	Luo et al., 2004	12S rRNA, ND1, ND2, COI, ND5, ND6, cyt *b*, CR
AY452110.1	1	Zhang et al., 2003	16S rRNA
AF053018–AF053051	34	Cracraft, 1998	cyt *b*
Total tiger sequences	500		

60 °C for 45 s, extension at 72 °C for 1 min 30 s, and a final extension at 72 °C for 20 min. The reaction was then held at 4 °C. From the final PCR, 2 μL were run on a 3% agarose gel to ensure that the amplifications were successful and provided all the expected fragments. The remainder of the PCR products were then purified using the QIAquick PCR purification kit (QIAGEN), following the manufacturer's protocol.

2.4.2. SNaPshot reaction and product analysis

Eleven SNaPshot extension primers were designed to bind adjacent to the SNPs either in the forward or in the reverse direction (Table 2). The SNaPshot primers were examined for their physical parameters and secondary structure as described previously [34]. Different-length tails (poly GACT) were added to the 5′ end of the primers to vary the primer sizes from 20 to 70 bp. The singleplex and multiplex SNaPshot reactions were performed using the SNaPshot multiplex kit (Applied Biosystems, Foster City, CA, USA) in a total volume of 10 μL, containing 5 μL reaction mix, 3 μL multiplex template, 1 μL sterile water, and 1 μL extension primer mix. For the singleplex reactions 0.2 μM of each extension primer was added, and the optimal concentrations of each primer added in the multiplex reaction are shown in Table 2. The SNaPshot PCRs were amplified in a 2720 Applied Biosystems thermal cycler using the following conditions: 25 cycles of 96 °C for 10 s, 50 °C for 5 s, and 60 °C for 30 s. SNaPshot products were then purified by Shrimp Alkaline Phosphatase (SAP) to remove unincorporated ddNTPs and primers, by adding 1 unit of SAP into the SNaPshot reaction mixtures. The mixture was incubated at 37 °C for 60 min and then 75 °C for 15 min to deactivate the enzyme.

From the SNaPshot-purified products, 2 μL were mixed with 15.5 μL of formamide and 0.5 μL of GeneScan-120 LIZ size standard (Applied Biosystems). The formamide mix was heated at 95 °C for 3 min and stored at 4 °C until ready for further analysis. The extended products were separated by capillary electrophoresis using the ABI Prism 310 Genetic Analyzer (Applied Biosystems), with a 36-cm length capillary and POP-4 polymer. The SNP typing results were analyzed using GeneMapper version 3.2.1.

2.5. The validation of the developed SNaPshot multiplex assay for tiger species and subspecies identification

The SNaPshot multiplex assay for tiger species and subspecies identification was validated for accuracy, sensitivity, specificity and blind-trial tests. The assay was used to analyze 15 tiger samples described in the sample collection method. Ten of fifteen voucher tiger samples were picked at random. Data were collected by using aliquots of the same PCR product which was injected onto the capillary 10 times to determine run variation. The average range and size of the fragments, and their standard deviation were calculated for all SNP peaks. For the sensitivity test, the *P. t. corbetti*

Table 2
The location, direction and sequence of the SNaPshot extension primer sequences used in this study. The size in nucleotide bases and the optimal primer concentration in the SNaPshot multiplex are also shown.

Position	Strand direction	Single based extension primer sequence (5–3)	Primer size (nucleotides)	[Opt.] (μM)
Tiger-15154	Forward	TTTGGCTCCTTACTAGGGGT	20	0.10
Tiger-15268	Reverse	gaTTGGCATGTAGATATCGGATAAT	25	0.50
Tiger-15385	Reverse	tgactgacTGACCGTAAACAATAGCACAAT	30	0.50
Tiger-15391	Forward	tgactgactgactAAACATGAAATATCGGGATTGT	35	0.20
Tiger-15673	Forward	gactgactgactgactgactAATAACCCCTCAGGAATGGT	40	0.15
TIG-5050	Forward	actgactgactgactgactgactAATGAACCGTATCAAAAGACCT	45	0.20
TIG-5533	Forward	actgactgactgactgactgactgacTATCCTACTGCTAATAATATCTCT	50	0.20
TIG-14618	Reverse	ctgactgactgactgactgactgactgactgactACCCGCACCATTAAACTTAAA	55	0.30
SUM-5608	Reverse	tgactgactgactgactgactgactgactgactTGTTATGGCTAGTAGTGTGGGTATTAT	60	0.12
SUM-15223	Forward	tgactgactgactgactgactgactgactgactgactgactgactACATCAGACACAATAACCGC	65	0.40
SUM-15743	Reverse	actgactgactgactgactgactgactgactgactgactgactGACGAGTAGTRTGAGGGTTAGGA	70	1.00

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G Model
FSIGEN-758; No. of Pages 8
ARTICLE IN PRESS

DNA was firstly quantified following the method described in [35] where copy number of mitochondrial DNA was obtained. This quantified tiger sample, with a starting concentration of 120,000 mitochondrial copies (equating to 2.06 pg) per μL, was used to make a two-fold serial dilution for 5 concentrations, 120,000, 60,000, 30,000, 15,000, and 7500 mitochondrial copies/μL. These serial dilutions were then analyzed by the developed assay. Fourteen other mammalian species were used to test the specificity of the assay. These mammalian species were cheetah (*Acinonyx jubatus*), jaguar (*Panthera onca*), lion (*Panthera leo*), leopard (*Panthera pardus*), clouded leopard (*Neofelis nebulosa*), puma (*Puma concolor*), domestic cat (*Felis catus*), bear (*Ursus thibetanus*), horse (*Equus caballus*), sika deer (*Cervus nippon*), domestic dog (*Canis familiaris*), cow (*Bos taurus*), goat (*Capra hircus*) and human (*Homo sapiens*). For the blind-trial test, 10 tiger and other mammalian samples were randomly picked from a total of 293 samples. Of these 293 samples, 250 samples are voucher non-*Panthera* mammalian DNA from 20 mammalian species, 15 samples are one of four tiger subspecies DNA, and 28 samples are voucher big cat DNA from 7 big cat species. The 10 blind samples were then analyzed by the developed SNaPshot assay.

3. Results and discussion

3.1. Tiger species- and subspecies-specific SNPs

The complete genome of eight tiger species was sequenced and the sequences registered with GenBank (Table 1). From a search of entire tiger mitochondrial genomes, a total of six tiger subspecies-specific SNPs were identified in three mitochondrial gene loci: ND2, ND6, and cyt *b*. Three of the six SNPs are specific to *P. t. sumatrae* and the rest are specific to *P. t. tigris*. SNPs specific to *P. t. altaica* or *P. t. corbetti* could not be identified over the entire mitochondrial genome. The position and location of SNPs on the mitochondrial genome are shown in Table 3. With the exception of the SNP at position 15223, the tiger species-specific SNPs are transition variants, which is consistent with nucleotide base substitutions biased in favor of transitions rather than transversions. Five of six

Table 3
Subspecies specific SNPs (shown in bold) for the tiger, with their position and location on the mitochondrial genome.

mtlocus	ND2			ND6	cyt *b*	
Position/17009[a]	5050	5533	5608	14618	15223	15743
P. t. altaica	C (3)	G (3)	C (3)	C (3)	T (20)	A (17)
P. t. tigris	**T** (29)	**A** (8)	C (8)	**T** (8)	T (10)	A (38)
P. t. sumatrae	C (10)	G (10)	**T** (10)	C (10)	**A** (11)	**G** (19)
P. t. amoy	C (1)	G (1)	C (1)	C (1)	T (1)	A (1)
P. t. corbetti	C (11)	G (12)	C (12)	C (11)	T (38)	A (15)

The number inside bracket is a number of tiger sequences used for the alignment.
[a] The position was determined by aligning tiger sequences with the cat sequences accession number U20753.

Table 4
Tiger species-specific SNPs and their position on the mitochondrial genome, including a list of the nucleotides of other mammalian species at the same base position.

Position/17009[a]	15154	15268	15385	15391	15673
Panthera tigris (Tiger)	G (43)	G (44)	G (69)	G (69)	G (70)
Melursus ursinus (Sloth bear)	. (2)	A (2)	C (2)	T (2)	A (2)
Ursus maritimus (Polar bear)	. (1)	A (1)	C (1)	T (1)	A (1)
Ursus arctos (Brown bear)	. (3)	A (3)	C (3)	T (3)	A (3)
Crossarchus obscurus (Long-nosed cusimanse)	. (2)	A (2)	A (2)	A (2)	A (2)
Panthera onca (Jaguar)	. (2)	A (2)	A (2)	A (2)	A (2)
Panthera onca (Jaguar)	. (1)	A (1)	–	–	–
Ovibos moschatus (Muskox)	C (4)	A (4)	. (4)	T (4)	A (4)
Tremarctos ornatus (Spectacled bear)	. (1)	A (1)	A (1)	T (1)	A (1)
Ailuropoda melanoleuca (Giant panda)	. (3)	A (3)	A (3)	T (3)	A (3)
Marmota caligata (Hoary marmot)	A (3)	A (3)	. (3)	T (3)	C (3)
Erignathus barbatus (Bearded seal)	C (3)	A (3)	C (3)	C (3)	. (3)
Fossa fossana (Malagasy civet)	A (2)	A (2)	. (2)	T (2)	A (2)
Herpestes naso (Long-nosed mongoose)	A (2)	A (2)	A (2)	C (2)	. (2)
Mungos mungo (Banded mongoose)	A (2)	A (2)	. (2)	C (2)	A (2)
Civettictis civetta (African civet)	C (2)	A (2)	A (2)	A (2)	. (2)
Martes zibellina (Sable)	C (2)	. (2)	T (2)	C (2)	C (2)
Microtus maximowiczii (Maximowicz's vole)	C (1)	A (1)	. (1)	C (1)	T (1)
Microtus arvalis (common vole)	T (2)	A (2)	. (2)	C (2)	C (2)
Lemmus trimucronatus (lemming)	T (1)	A (1)	. (1)	C (1)	C (1)
Crossarchus alexandri (Alexander's cusimanse)	A (1)	A (1)	A (1)	A (1)	. (1)
Prionailurus bengalensis (leopard cat)	A (1)	A (1)	A (1)	. (1)	A (1)
Meles meles (European badger)	C (1)	. (1)	C (1)	C (1)	C (1)
Proteles cristatus (Aardwolf)	C (1)	A (1)	. (1)	A (1)	A (1)
Tapirus indicus (Malayan tapir)	C (1)	A (1)	A (1)	C (1)	. (1)
Cynopterus brachyotis (Lesser short-nosed fruit bat)	C (1)	A (1)	. (1)	C (1)	A (1)
Talpa stankovici (Balkan mole)	C (1)	A (1)	. (1)	A (1)	A (1)
Dasypus novemcinctus (Nine-banded armadillo)	C (1)	A (1)	. (1)	C (1)	. (1)
Mystacina tuberculata (New Zealand lesser short-tailed bat)	C (1)	. (1)	A (1)	C (1)	C (1)
Oryctolagus cuniculus (European rabbit)	. (1)	A (1)	C (1)	C (1)	T (1)
Arctogalidia trivirgata (Small-toothed palm civet)	T (1)	A (1)	. (1)	A (1)	A (1)
Other mammals	A/C/T (281)	A (283)	A/C/T (280)	A/C/T (282)	A/C/T (283)

The number inside the bracket is the number of sequences showing the same nucleotide base from the same species.
'.' represents a nucleotide position showing the same nucleotide base as tiger.
[a] The position was determined by aligning these sequences with the cat sequences accession number U20753.

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G Model
FSIGEN-758; No. of Pages 8
ARTICLE IN PRESS
T. Kitpipit et al. / Forensic Science International: Genetics xxx (2011) xxx–xxx

SNPs, at positions 5050, 5533, 5608, 14618, and 15743, correspond to the only previously reported tiger subspecies-specific study [11]. In this previous report a further six subspecies-specific SNPs were recorded for the four tiger subspecies that we studied. However, these were not confirmed as subspecies-specific in our study as they were found in more than one subspecies.

Three hundred and forty-nine complete mammalian cyt *b* sequences from 169 mammalian species were aligned with 71 tiger sequences to search for SNPs. A haplotype of the five SNPs was identified that is specific for all tiger subspecies and not present in other mammalian species. Four of these SNPs are multi-allelic markers, with only one SNP position (15268) being a bi-allelic transition. Even though some mammalian species exhibit the same nucleotide base as the tiger at a particular SNP, the tiger can be distinguished by the remaining SNPs. The SNPs and their position on the mitochondrial genome, including the lists of mammalian species providing the same nucleotide base as tiger species for each SNP, are shown in Table 4. The positions of all eleven tiger species- and subspecies-specific SNPs are shown on a mitochondrial map (Fig. 1).

3.2. SNaPshot multiplex assay for tiger species and its subspecies-specific SNPs

The multiplex amplification using primer set P1, P2, and P3, which was designed to amplify mitochondrial regions surrounding all SNPs, was successfully performed on DNA samples of the four tiger subspecies. Each single subspecies sample provided the three expected PCR products of approximately 627, 656, and 683 bp for each of the primers P1, P2, and P3. These PCR products were separated on a 3% agarose gel. The purified PCR products of these samples were then used as a SNaPshot template for a multiplex SNaPshot reaction in the subsequent analysis.

Each of the eleven extension primers was used in a SNaPshot reaction to extend the primers by one base, using the purified PCR product template. The expected nucleotide base, dye color and fragment sizes for these tiger species- and subspecies-specific SNPs are shown in Table 5. The SNP typing for four tiger subspecies corresponded to the expected result, as shown in Fig. 2. It was noted that the observed peak size was slightly larger in mass than the actual size for all SNPs; this was most likely due to the influence of the dye attached to the ddNTPs, thus increasing their mass and affecting fragment mobility in the capillary electrophoresis. The other factors causing mobility shift of SNaPshot products are the nucleotide composition and fragment size; the shorter the fragment size, the greater the impact of the fluorescent dye that occurs [36].

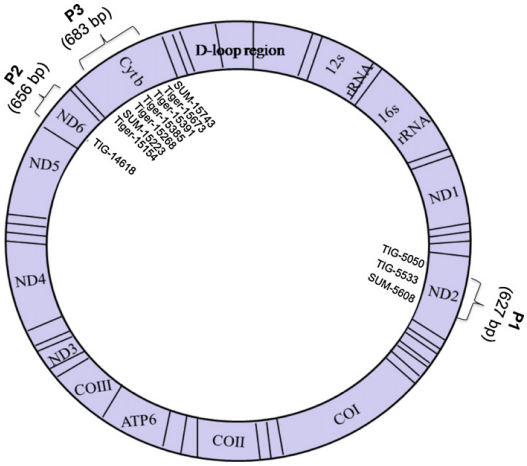


Fig. 1. The positions of all eleven tiger species- and subspecies-specific SNPs on the mitochondrial map. The SNPs are in the ND2, ND6 and cytochrome *b* genes.

3.3. SNaPshot assay validation

3.3.1. Accuracy test

The precision of the assay was tested with 15 voucher tiger DNA samples. This resulted in a 100% level of accuracy. Each sample also showed the expected SNP typing as predicted for its reported subspecies. For all single SNPs the observed range of peak sizes and

Table 5
The expected nucleotide base, dye color, expected and obtained fragment sizes, obtained peak size range, and standard deviation for the tiger species- and subspecies-specific SNPs.

Tiger subspecies	Tiger 15154		Tiger 15268		Tiger 15385		Tiger 15391		Tiger 15673		TIG 5050		TIG 5533		TIG 14618		SUM 5608		SUM 15223		SUM 15743	
	B	C	B	C	B	C	B	C	B	C	B	C	B	C	B	C	B	C	B	C	B	C
P. t. tigris	G		C		C		G		G		T		A		T		G		T		T	
P. t. sumatrae	G		C		C		G		G		C		G		C		A		A		C	
P. t. corbetti	G		C		C		G		G		C		G		C		G		T		T	
P. t. altaica	G		C		C		G		G		C		G		C		G		T		T	
Expected peak size	20		25		30		35		40		45		50		55		60		65		70	
Observed peak size average	30.11		32.04		34.27		39.78		44.52		48.58		53.06		57.87		64.72		68.66		75.54	
Observed peak size-range (n=10)	29.53–30.81		31.57–32.66		33.91–34.64		39.51–40.13		44.27–44.87		47.97–49.62		52.22–54.50		57.46–58.83		64.23–65.57		68.04–69.11		73.58–76.23	
STD (n=10)	0.39		0.31		0.22		0.19		0.18		0.37		0.55		0.38		0.40		0.31		0.54	

B is nucleotide base/C is color.

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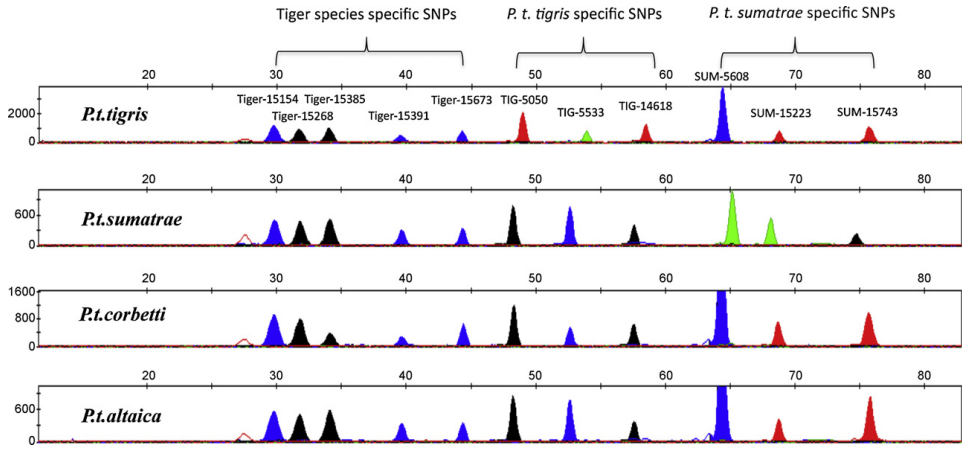


Fig. 2. The electropherogram showing SNP typing of four extant tiger subspecies (*P. t. tigris*, *P. t. sumatrae*, *P. t. corbetti*, and *P. t. altaica*) when analyzed with the single SNaPshot kit developed in this study for tiger species and subspecies identification.

standard deviations were calculated as shown in Table 5. The standard deviations of the observed fragment size are in the range of 0.18–0.55. The lowest values of standard deviation were found in the tiger species-specific SNPs of Tiger-15673 and Tiger-15391. Conversely, two of the tiger subspecies-specific SNPs, TIG-5533 and SUM-15743, reported the highest standard deviation, owing to the significant difference in fragment size between those for the species-specific assays and those for other tiger subspecies. However, this difference was still less than one base pair.

3.3.2. Sensitivity test

The sensitivity of the assay was determined by preparing five DNA concentrations from a two-fold serial dilution containing quantified tiger DNA. A full SNP profile can be obtained from as little as 15,000 copies of target mitochondrial DNA (equating to 0.26 pg), indicating that the test will work on trace amounts of tissue or hair samples. The PCR product amplified from this sample was also the lowest concentration of starting template from which a PCR product could be observed on an agarose gel when stained with ethidium bromide. The presence of an amplification product acted as a rapid screening test to indicate the potential success in obtaining a full SNP profile.

3.3.3. Specificity test

One tiger and fourteen mammalian samples were tested to determine the specificity of the assay. A full SNP profile was retrieved only for *P. tigris*, indicating that the developed assay is specific to this species. However, DNA from other cat species was also successfully amplified by P1, P2 and P3, including cheetah, jaguar, lion, leopard, snow leopard, clouded leopard, puma and domestic cat. All three expected multiplex PCR fragments were generated by the tiger sample as predicted. The band patterns and the intensities obtained for the cat species were different to those for the tiger samples as shown in Fig. 3.

A SNP specificity test was performed using 14 mammalian species, including closely related *Panthera* species, none of which produced products at the same positions as tiger SNPs; this new SNP test has the potential to identify other big cat species.

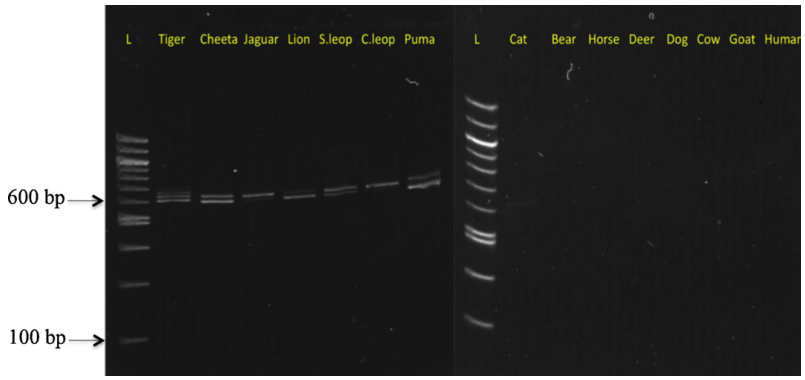


Fig. 3. The specificity test for the SNaPshot multiplex assay for tiger species and subspecies identification. Lanes 1 and 9 are 100 bp DNA ladders (100 bp is the smallest fragment shown); lane 2 is tiger (*Panthera tigris*); lane 3 is cheetah (*Acinoyx jubatus*); lane 4 is jaguar (*Panthera onca*); lane 5 is lion (*Panthera leo*); lane 6 is snow leopard (*Panthera pardus*); lane 7 is clouded leopard (*Neofelis nebulosa*); lane 8 is puma (*Puma concolor*); lane 10 is domestic cat (*Felis catus*); lane 11 is bear (*Ursus thibetanus*); lane 12 is horse (*Equus caballus*); lane 13 is sika deer (*Cervus nippon*); lane 14 is domestic dog (*Canis familiaris*); lane 15 is cow (*Bos taurus*); lane 16 is goat (*Capra hircus*); and lane 17 is human (*Homo sapiens*). The PCR products (10 μL/well) were separated on a 3% agarose gel and visualized with ethidium bromide staining.

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Table 6
The result of blind trial testing in 10 DNA sample picked at random.

Result	Sample no.									
	1	2	3	4	5	6	7	8	9	10
Observed result	Other	Tiger *P. t. tigris*	Big cat	Big cat	Tiger *P. t. tigris*	Tiger *P. t. corbetti*	Other	Tiger *P. t. tigris*	Other	Tiger *P. t. altaica*
DNA source	Lamp	Tiger *P. t. tigris*	Jaguar	Puma	Tiger *P. t. tigris*	Tiger *P. t. corbetti*	Horse	Tiger *P. t. tigris*	Fox	Tiger *P. t. altaica*
Correct	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

3.3.4. Blind-trial test

Random single blind trials were performed to examine the SNaPshot multiplex effectiveness of the assay. Ten DNA samples were picked at random and amplified by the multiplex primers and run on a 3% agarose gel. Eight of ten samples were successfully amplified as noted by gel electrophoresis. The two samples that were not successfully amplified were identified as samples from other mammalian species, but were neither tiger nor other big cat species. The eight samples that were amplified successfully were then analyzed by SNaPshot multiplex assay. Of these samples, five provided full SNP typing as predicted if they were one of the tiger subspecies; this was later confirmed. The samples that showed no SNP peaks were later identified as a big cat species, other than tiger, again as predicted by the SNP testing. The blind-trial results for all samples revealed 100% accuracy when categorizing unknown samples into one of the three categories: tiger, other big cats, and other mammalian species, as shown in Table 6.

4. Conclusion

A common approach to species identification, using molecular methods, is to sequence a mitochondrial gene locus such as cyt *b* or COI; or to use species-specific primers [37]. In the case of subspecies identification, there are only a few signature bases that differentiate such closely related taxa. In the entire tiger mitochondrial genome, with a range of approximately 17,000 bp, only six SNP bases were identified that could distinguish between subspecies. Within the cyt *b* gene, one of the most commonly used gene loci in species identification [38], there were only five SNPs of value that separate any subspecies of *P. tigris* from other mammals. The development of a SNP test to identify these bases circumvents generating long DNA sequences that are of little or no diagnostic value. Further, the multiplex SNP assay allows SNPs from more than one gene to be identified in one reaction. We were able to identify and validate eleven tiger species- and subspecies-specific SNPs, spanning the entire tiger mitochondrial genome. The single SNaPshot multiplex assay developed to detect these SNPs was found to be reliable, accurate, specific, sensitive and robust. The assay will prove to be useful in forensic applications as it is able to detect and identify tiger species and subspecies in trace or degraded biological evidence.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.fsigen.2011.06.001.

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6.1.2 Research article on the title of 'The complete mitochondrial genome analysis of the tiger (Panthera tigris)' submitted to the Journal of Molecular Biology Reports in July 2011.

The complete mitochondrial genome analysis of the tiger (*Panthera tigris*)

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Abstract

The complete mitochondrial genomes of five tiger samples from three subspecies (*P. t. sumatrae*, *P. t. altica,* and *P. t. tigris*) were successfully obtained by using 26 specifically designed *Panthera*-specific primer sets. The genome organization and gene arrangement of the five tiger samples were similar to each other; however polymorphic tandem repeat sequences were observed in the control region. This led to a difference in the genome lengths obtained from these five samples with an average size of 16,994 bp for the five tiger mitochondrial genomes. The nucleotide base composition was on average as follows: A, 31.8%; T, 27.0%; C, 26.6%; G, 14.6% and exhibited compositional asymmetry. Most of tiger mitochondrial genome characteristics are similar to those of other common vertebrate species; however, some distinctive features were observed in the control region. First, the repetitive sequence 2 (RS2) contained two repeat units of 80 bp and the first 15 bp of what would be the third repeat motif. The repetitive sequence 3 (RS3) contained 47-50 repeat motifs of a shorter 8 bp $(ACGTAYAC)_n$. Second, length heteroplasmy polycystosine (poly-C) stretches was observed at the end of the HVI locus in all tiger samples.

Keywords: Tiger (*Panthera tigris*), complete mitochondrial genome, genome characterization.

Introduction

Much of the vertebrate mitochondrial genome is highly conserved within and between species; the complete genome ranges from 14-17 kb in circumference [1,2]. The genome typically contains the D-loop region and a total of 37 of genes comprising 13 protein-coding genes, 22 tRNA genes, and 2 rRNA genes. Due to the particular characteristics of the mitochondrial genome, such as numerous copy numbers, good stability, maternal inheritance, and a higher rate of evolution [3], this locus has been used widely as a molecular tool for several research fields such as phylogenetics, phylogeography, molecular evolution, and population and conservation genetics [4-6]. To aid in the conservation and breeding programs of these highly endangered subspecies and assist in their phylogenetics [7-11], the complete mitochondrial genomes of five members of *Panthera tigris* were sequenced.

More than 500 vertebrate complete mitochondrial genomes have been sequenced and reported since the first human complete mitochondrial genome was successfully determined in 1981 [12]. Among these several species, only four felid species (*Felis catus*, *Acinonyx jubatus*, *Neofelis nebulosa*, and *Panthera uncia*) complete mitochondrial sequences have been analyzed and reported. This could be due to a difficulty in the amplification of the entire mitochondrial genome of this taxonomic group in which a nuclear pseudogene (Numt), being a nuclear DNA sequence that is homologous to mitochondrial DNA sequence, has also been amplified erroneously along with the expected mitochondrial amplicons. The numt is found especially in cat and *Panthera* genus species [13,14]. In this paper, we report a set of primers and techniques to amplify the entire-genuine tiger mitochondrial genome and comment on the structure and gene composition of tiger mitochondrial genome.

Materials and methods

Sample collection and DNA extraction

Five voucher tiger samples were obtained from the National Museum of Scotland and Isle of Wight Zoo, UK. These samples comprised hairs and tissues from different and unrelated five individual tigers; two from each of

the tiger subspecies *P. t. sumatrae* and *P. t. altica,* and one from *P. t. tigris*. DNA was extracted using QIAamp DNA Mini Kit (QIAGEN, Crawley, UK), according to the manufacturer's protocols for the relevant sample type. The DNA extracts were then stored at -20 ^{o}C for further analysis.

Amplification and DNA Sequencing of five tiger mitochondrial genomes

Establishment of *Panthera* sequence alignment

Alignment of the *Panthera* mitochondrial gene sequences allowed sequence variation to be noted from which *Panthera*-specific primers could be designed. Eight complete mitochondrial genomes of *Panthera* species were obtained from GenBank (NC010641-2, EF551003-4, NC 010638, NC 008450, NC 005212, NC 001700) and aligned by Mega 4 [15].

Primer design

Panthera-specific primers were designed from conserved regions based on the *Panthera* sequence alignment to minimize the chance of sequence variation in the priming sites. Each candidate primer set was designed to provide a PCR fragment in the rage of 700 – 900 bp. The next primer set amplifying the adjacent region was designed to give overlapping PCR segments with an overlap of between 100 and 150 bp. The physical parameters of the candidate primers were also assessed to ensure limited self-complementary and minimal secondary structure. The primers were also designed to avoid false positive results resulting from contamination with human DNA. The software used were the bioinformatics web-based tool DNA calculator (http://www.sigma-genosys.com/calc/DNACalc.asp) and Basic Local Alignment Search Tool (BLAST) from the NCBI website (http://blast.ncbi.nlm.nih. gov/Blast.cgi). A total of 26 primer sets were designed to amplify the entire tiger mitochondrial genome, as shown in Table 1.

The polymerase chain reaction (PCR)

Each of the five tiger DNA samples were amplified with the 26 *Panthera*-specific primer sets resulting in a total of 130 PCRs. Each PCR was performed in a total volume of 20 µL containing, 200 µM of each dNTP, 1X PCR buffer (10 mM Tris HCl, pH 8.3, 50 mM KCl) (Invitrogen, Paisley, UK), 2.0 mM $MgCl_2$ (Invitrogen, Paisley, UK), 1.5 units Platinum *Taq* polymerase

(Invitrogen, Paisley, UK) and 0.5 pmol of each primer. The PCRs were conducted in a 2720 thermal cycler (Applied Biosystems, CA, USA). Amplification conditions for all 26 primer sets were as follows: 35 cycles of denaturation at 95 ^{o}C for 45 s, annealing at 60 ^{o}C for 45 s, extension at 72 ^{o}C for 1 min 30 s., and a final extension at 72 ^{o}C for 20 min. The reaction was then held at 4 ^{o}C.

PCR product separation, detection and purification

The PCR products (20 μL) were separated on a 2% agarose gel at 100 V for 40 min. DNA fragments of the expected size were removed from the agarose gel using a clean razor blade and placed in a 1.5 mL microcentrifuge tube. DNA was then purified from the agarose using a QIAquick PCR purification column (QIAGEN, Crawley UK) following the manufacturer's protocol.

DNA sequencing and post-sequencing method

The purified PCR products were sequenced on an ABI 3100XL genetic analyser (Applied Biosystems, CA, USA). The sequences were edited using the FINCH TV Version 1.4.0 (Geospiza Inc, WA). Any ambiguities in the DNA sequences were assessed by aligning the forward and reverse complementary sequences. The DNA sequences once confirmed were then grouped into their overlapping fragments to generate entire tiger mitochondrial genomes.

Tiger mitochondrial genome analysis

Genome characterization and annotation

The DNA sequence data for the five entire tiger mitochondrial genomes were examined for the locations of 13 protein-coding genes (PCGs), 22 transfer RNA (tRNA), and 2 ribosomal RNA (rRNA) using the Open Reading Frame Finder or ORF Finder (http://www.ncbi.nlm.nih.gov/projects/gorf), the software tRNAscan-SE, version 1.21, and the NCBI Sequin software. Secondary structures of tRNA and rRNA genes were predicted by using the RNAfold web server (http://rna.tbi.univie.ac.at/cgi-bin/RNAfold.cgi). The five new tiger mitochondrial genomes were also annotated and prepared for

submission to the GenBank database using the software Sequin, following the instruction available on the NCBI website.

Nucleotide compositional pattern and codon usage

The nucleotide composition base frequency and codon usage in the coding region of the entire tiger mitochondrial genome was examined by using Mega 4 [15]. The GC- and AT- skews were used to indicate compositional difference within one strand and between the two strands of mitochondrial DNA. These parameters and their standard deviation were measured following the formulae: AT-skew = (A-T)/(A+T), GC-skew = (G-C)/(G+C) [16], SD (GC-skew) = [2/(G+C)][(G.C)/(G+C)], SD (AT-skew) = [2/(A+T)][(A.T)/(A+T)] [17], where G, C, A, and T are the frequency of the four nucleotides found in the observed sequence.

Results and discussions

Tiger genome characterization

The five complete-genuine tiger mitochondrial genome sequences were successfully obtained using the designed 26 *Panthera*-specific primer sets and methods used in this study. The mitochondrial genome characteristics obtained from the five tiger samples were similar, with the except of the control region where variability was noted due to tandem repeated sequences (Table 2); this resulted in variable lengths of these tiger mitochondrial genomes. The average size of the five tiger mitochondrial genomes was 16,994 bp, which is smaller than the mitochondrial genome of the domestic cat (*Felis catus*) (17,009 bp) [13] and cheetah (*Acinonyx jubatus*) (17,011 bp) [18] but larger than those of clouded leopard (*Neofelis nebulosa*) (16,844 bp) [19] and snow leopard (*Panthera uncia*) (16,773 bp) [20].

Similar to other mammalian species, the complete tiger mitochondrial genomes contained the D-loop 13 genes encoding respiration-related proteins; 22 tRNA molecules; and 2 rRNA molecules (Fig. 1). Nine of the 37 genes, ND6, $tRNA^{-Gln}$, $tRNA^{-Ala}$, $tRNA^{-Asn}$, $tRNA^{-Cys}$, $tRNA^{-Tyr}$, $tRNA^{-Ser}$, $tRNA^{-Glu}$, and $tRNA^{-Pro}$, were found to be encoded by the light strand of mitochondrial DNA. The arrangement of all 37 coding genes is the same as other

mammalian species [1]. The origins of replication of both the heavy and light strands are also noted in Fig. 1.

Protein coding genes (PCGs)

The organization and arrangement of the 13 PCGs as identified in the tiger mitochondrial sequences are shown in Table 2. The arrangement is similar to those of other vertebrate species [8,21-24], including the closely related species such as the clouded leopard (*Neofelis nebulosa*), snow leopard (*Panthera uncia*), and cheetah (*Acinonyx jubatus*) [18-20]. Of these 13 PCGs, the ND5 gene was the longest, which was 1,821 bp in length, and the ATP8 was the smallest PCGs having a size of 204 bp. This is similar with almost vertebrate species reported to date [8,21-24]; however, the ND5 gene in this study was slightly larger than those of species such as pig (*Sus scrofa*) (1,820 bp) [22] and rabbit (*Oryctolagus cuniculus*) (1,812 bp) [23], while the same size of ATP8 was found in all observed species. It is noted that some PCGs were found to share their nucleotide compositional base with the adjacent gene (Table 2), which is also reported in several species and most likely a feature of metazoan mitochondrial genomes [24].

The methionine codon (ATG and ATA) was the most common start codon used by the tiger PCGs. The codon ATG was used by 10 PCGs while two PCGs, ND3 and ND5, used the start codon ATA. These two initiation codons were found to be used by many other mammalian species [8,13,18,19,21-24]. The ND2 gene used the start codon of isoleucine (ATC), which is rather common and found in some mammalian species such as horse (*Equus ferus*) [25] and the snow leopard (*Panthera uncia*) [20]. A different isoleucine start codon (ATT) was also used by cat (*Felis catus*), cheetah (*Acinonyx jubatus*) [18], clouded leopard (*Neofelis nebulosa*) [19], harbor seal (*Phoca vitulina)* and grey seal (*Halichoerus grypus*) [25].

There were four different stop codons used by the PCGs; being TAA, TA, T, AGA. The stop codon TAA was used by COI, COIII, ATP8, ATP6, ND4L, ND5, and ND6; TA was used by ND1 and ND3; T by ND2, COIII, and ND4; and AGA was used as the stop codon only by the cyt *b* gene in the tiger

mitochondrial genome. The stop codons observed from the tiger genomes were similar to those of most mammals, except the ND1 gene where the stop codon TAA was used instead of a single T [19,20]. Termination with the incomplete stop codon is a common characteristic found in many mammalian PCGs [26]. These incomplete stop codons, such as TA and T, are thought to be completed by a post-transcriptional addition of polyadenylation (poly A) during the mRNA maturation process [27].

Tranfer RNAs (tRNAs)

Twenty-one tRNA genes were successfully identified by tRNAscan-SE. The obtained cove scores for the tRNA identification were between 15.30 and 48.36 (Table 2), indicating a high specificity and reliability of the identification. The exception was $tRNA^{-Ser\ (AGY)}$, which was identified successfully by comparing the new tiger sequences with the tiger mitochondrial genome sequences, available on GenBank, by using the program Sequin. The tRNA genes ranged in size between 59-75 bp, with the longest being $tRNA^{-Leu\ (UUR)}$ and the shortest was $tRNA^{-Ser}$. This size variation exhibited by tRNA genes in the tiger mitochondrial genome was similar to other vertebrates [13,14,18-20]; however in the snow leopard (*Panthera uncia*) mitochondrial genome, the longest tRNA gene was the $tRNA^{-Asn}$ which was slightly shorter than that of the tiger by 2 bp [20]. Three tRNA genes ($tRNA^{-Ile}$, $tRNA^{-Gln}$ and $tRNA^{-Ser}$) were found to share their nucleotide base with the adjacent gene. Each of the gene pair $tRNA^{-Ile}$/$tRNA^{-Gln}$ and COI/$tRNA^{-Ser}$ was found to overlap each other by 3 bp.

Twenty-one of the 22 tRNA genes were successfully folded into a cloverleaf secondary structure. With the exception of the $tRNA^{-Ser\ (AGY)}$, the secondary structures of all identified tRNAs were found to be similar, mainly comprising of the amino acid acceptor stem (AA stem), TΨC stem (T stem), anticodon stem (AC stem), and dihydrouridine (D stem). The D stem was absent in the $tRNA^{-Ser\ (AGY)}$. These characteristics of the observed tRNA secondary structures were homologous to most other vertebrates [18-20,25,28].

Ribosomal RNA (rRNA)

The size of the 12S rRNA gene was 960 bp, which is similar to those of the domestic cat (*Felis catus*) and cheetah (*Acinonyx jubatus*) but larger than that of clouded leopard (*Neofelis nebulosa*) by 2 bp. The size of the 16S rRNA gene was 1,575 bp which is a few base pairs larger than those of other big cat species [18-20].

Control Region (CR)

The sizes of the CR in the five tiger mitochondrial genome varied from 1,527 to 1,566 bp, leading to a variation in size of the resulting tiger mitochondrial genomes. The CR of tigers could be divided into five parts: hypervariable region I (HV I), repeat sequence 2 (RS2), conserved control region (CCR), repeat sequence 3 (RS3), and hypervariable region II (HV II) [29], as shown in Fig. 2. Variable sites were found commonly in the HVI and HVII loci compared to the other region in the mitochondrial genome. Two tandem repeat sites (RS2 and RS3) were observed at the two ends of the highly conserved core of the control region (CCR). Both of these two repetitive sequence types have been documented in some felid species, such as the domestic cat and cheetah [29,30], while only either one of these types were found in several mammalian species such as the evening bat (*Nycticeius humeralis*), pig (*Sus scrofa*), rabbit (*Oryctolagus cuniculus*), harbour seal (*Phoca vitulina*), two species of elephant seal (*Mirounga angustirostris* and *M. leonine*), and 18 other carnivore species [10,29,31-34].

The RS2 locus, located at the 5' end of the light strand, is 175 bp in length. This locus contained two repeat units of 80 bp and the first 15 bp of what would be the third repeat motif. These two repeat units had 89-93% similarity with each other. The RS2 motif length in tigers is the same as those of cat, cheetah and the evening bat but differ in the number of repeat units. Cat and cheetah CR loci were found to contain two and four repeat units, respectively, while the number of repeats is higher in the evening bat [13,32,35]. It is noted that there was no RS2 sequence found in a clouded leopard CR [19]. The RS3, located at the 3' end of the light strand, contained 47-50 repeat motifs of a shorter 8 bp $(ACGTAYAC)_n$. Similar to the RS2 array type, the RS3 of tiger

array sequence (ACGTAYAC) is homologous to the cat; however the repeated unit number of this array type observed in the CR of tigers is 10-13 times longer than another species [13]. This array is also found to share a core motif 'ACGT' with 18 species of carnivores, although the array sequence pattern among these species are different [29].

There is an observation of a length heteroplasmy in this study (Fig. 3); where two or more mitochondrial types with a different length were found within an individual [36,37]. The observed length heteroplasmy was a polycystosine (poly-C) sequence, which was observed at the end of the HVI locus in all of the tiger samples. This result corresponded to the position of a poly-C length heteroplasmy in humans [38].

Nucleotide compositional pattern

The nucleotide compositional patterns of the five tiger genome sequences were similar to each other. The average percentages of nucleotide base composition of the tiger mitochondrial genome were as follows: A, 31.8%; T, 27.0%; C, 26.6%; G, 14.6%. The nucleotide base A was the most represented base while the lowest nucleotide base frequency was observed for the base G; as would be expected if the data were obtained from the light strand (L-strand). The percentages of all nucleotide bases represented in tiger mitochondrial genome were homologous to those of other big cats species [18,19,39]. This result also indicated that the tiger mitochondrial genome is AT-rich (GC poor) which is common with all vertebrate mitochondrial genomes sequenced to date [40]. The bias of nucleotide composition along the same mitochondrial strand would be explained by a bias in the dNTP pool or strand-specific misparing rate of the DNA polymerase during DNA replication [41,42].

The average GC-skew and AT-skew values were – 0.291 ±0.13 and 0.082 ±0.15, respectively. The values indicated an existence of nucleotide compositional asymmetry in the tiger mitochondrial genome, which was noted in other animal species [43,44], including humans [45]. The absolute value of GC-skew is much higher than AT-skew, meaning that there is a considerable

asymmetry of the base G and C between the two strands of tiger mitochondrial genome; this characteristic is ubiquitous in mammalian species [44]. However, the strength of GC-skew has been found to vary among different mammalian species [16], while the AT-skew value was similar among other mammalian species [40]. The significant uneven asymmetry in the nucleotide composition of the two mitochondrial strands can be explained by an irregularity mechanism of mitochondrial DNA replication - the parental H-strand remained single strand for a much longer time comparing to other strand during the replication process so that it effected more by hydrolylic and oxidative damage, leading to preferential mutation of the H-strand [41,46]. Moreover, nucleotide substitution is bias toward the γ-bases (G and C), and least for the α-bases (A and T) [44], which can lead to a significant asymmetry of base G and C between the two strands.

Codon usage

The average codon frequency and relative synonymous codon usage for the entire tiger mitochondrial genome are shown in Table 3. Synonymous codons occurred at varying frequencies for the same amino acid and as expected the most frequently used synonymous codon matched that of the corresponding anticodons, as shown in Table 2. This correspondence is found commonly in other vertebrate mitochondrial genomes [47], which is different to insect mitochondrial genomes where the association between the most used-codon and subsequent anti-codon was not observed [48]. With the exception of the amino acid aspartic acid, RSCU values of all codons were above or under 1.00. These results indicated that the codon usage bias occurred in the tiger mitochondrial genome. The occurrence of bias is most likely due to a codon usage optimization affecting the efficiency of amino acid translation in protein coding genes [49,50], or a mutation pressure biased towards the base pair GC, particularly at the third codon position [44,51]. In addition, other factors such as transcription efficiency, mRNA secondary structure, and protein structure could effect the selection pressure in codon usage [52-54].

Conclusions

A set of primers for the complete amplification of genuine tiger mitochondrial genomes were successfully designed and employed. This paper has been the first report of a detailed examination of the tiger mitochondrial genome structure and organization. The five complete mitochondrial genomes were annotated and published in the GenBank database as the accession number of JF357968-JF357970, JF357973- JF357974.

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Table 1: Nucleotide sequences of twenty-six primer sets amplifying complete tiger mitochondrial DNA

Primer set	Direction	Sequences ($5^{/}$-$3^{/}$)	Tm (^{0}c)	Size of PCR product
1	Forward	CTCCCAGTACGAAAGGACAAG	62.52	788
	Reverse	GCTCGGTTGGTCTCTGCTAG	64.00	
2	Forward	TCAAAATAYGCYCTAATCGG	56.85	755
	Reverse	GGCCCGATAGCTTATTTAGC	61.40	
3	Forward	ACAGCAAGCATTCCACC	61.21	818
	Reverse	TATGATGGCTGTTATTCAACCTAT	65.05	
4	Forward	TACCCGAAGTTACACAAGGAAT	61.14	868
	Reverse	CCCACCAATCTAGTGAGGACTTAGC	66.18	
5	Forward	TAGACCAAGAGCCTTCAAAGC	62.33	803
	Reverse	GATGCTCCTGCATGAGC	60.71	
6	Forward	ATTGGAGGATTCGGAAACTG	62.72	854
	Reverse	GCTAGTACAATTCCTGTTAAGCC	59.72	
7	Forward	ACACGAGCATACTTTACGTCAGC	64.18	721
	Reverse	CTTCTTAATTGAGAAAGACATAGTGGT	60.75	
8	Forward	CCTCCGTATCACACATTTGAAGA	64.80	830
	Reverse	ACTAGTTCAAGGACAATGGG	58.04	
9	Forward	CTAAAAACTGACGCTATCCCAGG	64.55	811
	Reverse	GGTGTTCCTTGTGGTAGAAAGTG	63.46	
10	Forward	ACAAACYTGRGCCCTAATACT	62.33	803
	Reverse	AGGCTTGAGTGRTAGAAGGC	59.99	
11	Forward	GARAGCACATTCCAAGG	56.44	906
	Reverse	GTTTGTGAGGCYCAGGGAAG	63.73	
12	Forward	TATGAATGTGGATTTGACCC	59.60	894
	Reverse	AGTATTGTAATGTATAGTTTTTTTCG	55.70	
13	Forward	CACTCTCTGCACCCCTACTAGT	61.28	830
	Reverse	TCG TTCGTAGTTTGAGTTTG	57.94	
14	Forward	TAATCGCATATTCATCCGTAAG	60.33	855
	Reverse	AAGGCGTAAGAGATTGTGGTT	61.43	
15	Forward	GGTGCAACTCCAAATAAAAG	58.65	888
	Reverse	GCTGTGAATAGGGTTGTGAT	58.99	
16	Forward	ATTTGGCCTACACCCATGA	62.74	831
	Reverse	TCTAATGCCAGGATAAAGCCT	61.46	
17	Forward	ATCAACTCCATTAAACGTCTCTT	63.70	925
	Reverse	TTTTCTTCAAAGCCTTCTCC	62.42	
18	Forward	TTATTAGATGTCCACGCCTC	59.13	876
	Reverse	GGAAGGCAAAGAATCGTGT	61.63	
19	Forward	CAGCCTTCATAGGATATGTCTTACC	62.61	854
	Reverse	GGCTATTGCTTCTTCCTTGA	60.88	
20	Forward	CAACTAGCCTCYATCCTATACTTCT	57.08	921
	Reverse	TTGAGAAAGTTGAAGGATTGG	60.62	
21	Forward	CGTGTACCTCTTCTCGCTC	60.16	886
	Reverse	ATAAATAAGATTAACGGGGGGT	60.17	
22	Forward	CCTATTGTTCCACAGGACAC	59.41	915
	Reverse	TGATTTAGAGGGCATTTTCA	59.64	
23	Forward	AAAGCAAGGCACTGAAAATG	61.74	813
	Reverse	TAAGGATTTTCGTGGATGTTCTA	61.19	
24	Forward	ATATACCGCCATCTTCAGC	59.09	773
	Reverse	CAGCTATCACCAGGCTCGT	63.03	
25	Forward	CCGAAACCAGACGAGCTA	61.58	793
	Reverse	GGAAGGTCAATTTCACGGAT	62.61	
26	Forward	CAAAAACATCACCTCTAGCATT	59.65	801
	Reverse	TGAACCTCTGATAGTAAAAGCTTAAG	59.89	

Table 2: Tiger genome organization: showing the locations and position of each gene, start and stop codon (for PCGs), anticodon (for tRNAs gene), gene size, and intergenic nucleotides.

Gene	St[a]	Position[b]	size (bp)	In[c]	codon		Anticodon[d]		
					start	stop	base	position	score
tRNA^{-Phe}	+	1-71	71	0			GAA	36-38	27.4
12S rRNA	+	72-1031	960	0					
tRNA^{-Val}	+	1032-1099	68	0			TAC	1062-1064	27.88
16S rRNA	+	1100-2674	1575	0					
tRNA^{-Leu}	+	2675-2749	75	0			TAA	2710-2712	56.37
ND1	+	2752-3707	956	2	ATG	TA*			
tRNA^{-Ile}	+	3708-3776	69	0			GAT	3737-3739	38.59
tRNA^{-Gln}	-	3774-3847	74	-3			TTG	3812-3810	40.16
tRNA^{-Met}	+	3848-3916	69	0			CAT	3878-3880	20.96
ND2	+	3917-4958	1042	0	ATC	T*			
tRNA^{-Trp}	+	4959-5026	68	0			TCA	4990-4992	25.31
tRNA^{-Ala}	-	5042-5110	69	15			TGC	5080-5078	41.79
tRNA^{-Asn}	-	5112-5184	73	1			GTT	5151-5149	26.61
tRNA^{-Cys}	-	5218-5282	65	0			GCA	5254-5252	17.88
tRNA^{-Tyr}	-	5283-5349	67	0			GTA	5321-5319	61.35
COI	+	5351-6895	1545	1	ATG	TAA			
tRNA^{-Ser}	-	6893-6961	69	-3			TGA	6931-6929	35.67
tRNA^{-Asp}	+	6968-7036	69	6			GTC	6998-7000	35.84
COII	+	7037-7720	684	0	ATG	TAA			
tRNA^{-Lys}	+	7724-7791	68	3			TTT	7752-7754	47.86
ATP8	+	7793-7996	204	1	ATG	TAA			
ATP6	+	7954-8634	681	-43	ATG	TAA			
COIII	+	8634-9417	784	-1	ATG	T*			
tRNA^{-Gly}	+	9418-9486	69	0			TCC	9449-9451	31.4
ND3	+	9487-9833	347	0	ATA	TA*			
tRNA^{-Arg}	+	9834-9902	69	0			TCG	9865-9867	32.97
ND4L	+	9903-10199	297	0	ATG	TAA			
ND4	+	10193-11570	1378	-7	ATG	T*			
tRNA^{-His}	+	11571-11639	69	0			GTG	11601-11603	48.36
tRNA^{-Ser}	+	11640-11698	59	0			GCT	11659-11661	NA
tRNA^{-Leu}	+	11699-11768	70	0			TAG	11731-11733	46.65
ND5	+	11769-13589	1821	0	ATA	TAA			
ND6	-	13573-14100	528	-17	ATG	TAA			
tRNA^{-Glu}	-	14101-14169	69	0			TTC	14139-14137	41.22
Cytb	+	14173-15312	1140	3	ATG	AGA			
tRNA^{-Thr}	+	15313-15382	70	0			TGT	15343-15345	15.3
tRNA^{-Pro}	-	15383-15449	67	0			TGG	15418-15416	22.66
CR	+	S1: 15450-16976	1527	0					
		S2:15450-16998	1549						
		S3:15450-17001	1552						
		S4: 15450-17015	1566						
		S5: 15450-16980	1531						

[a] St denotes " Mitochondrial strand"; + Heavy strand, - Light strand.

[b] The first base position of all tiger mitochondrial genomes start from the first base of the tRNA^{-Phe} gene.

[c] In denotes an intergenic space between a particular gene and the adjacent gene upstream.

[d] Anticodon refers to three base-sequences on a strand of tRNA coding to an amino acid.

[e] P denotes partial gene sequence gap; C denotes complete gene sequence gap; A denotes ambiguous bases found.

* Incomplete stop codons thought to be completed by a post-transcriptional addition of polyadenylation (poly A).

S1-S5 represent the tiger samples 1to5.

Table 3: The codon usage frequency and relative synonymous codon usage observed in the entire tiger mitochondrial genome.

Amino acid	Codon	N[a]	RSCU[b]	Amino acid	Codon	N[a]	RSCU[b]
Phenylalanine	UUU	88.20	1.02	Tyrosine	UAU	160.50	1.22
Phenylalanine	UUC	84.30	0.98	Tyrosine	UAC	102.70	0.78
Leucine	UUA	128.70	1.35	*	UAA	121.20	1.48
Leucine	UUG	40.00	0.42	*	UAG	61.70	0.75
Leucine	CUU	92.50	0.97	Histidine	CAU	119.80	1.09
Leucine	CUC	107.20	1.13	Histidine	CAC	100.70	0.91
Leucine	CUA	151.50	1.59	Glutamine	CAA	112.80	1.44
Leucine	CUG	51.30	0.54	Glutamine	CAG	44.00	0.56
Isoleucine	AUU	119.50	0.99	Asparagine	AAU	191.20	1.19
Isoleucine	AUC	122.70	1.01	Asparagine	AAC	130.00	0.81
Methionine	AUA	115.00	1.30	Lysine	AAA	194.20	1.47
Methionine	AUG	62.00	0.70	Lysine	AAG	70.00	0.53
Valine	GUU	58.30	1.30	Aspartic acid	GAU	51.20	1.00
Valine	GUC	40.70	0.90	Aspartic acid	GAC	51.70	1.00
Valine	GUA	55.80	1.24	Glutamic acid	GAA	69.50	1.35
Valine	GUG	25.00	0.56	Glutamic acid	GAG	33.70	0.65
Serine	UCU	94.30	1.14	Cysteine	UGU	37.00	0.84
Serine	UCC	96.70	1.16	Cysteine	UGC	51.00	1.16
Serine	UCA	112.80	1.37	Tryptophan	UGA	68.70	1.14
Serine	UCG	29.30	0.36	Tryptophan	UGG	52.20	0.86
Proline	CCU	136.50	1.33	Arginine	CGU	33.00	0.99
Proline	CCC	132.20	1.28	Arginine	CGC	33.70	1.01
Proline	CCA	107.30	1.04	Arginine	CGA	43.70	1.31
Proline	CCG	35.80	0.35	Arginine	CGG	23.00	0.69
Threonine	ACU	138.70	1.36	Serine	AGU	75.70	0.92
Threonine	ACC	125.00	1.23	Serine	AGC	87.00	1.05
Threonine	ACA	107.20	1.05	Arginine (*)	AGA	80.00	0.98
Threonine	ACG	37.00	0.36	Arginine (*)	AGG	64.00	0.78
Alanine	GCU	72.50	1.27	Glycine	GGU	30.30	0.75
Alanine	GCC	87.20	1.52	Glycine	GGC	46.00	1.14
Alanine	GCA	59.30	1.04	Glycine	GGA	48.80	1.21
Alanine	GCG	10.20	0.18	Glycine	GGG	36.30	0.90

N[a] represents a codon usage frequency
RSCU[b] represents relative synonymous codon usage
The yellow highlights represent the most frequent-used synonymous codon for all the amino acids.

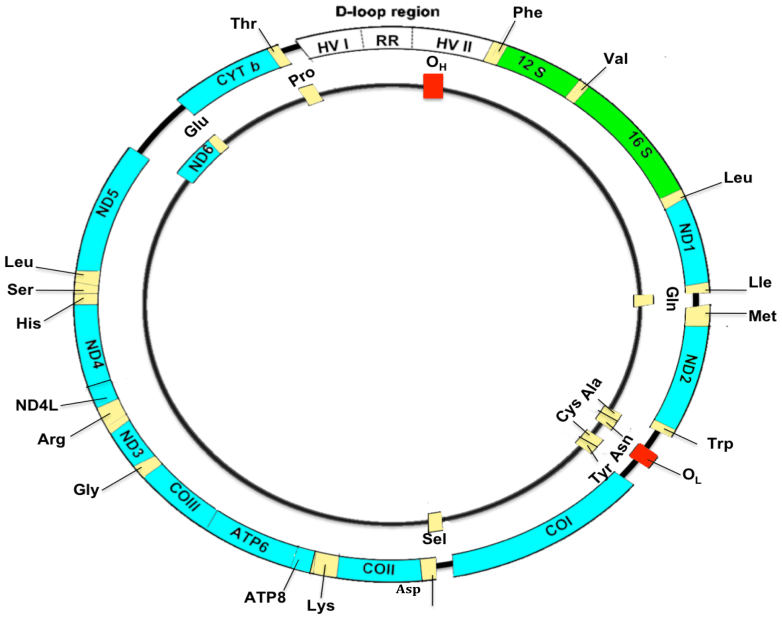


Fig. 1: The mitochondrial genome map of *Panthera tigris.* Thirteen protein-coding genes are in blue; 2 rRNA genes are in green; 22 tRNA genes are in yellow; and D-loop region is in white. The inner circle is the light strand of mitochondrial DNA that contains a total of nine coding genes. The origin of replication of the both heavy and light strand are labelled and shown in red.

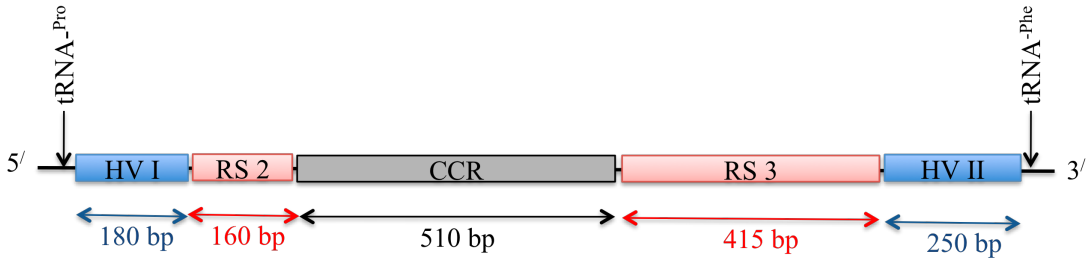


Fig. 2: The tiger control region organization which consists of five sections: Hypervariable Region I (HV I), Repeat Sequence I (RS I), Conserved Control Region (CCR), Repeat Sequence II (RS II), and Hypervariable Region II (HV II). The size of each section is shown in base pairs.

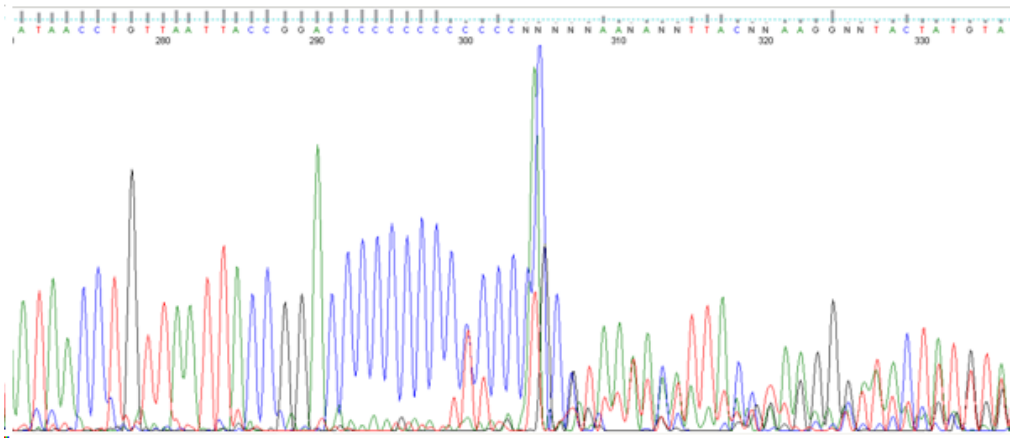


Fig. 3: A characteristic of the length heteroplasmy found in the control region of tiger mitochondrial genome (TIG1) at the position 270-335. It was observed in the three tiger samples, COB1, COB2, and TIG1.

6.1.3 Research article and conference proceeding of the 23th International Society for Forensic Genetics taking place in Buenos Ares, Argentina (Poster presentation). Title: Tiger species identification by molecular approach published in the Journal of Forensic Science International: Genetics Supplementary Series (September 2009).

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Research article

Tiger species identification based on molecular approach

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ABSTRACT

The trade in samples of tiger (*Panthera tigris*), or parts derived from tiger, is controlled through the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), which lists all subspecies as protected at the highest level. Tiger has been used as a component in traditional medicines for centuries, often as powder thus making its presence difficult to identify. It is therefore necessary to use a molecular approach for the unambiguous identification of the species. Some countries require knowledge of the exact subspecies present in order to prosecute anyone alleged to trade in tiger products. To this end, mitochondrial DNA from two individuals of four of the five subspecies of tiger were sequenced to determine if subspecies-specific variation could be identified that could be the basis for a molecular test. We report on the determination of a total of 7891 bp of the tiger mitochondrial genome spanning 16S rRNA through ND4.

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1. Introduction

The tiger population has declined heavily through the combination of habitat loss and extreme poaching. The international trade of this species is regulated and controlled through the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) which lists all five recognized subspecies in Appendix 1, affording it the highest level of protection. The five recognized subspecies are *Panthera tigris tigris*, *P. t. sumatrae*, *P. t. corbetti*, *P. t. altaica* and *P. t. amoyensis*.

The number of tiger subspecies have recently been evaluated by many researchers based on morphological, biochemical and molecular genetic studies. Different authors have proposed diverse conclusions [1–3]. The five currently recognized subspecies of tiger are generally classified on their phenotypic appearance, particularly on skull morphology [2]. There is much discussion about the classification of the tiger subspecies with some researchers [3] wanting to add new subspecies while others [1] think the number should be reduced. Although all subspecies of tiger are listed in Appendix 1 of CITES, some countries require determination of the exact subspecies in order to convict anyone alleged to trade in tiger parts. There is therefore a need to confirm the taxonomic grouping within this species to ensure that the current subspecies classifications are correct and to ensure samples can be identified to the subspecies level.

Tigers are poached for use in traditional medicines and nearly every part of a tiger is used, often as ground bone or in elixirs. When received in this state, morphological characteristics needed to determine species or subspecies are not present. It is therefore necessary to identify the genetic material using a molecular based test. Due to the degraded and fragmented nature of the samples, nuclear DNA analysis is not possible, but mitochondrial DNA analysis is. Generally the cytochrome *b* or cytochrome oxidase subunit I genes are used for species identification; however preliminary studies indicate that neither of these genes are suitable for subspecies separation in tigers. To aid in the prosecution and stem the trade in tiger parts, it is necessary to identify a region of the mitochondrial genome able to separate the different tiger subspecies.

In this study we have designed overlapping primer sets able to amplify the entire tiger mitochondrial genome. Samples from four of the five recognized subspecies of tiger were obtained and we report on the genetic basis of sub-speciation of *Panthera tigris* to ensure that samples examined match those listed as protected.

2. Materials and methods

A mitochondrial sequence alignment was first established to observe areas of homology and variation among the genus *Panthera*. Tiger specific primers were designed from conserved regions on the *Panthera* sequence alignment to amplify the entire mitochondrial genome of the tiger (*Panthera tigris*). Primers were designed such that there was no expected sequence variation within the priming site. Each primer set was designed to provide a PCR fragment in the range of 700–900 bp and to overlap with

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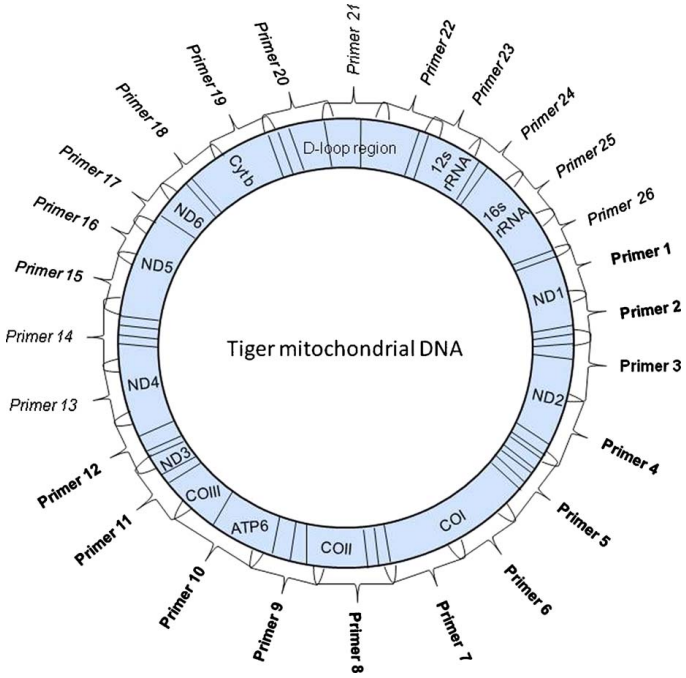


Fig. 1. Depicts the positions of the 26 designed primer sets on the tiger mtDNA map. Primers in bold have been successfully amplified and sequenced, primers in italics have been successfully amplified but not yet sequenced.

adjacent primer sets by approximately 100 bp. Twenty-six primer sets in total were designed to amplify overlapping sections of the entire tiger mitochondrial genome (Fig. 1).

To avoid erroneous results which could be caused by contamination with human DNA, all primer sets were checked using the Basic Local Alignment Search Tool (BLAST), available from the NCBI website (http://blast.ncbi.nlm.nih.gov/Blast.cgi), to ensure they would not amplify human mtDNA.

Tiger samples were obtained from unrelated individuals from four tiger subspecies; *P. t. tigris*, *P. t. sumatrae*, *P. t. corbetti* and *P. t. altaica*. Samples were in the form of either plucked hair or tissue swabs. DNA was extracted using QIAamp DNA Mini Kit (QIAGEN, UK) according to the manufacture's protocols for the relevant sample type.

A total of eight DNA samples, two individual samples for each tiger subspecies, were amplified using twelve of the primer sets. The PCR products were purified by either gel extraction purification (QIAquick PCR Purification Kit, QIAGEN, UK) or Exo-Sap (USB, Crawley, UK) prior to sequencing.

All PCR products were sequenced using an ABI 3100XL genetic analyser (Applied Biosystems, CA, USA) in both the forward and reverse direction. Sequence results were examined and edited, as needed, using FINCH TV Version 1.4.0 (Geospiza Inc, WA). The forward and reversed complementary strands were aligned by ClustalX [4] to confirm the sequences and to determine if there were any differences or mismatches. The DNA sequences obtained from the same sample were then grouped and manually combined. Sequences from the different individuals were then aligned using ClustalX.

Sequences were assessed for their levels of variation based on the number of variations over the entire sequence. Variation was assessed to determine if any was subspecies specific and could be used in a molecular test to determine the subspecies present in a sample.

3. Results and conclusions

Twelve primer sets were used successfully to amplify nearly half of the mitochondrial genome from two members each of *P. t. tigris*, *P. t. sumatrae*, *P. t. corbetti* and *P. t. altaica*. A total of 7891 bp, or 46.4%, of the total tiger mitochondrial genome was successfully sequenced and aligned. The remaining portion of the genome will be sequenced and, once complete, results will be posted to EMBL.

The portion of the mitochondria sequenced currently shows a total of 50 points of variation for all subspecies. Out of the 50 bases of variation, 30 were classified as intra-species variation. In this case we classify intra-species variation as variation which occurs in only one of the two individuals of a particular subspecies or if the variation was observed in multiple subspecies.

The 20 remaining bases of variation could be considered subspecies specific, but only for two of the four subspecies of tiger. *P. t. corbetti* and *P. t. altaica* did not show any variation between each other and could not be distinguished based on the 7891 base pairs sequenced. *P. t. tigris* and *P. t. sumatrae* each showed ten bases of variation from the other subspecies. This amounts to approximately a 0.1% variation.

Based on the results to date there is currently no sequence variation within the 7891 bp that can be used to reliably separate

the different tiger subspecies. It is possible that upon sequence completion of the entire mitochondrial genome that an area able to differentiate between the different tiger subspecies can be located and developed into a test to separate the subspecies.

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Conflict of interests

None.

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6.1.4 Conference proceeding of the 24th International Society of Forensic Genetics (ISFG) taking place in Vienna, Austria (Oral presentation) (September 2011).

Where does this tiger come from? - A robust molecular technique for simultaneous identification of endangered species and subspecies.

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Abstract. The Convention on the International Trade in Endangered Species of Wild Fauna and Flora (CITES) monitors the international trade in endangered animal and plant species; a high profile example is the tiger, *Panthera tigris*. To investigate alleged illegal trade in protected species' parts and derivatives, molecular approaches have been developed to aid in their identification. Some countries also require knowledge of the exact subspecies in order to prosecute anyone alleged to be trading in seized products. We report on the application of a SNaPshot multiplex technique to simultaneously identify tiger species and subspecies; this test is based on identification of SNPs within the tiger mitochondrial genome. The mitochondrial DNA sequence from four of the five extant putative tiger subspecies that currently exist in the wild were obtained and combined with DNA sequence data from 492 tiger and 349 other mammalian species available on GenBank. From the sequence data a total of 11 SNP loci were identified; five specific for tiger; three specific to *P. t. sumatrae* and; three specific to *P. t. tigris*. The multiplex assay was able to reliably identify 15 voucher tiger samples. The sensitivity of the test was 15,000 mitochondrial DNA copies (approximately 260 fg), indicating that it will work on trace amounts of tissue, bone or hair. This simple and reliable technique can be applied to identify a variety of other species listed in the CITES appendices.

Keywords: CITES, tiger, subspecies, mitochondrial DNA, SNP, SNaPshot.

1. Introduction

The Convention on the International Trade in Endangered Species of Wild Fauna and Flora (CITES) monitors the international trade in endangered animal and plant species. CITES may recommend a total ban on international trade of highly endangered species, an example of which is all the extant tiger subspecies (*Panthera tigris tigris P.t. altica, P. t. corbetti,* and *P. t. sumatrae*). These subspecies are listed on CITES Appendix I, affording them protection at the highest level from international trade. The role of a forensic science laboratory is to determine if seized material contains even traces of species for which trade is prohibited by CITES agreements or national legislation. To aid in the investigation of alleged illegal trade in protected species' parts and derivatives in which recognizable parts are not present, molecular approaches have been used to ensure whether or not examined samples contain tiger DNA. Owing to the potential for degradation of samples found in a forensic context, nuclear DNA is unlikely to yield results, therefore mitochondrial DNA may be used as an alternative means of species identification.

Single nucleotide polymorphisms (SNPs) have been used in forensic wildlife investigations to identify a number of other protected or endangered wildlife species [1, 2]. SNPs have been used to separate tiger subspecies [3], but were never developed into a fully functional or validated forensic test. In this study we developed and validated a single SNaPshot multiplex assay for simultaneous identification of tiger species and subspecies. This assay also served as a demonstration technique that can be applied to other endangered species.

2. Materials and Methods

Eight tiger mitochondrial genome sequences from the four extant tiger subspecies (*P. t. tigris, P. t. sumatrae*, , *P. t. altaica*, and *P. t. corbetti*) were obtained in this study. These new data were combined with 492 registered *P. tigris* sequences available on GenBank (www.ncbi.nih.gov) and aligned by using MEGA 4 [4]. DNA-sequence variability between tiger subspecies over the entire mitochondrial genome was determined. Any SNPs that were specific to a particular tiger subspecies (tiger subspecies-specific SNPs) were identified and recorded. To examine tiger-species specific SNPs, 349 DNA sequences of the cyt *b* gene from mammalian species spanning a wide range of taxonomic groups were aligned with 71 tiger sequences which included all four extant tiger subspecies. A haplotype of SNPs was identified that is specific for all tiger subspecies and not present in other mammalian species. Within the haplotype it should be noted that other mammalian species share one or more of the SNPs with tiger subspecies but no other species had all five.

The tiger species- and subspecies-specific SNPs were detected simultaneously by using a multiplex SNaPshot kit (Applied Biosystems, Foster City, CA, USA), according to the manufacturer's protocol. A multiplex amplification of mitochondrial regions that included all these SNPs was firstly performed to serve as template for SNP typing. Eleven SNaPshot extension primers were designed to bind adjacent to the SNPs located on the template either in the forward or reverse direction. Different-length tails (poly GACT) were added to the 5' end of the primers to vary the primer sizes from 20 to 70 bp. The extended products were separated by capillary electrophoresis using the ABI Prism 310 Genetic Analyzer (Applied Biosystems). The developed SNaPshot multiplex assay for tiger species and subspecies identification was then validated for accuracy, sensitivity, specificity and blind-trial tests.

3. Results and Discussion

A total of eleven tiger species- and subspecies-specific SNPs were identified in three mitochondrial gene loci; ND2, ND6, and cyt *b*. Six out of these eleven are tiger subspecies-specific SNPs; three of the six SNPs are specific to *P. t. sumatrae* and the rest are specific to *P. t. tigris*. SNPs specific to *P. t. altaica* or *P. t. corbetti* could not be identified over the entire mitochondrial genome. Another five were identified as a haplotype that is specific for all tiger subspecies and not present in other mammalian species. Even though some mammalian species exhibit the same nucleotide base as the tiger at a particular SNP, the tiger can be distinguished by the remaining SNPs.

The single SNaPshot multiplex assay was successfully developed and validated for simultaneous identification of tiger species and subspecies. Full SNP profiles were obtained from the four extant tiger subspecies and also corresponded to the expected SNP typing as predicted for each particular subspecies, as shown in Fig 1. The precision of the assay was tested with 15 voucher tiger DNA samples. This resulted in a 100% level of accuracy. The sensitivity of the test was 15,000 mitochondrial DNA copies (approximately 260 fg [5]), indicating that the test will work on trace amounts of tissue or hair samples. It was also shown that the assay is specific only to *P. tigris* species.

4. Conclusions

We were able to identify and validate eleven tiger species- and subspecies-specific SNPs, spanning the entire tiger mitochondrial genome. The single SNaPshot multiplex assay developed to detect these SNPs was found to be reliable, accurate, specific, sensitive and

robust. The assay will prove to be useful in forensic applications as it is able to detect and identify tiger species and subspecies in trace or degraded biological evidence.

5. Role of Funding

This project was part funded by the Leverhulme Trust (Grant number A20080076) awarded to ST, the Royal Thai Government Scholarship awarded to TK, and the South Australia Ministry of Justice in support of AL.

6. Conflict of interest

None.

7. Reference

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Fig. 1. The electropherogram showing SNP typing of four extant tiger subspecies (*P.t.tigris*, *P.t.sumatrae*, *P.t.corbetti, and P.t.altaica*) when analyzed with the single SNaPshot kit developed in this study for tiger species and subspecies identification [6].

6.1.5 Conference proceeding of the 2th International Conference on Forensic Genetics taking place in Telc, The Czech Republic (Oral presentation).

Program
Wednesday May 26, 2010

8:30 AM-9:30 AM	registration
9:30 AM – 10:15 AM	Petter Mostad COMPUTATIONS FOR DETERMINING FAMILIAL RELATIONSHIPS: METHODS AND CHALLENGES
10:15 AM – 11:00 AM	Vladimir Ferak GENOTYPE: SOFTWARE FOR FORENSIC GENETIC APPLICATIONS
11:00 AM – 11:35 AM	Willem van Loon OPTIMIZATION OF AUTOMATION STRATEGIES THROUGH IMPROVED USER INTERFACES
11:35 AM – 12:05 PM	coffee break
12:05 PM – 12:50 PM	Jiri Drabek (FORENSIC RELEVANCE OF) THE ADVANCEMENT OF SEQUENCING MACHINES
12:50 PM – 1:15 PM	Marek Minarik RAPID TYPING OF UP TO 33 Y-SPECIFIC STR MARKERS IN LARGE SETS BY CONVENTIONAL CE AS WELL AS MICROCHIP CE PLATFORMS
1:15 PM – 1:40 PM	Thitika Kitpipit THE USE OF SNPs IN SPECIES IDENTIFICATION - DESIGN AND APPLICATIONS
1:40 PM – 2:00 PM	CLOSING CEREMONY
2:00 PM – 3:00 PM	poster removal

The use of SNPs in species identification: Design and applications

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Species identification is needed to control the international trade in endangered species through the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and enforce national legislations.

One main reason why the mammalian species listed on CITEs are endangered is that they are killed for their body parts. These body parts may be used in traditional remedies and due to their powdered form, no morphological information is present requiring the application of molecular approaches to identify their presence.

In this study, a new reliable method for Mammalian species identification based on mitochondrial single nucleotide polymorphisms (mtSNPs) is demonstrated, with a particularly highlight on the Panthera genus.

A number of Panthera tigris DNA samples were sequenced, compared to those available on Genbank, and alignments obtained. These data allowed the identification of species and sub-species specific SNPs.

A multiplex SNaPshot assay was developed to identify these variable sites and tested to ensure specificity. This application of SNP on species identification is illustrated on Panthera species.

6.1.6 Conference proceeding of the 20th Australian and New Zealand Forensic Science Society (ANZFSS) taking place in Sydney, Australia (Oral presentation) (September 2010).

Tiger subspecies identification and classification by the entire mitochondrial analysis and multiplex snapshot method

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All subspecies of tigers (Panthera tigris) have been listed on Appendix 1 of the Convention on International Trade in Endangered Species of Wild Fauna and Flora affording them the highest level of protection. The five sub-species are classified primarily on their phenotypic appearances, but these features are not present in many of the powders and parts derived from tiger that are traded. To aid the in the prosecution of the trade in tiger, molecular approaches are being used to identify tiger in commercial products to ensure that samples examined match those listed as protected. Some countries also require knowledge of the exact subspecies present in order to prosecute anyone alleged to trade in tiger products. The entire mitochondrial DNA from two individuals of four of the five subspecies of tiger were sequenced. The sequences were compared to those available on Genbank and alignments were made. Results demonstrate very limited sub-species diversity. In addition, we identify the mitochondrial loci with the greatest sequence information available and report subspecies-specific variable sites found through the entire mitochondrial genome. A multiplex SNaPshot assay was developed able to identify two out of five subspecies of tiger. The assay has been tested with a number of products purportedly containing tiger.

6.2 Appendix 2: The entire mitochondrial sequence alignment for all eight tiger samples.

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TIGRIS1   GTTAATGTAGCTTAAATATATTAAAGCAAGGCACTGAAAATGCCTAGATGGGCCGCCAGGCTCCATAAACATAAAGGTTT 80
TIGRIS2   ................................................................................
SUMATRA1  ................................................................................
SUMATRA2  ................................................................................
CORBETTI1 --------------------------------------------------------------------------------
CORBETTI2 ----------------------------------.....................................------------
ALTAICA4  ................................................................................
ALTAICA1  ................................................................................

TIGRIS1   GGTCCTAGCCTTTCCATTAGTTGTTAATAAAATTACACATGCAAGCCTCCGCATCCCGGTGAAAATGCCCTCTAAATCAC 160
TIGRIS2   ................................................................................
SUMATRA1  ................................................................................
SUMATRA2  ................................................................................
CORBETTI1 ----------------.....................................................------------
CORBETTI2 ................................................................................
ALTAICA4  ................................................................................
ALTAICA1  ................................................................................

TIGRIS1   CCAGTGATCCAAAGGAGCCGGTATCAAGTACACAACCATTGTAGCTCATGACACCTTGCTCAGCCACACCCCCACGGGAT 240
TIGRIS2   ................................................................................
SUMATRA1  ................................................................................
SUMATRA2  ................................................................................
CORBETTI1 ...............................................................................C
CORBETTI2 ...............................................................................C
ALTAICA4  ...............................................................................C
ALTAICA1  ................................................................................

TIGRIS1   ACAGCAGTGATAAAAATTAAGCCATGAATGAAAGTTCGACTAAGCTATATTAAATTAGGGTTGGTAAATTTCGTGCCAGC 320
TIGRIS2   ................................................................................
SUMATRA1  ................................................................................
SUMATRA2  ................................................................................
CORBETTI1 ................................................................................
CORBETTI2 ................................................................................
ALTAICA4  ................................................................................
ALTAICA1  ................................................................................

TIGRIS1   CACCGCGGTCATACGATTAACCCAAACTAATAGACCCACGGCGTAAAGCGTGTTACAGAAAAAAGTATACTAAAGTTAAG 400
TIGRIS2   ................................................................................
SUMATRA1  ................................................................................
SUMATRA2  ................................................................................
CORBETTI1 ................................................................................
CORBETTI2 ................................................................................
ALTAICA4  ................................................................................
ALTAICA1  ................................................................................

TIGRIS1   CCTTAACTAGGCTGTAAAAAGCCACAGTTAACGTAAAAATACAGCACGAAAGTAACTTTAATATTTCTGACCACACGATA 480
TIGRIS2   ................................................................................
SUMATRA1  ................................................................................
SUMATRA2  ................................................................................
CORBETTI1 ................................................................................
CORBETTI2 ................................................................................
ALTAICA4  ................................................................................
ALTAICA1  ................................................................................

TIGRIS1   GCTAAGACCCAAACTGGGATTAGATACCCCACTATGCTTAGCCCTAAACCTAGATAGTTAACCCAAACAAAACTATCCGC 560
TIGRIS2   ................................................................................
SUMATRA1  ................................................................................
SUMATRA2  ................................................................................
CORBETTI1 ................................................................................
CORBETTI2 ................................................................................
ALTAICA4  ................................................................................
ALTAICA1  ................................................................................

TIGRIS1   CAGAGAACTACTAGCAACAGCTTAAAACTCAAAGGACTTGGCGGTGCTTTATATCCCTCTAGAGGAGCCTGTTCCATAAT 640
TIGRIS2   ................................................................................
SUMATRA1  ................................................................................
SUMATRA2  ................................................................................
CORBETTI1 ................................................................................
CORBETTI2 ................................................................................
ALTAICA4  ................................................................................
ALTAICA1  ................................................................................
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TIGRIS1   CGATAAACCCCGATAAACCTCACCATCTCTTGCTAATTCAGCCTATATACCGCCATCTTCAGCAAACCCTAAAAAGGAAG 720
TIGRIS2   ................................................................................
SUMATRA1  ................................................................................
SUMATRA2  ................................................................................
CORBETTI1 ................................................................................
CORBETTI2 ................................................................................
ALTAICA4  ................................................................................
ALTAICA1  ................................................................................

TIGRIS1   AAAAGTAAGCACAAGTATCTTAACATAAAAAAGTTAGGTCAAGGTGTAGCCCATGAGATGGGGAAGTAATGGGCTACATT 800
TIGRIS2   ................................................................................
SUMATRA1  ................................................................................
SUMATRA2  ................................................................................
CORBETTI1 ................................................................................
CORBETTI2 ................................................................................
ALTAICA4  ................................................................................
ALTAICA1  ................................................................................

TIGRIS1   TTCTACAACTAGAACATCCACGAAAATCCTTATGAAATTAAGTATTAAAGGAGGATTTAGTAGTAAATTCGAGAATAGAG 880
TIGRIS2   ................................................................................
SUMATRA1  ................................................................................
SUMATRA2  ................................................................................
CORBETTI1 .....T..........................................................................
CORBETTI2 .....T..........................................................................
ALTAICA4  .....T..........................................................................
ALTAICA1  ................................................................................

TIGRIS1   AGCTCGATTGAATCGGGCCATGAAGCACGCACACACCGCCCGTCACCCTCCTCAAGTGATTAGACCCCAAAGAAACCTAT 960
TIGRIS2   ................................................................................
SUMATRA1  ................................................................................
SUMATRA2  ................................................................................
CORBETTI1 ................................................................................
CORBETTI2 ................................................................................
ALTAICA4  ................................................................................
ALTAICA1  ................................................................................

TIGRIS1   TCAAACCACTACACCCACAAGAGGAGACAAGTCGTAACAAGGTAAGCATACTGGAAAGTGTGCTTGGATAACAAGATGTA 1040
TIGRIS2   ................................................................................
SUMATRA1  ................................................................................
SUMATRA2  ................................................................................
CORBETTI1 ................................................................................
CORBETTI2 ................................................................................
ALTAICA4  ................................................................................
ALTAICA1  ................................................................................

TIGRIS1   GCTTAAACAAAGCATCTGGCCTACACCCAGAAGATTTCATATTAAACTGACCATCTTGAGCTAGAGCTAGCCCAACTACC 1120
TIGRIS2   ................................................................................
SUMATRA1  ................................................................................
SUMATRA2  ................................................................................
CORBETTI1 ................................................................................
CORBETTI2 ............................................................................Y....
ALTAICA4  ................................................................................
ALTAICA1  ................................................................................

TIGRIS1   CATAAACACAACTAACATTAGAAAGTAAAACAAAACATTTAGTTACTCTAAAAAGTATAGGAGATAGAAATTTAACTCGG 1200
TIGRIS2   ................................................................................
SUMATRA1  ................................................................................
SUMATRA2  ................................................................................
CORBETTI1 ................................................................................
CORBETTI2 ................................................................................
ALTAICA4  ................................................................................
ALTAICA1  ................................................................................
TIGRIS1   CGCTATAGAAAAAGTACCGCAAGGGAATGATGAAAGAAAAAACTAAAAGCACTATACAGCAAAGATTACCCCTTGTACCT 1280
TIGRIS2   ................................................................................
SUMATRA1  ................................................................................
SUMATRA2  ................................................................................
CORBETTI1 ................................................................................
CORBETTI2 ................................................................................
ALTAICA4  ................................................................................
ALTAICA1  ................................................................................

TIGRIS1   TTTGCATAATGAATTAGCTAGAATAACCTAACAAAGAGAACTTCAGCTAGGCCCCCCGAAACCAGACGAGCTACCCATAA 1360
TIGRIS2   ................................................................................
SUMATRA1  ................................................................................
SUMATRA2  ................................................................................
CORBETTI1 ................................................................................
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CORBETTI2 ..........................................................................
ALTAICA4  ..........................................................................
ALTAICA1  ..........................................................................

TIGRIS1   ACAATCTATTACAGGATGAACTCGTCTATGTTGCAAAATAGTGAGAAGATTTATGGGTAGAGGTGAAAAGCCTAACGAGC 1440
TIGRIS2   ..........................................................................
SUMATRA1  ..........................................................................
SUMATRA2  ..........................................................................
CORBETTI1 ..........................................................................
CORBETTI2 ..........................................................................
ALTAICA4  ..........................................................................
ALTAICA1  ..........................................................................

TIGRIS1   CTGGTGATAGCTGGTTGCCCAGAACAGAATCTTAGTTCAGCTTTAAACTTACCTCAAAAACCCTAAAATTCCAATGTAAG 1520
TIGRIS2   ..........................................................................
SUMATRA1  ..........................................................................
SUMATRA2  ..........................................................................
CORBETTI1 ..........................................................................
CORBETTI2 ...........----------------------------------------------------------------------
ALTAICA4  ..........................................................................
ALTAICA1  ..........................................................................

TIGRIS1   TTTAAAATATAGTCTAAAAAGGTACAGCTTTTTAGAATCTAGGATACAGCCTTAATTAGAGAGTAAGCATATAACACAAA 1600
TIGRIS2   ..........................................................................
SUMATRA1  .......C..................................................................
SUMATRA2  .......C..................................................................
CORBETTI1 ..........................................................................
CORBETTI2 ----------------------------------------------------------------------------
ALTAICA4  ..........................................................................
ALTAICA1  ..........................................................................

TIGRIS1   CCATAGTTGGCCTAAAAGCAGCCACCAATTAAGAAAGCGTTCAAGCTCAACAATCAAAACATCTCAATGTCAAAAAACGC 1680
TIGRIS2   ..........................................................................
SUMATRA1  ..........................................................................
SUMATRA2  ..........................................................................
CORBETTI1 ..........................................................................
CORBETTI2 ----------------------------------------------------------------------------
ALTAICA4  ..........................................................................
ALTAICA1  ..........................................................................

TIGRIS1   AACCAACTCCTAATCTAAAACTGGGCCAATCTATTTAACAATAGAAGCAATAATGCTAATATGAGTAACAAGAAATACTT 1760
TIGRIS2   ..........................................................................
SUMATRA1  ........................T.................................................
SUMATRA2  ........................T.................................................
CORBETTI1 ........................T.................................................
CORBETTI2 ----------------------------------------------------------------------------
ALTAICA4  ........................T.................................................
ALTAICA1  ........................T.................................................

TIGRIS1   CTCCCGCGCATAAGCTTATATCAGAACGGATAACCACTGATAGTTAACAACAAGATATATATAACCTAACTACAAGCAAA 1840
TIGRIS2   ..........................................................................
SUMATRA1  ..........................................................C...............
SUMATRA2  ..........................................................C...............
CORBETTI1 ..........................................................................
CORBETTI2 ----------------------------------------------------------------------------
ALTAICA4  ..........................................................................
ALTAICA1  ..........................................................................

TIGRIS1   ATATCAGACTAATTGTTAACCCAACACAGGCATGCAATTTAGGGAAAGATTAAAAGAAGTAAAAGGAACTCGGCAAACAC 1920
TIGRIS2   ..........................................................................
SUMATRA1  ..........................................................................
SUMATRA2  ..........................................................................
CORBETTI1 ......A...................................................................
CORBETTI2 ----------------------------------------------------------------------------
ALTAICA4  ..........................................................................
ALTAICA1  ..........................................................................

TIGRIS1   AAGCCCCGCCTGTTTACCAAAAACATCACCTCTAGCATTTCCAGTATTAGAGGCACTGCCTGCCCAGTGACATTAGTTAA 2000
TIGRIS2   ..........................................................................
SUMATRA1  ..........................................................................
SUMATRA2  ..........................................................................
CORBETTI1 ..........................................................................
CORBETTI2 ----------------------------------------------------------------------------
ALTAICA4  ..........................................................................
ALTAICA1  ..........................................................................

TIGRIS1   ACGGCCGCGGTATCCTGACCGTGCAAAGGTAGCATAATCATTTGTTCCTTAAATAGGGACTTGTATGAATGGCCACACGA 2080
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TIGRIS2   ..........................................................................
SUMATRA1  ..........................................................................
SUMATRA2  ..........................................................................
CORBETTI1 ..........................................................................
CORBETTI2 --------------------------------------------------------------------------
ALTAICA4  ..........................................................................
ALTAICA1  ..........................................................................

TIGRIS1   GGGCTTTACTGTCTCTTACTTCCAATCCGTGAAATTGACCTTCCCGTGAAGAGGCGGGAATACGACAATAAGACGAGAAG 2160
TIGRIS2   ..........................................................................
SUMATRA1  ..........................................................................
SUMATRA2  ..........................................................................
CORBETTI1 ..........................................................................
CORBETTI2 --------------------------------------------------------------------------
ALTAICA4  ..........................................................................
ALTAICA1  ..........................................................................

TIGRIS1   ACCCTGTGGAGCTTTAATTAATCGACCCAAAGAGACCTTAATAACCAACCGACAGGAACAACAGACCTCTGCCATGGGCC 2240
TIGRIS2   ..........................................................................
SUMATRA1  ..........................................................................
SUMATRA2  ..........................................................................
CORBETTI1 ..........................................................................
CORBETTI2 --------------------------------------------------------------------------
ALTAICA4  ..........................................................................
ALTAICA1  ..........................................................................

TIGRIS1   GACAATTTAGGTTGGGGTGACCTCGGAGAATAAAACAACCTCCGAGTGATTTAAATCTAGACTAACCAGTCGAAAGTATT 2320
TIGRIS2   ..........................................................................
SUMATRA1  ..........................................................................
SUMATRA2  ..........................................................................
CORBETTI1 ..........................................................................
CORBETTI2 --------------------------------------------------------------------------
ALTAICA4  ..........................................................G.................
ALTAICA1  ..........................................................................

TIGRIS1   ACATCACTTATTGATCCAAAGCTTGATCAACGGAACAAGTTACCCCAGGGATAACAGCGCAATCCTATTTCAGAGTCCAT 2400
TIGRIS2   ..........................................................................
SUMATRA1  ..........................................................................
SUMATRA2  ..........................................................................
CORBETTI1 ..........................................................................
CORBETTI2 --------------------------------------------------------------------------
ALTAICA4  ..........................................................................
ALTAICA1  ..........................................................................

TIGRIS1   ATCGACAATAGGGTTTACGACCTCGATGTTGGATCAGGACATCCCGATGGTGCAGCAGCTATCAAAGGTTCGTTTGTTCA 2480
TIGRIS2   ..........................................................................
SUMATRA1  ..........................................................................
SUMATRA2  ..........................................................................
CORBETTI1 ..........................................................................
CORBETTI2 --------------------------------------------------------------------------
ALTAICA4  ..........................................................................
ALTAICA1  ..........................................................................

TIGRIS1   ACGATTAAAGTCCTACGTGATCTGAGTTCAGACCGGAGTAATCCAGGTCGGTTTCTATCTATTAAATAATTTCTCCCAGT 2560
TIGRIS2   ..........................................................................
SUMATRA1  ..........................................................................
SUMATRA2  ..........................................................................
CORBETTI1 ..........................................................................
CORBETTI2 --------------------------------------------------------------------------
ALTAICA4  ..........................................................................
ALTAICA1  ..........................................................................

TIGRIS1   ACGAAAGGACAAGAGAAATAAGGCCCACTTTACCAAAGCGCCTTTAACCAAATAGATGATATAATCTCAATCTAAACAGT 2640
TIGRIS2   ..........................................................................
SUMATRA1  ..........................................................................
SUMATRA2  ..........................................................................
CORBETTI1 ..........................................................................
CORBETTI2 ----------.....................................................................
ALTAICA4  ..........................................................................
ALTAICA1  ..........................................................................

TIGRIS1   TTATCTAAACATATCACCCGTAGAGCTCGGGTTTGTTAGGGTGGCAGAGCCCGGCAATTGCATAAAACTTAAGCTTTTAC 2720
TIGRIS2   ..........................................................................
SUMATRA1  ..........................................................................
SUMATRA2  ..........................................................................
CORBETTI1 ..........................................................................
CORBETTI2 ..........................................................................
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ALTAICA4  ..........................................................................
ALTAICA1  ..........................................................................

TIGRIS1   TATCAGAGGTTCAACTCCTCTCCCTAACAGCATGTTTATAATCAATATTCTCTCATTAATTATCCCTATTCTTCTCGCCG 2800
TIGRIS2   ..........................................................................
SUMATRA1  ..........................................................................
SUMATRA2  ..........................................................................
CORBETTI1 ..........................................................................
CORBETTI2 ..........................................................................
ALTAICA4  ..........................................................................
ALTAICA1  ..........................................................................

TIGRIS1   TAGCCTTCCTAACCCTAGTTGAACGTAAAGTACTGGGCTACATACAACTCCGTAAAGGACCAAACGTCGTAGGACCATAC 2880
TIGRIS2   ..........................................................................
SUMATRA1  ..........................................................................
SUMATRA2  ..........................................................................
CORBETTI1 ..........................................................................
CORBETTI2 ..........................................................................
ALTAICA4  ..........................................................................
ALTAICA1  ..........................................................................

TIGRIS1   GGCCTACTTCAGCCTATTGCAGACGCCATGAAACTCTTCACTAAAGAACCCCTCCGACCCCTCACATCCTCCACATTCAT 2960
TIGRIS2   ..........................................................................
SUMATRA1  ..........................................................................
SUMATRA2  ..........................................................................
CORBETTI1 ..........................................................................
CORBETTI2 ..........................................................................
ALTAICA4  ..........................................................................
ALTAICA1  ..........................................................................

TIGRIS1   ATTCATCACAGCACCCATCCTAGCTCTCACACTAGCCCTAACCATATGAATCCCACTGCCCATACCATACCCACTCATTA 3040
TIGRIS2   ..........................................................................
SUMATRA1  ........................T.................................................
SUMATRA2  ........................T.................................................
CORBETTI1 ........................T.................................................
CORBETTI2 ........................T.................................................
ALTAICA4  ........................T.................................................
ALTAICA1  ..........................................................................

TIGRIS1   ACATAAACTTAGGAGTGCTATTTATACTAGCTATGTCCAGCCTAGCTGTTTACTCCATTCTATGATCAGGATGGGCTTCA 3120
TIGRIS2   ..........................................................................
SUMATRA1  ..........................................................................
SUMATRA2  ..........................................................................
CORBETTI1 ..........................................................................
CORBETTI2 ..........................................................................
ALTAICA4  ..........................................................................
ALTAICA1  ..........................................................................

TIGRIS1   AACTCAAAATATGCCCTAATCGGAGCCCTACGAGCCGTAGCCCAAACAATCTCATATGAAGTCACATTAGCTATCATTCT 3200
TIGRIS2   ..........................................................................
SUMATRA1  ..........................................................................
SUMATRA2  ..........................................................................
CORBETTI1 ..........................................................................
CORBETTI2 ..........................................................................
ALTAICA4  ..........................................................................
ALTAICA1  ..........................................................................

TIGRIS1   CTTATCAGTACTACTAATAAATGGATCCTTCACATTAGCTGCACTAATTACCACCCAAGAATACATCTGGCTCATCATCC 3280
TIGRIS2   ..........................................................................
SUMATRA1  ..........................................................................
SUMATRA2  ..........................................................................
CORBETTI1 ..........................................................................
CORBETTI2 ..........................................................................
ALTAICA4  ..........................................................................
ALTAICA1  ..........................................................................

TIGRIS1   CTGCATGACCCCTAGCCATAATATGATTCATCTCCACACTAGCAGAAACCAACCGAGCTCCATTTGATCTAACAGAAGGA 3360
TIGRIS2   ..........................................................................
SUMATRA1  ..........................................................................
SUMATRA2  ..........................................................................
CORBETTI1 ..........................................................................
CORBETTI2 ..........................................................................
ALTAICA4  ..........................................................................
ALTAICA1  ..........................................................................

TIGRIS1   GAATCAGAACTCGTTTCCGGATTCAACGTAGAATACGCAGCAGGCCCCTTTGCCCTATTTTTTCTAGCAGAATACGCTAA 3440
TIGRIS2   ..........................................................................
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SUMATRA1  ..........................................................................
SUMATRA2  ..........................................................................
CORBETTI1 ..........................................................................
CORBETTI2 ..........................................................................
ALTAICA4  ..........................................................................
ALTAICA1  ..........................................................................

TIGRIS1   TATTATCATAATAAACATCCTCACAACAATCTTATTTTTCGGAGCATTCCATAATCCCTATATACCAGAACTATATACTA 3520
TIGRIS2   ..........................................................................
SUMATRA1  ..........................................................................
SUMATRA2  ..........................................................................
CORBETTI1 ..........................................................................
CORBETTI2 ..........................................................................
ALTAICA4  ..........................................................................
ALTAICA1  ..........................................................................

TIGRIS1   TCAACTTCACTGTAAAAACCCTAATTCTAACAACCACCTTCCTATGGATCCGAGCATCCTATCCACGATTCCGATATGAC 3600
TIGRIS2   ..........................................................................
SUMATRA1  ..........................................................................
SUMATRA2  ..........................................................................
CORBETTI1 ..........................................................T.....................
CORBETTI2 ..........................................................T.....................
ALTAICA4  ..........................................................T.....................
ALTAICA1  ..........................................................................

TIGRIS1   CAATTAATGCACCTCCTATGAAAAAACTTCCTACCCCTTACTCTAGCCCTATGCATATGACACGTCTCCCTACCCATCAT 3680
TIGRIS2   ..........................................................................
SUMATRA1  ..........................................................................
SUMATRA2  ..........................................................................
CORBETTI1 ..........................................................................
CORBETTI2 ..........................................................................
ALTAICA4  ..........................................................................
ALTAICA1  ..........................................................................

TIGRIS1   TACAGCAAGCATTCCACCCCAAACATAAGAAATATGTCTGACAAAAGAATTACTTTGATAGAGTAAAACATAGAGGTTTA 3760
TIGRIS2   ..........................................................................
SUMATRA1  ..........................................................................
SUMATRA2  ..........................................................................
CORBETTI1 ..........................................................................
CORBETTI2 ..........................................................................
ALTAICA4  ..........................................................................
ALTAICA1  ..........................................................................

TIGRIS1   AGCCCTCTTATTTCTAGAATTATAGGAATCGAACCTAATCCTAAGAATCCAAAAATCTTCGTGCTACCAATATTACACCA 3840
TIGRIS2   ..........................................................................
SUMATRA1  ..........................................................................C.......
SUMATRA2  ..........................................................................C.......
CORBETTI1 ..........................................................................
CORBETTI2 ..........................................................................
ALTAICA4  ..........................................................................
ALTAICA1  ..........................................................................

TIGRIS1   CATTCTAAGTAAGGTCAGCTAAATAAGCTATCGGGCCCATACCCCGAAAATGTTGGTTTACACCCTTCCCATACTAATCA 3920
TIGRIS2   ..........................................................................
SUMATRA1  ..........................................................................
SUMATRA2  ..........................................................................
CORBETTI1 ..........................................................................
CORBETTI2 ..........................................................................
ALTAICA4  ..........................................................................
ALTAICA1  ..........................................................................

TIGRIS1   AACCCCCTATCCTCACCATCATTATACTAACCGTTATCTCAGGAACTATAATCGTAATAACAACTTCTCACTGACTTATA 4000
TIGRIS2   ..........................................................................
SUMATRA1  ..........................................................................
SUMATRA2  ..........................................................................
CORBETTI1 ..........................................................................
CORBETTI2 ..........................................................................
ALTAICA4  ..........................................................................
ALTAICA1  ..........................................................................

TIGRIS1   GTCTGAATTGGCTTCGAAATAAACCTATTAGCTATTATTCCCATCCTCATGAAAAAATATAACCCACGAGCCATAGAAGC 4080
TIGRIS2   ..........................................................................A....
SUMATRA1  ..........................................................................
SUMATRA2  ..........................................................................
CORBETTI1 ..........................................................................
CORBETTI2 ..........................................................................
ALTAICA4  ..........................................................................
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ALTAICA1  ....................................................................................

TIGRIS1   AGCCACAAAATACTTCCTGACACAAGCAACCGCTTCAATACTCCTAATAATAGGAATTATCATCAACCTGCTGCACTCAG 4160
TIGRIS2   ....................................................................................
SUMATRA1  ....................................................................................
SUMATRA2  ....................................................................................
CORBETTI1 ....................................................................................
CORBETTI2 ....................................................................................
ALTAICA4  ....................................................................................
ALTAICA1  ....................................................................................

TIGRIS1   GACAATGAACCGTATCAAAAGACCTTAACCCCATGGCATCCATTATAATAACAACCGCCTTAGCAGTAAAACTAGGACTA 4240
TIGRIS2   ....................................................................................
SUMATRA1  ........................C.......................................................
SUMATRA2  ........................C.......................................................
CORBETTI1 ........................C.......................................................
CORBETTI2 ........................C.......................................................
ALTAICA4  ........................C.......................................................
ALTAICA1  ........................C.......................................................

TIGRIS1   GCCCCATTCCACTTCTGAGTGCCCGAAGTTACACAAGGAATCTCCTTGTCCTCAGGCCTGATCCTACTCACATGACAAAA 4320
TIGRIS2   ....................................................................................
SUMATRA1  ....................................................................................
SUMATRA2  ....................................................................................
CORBETTI1 ..................................................T.................................
CORBETTI2 ..................................................T.................................
ALTAICA4  ..................................................T.................................
ALTAICA1  ..................................................T.................................

TIGRIS1   AATCGCACCACTATCAATTCTTTACCAAATTTCACCCACCATTAACCCCAACCTACTCCTAGCAATAGCCATTATATCAG 4400
TIGRIS2   ....................................................................................
SUMATRA1  ....................................................................................
SUMATRA2  ....................................................................................
CORBETTI1 ....................................................................................
CORBETTI2 ....................................................................................
ALTAICA4  ....................................................................................
ALTAICA1  ....................................................................................

TIGRIS1   TTATAATCGGAGGCTGAGGGGGACTTAACCAAACCCAGCTACGAAAAATCATAGCATACTCCTCAATTGCCCATATAGGT 4480
TIGRIS2   ....................................................................................
SUMATRA1  ....................................................................................
SUMATRA2  ....................................................................................
CORBETTI1 ....................................................................................
CORBETTI2 ..........................................................................C.....
ALTAICA4  ..........................................................................C.....
ALTAICA1  ..........................................................................C.....

TIGRIS1   TGAATAACAGCCATCATAATATATAGCCCCACAATAATAATTTTAAACCTAACTATCTATATCATTATAACACTAACCAC 4560
TIGRIS2   ....................................................................................
SUMATRA1  ....................................................................................
SUMATRA2  ....................................................................................
CORBETTI1 ....................................................................................
CORBETTI2 ....................................................................................
ALTAICA4  ....................................................................................
ALTAICA1  ....................................................................................

TIGRIS1   TTTCATGTTACTCATATACAACTCCACCACAACAACATTATCCTTATCACAAACATGAAACAAAACGCCCCTGATCACCT 4640
TIGRIS2   ....................................................................................
SUMATRA1  ....................................................................................
SUMATRA2  ....................................................................................
CORBETTI1 ....................................................................................
CORBETTI2 ....................................................................................
ALTAICA4  ....................................................................................
ALTAICA1  ....................................................................................

TIGRIS1   CACTTATCCTACTGCTAATAATATCTCTAGGCGGCCTCCCCCCCACTCTCTGGCTTCATCCCAAAATGAATAATCATTCAA 4720
TIGRIS2   ....................................................................................
SUMATRA1  ............................G...................................................
SUMATRA2  ............................G...................................................
CORBETTI1 ............................G...................................................
CORBETTI2 ............................G...................................................
ALTAICA4  ............................G...................................................
ALTAICA1  ............................G...................................................

TIGRIS1   GAACTAACCAAAAATGAAATAATCATAATACCCACACTACTAGCCATAACAGCACTACTTAACCTATACTTCTACATACG 4800
TIGRIS2   ....................................................................................
SUMATRA1  ......................T.............................................................
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SUMATRA2  ......................T.....................................................
CORBETTI1 ......................................................................
CORBETTI2 ......................................................................
ALTAICA4  ......................................................................
ALTAICA1  ......................................................................

TIGRIS1   ACTAACATATACCACTGCACTAACTATATTCCCCTCAAACAACTGTATAAAAATAAAATGACGGTTCAAATGCACAAAAA 4880
TIGRIS2   ......................................................................
SUMATRA1  ......................................................................
SUMATRA2  ......................................................................
CORBETTI1 ......................................................................
CORBETTI2 ......................................................................
ALTAICA4  ......................................................................
ALTAICA1  ......................................................................

TIGRIS1   AAATAATCTTTTTACCCCCCTTAATCGTAATGTCCACCATACTACTCCCACTCACACCAATACTATCCGTCCTTGATTAG 4960
TIGRIS2   ......................................................................
SUMATRA1  ......................................................................
SUMATRA2  ......................................................................
CORBETTI1 ......................................................................
CORBETTI2 ......................................................................
ALTAICA4  ......................................................................
ALTAICA1  ......................................................................

TIGRIS1   AAGTTTAGGTTAAACTAGACCAAGAGCCTTCAAAGCTCTAAGTAAGCCCTATAGACTTAACTTCTGCATACCTATTAACT 5040
TIGRIS2   ......................................................................
SUMATRA1  ......................................................................
SUMATRA2  ......................................................................
CORBETTI1 ......................................................................
CORBETTI2 ......................................................................
ALTAICA4  ......................................................................
ALTAICA1  ......................................................................

TIGRIS1   CTAAGGACTGCAAGAATCTATCTTACATCAATTGACTGCAAATCAAACACTTTAATTAAGCTAAGCCCTTACTAGATTGG 5120
TIGRIS2   ......................................................................
SUMATRA1  ......................................................................
SUMATRA2  ......................................................................
CORBETTI1 ......................................................................
CORBETTI2 ......................................................................
ALTAICA4  ......................................................................
ALTAICA1  ......................................................................

TIGRIS1   TGGGCCCCAACCCCACGAAATTTTAGTTAACAGCTAAATACCCTAGTCAACTGGCTTCAATCTACTTCTCCCGCCGCCTG 5200
TIGRIS2   ......................................................................
SUMATRA1  ......................................................................
SUMATRA2  ......................................................................
CORBETTI1 ..........................................A.........................................
CORBETTI2 .......T..................................A.........................................
ALTAICA4  .......T..................................A.........................................
ALTAICA1  ..........................................A.........................................

TIGRIS1   GAAAAAAA-GGCGGGAGAAGCCCCGGCAGCGTCAAGCTGCTTCTTTGAATTTGCAATTCAATATGACATTCACTACAGGA 5280
TIGRIS2   ........-.............................................................................
SUMATRA1  ........A.............................................................................
SUMATRA2  ........A.............................................................................
CORBETTI1 ........A.............................................................................
CORBETTI2 ........A.............................................................................
ALTAICA4  ........A.............................................................................
ALTAICA1  ........A.............................................................................

TIGRIS1   CTTGGTAAAAAGAGGGTTAGAACCTCTGTCTTTAGATTTACAGTCTAATGCTTACTCAGCCATTTTACCTATGTTCATAA 5360
TIGRIS2   ......................................................................
SUMATRA1  ......................................................................
SUMATRA2  ......................................................................
CORBETTI1 ......................................................................
CORBETTI2 ......................................................................
ALTAICA4  ......................................................................
ALTAICA1  ......................................................................

TIGRIS1   ACCGCTGACTATTTTCAACCAATCACAAGGATATTGGAACTCTTTACCTTTTATTTGGCGCCTGGGCTGGTATGGTGGGG 5440
TIGRIS2   ......................................................................
SUMATRA1  ......................................................................
SUMATRA2  ......................................................................
CORBETTI1 ..........................................................T.........................
CORBETTI2 ..................................................................A.....
ALTAICA4  ..................................................................A.....
ALTAICA1  ......................................................................
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TIGRIS1   ACTGCCCTCAGTCTCCTAATTCGAGCCGAACTGGGTCAACCTGGCACACTACTAGGAGATGACCAAATTTATAATGTAGT 5520
TIGRIS2   ..............................................................................
SUMATRA1  ..............................................................................
SUMATRA2  ..............................................................................
CORBETTI1 ..........................T...................................................
CORBETTI2 ..............................................................................
ALTAICA4  ..............................................................................
ALTAICA1  ..............................................................................

TIGRIS1   AGTTACTGCCCATGCCTTTGTGATAATCTTTTTTATAGTAATGCCTATTATAATTGGAGGATTCGGAAACTGGCTAGTTC 5600
TIGRIS2   ..............................................................................
SUMATRA1  ..............................................................................
SUMATRA2  ..............................................................................
CORBETTI1 ..............................................................................
CORBETTI2 ..............................................................................
ALTAICA4  ..............................................................................
ALTAICA1  ..............................................................................

TIGRIS1   CGTTAATAATCGGAGCCCCCGATATGGCATTCCCTCGAATGAATAACATAAGCTTCTGACTCCTTCCCCCATCCTTCCTA 5680
TIGRIS2   ..............................................................................
SUMATRA1  ..............................................................................
SUMATRA2  ..............................................................................
CORBETTI1 ..............................................................................
CORBETTI2 ..............................................................................
ALTAICA4  ..............................................................................
ALTAICA1  ..............................................................................

TIGRIS1   CTTCTGCTCGCATCGTCTATGGTAGAAGCTGGGGCAGGAACTGGGTGGACAGTATACCCACCCCTAGCTGGCAACCTAGC 5760
TIGRIS2   ..............................................................................
SUMATRA1  ....................................G.........................................
SUMATRA2  ....................................G.........................................
CORBETTI1 ..............................................................................
CORBETTI2 ..............................................................................
ALTAICA4  ..............................................................................
ALTAICA1  ..............................................................................

TIGRIS1   CCATGCAGGAGCATCCGTGGATCTAACTATTTTTTCACTACACCTAGCAGGCGTCTCCTCAATCTTAGGTGCTATTAATT 5840
TIGRIS2   ..............................................................................
SUMATRA1  ..............................................................................
SUMATRA2  ..............................................................................
CORBETTI1 ..............................................................................
CORBETTI2 ..............................................................................
ALTAICA4  ..............................................................................
ALTAICA1  ..............................................................................

TIGRIS1   TTATTACTACTATTATTAATATAAAACCGCCCGCTATGTCCCAATACCAAACGCCCCTGTTTGTTTGATCGGTTCTAATT 5920
TIGRIS2   ..............................................................................
SUMATRA1  ..................................................A.............................
SUMATRA2  ..................................................A.............................
CORBETTI1 ..................................................A.............................
CORBETTI2 ..................................................A.............................
ALTAICA4  ..................................................A.............................
ALTAICA1  ..................................................A.............................

TIGRIS1   ACTGCTGTGTTGCTACTTCTATCACTGCCAGTTTTAGCAGCAGGCATCACCATGCTACTGACAGATCGAAATCTAAATAC 6000
TIGRIS2   ..............................................................................
SUMATRA1  ..............................................................................
SUMATRA2  ..............................................................................
CORBETTI1 ..............................................................................
CORBETTI2 ..........................................................................R.....
ALTAICA4  ..............................................................................
ALTAICA1  ..............................................................................

TIGRIS1   CACATTTTTTGATCCTGCCGGGGGGAGGAGACCCCATCTTATATCAACACCTATTCTGATTCTTCGGTCACCCAGAAGTCT 6080
TIGRIS2   ..............................................................................
SUMATRA1  ..............................................................................
SUMATRA2  ..............................................................................
CORBETTI1 ..............................................................................
CORBETTI2 ..............................................................................
ALTAICA4  ..............................................................................
ALTAICA1  ..............................................................................

TIGRIS1   ATATCTTAATCCTGCCCGGGTTTGGAATAATTTCACATATTGTCACCTACTACTCAGGCAAAAAAGAACCTTTTGGCTAC 6160
TIGRIS2   ..............................................................................
SUMATRA1  ..............................................................................
SUMATRA2  ..............................................................................
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CORBETTI1 ....................................................................
CORBETTI2 ....................................................................
ALTAICA4  ....................................................................
ALTAICA1  ....................................................................

TIGRIS1   ATGGGGATAGTCTGAGCCATAATGTCAATTGGCTTTCTGGGCTTTATCGTATGGGCCCATCACATGTTTACTGTAGGGAT 6240
TIGRIS2   ....................................................................
SUMATRA1  ....................................................................
SUMATRA2  ....................................................................
CORBETTI1 ....................................................................
CORBETTI2 ....................................................................
ALTAICA4  ....................................................................
ALTAICA1  ....................................................................

TIGRIS1   AGATGTGGATACACGAGCATACTTTACGTCAGCTACTATAATTATCGCTATTCCTACTGGGGTAAAAGTATTTAGCTGAT 6320
TIGRIS2   ....................................................................
SUMATRA1  ....................................................................
SUMATRA2  ....................................................................
CORBETTI1 ....................................................................
CORBETTI2 ....................................................................
ALTAICA4  ....................................................................
ALTAICA1  ....................................................................

TIGRIS1   TGGCCACTCTTCACGGGGGTAATATTAAATGGTCTCCCGCTATACTATGGGCTTTGGGATTCATTTTCCTATTCACCGTA 6400
TIGRIS2   ..A.................................................................
SUMATRA1  ....................................................................
SUMATRA2  ....................................................................
CORBETTI1 ....................................................................
CORBETTI2 ....................................................................
ALTAICA4  ....................................................................
ALTAICA1  ....................................................................

TIGRIS1   GGGGGCTTAACAGGAATTGTATTAGCAAACTCCTCATTGGATATTGTCCTTCACGACACATACTACGTAGTAGCCCACTT 6480
TIGRIS2   ....................................................................
SUMATRA1  ....................................................................
SUMATRA2  ....................................................................
CORBETTI1 ....................................................................
CORBETTI2 ....................C.............................................
ALTAICA4  ....................C.............................................
ALTAICA1  ....................................................................

TIGRIS1   CCACTACGTCTTGTCAATAGGAGCAGTATTTGCTATCATAGGGGGCTTCGTTCACTGATTCCCCTTATTCTCAGGGTATA 6560
TIGRIS2   ....................................................................
SUMATRA1  ....................................................................
SUMATRA2  ....................................................................
CORBETTI1 ....................................................................
CORBETTI2 ..................................T.................................
ALTAICA4  ..................................T.................................
ALTAICA1  ....................................................................

TIGRIS1   CTCTTGATAATACTTGGGCAAAAGTTCATTTTACGATCATGTTCGTAGGTGTCAATATAACGTTTTTCCCTCAGCATTTC 6640
TIGRIS2   ....................................................................
SUMATRA1  ....................................................................
SUMATRA2  ....................................................................
CORBETTI1 ....................................................................
CORBETTI2 ....................................................................T
ALTAICA4  ....................................................................
ALTAICA1  ............G.....................................................

TIGRIS1   CTAGGCCTGTCTGGGATGCCTCGACGTTATTCTGACTATCCAGACGCGTATACAACTTGAAACACAATCTCCTCAATAGG 6720
TIGRIS2   ....................................................................
SUMATRA1  ....................................................................
SUMATRA2  ....................................................................
CORBETTI1 ....................................................................
CORBETTI2 ....................................................................
ALTAICA4  ....................................................................
ALTAICA1  ....................................................................

TIGRIS1   CTCTTTTATTTCACTAACAGCAGTAATATTAATAGTCTTTATAGTGTGAGAAGCTTTCGCATCAAAGCGAGAAGTAGCCA 6800
TIGRIS2   ....................................................................
SUMATRA1  ....................................................................
SUMATRA2  ....................................................................
CORBETTI1 ....................................................................
CORBETTI2 ..........................................A.......................
ALTAICA4  ..........................................A.......................
ALTAICA1  ....................................................................
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TIGRIS1   CAGTGGAACTAACCACAACTAATCTCGAATGACTTCACGGATGTCCTCCTCCGTATCACACATTTGAAGAGCCAGCCTAC 6880
TIGRIS2   ................................................................................
SUMATRA1  ................................................................................
SUMATRA2  ................................................................................
CORBETTI1 ................................................................................
CORBETTI2 ................................................................................
ALTAICA4  ................................................................................
ALTAICA1  ................................................................................

TIGRIS1   GTGCTGTTAAAATAAGAAAGGAAGGAATCGAACCTCCTTAGACTGGTTTCAAGCCAATACCATAACCACTATGTCTTTCT 6960
TIGRIS2   ................................................................................
SUMATRA1  ................................................................................
SUMATRA2  ................................................................................
CORBETTI1 ................................................................................
CORBETTI2 .......G........................................................................
ALTAICA4  ................................................................................
ALTAICA1  ................................................................................

TIGRIS1   CAATTAAGAAGTATTAGTAAAATAATTACATAACTTTGTCAAAGTTAAATTATAGGTTTAAGCCCTATGTGCTTCCATGG 7040
TIGRIS2   ................................................................................
SUMATRA1  ................................................................................
SUMATRA2  ................................................................................
CORBETTI1 ................................................................................
CORBETTI2 ................................................................................
ALTAICA4  ................................................................................
ALTAICA1  ................................................................................

TIGRIS1   CATACCCCTTCCAGCTAGGTTTTCAAGATGCTACATCCCCCATTATAGAAGAGCTTTTACACTTCCATGATCATACATTA 7120
TIGRIS2   ................................................................................
SUMATRA1  ..............A.................................................................
SUMATRA2  ..............A.................................................................
CORBETTI1 ..............A.................................................................
CORBETTI2 ..............A.................................................................
ALTAICA4  ..............A.................................................................
ALTAICA1  ..............A.................................................................

TIGRIS1   ATAATTGTATTCCTAATTAGCTCCCTAGTCCTCTACATTATCTCATTAATACTGACAACTAAACTTACGCATACAAGCAC 7200
TIGRIS2   ................................................................................
SUMATRA1  ................................................................................
SUMATRA2  ................................................................................
CORBETTI1 ................................................................................
CORBETTI2 ................................................................................
ALTAICA4  ................................................................................
ALTAICA1  ................................................................................

TIGRIS1   AATAGACGCCCAAGAAGTAGAAACTATCTGAACCATTTTACCAGCCATCATCTTAATTCTCATTGCCCTGCCTTCCTTAC 7280
TIGRIS2   ................................................................................
SUMATRA1  ......T.........................................................................
SUMATRA2  ......T.........................................................................
CORBETTI1 ......T..............G...........................................................
CORBETTI2 ......T.........................................................................
ALTAICA4  ......T.........................................................................
ALTAICA1  ......T...............................C.........................................

TIGRIS1   GAATTCTCTATATAATAGATGAGATTAATAATCCCTCCCTCACTGTAAAGACTATAGGACATCAGTGATACTGAAGTTAT 7360
TIGRIS2   ................................................................................
SUMATRA1  ................................................................................
SUMATRA2  ................................................................................
CORBETTI1 ................................................................................
CORBETTI2 ................................................................................
ALTAICA4  ................................................................................
ALTAICA1  ................................................................................

TIGRIS1   GAGTACACCGACTATGAGGACCTAAGCTTCGACTCCTACATAATCCCCACTCAAGAGTTAAAGCCCGGAGAGCTCCGACT 7440
TIGRIS2   ................................................................................
SUMATRA1  ........................................G.......................................
SUMATRA2  ........................................G.......................................
CORBETTI1 ................................................................................
CORBETTI2 ................................................................................
ALTAICA4  ................................................................................
ALTAICA1  ..A.....................................................A.........................

TIGRIS1   ACTAGAAGTTGATAACCGAGTAGTGTTGCCAATAGAAGTGACTATTCGCATGTTAGTCTCATCAGAGGACGTACTGCACT 7520
TIGRIS2   ................................................................................
SUMATRA1  ................................................................................
SUMATRA2  ................................................................................
CORBETTI1 ................................................................................
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CORBETTI2 ..................................................A.......................
ALTAICA4  ..............................................................................
ALTAICA1  ..............................................................................

TIGRIS1   CGTGAGCCATCCCGTCCCTGGGCCTAAAAACTGACGCTATCCCAGGCCGACTAAACCAAACAACCCTAATAGGCACACGG 7600
TIGRIS2   ..............................................................................
SUMATRA1  ............A.............................................................
SUMATRA2  ............A.............................................................
CORBETTI1 ............A.............................................................
CORBETTI2 ............A.............................................................
ALTAICA4  ............A.............................................................
ALTAICA1  ............A.............................................................

TIGRIS1   CCTGGGCTATATTATGGTCAGTGCTCAGAAATCTGCGGCTCAAATCACAGTTTTATGCCCATTGTCCTTGAACTAGTCCC 7680
TIGRIS2   ..............................................................................
SUMATRA1  ..............................................................................
SUMATRA2  ..............................................................................
CORBETTI1 ..............................................................................
CORBETTI2 ..............................................................................
ALTAICA4  ..............................................................................
ALTAICA1  ..............................................................................

TIGRIS1   GCTGTCATATTTCGAAAAATGATCTGCATCTATACTGTAATTTCACTAAGAAGCTAAATTAGCGTTAACCTTTTAAGTTA 7760
TIGRIS2   ..............................................................................
SUMATRA1  ..............................................................................
SUMATRA2  ..............................................................................
CORBETTI1 ..............................................................................
CORBETTI2 RY.R........Y..............R.....R...........Y.................................
ALTAICA4  ................................G.............................................
ALTAICA1  ..............................................................................

TIGRIS1   AAAACTGGGAGTTCAAACCTCCCCTTAGTGACATGCCACAGTTAGACACATCAACCTGGTTTATTACTATTATTTCAATA 7840
TIGRIS2   ..............................................................................
SUMATRA1  ..............................................................................
SUMATRA2  ..............................................................................
CORBETTI1 ..............................................................................
CORBETTI2 ............Y.............A..................Y...........R..Y..Y...............
ALTAICA4  ..............................................................................
ALTAICA1  ..............................................................................

TIGRIS1   ATCATGACACTGTTCGTTATATTTCAACTAAAAATCTCAAAACATCTGTACCCATCAAGCCCAGAACCCAAATCTACAGC 7920
TIGRIS2   ..............................................................................
SUMATRA1  ..............................................................................
SUMATRA2  ..............................................................................
CORBETTI1 ..............................................................................
CORBETTI2 ..Y...........TR.....................................................R...............
ALTAICA4  ..............................................................................
ALTAICA1  ..............................................................................

TIGRIS1   TGCATTAAAACAGCCGAGTCCCTGAGAAAAAAAAATGAACGAAAATCTATTCACCTCTTTTACTACCCCAACAATAATAGG 8000
TIGRIS2   ..............................................................................
SUMATRA1  ..............................................................................
SUMATRA2  ..............................................................................
CORBETTI1 ..............................................................................
CORBETTI2 ..............K.RY..Y.........................................................
ALTAICA4  ..............................................................................
ALTAICA1  ..............................................................................

TIGRIS1   ACTGCCTGTTGTTGTGTTAATCGTTATGTTCCCCAGCATTCTATTTCCCTCACCTAACCGACTAATTAATAACCGCCTAG 8080
TIGRIS2   ..............................................................................
SUMATRA1  ..............................................................................
SUMATRA2  ..............................................................................
CORBETTI1 ..................................................G.............................
CORBETTI2 .Y...................YR.....................Y.............................Y...
ALTAICA4  ..................................................G.............................
ALTAICA1  ..................................................G.............................

TIGRIS1   TCTCACTCCAACAATGATTAGTACAACTTACATTAAAGCAAATACTGATTACCCACAATTACAAAGGACAAACCTGGGCC 8160
TIGRIS2   ..............................................................................
SUMATRA1  ..............................................................................
SUMATRA2  ..............................................................................
CORBETTI1 ................C.............................................................
CORBETTI2 ..............................................CC.TT............................
ALTAICA4  ..............................................................................
ALTAICA1  ......................G.......................................................

TIGRIS1   CTAATACTTATGTCTCTCATTTTATTTATTGGGTCAACAAATCTGCTAGGTCTACTACCTCACTCATTTACTCCAACTAC 8240
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TIGRIS2   ...........................................................................
SUMATRA1  ...........................................................................
SUMATRA2  ...........................................................................
CORBETTI1 ...........................................................................
CORBETTI2 ..........................................Y................................
ALTAICA4  ...........................................................................
ALTAICA1  ..........................................................C................

TIGRIS1   CCAATTATCAATAAACCTAGGCATAGCCATCCCCTTGTGAGCCGGCACCGTAATCACTGGATTCCGTCACAAAACTAAAG 8320
TIGRIS2   ...........................................................................
SUMATRA1  ...........................................................................
SUMATRA2  ...........................................................................
CORBETTI1 ...........................................................................
CORBETTI2 ..............Y............................................................
ALTAICA4  ...........................................................................
ALTAICA1  ...........................................................................

TIGRIS1   CATCCCTGGCCCACTTTCTACCACAAGGAACACCAGTCCCCTTAATCCCTATGCTCGTAATTATCGAAACTATCAGCCTT 8400
TIGRIS2   ...........................................................................
SUMATRA1  ...........................................................................
SUMATRA2  ...........................................................................
CORBETTI1 ...........................................................................
CORBETTI2 .....T.....................................................................
ALTAICA4  .....T.....................................................................
ALTAICA1  ...........................................................................

TIGRIS1   TTTATCCAGCCCGTAGCCCTAGCCGTACGACTCACAGCTAATATTACTGCAGGCCATTTATTAATACACCTAATTGGAGG 8480
TIGRIS2   ...........................................................................
SUMATRA1  ...........................................................................
SUMATRA2  ...........................................................................
CORBETTI1 ...........................................................................C.....
CORBETTI2 ..........................................................................Y.....
ALTAICA4  ...........................................................................C.....
ALTAICA1  ...........................................................................C.....

TIGRIS1   AGCTGCTTTAGCCCTAACAAATATTAGTGCCCCTACTGCTTTAATTACCTTTATCATCCTCATCCTACTAACAATTCTTG 8560
TIGRIS2   ...........................................................................
SUMATRA1  ..........................................................................G..........
SUMATRA2  ..........................................................................G..........
CORBETTI1 ..........................................................................G..........
CORBETTI2 ..........................................................................G..........
ALTAICA4  ..........................................................................G..........
ALTAICA1  ..........................................................................G..........

TIGRIS1   AATTCGCTGTAGCTCTAATCCAAGCCTATGTTTTTACCCTACTTGTGAGCCTATATTTACATGATAATACTTAATGACCC 8640
TIGRIS2   ...........................................................................
SUMATRA1  ....T.....................................................G.....................
SUMATRA2  ....T.....................................................G.....................
CORBETTI1 ..........................................................G.....................
CORBETTI2 ..........................................................G.....................
ALTAICA4  ..........................................................G.....................
ALTAICA1  ..........................................................G.....................

TIGRIS1   ACCAAACCCACGCATATCACATGGTTAATCCCAGCCCATGGCCACTTACAGGGGCCCTTTCGGCCCTACTAATAACCTCA 8720
TIGRIS2   ...........................................................................
SUMATRA1  ...........................................................................
SUMATRA2  ...........................................................................
CORBETTI1 ...........................................................................
CORBETTI2 .Y........................................................R..................
ALTAICA4  ...........................................................................
ALTAICA1  ...........................................................................

TIGRIS1   GGCCTGGCTATATGATTTCACTATAACTCAATACTACTATTAACTCTAGGAATAACCACTAACCTATTGACTATATACCA 8800
TIGRIS2   ...........................................................................
SUMATRA1  ...........................................................................
SUMATRA2  ...........................................................................
CORBETTI1 ...........................................................................
CORBETTI2 ..................................................................................Y..
ALTAICA4  ...........................................................................
ALTAICA1  ...........................................................................

TIGRIS1   ATGGTGACGAGACATCATTCGAGAGAGCACATTCCAAGGCCACCACACACCCATTGTTCAAAAAGGCCTCCGATACGGAA 8880
TIGRIS2   ...........................................................................
SUMATRA1  ......................G................................................................
SUMATRA2  ......................G................................................................
CORBETTI1 ......................G................................................................
CORBETTI2 ......................G................................................................
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ALTAICA4  ......................G..............................G.............................
ALTAICA1  ......................G..............................G.............................

TIGRIS1   TAATCCTTTTCATCATCTCAGAAGTATTCTTCTTCGCAGGATTTTTCTGGGCCTTCTATCACTCAAGCCTGGCCCCGACC 8960
TIGRIS2   ..............................................................................
SUMATRA1  ........................................T.....................................
SUMATRA2  ........................................T.....................................
CORBETTI1 ........................................T.....................................
CORBETTI2 ........................................T.....................................
ALTAICA4  ........................................T.....................................
ALTAICA1  ........................................T.....................................

TIGRIS1   CCCGAATTGGGAGGATGCTGGCCACCAACAGGTATTATTCCCCTAAACCCCCTAGAAGTCCCACTACTCAATACTTCTGT 9040
TIGRIS2   ..............................................................................
SUMATRA1  ..........................................................................C.....
SUMATRA2  ..........................................................................C.....
CORBETTI1 ..............................................................................
CORBETTI2 ..............................................................................
ALTAICA4  ..............................................................................
ALTAICA1  ..............................................................................

TIGRIS1   GCTCTTAGCTTCCGGAGTGTCAATCACCTGAGCCCATCATAGCCTAATAGAAGGAAATCGAAAACACATGCTCCAAGCAC 9120
TIGRIS2   ..............................................................................
SUMATRA1  ..............................................................................
SUMATRA2  ..............................................................................
CORBETTI1 ..............................................................................
CORBETTI2 ..............................................................................
ALTAICA4  ..............................................................................
ALTAICA1  ..............................................................................

TIGRIS1   TATTTATTACAATCTCCCTAGGAGTCTATTTTACCCTCCTCCAAGCCTCTGAGTACTATGAAACATCATTTACAATCTCG 9200
TIGRIS2   ..............................................................................
SUMATRA1  ..................................................................T.....
SUMATRA2  ..................................................................T.....
CORBETTI1 ..............................................................................
CORBETTI2 ..............................................................................
ALTAICA4  ..............................................................................
ALTAICA1  ..............................................................................

TIGRIS1   GACGGAGTTTATGGGTCCACCTTTTTCATAGCCACAGGGTTCCACGGACTACACGTAATTATTGGCTCTACCTTCCTAAT 9280
TIGRIS2   ..............................................................................
SUMATRA1  ..............................................................................
SUMATRA2  ..............................................................................
CORBETTI1 ..............................................................................
CORBETTI2 ....................................A.........................................
ALTAICA4  ..............................................................................
ALTAICA1  ..............................................................................

TIGRIS1   CGTATGTTTCTTGCGCCAACTAAAATACCACTTCACATCGAGCCACCATTTTGGATTCGAAGCCGCTGCTTGATATTGAC 9360
TIGRIS2   ..............................................................................
SUMATRA1  ......C.......................................................................
SUMATRA2  ......C.......................................................................
CORBETTI1 ..............................................................................
CORBETTI2 ..............................................................................
ALTAICA4  ..............................................................................
ALTAICA1  ..............................................................................

TIGRIS1   ATTTCGTAGACGTGGTTTGACTGTTCTTATACGTTTCCATTTATTGATGAGGATCCTATTCCCTTAGTATCAACAAGTAC 9440
TIGRIS2   ..............................................................................
SUMATRA1  ..............................................................................
SUMATRA2  ..............................................................................
CORBETTI1 ..............................................................................
CORBETTI2 ..............................................................................
ALTAICA4  ..............................................................................
ALTAICA1  ..............................................................................

TIGRIS1   AGTTGACTTCCAATCAACCAGTTTCGGTATAATCCGAAAGGGAATAATAAACATAATACTCGCTCTACTCACCAACACAC 9520
TIGRIS2   ..............................................................................
SUMATRA1  ..............................................................................
SUMATRA2  ..............................................................................
CORBETTI1 ..............................................................................
CORBETTI2 ..............................................................................
ALTAICA4  ..............................................................................
ALTAICA1  ..............................................................................

TIGRIS1   TTCTATCCACACTACTTGTACTCATCGCGTTCTGACTACCCCAACTAAACACCTATGCAGAAAAAGCAAGTCCTTATGAA 9600
TIGRIS2   ..............................................................................
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SUMATRA1  ...........................................................G..................
SUMATRA2  ...........................................................G..................
CORBETTI1 ...........................................................................
CORBETTI2 ...........................................................................
ALTAICA4  ...........................................................................
ALTAICA1  ...........................................................................

TIGRIS1   TGTGGATTTGACCCCATAGGATCCGCTCGCCTGCCCTTCTCCATAAAATTCTTCCTAGTAGCTATCACATTCTTGCTATT 9680
TIGRIS2   ...........................................................................
SUMATRA1  ...........................................................................
SUMATRA2  ...........................................................................
CORBETTI1 ...........................................................................
CORBETTI2 ............................T..............................................
ALTAICA4  ...........................................................................
ALTAICA1  ...........................................................................

TIGRIS1   CGACCTAGAAATTGCACTACTGCTCCCTCTTCCCTGAGCCTCACAAACAAACAAACTGTCAACCATGCTTATCACAGCCC 9760
TIGRIS2   ...........................................................................
SUMATRA1  ...........................................................................
SUMATRA2  ...........................................................................
CORBETTI1 ...........................................................................
CORBETTI2 ...........................................................................
ALTAICA4  ...........................................................................
ALTAICA1  ...........................................................................

TIGRIS1   TTCTACTAATCTCCCTATTAGCCGCAAGCCTAGCCTACGAGTGAACCCAAAAAGGATTAGAATGAACTGAATATGATAAT 9840
TIGRIS2   ...........................................................................
SUMATRA1  ...........................................................................
SUMATRA2  ...........................................................................
CORBETTI1 ...........................................................................
CORBETTI2 ...........................................................................
ALTAICA4  ...........................................................................
ALTAICA1  ...........................................................................

TIGRIS1   TAGTTTAAACTAAAACAAATGATTTCGACTCATTAGATTGTAGCTTACCCTATAATTATCAAATGTCCATAGTCTATGTT 9920
TIGRIS2   ...........................................................................
SUMATRA1  ...........................................................................
SUMATRA2  ...........................................................................
CORBETTI1 ...........................................................................
CORBETTI2 ...........................................................................
ALTAICA4  ...........................................................................
ALTAICA1  ...........................................................................

TIGRIS1   AACATCTTCCTGGCTTTCATCGTATCACTCATAGGACTATTAATGTACCGATCCCACTTAATATCCTCCCTTCTATGCTT 10000
TIGRIS2   ...........................................................................
SUMATRA1  ...........................................................................C.
SUMATRA2  ...........................................................................C.
CORBETTI1 ...........................................................................C.
CORBETTI2 ...........................................................................C.
ALTAICA4  ...........................................................................C.
ALTAICA1  ...........................................................................C.

TIGRIS1   AGAAGGCATAATACTATCCCTATTTATTATGATAACCATGGCAGTTCTAAACAATCACTTTACACTAGCTAGCATGACCC 10080
TIGRIS2   ...........................................................................
SUMATRA1  ...........................................................................
SUMATRA2  ...........................................................................
CORBETTI1 ...........................................................................
CORBETTI2 ...........................................................................
ALTAICA4  ...........................................................................
ALTAICA1  ...........................................................................

TIGRIS1   CCATTATCCTGCTAGTATTTGCAGCCTGCGAGGCAGCACTGGGCTTGTCCCTACTAGTAATGGTATCAAATACATATGGT 10160
TIGRIS2   ...........................................................................
SUMATRA1  ...........................................................................
SUMATRA2  ...........................................................................
CORBETTI1 ...........................................................................
CORBETTI2 ...........................................................................
ALTAICA4  ...........................................................................
ALTAICA1  ...........................................................................

TIGRIS1   ACCGACTATGTACAAAACCTAAACCTCTTGCAATGCTAAAAATTATTATCCCCACTGCCATACTCATACCAATAACATGA 10240
TIGRIS2   ...........................................................................
SUMATRA1  ...........................................................................
SUMATRA2  ...........................................................................
CORBETTI1 ...........................................................................
CORBETTI2 ...........................................................................
ALTAICA4  ...........................................................................
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ALTAICA1  ..........................................................................

TIGRIS1   TTATCAAAACCCAGCATAATCTGAATTAACTCAACCACCTATAGTTTTCTGATCAGCCTTGTTAGCCTGTCCTACTTAAA 10320
TIGRIS2   ..........................................................................
SUMATRA1  ..........................................................................
SUMATRA2  ..........................................................................
CORBETTI1 ..........................................................................
CORBETTI2 ..........................................................................
ALTAICA4  ..........................................................................
ALTAICA1  ..........................................................................

TIGRIS1   TCAACTAGGCGACAACAGCCTAAATCTCTCATTACTATTTTTCTCAGACTCACTCTCTGCACCCCTACTAGTATTAACAA 10400
TIGRIS2   ..........................................................................
SUMATRA1  ..........................................................................
SUMATRA2  ..........................................................................
CORBETTI1 ..........................................................................
CORBETTI2 ..........................................................................
ALTAICA4  ..........................................................................
ALTAICA1  ..........................................................................

TIGRIS1   CATGACTCTTACCACTAATGCTCATGGCTAGTCAATCACACCTGTCAAAAGAGACCCTAGCCCGAAAAAAACTATACATT 10480
TIGRIS2   ..........................................................................
SUMATRA1  ..........................................................................
SUMATRA2  ..........................................................................
CORBETTI1 ..........................................................................
CORBETTI2 ..........................................................................
ALTAICA4  ..........................................................................
ALTAICA1  ..........................................................................

TIGRIS1   ACAATACTTATTATCCTACAACTCCTCTTAATTATAACATTCACCGCTACAGAACTGATTATATTCTACATTCTATTCGA 10560
TIGRIS2   ..........................................................................
SUMATRA1  ..........................................................................
SUMATRA2  ..........................................................................
CORBETTI1 ..........C.............................................................
CORBETTI2 ..........................................................................
ALTAICA4  ..........................................................................
ALTAICA1  ..........................................................................

TIGRIS1   AGCTACATTAATCCCTACTCTTATTATTATCACTCGATGAGGCAATCAAACAGAGCGACTAAACGCTGGTCTGTACTTTC 10640
TIGRIS2   ..........................................................................
SUMATRA1  ..........................................................................
SUMATRA2  ..........................................................................
CORBETTI1 ..........................................................................
CORBETTI2 ..............Y...........................................................
ALTAICA4  ..........................................................................
ALTAICA1  ..........................................................................

TIGRIS1   TATTCTACACCCTGGTAGGCTCACTACCCCTCCTAGTCGCACTACTATACATCCAAAACACAACAGGAACTCTGAACTTC 10720
TIGRIS2   ..........................................................................
SUMATRA1  ..........................................................................
SUMATRA2  ..........................................................................
CORBETTI1 ..........................................................................
CORBETTI2 ..........................................................................Y...
ALTAICA4  ..........................................................................
ALTAICA1  ..........................................................................

TIGRIS1   CTAATTATTCAATACTGAGCCAAACCAATTTCAGCCACCTGATCTAATATCTTTCTCTGACTAGCATGCATAATAGCATT 10800
TIGRIS2   ..........................................................................
SUMATRA1  ..........................................................................
SUMATRA2  ..........................................................................
CORBETTI1 ..........................................................................
CORBETTI2 ..........................................................................
ALTAICA4  ..........................................................................
ALTAICA1  ..........................................................T.............................

TIGRIS1   CATAGTAAAAATACCTCTATATGGGCTCCACCTGTGACTACCAAAAGCACATGTCGAAGCTCCCATTGCCGGCTCAATAG 10880
TIGRIS2   ..........................................................................
SUMATRA1  ..........................................................................G.
SUMATRA2  ..........................................................................G.
CORBETTI1 ..........................................................................
CORBETTI2 ..........................................................................
ALTAICA4  ..........................................................................
ALTAICA1  ..........................................................................

TIGRIS1   TCCTTGCTGCTGTACTGTTGAAGCTAGGAGGATATGGAATGATACGCATTACAATCCTACTCAACCCCACAACAAACCAA 10960
TIGRIS2   ..........................................................................
SUMATRA1  ..........................................................................T
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SUMATRA2  ..........................................................................T
CORBETTI1 ............................G.............................................
CORBETTI2 ..........................................................................
ALTAICA4  ..........................................................................
ALTAICA1  ..........................................................................

TIGRIS1   ATGGCATACCCCTTCATAATGCTATCCCTATGGGGAATAATTATAACAAGCTCTATTTGTCTACGCCAGACAGACCTAAA 11040
TIGRIS2   ..........................................................................
SUMATRA1  ..........................................................................
SUMATRA2  ..........................................................................
CORBETTI1 ..........................................................................
CORBETTI2 ..........................................................................
ALTAICA4  ..........................................................................
ALTAICA1  ..........................................................................

TIGRIS1   ATCCCTAATCGCATATTCATCCGTAAGCCATATGGCCCTAGTAATCGTGGCCGTACTAATTCAAACACCTTGGAGTTACA 11120
TIGRIS2   ..........................................................................
SUMATRA1  ..........................................................................
SUMATRA2  ..........................................................................
CORBETTI1 ..........................................................................
CORBETTI2 ..........................................................................
ALTAICA4  ..........................................................................
ALTAICA1  ..........................................................................

TIGRIS1   TAGGAGCCACAGCTCTTATAATCGCCCACGGACTAACTTCCTCAGTGCTATTTTGCCTTGCAAACTCAAACTACGAACGA 11200
TIGRIS2   ..........................................................................
SUMATRA1  ..........................................................................
SUMATRA2  ..........................................................................
CORBETTI1 ..........................................................................
CORBETTI2 ..........................................................................
ALTAICA4  ..........................................................................
ALTAICA1  ..........................................................................

TIGRIS1   ATCCATAGCCGAACAATAATTCTCGCACGAGGCCTACAAACCATCCTCCCCCTAATAGCTGCTTGATGACTACTGGCCAG 11280
TIGRIS2   ..........................................................................
SUMATRA1  ..........................................................................
SUMATRA2  ..........................................................................
CORBETTI1 ..........................................................................
CORBETTI2 ..........................................................................
ALTAICA4  ..........................................................................
ALTAICA1  ..........................................................................

TIGRIS1   CCTCGCAAACCTGGCCCTACCTCCTACTATTAACCTAATTGCAGAGCTATTTGTAGTAGTGGCCTCCTTTTCATGATCTA 11360
TIGRIS2   ..........................................................................
SUMATRA1  ..........................................................................
SUMATRA2  ..........................................................................
CORBETTI1 ..........................................................................
CORBETTI2 ..........................................................................
ALTAICA4  ..........................................................................
ALTAICA1  ..........................................................................

TIGRIS1   ACATAACCATTACTCTCATGGGCACAAATATCATCATCACAGCCCTATATACCCTCTACATACTCATTACAACCCAACGA 11440
TIGRIS2   ..........................................................................
SUMATRA1  ..........................................................................
SUMATRA2  ..........................................................................
CORBETTI1 ..........................................................................
CORBETTI2 ..........................................................................
ALTAICA4  ..........................................................................
ALTAICA1  ..........................................................................

TIGRIS1   GGCAAATATACACACCACATTAAAAACATCAATCCATCATTCACACGAGAAAATGCCCTAATAACCCTTCATCTGCTCCC 11520
TIGRIS2   ..........................................................................
SUMATRA1  ..........................................................................
SUMATRA2  ..........................................................................
CORBETTI1 ..........................................................................
CORBETTI2 ..........................................................A.............
ALTAICA4  ..........................................................A.............
ALTAICA1  ..........................................................................

TIGRIS1   ACTTTTTCTCTTATCTCTCAACCCCAAAATCGTACTAGGTCCTATTTACTGTAAATATAGTTTAATAAAAACATTAGATT 11600
TIGRIS2   ..........................................................................
SUMATRA1  ..........................................................................
SUMATRA2  ..........................................................................
CORBETTI1 ..........................................................................C.
CORBETTI2 ..........................................................................
ALTAICA4  ..........................................................................
ALTAICA1  ..........................................................................
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TIGRIS1   GTGAATCTAATAATAGAAGTGCAAATCTTCCTATTTACCGAAAAAGTATGCAAGAGCTGCTAACTCATGCCCCCACGTAT 11680
TIGRIS2   ................................................................................
SUMATRA1  ................................................................................
SUMATRA2  ................................................................................
CORBETTI1 ................................................................................
CORBETTI2 ................................................................................
ALTAICA4  ................................................................................
ALTAICA1  ................................................................................

TIGRIS1   AAAAACGTGGCTTTTTCAACTTTTATAGGATAGAAGTAATCCATTGGTCTTAGGAGCCAAAAAATTGGTGCAACTCCAAA 11760
TIGRIS2   ................................................................................
SUMATRA1  ................................................................................
SUMATRA2  ................................................................................
CORBETTI1 ................................................................................
CORBETTI2 ................................................................................
ALTAICA4  ................................................................................
ALTAICA1  ................................................................................

TIGRIS1   TAAAAGTAATAAACCTACTTACCTCCTCTATACTCACTGCAATATTTATCCTACTCCTACCTATCATTACATCCAACACT 11840
TIGRIS2   ................................................................................
SUMATRA1  ......................................G.........................................
SUMATRA2  ......................................G.........................................
CORBETTI1 ......................................G.........................................
CORBETTI2 ......................................G.........................................
ALTAICA4  ......................................G.........................................
ALTAICA1  ......................................G.........................................

TIGRIS1   CAATTATATAAAAGTAACCTATACCCTCACTATGTAAAAACCACAATCTCTTACGCCTTTACCATTAGTATAATCCCAGT 11920
TIGRIS2   ................................................................................
SUMATRA1  ................................................................................
SUMATRA2  ................................................................................C
CORBETTI1 ................................................................................
CORBETTI2 ................................................................................C
ALTAICA4  ................................................................................
ALTAICA1  ................................................................................

TIGRIS1   CATAATATTCATTTCCTCCGGACAAGAGATAACCATCTCAAACTGATGTTGACTATCAATTCAAACCCTTAAATTATCAC 12000
TIGRIS2   ................................................................................
SUMATRA1  ................................................................................
SUMATRA2  ................................................................................
CORBETTI1 ................................................................................
CORBETTI2 ................................................................................
ALTAICA4  ................................................................................
ALTAICA1  ................................................................................

TIGRIS1   TAAGCTTCAAACTAGATTATTTCTCGATCATCTTCATCCCAGTAGCACTTTTCGTTACATGGTCGATCATAGAATTCTCA 12080
TIGRIS2   ................................................................................
SUMATRA1  ................................................................................
SUMATRA2  ................................................................................
CORBETTI1 ................................................................................
CORBETTI2 ................................................................................
ALTAICA4  ................................................................................
ALTAICA1  ................................................................................

TIGRIS1   ATGTGATACATACACACAGATCCCTATATTAACCAGTTCTTTAAGTACCTCCTTATATTCCTAATCACTATAATGATCTT 12160
TIGRIS2   ................................................................................
SUMATRA1  ................................................................................
SUMATRA2  ................................................................................
CORBETTI1 ................................................................................
CORBETTI2 ................................................................................
ALTAICA4  ................................................................................
ALTAICA1  ................................................................................

TIGRIS1   AGTGACCGCCAATAATCTATTTCAGCTGTTTATTGGATGGGAGGGAGTAGGAATTATATCTTTCCTACTTATCGGATGAT 12240
TIGRIS2   ................................................................................
SUMATRA1  ...A............................................................................
SUMATRA2  ................................................................................
CORBETTI1 ................................................................................
CORBETTI2 ................................................................................
ALTAICA4  ...A............................................................................
ALTAICA1  ................................................................................

TIGRIS1   GATATGGTCGAGCAGACGCAAACACTGCCGCCCTACAAGCAATTCTCTACAACCGTATTGGAGATGTGGGATTTATCATG 12320
TIGRIS2   ................................................................................
SUMATRA1  ..................................G.............................................
SUMATRA2  ..................................G.............................................
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CORBETTI1 ..............................T.G..............................A............
CORBETTI2 ..............................G..............................A............
ALTAICA4  ..............................G.............................................
ALTAICA1  ..............................G.............................................

TIGRIS1   GCCATAGCATGATTCCTTACCAACCTAAATGCATGAAACCTCCAACAAATCTTTATCACTCAACATGAAAGCCTGAATAT 12400
TIGRIS2   ...............................................................................
SUMATRA1  ...............................................................................
SUMATRA2  ...............................................................................
CORBETTI1 ...............................................................................
CORBETTI2 ...............................................................................
ALTAICA4  ...............................................................................
ALTAICA1  ...............................................................................

TIGRIS1   GCCATTACTAGGACTCCTCCTAGCCGCCACAGGCAAGTCCGCCCAATTTGGCCTACACCCATGATTGCCATCAGCCATAG 12480
TIGRIS2   ...............................................................................
SUMATRA1  ...............................................................................
SUMATRA2  ...............................................................................
CORBETTI1 ...............................................................................
CORBETTI2 ...............................................................................
ALTAICA4  ...............................................................................
ALTAICA1  ...............................................................................

TIGRIS1   AAGGTCCAACTCCCGTCTCCGCCCTACTCCACTCAAGCACAATAGTTGTAGCCGGAGTCTTCTTATTAATCCGCTTCCAC 12560
TIGRIS2   ...............................................................................
SUMATRA1  ...............................................................................
SUMATRA2  ...............................................................................
CORBETTI1 ...............................................................................
CORBETTI2 ...............................................................................
ALTAICA4  ...............................................................................
ALTAICA1  ...............................................................................

TIGRIS1   CCACTCATAGAACAAAATAAAGCCATACAAACCCTCACTCTATGCCTGGGGGCCATCACAACCCTATTCACAGCCATCTG 12640
TIGRIS2   ...............................................................................
SUMATRA1  ...............................................................................
SUMATRA2  ...............................................................................
CORBETTI1 ...............................................................................
CORBETTI2 ...............................................................................
ALTAICA4  ...............................................................................
ALTAICA1  ...............................................................................

TIGRIS1   TGCCCTCACACAAAATGATATTAAAAAAATTGTTGCTTTCTCAACTTCAAGCCAATTAGGCCTGATAATCGTTACTATCG 12720
TIGRIS2   ...............................................................................
SUMATRA1  ...............................................................................
SUMATRA2  ...............................................................................
CORBETTI1 ..............................A................................................
CORBETTI2 ...............................................................................
ALTAICA4  ...............................................................................
ALTAICA1  ...............................................................................

TIGRIS1   GAATTAACCAACCCTACCTTGCATTCCTGCATATCTGCACACACGCATTTTTTAAAGCCATATTATTCATGTGCTCCGGA 12800
TIGRIS2   ...............................................................................
SUMATRA1  ........................T......................................................
SUMATRA2  ...............................................................................
CORBETTI1 ...............................................................................
CORBETTI2 ...............................................................................
ALTAICA4  ........................T......................................................
ALTAICA1  ...............................................................................

TIGRIS1   TCAATTATCCACAGTCTAAACGACGAGCAAGATATTCGAAAAATAGGCGGACTATACAAACCAATACCCTTTACTACCAC 12880
TIGRIS2   ...............................................................................
SUMATRA1  ...............................................................................
SUMATRA2  ...........................................................T...................
CORBETTI1 ...............................................................................
CORBETTI2 ...........................................................T...................
ALTAICA4  ...............................................................................
ALTAICA1  ...............................................................................

TIGRIS1   CTCCCTTATTATCGGAAGCCTCGCATTAACAGGCATGCCATTCCTAACAGGCTTTTACTCCAAAGACCTAATCATCGAGA 12960
TIGRIS2   ...............................................................................
SUMATRA1  ...............................................................................
SUMATRA2  ...............................................................................
CORBETTI1 ...............................................................................
CORBETTI2 ...............................................................................
ALTAICA4  ...............................................................................
ALTAICA1  ...............................................................................
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TIGRIS1   CAGCCAATACGTCGTATACCAACGCCTGAGCCCTATTGGTCACTCTCATTGCTACATCCCTCACAGCCGCCTATAGTACT 13040
TIGRIS2   ................................................................................
SUMATRA1  ................................................................................
SUMATRA2  ................................................................................
CORBETTI1 ................................................................................
CORBETTI2 ................................................................................
ALTAICA4  ................................................................................
ALTAICA1  ................................................................................

TIGRIS1   CGAATCATATTCTTTGCACTCCTGGGGCAACCCCGATTCAACTCCCTAAGCCCAATCAATGAAAACAACCCCCACCTCAT 13120
TIGRIS2   ................................................................................
SUMATRA1  ................................................................................
SUMATRA2  ................................................................................
CORBETTI1 ................................................................................
CORBETTI2 ................................................................................
ALTAICA4  ................................................................................
ALTAICA1  ..T.............................................................................

TIGRIS1   CAACTCCATTAAACGTCTCTTAATTGGAAGCATTTTTGCAGGATACTTGATCTCCCATAACATCCCCCCAACGACCATCC 13200
TIGRIS2   ................................................................................
SUMATRA1  ................................................................................
SUMATRA2  ................................................................................
CORBETTI1 ................................................................................
CORBETTI2 ................................................................................
ALTAICA4  ................................................................................
ALTAICA1  ................................................................................

TIGRIS1   CACAAATGACCATACCCTGCCACCTAAAACTAACTGCTCTCGCCATGACCATCATAGGCTTTATCCTGGCATTAGAGCTT 13280
TIGRIS2   ................................................................................
SUMATRA1  ...............................................................T................
SUMATRA2  ................................................................................
CORBETTI1 ................................................................................
CORBETTI2 ................................................................................
ALTAICA4  ...............................................................T................
ALTAICA1  ................................................................................

TIGRIS1   AACCTCGTGGCTAAAAACTTAAAATTTAAATACCCCTCAAATCTTTTTAAGTTTTCTAACCTCCTCGGGTACTTTCCAAT 13360
TIGRIS2   ................................................................................
SUMATRA1  ................................................................................
SUMATRA2  ................................................................................
CORBETTI1 ................................................................................
CORBETTI2 ..............................................................G.............
ALTAICA4  ................................................................................
ALTAICA1  ................................................................................

TIGRIS1   CGTAATTCACCGCCTCCCATCGATAATAAGCCTAACCATAAGCCAAAAATCCGCATCGATACTATTAGATATAATCTGGC 13440
TIGRIS2   ................................................................................
SUMATRA1  ................................................................................
SUMATRA2  ................................................................................
CORBETTI1 ..............................................................C.............
CORBETTI2 ................................................................................
ALTAICA4  ................................................................................
ALTAICA1  ................................................................................

TIGRIS1   TAGAAAATGTATTACCAAAATCCATCTCCCACTTCCAAATAAAAATATCAACCGCCGTATCTAATCAGAAGGGACTAGTT 13520
TIGRIS2   ................................................................................
SUMATRA1  ................................................................................
SUMATRA2  ................................................................................
CORBETTI1 ................................................................................
CORBETTI2 ................................................................................
ALTAICA4  ................................................................................
ALTAICA1  ................................................................................

TIGRIS1   AAGCTCTACTTCCTATCCTTCATAATCACCCTGACCCTTAGCCTACTCTTACTTAGTTTCCACGAGTAACCTCTATAATC 13600
TIGRIS2   ................................................................................
SUMATRA1  ..................T.............................................................
SUMATRA2  ..................T.............................................................
CORBETTI1 ................................................................................
CORBETTI2 ................................................................................
ALTAICA4  ................................................................................
ALTAICA1  ................................................................................

TIGRIS1   ACCAATACACCAATAAGCAAAGACCAACCAGTGACAACCACTAGCCAGGTTCCATAACTATACAGTGCTGCAATTCCTAT 13680
TIGRIS2   ................................................................................
SUMATRA1  ................................................................................
SUMATRA2  ................................................................................
CORBETTI1 ................................................................................
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CORBETTI2 ..........................................................................
ALTAICA4  ..........................................................................
ALTAICA1  ..........................................................................

TIGRIS1   GGCCTCCTCACTAAAAAACCCCGAGTCACCCGTATCATAGATCACTCAATCACCCGCACCATTAAACTTAAATACAACCT 13760
TIGRIS2   ..........................................................................
SUMATRA1  ........................................................................C.......
SUMATRA2  ........................................................................C.......
CORBETTI1 ........................................................................C.......
CORBETTI2 ........................................................................C.......
ALTAICA4  ........................................................................C.......
ALTAICA1  ........................................................................C.......

TIGRIS1   CAACCTCATCTTCCTTTAAAATATAGCAAGCAGTCAACAACTCCGCTAATACCCCCGTAATAAACGCACCTAATACGGCT 13840
TIGRIS2   ..........................................................................
SUMATRA1  ..........................................................................
SUMATRA2  ..........................................................................
CORBETTI1 ..........................................................................
CORBETTI2 ..........................................................................
ALTAICA4  ..........................................................................
ALTAICA1  ..........................................................................

TIGRIS1   TTATTGGATGTCCACGCCTCGGGGGTAGGGCTCAGTAGCCATAGCTGTAGTGTACCCAAACACCACAAGCATGCCCCCCAA 13920
TIGRIS2   ..........................................................................
SUMATRA1  ..........................................................................
SUMATRA2  ..........................................................................
CORBETTI1 ..........................................................................
CORBETTI2 .....A....................................................................
ALTAICA4  .....A....................................................................
ALTAICA1  ........................................................................T.....

TIGRIS1   ATAAATTAAAAAAACTATTAAACCTAAAAATGACCCCCCAAAATTCAATACAATACCGCAACCAACACCACCAGCCACAA 14000
TIGRIS2   ..........................................................................
SUMATRA1  ..........................................................................
SUMATRA2  ..........................................................................
CORBETTI1 ..........................................................................
CORBETTI2 ..........................................................................
ALTAICA4  ..........................................................................
ALTAICA1  ..........................................................................

TIGRIS1   TCAATCCAAGCCCACCATAAATAGGAGAAGGCTTTGAAGAAAAACTCACAAAGCTCACCACGAAAATTGTACTTAAAATA 14080
TIGRIS2   ..........................................................................
SUMATRA1  ..........................................................................
SUMATRA2  ..........................................................................
CORBETTI1 ..........................................................................
CORBETTI2 ..........................................................................
ALTAICA4  ..........................................................................
ALTAICA1  ..........................................................................

TIGRIS1   AATACAATGTATGTTATCATAATTCTCACATGGATTCTAACCACGACCAATGATATGAAAAACCATCGTTGTATTTCAAC 14160
TIGRIS2   ..........................................................................
SUMATRA1  ..........................................................................
SUMATRA2  ..........................................................................
CORBETTI1 ..........................................................................
CORBETTI2 ..........................................................................
ALTAICA4  ..........................................................................
ALTAICA1  ..........................................................................

TIGRIS1   TATAAGAACTTAATGACCAACATTCGAAAATCACACCCCCTTATCAAAATTATTAATCACTCATTTATTGACCTACCCGC 14240
TIGRIS2   ..........................................................................
SUMATRA1  ..........................................................................
SUMATRA2  ..........................................................................
CORBETTI1 ........................................................................A.
CORBETTI2 ..........................................................................
ALTAICA4  ..........................................................................
ALTAICA1  ..........................................................................

TIGRIS1   CCCATCCAATATTTCAGCATGATGAAACTTTGGCTCCTTACTAGGGGTGTGCTTAATCTTACAAATCCTCACTGGCCTCT 14320
TIGRIS2   ..........................................................................
SUMATRA1  ..........................................................................
SUMATRA2  ..........................................................................
CORBETTI1 ..........................................................................
CORBETTI2 ..........................................................................
ALTAICA4  ..........................................................................
ALTAICA1  ........................................................................C.......

TIGRIS1   TTCTAGCCATACACTACACATCAGACACAATAACCGCTTTCTCATCAGTTACCCACATTTGCCGCGACGTAAACTACGGC 14400
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TIGRIS2   ..........................................................................
SUMATRA1  ....................................A.....................................
SUMATRA2  ....................................A.....................................
CORBETTI1 ..........................................................................
CORBETTI2 ..........................................................................
ALTAICA4  ..........................................................................
ALTAICA1  ..........................................................................

TIGRIS1   TGGATTATCCGATATCTACATGCCAACGGAGCCTCCATATTCTTTATCTGTCTATACATGCACGTAGGACGAGGAATATA 14480
TIGRIS2   ..........................................................................
SUMATRA1  ..........................................................................
SUMATRA2  ..........................................................................
CORBETTI1 ..........................................................................
CORBETTI2 ..........................................................................
ALTAICA4  ..........................................................................
ALTAICA1  ..........................................................................

TIGRIS1   CTACGGCTCCTACACCTTCTCAGAAACATGAAACATCGGGATTGTGCTATTGTTTACGGTCATGGCTACAGCCTTCATAG 14560
TIGRIS2   ..........................................................................
SUMATRA1  ................................T.....................................
SUMATRA2  ................................T.....................................
CORBETTI1 ................................T...................A.....................
CORBETTI2 ................................T.....................................
ALTAICA4  ................................T.....................................
ALTAICA1  ................................T.........C.....................................

TIGRIS1   GATATGTCTTACCATGAGGCCAAATGTCTTTTTGAGGGGCAACCGTAATCACCAACCTCCTGTCAGCAATCCCATATATT 14640
TIGRIS2   ..........................................................................
SUMATRA1  ..........................................................................
SUMATRA2  ..........................................................................
CORBETTI1 ..........................................................................
CORBETTI2 ..........................................................................
ALTAICA4  ..........................................................................
ALTAICA1  ..........................................................................

TIGRIS1   GGGACCGACCTAGTAGAGTGAATCTGAGGGGGTTTCTCAGTAGACAAAGCTACCCTGACACGATTCTTTGCCTTCCACTT 14720
TIGRIS2   ..........................................................................
SUMATRA1  ..........................................................................
SUMATRA2  ..........................................................................
CORBETTI1 ..........................................................................
CORBETTI2 ..........................................................................
ALTAICA4  ..........................................................................
ALTAICA1  ..........................................................................

TIGRIS1   CATCCTTCCGTTTATCGTCTCAGCCCTAGCAGCAGTCCACCTCCTATTCCTTCACGAAACAGGATCCAATAACCCCTCAG 14800
TIGRIS2   ..........................................................................
SUMATRA1  ..........................................................................
SUMATRA2  ..........................................................................
CORBETTI1 .........A................................................................
CORBETTI2 .........A.....................................Y..R...........Y..........
ALTAICA4  ..........................................................................
ALTAICA1  ..........................................................................

TIGRIS1   GAATGGTGTCCGACTCAGACAAAATCCCATTCCACCCATACTACACAATTAAAGATATCTTAGGCCTCTTAGTACTAATC 14880
TIGRIS2   ..........................................................................
SUMATRA1  ..........................................................................G..
SUMATRA2  ..........................................................................G..
CORBETTI1 ..........................................................................
CORBETTI2 .......R..Y..............R.....................Y.....Y.....R.....Y............
ALTAICA4  ..........................................................................
ALTAICA1  ..........................................................................

TIGRIS1   CTAACCCTCATACTACTCGTCCTATTCTCACCAGACCTATTAGGAGACCCTGATAACTACATCCCCGCCAACCCCCTAAA 14960
TIGRIS2   ..........................................................................
SUMATRA1  ..........................................................................
SUMATRA2  ..........................................................................
CORBETTI1 ..........C...............................................................
CORBETTI2 ..........Y.................................R.....Y.......................Y.....
ALTAICA4  ..........C...............................................................
ALTAICA1  ..........................................................................

TIGRIS1   TACCCCTCCCCATATTAAGCCCGAATGGTATTTCCTATTCGCATACGCAATCCTCCGATCTATTCCCAATAAACTAGGAG 15040
TIGRIS2   ..........................................................................
SUMATRA1  ..........................................................................
SUMATRA2  ..........................................................................
CORBETTI1 ..........................................................................
CORBETTI2 Y............Y....S................Y.....................................R.
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ALTAICA4  ..........................................................................
ALTAICA1  ..........................................................................

TIGRIS1   GAGTTCTAGCCCTAGTCTTATCCATCTTAATCTTAGCCATTATCCCTGCCCTCCACACATCCAAACAACGAGGAATAATG 15120
TIGRIS2   ..........................................................................
SUMATRA1  ..........................................................................
SUMATRA2  ..........................................................................
CORBETTI1 ..........................................................................
CORBETTI2 .....Y......Y....Y.............................Y.............................
ALTAICA4  ....................................C.....................................
ALTAICA1  ..........................................................................

TIGRIS1   TTTCGACCGCTAAGCCAATGCTTATTCTGACTCTTAGTGGCAGACCTTCTGACCCTAACATGAATTGGTGGCCAACCTGT 15200
TIGRIS2   ..........................................................................
SUMATRA1  ........A.................................................................
SUMATRA2  ........A.................................................................
CORBETTI1 ........A.........................................A........................
CORBETTI2 .....R...........R...Y.......Y.........R..............R...........Y..........
ALTAICA4  ..........................................................A...............
ALTAICA1  ..........................................................................

TIGRIS1   AGAACACCCCTTTATTGCCATCGGCCAACTAGCCTCTATCCTATACTTCTTCATCCTCCTAGTCCTAATACCCATCTCAG 15280
TIGRIS2   ..........................................................................
SUMATRA1  ..........................................................................
SUMATRA2  ..........................................................................
CORBETTI1 ..........................................................................
CORBETTI2 ......Y.....Y...R...................Y.....................YY..R...................
ALTAICA4  ..............................................................G...............
ALTAICA1  ..........................................................................

TIGRIS1   GCATTATTGAAAACCGCCTCCTTAAATGAAGAGTCTTCGTAGTATATAAATTACTTTGGTCTTGTAAACCAAAAAAGGAG 15360
TIGRIS2   ..........................................................................
SUMATRA1  ..........................................................................
SUMATRA2  ..........................................................................
CORBETTI1 ..........................................................................
CORBETTI2 ..................................................-----------------------------
ALTAICA4  ..........................................................................
ALTAICA1  ..........................................................................

TIGRIS1   AATATGTACTCTCCCTAAGACTTCAAGGAAGAAGCAATAGCCCCACCATCAGCACCCAAAGCTGAAATTCTTTCTTAAAC 15440
TIGRIS2   ..........................................................................
SUMATRA1  ..........................................................................
SUMATRA2  ..........................................................................
CORBETTI1 ..........................................................................
CORBETTI2 ---------------------------------------------------------------------------
ALTAICA4  ..........................................................................
ALTAICA1  ..........................................................................

TIGRIS1   TATTCCTTGCCAATACCAAAAAACAACCCCATGACTTTCATAATTCATATATTGCATATACCCGTACTGTGCTTGCCCAG 15520
TIGRIS2   ..........................................................................
SUMATRA1  ..........................................................................
SUMATRA2  ..........................................................................
CORBETTI1 .........T................................................................
CORBETTI2 ---------------------------------------------------------------------------
ALTAICA4  ..........................................................................
ALTAICA1  ............C.............................................................

TIGRIS1   TATGTCCTCATCCCCACAAAAA-TAAGTGAAAAAATCCTCAATCCCCGTTAATACAGAACACACAACACGAAATAACCTG 15600
TIGRIS2   ......................-...................................................
SUMATRA1  ......................A...................................................
SUMATRA2  ......................A...................................................
CORBETTI1 ......................A...................................................
CORBETTI2 ---------------------------------------------------------------------------
ALTAICA4  ......................A...................................................
ALTAICA1  ......................A...................................................

TIGRIS1   TTAATTACCGGACCCCCCCCCTCCCCCCGT-AATACATTACGTAAGGCATACTATGTATATCGTGCATTAATCGCCTGTC 15680
TIGRIS2   ............................-.............................................
SUMATRA1  ....C.........................T.............G...................G.........T......
SUMATRA2  ....C.........................T.............G.................................
CORBETTI1 ....C.........................T.............G...................G.............
CORBETTI2 ---------------------------------------------------------------------------
ALTAICA4  ....C.........................T..C..........G...................G.............
ALTAICA1  ....C.........................T.............G.................................

TIGRIS1   CCCATGAATATTAAGCATGTACAGTAGTTTATATATATTACATAAGGCATACTATGTATATCGTGCATTAATCGCTTGTC 15760
TIGRIS2   ..........................................................................
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SUMATRA1  ..........................................................G.................
SUMATRA2  ..........................................................G.................
CORBETTI1 .......................A..................................G.................
CORBETTI2 ---------------------------------------------------------------------------
ALTAICA4  ..........................................................G.................
ALTAICA1  ..........................................................G.................

TIGRIS1   CCCATGAATATTAAGCATGTACAGTAGTTTATATATATTACATAAGACATAATAGTGCTTAATCGTGCATATTCATGATT 15840
TIGRIS2   ..........................................................G.................
SUMATRA1  ..........................................................G.................
SUMATRA2  ..........................................................G.................
CORBETTI1 ..........................................................G.................
CORBETTI2 ---------------------------------------------------------------------------
ALTAICA4  ..........................C.....................................................
ALTAICA1  ..........................C.....................................................

TIGRIS1   TAGAGCAGTTCTTTCATGGATCTCAACTATCCGAAAGAGCTTAATCACCTGGCCTCGAGAAACCAACAACCCTTGCTCGA 15920
TIGRIS2   ..........................................................G.................
SUMATRA1  ..........................G...A.....................................................
SUMATRA2  ..........................G.....................................................
CORBETTI1 ..A.....................................................A.....................
CORBETTI2 ---------------------------------------------------------------------------
ALTAICA4  ..A.A.....................C.....................................................
ALTAICA1  ..........................................................G.................

TIGRIS1   GCGTGTACCTCTT-CTCGCTCCGGGCCCATTTCAACGTGGGGGTGTCTATAGTGAAAC---------------------- 15978
TIGRIS2   ............-.....................................................TATATCTGGCATCTGGTTCTTA
SUMATRA1  ............-.....................................................-.TATATCTGGCATCTGGTTCTTA
SUMATRA2  ............-.....................................................TATATCTGGCATCTGGTTCTTA
CORBETTI1 ............-.....................................AC.....TATATCTGGCATCTGGTTCTTA
CORBETTI2 ---------------------------------------------------------------------------
ALTAICA4  ............T.....................................C..........TATACCTGGCATCTGGTTCTTA
ALTAICA1  ............-.....................................C..........TATACCTGGCATCTGGTTCTTA

TIGRIS1   ---------------------------------------------------------------------------- 15978
TIGRIS2   CTTCAGGGTCATGACATTCTTAAATCCAATCCTTCAACTTTCTCAAATAGGACATCTCGATGGGTTAATGACTAATCAGC
SUMATRA1  CTTCAGGGTCATGACATTCTTAAATCCAATCCTTCAACTTTCTCAAATAGGACATCTCGATGGGTTAATGACTAATCAGC
SUMATRA2  CTTCAGGGTCATGACATTCTTAAATCCAATCCTTCAACTTTCTCAAATAGGACATCTCGATGGGTTAATGACTAATCAGC
CORBETTI1 CTTCAGGGTCATGACATTCTTAAATCCAATCCTTCAACTTTCTCAAATAGGACATCTCGATGGGTTAATGACTAATCAGC
CORBETTI2 ---------------------------------------------------------------------------
ALTAICA4  CTTCAGGGTCATGACATTCTTAAATCCAATCCTTCAACTTTCTCAAATAGGACATCTCGATGGGTTAATGACTAATCAGC
ALTAICA1  CTTCAGGGTCATGACATTCTTAAATCCAATCCTTCAACTTTCTCAAATAGGACATCTCGATGGGTTAATGACTAATCAGC

TIGRIS1   ---------------------------------------------------------------------------- 15978
TIGRIS2   CCATGATCACACATAACTGTGGTGTCATGCATTTGGTATTTTTAATTTTTAGGGGGTCGAACTTGCTATGACTCAGCTAT
SUMATRA1  CCATGATCACACATAACTGTGGTGTCATGCATTTGGTATTTTTAATTTTTAGGGGGTCGAACTTGCTATGACTCAGCTAT
SUMATRA2  CCATGATCACACATAACTGTGGTGTCATGCATTTGGTATTTTTAATTTTTAGGGGGTCGAACTTGCTATGACTCAGCTAT
CORBETTI1 CCATGATCACACATAACTGTGGTGTCATGCATTTGGTATTTTTAATTTTTAGGGGGTCGAACTTGCTATGACTCAGCTAT
CORBETTI2 ---------------------------------------------------------------------------
ALTAICA4  CCATGATCACACATAACTGTGGTGTCATGCATTTGGTATTTTTAATTTTTAGGGGGTCGAACTTGCTATGACTCAGCTAT
ALTAICA1  CCATGATCACACATAACTGTGGTGTCATGCATTTGGTATTTTTAATTTTTAGGGGGTCGAACTTGCTATGACTCAGCTAT

TIGRIS1   ---------------------------------------------------------------------------- 15978
TIGRIS2   GACCTAAAGGTCCCGACTCAGTCAAATATAATGTAGCTGGACTTATTCTCTATGCGGGGGTTCCACACGTACAACAAACA
SUMATRA1  GACCTAAAGGTCCCGACTCAGTCAAATATAATGTAGCTGGGCTTATTCTCTATGCGGGGGTTCCACACGTACAACAAACA
SUMATRA2  GACCTAAAGGTCCCGACTCAGTCAAATATAATGTAGCTGGGCTTATTCTCTATGCGGGGGTTCCACACGTACAACAAACA
CORBETTI1 GACCTAAAGGTCCCGACTCAGTCAAATATAATGTAGCTGGACTTATTCTCTATGCGGGGGTTCCACACGTACAACAAACA
CORBETTI2 ---------------------------------------------------------------------------
ALTAICA4  GACCTAAAGGTCCCGACTCAGTCAAATATAATGTAGCTGGACTTATTCTCTATGCGGGGGTTCCACACGTACAACAAACA
ALTAICA1  GACCTAAAGGTCCCGACTCAGTCAAATATAATGTAGCTGGACTTATTCTCTATGCGGGGGTTCCACACGTACAACAAACA

TIGRIS1   ----------------------------------------------------------------------------GCG 15981
TIGRIS2   AGGTGTTATTCAGTCAATGGTCACAGGACATATACTTAAATTCCTATTGTTCCACAGGACACGGCATGCGCGCACCCA..
SUMATRA1  AGGTGTTATTCAGTCAATGGTCGCAGGACATATACTTAAATTCCTATTGTTCCACAGGACACGGCATGCGCGCACCCA..
SUMATRA2  AGGTGTTATTCAGTCAATGGTCGCAGGACATATACTTAAATTCCTATTGTTCCACAGGACACGGCATGCGCGCACCCA..
CORBETTI1 AGGTGTTATTCAGTCAATGGTCACAGGACATATACTTAAATTCCTATTGTTCCACAGGACACGGCATGCGCGCACCCA..
CORBETTI2 ---------------------------------------------------------------------------
ALTAICA4  AGGTGTTATTCAGTCAATGGTCACAGGACATATACTTAAATTCCTATTGTTCCACAGGACACGGCATGCGCGCACCCA..
ALTAICA1  AGGTGTTATTCAGTCAATGGTCGCAGGACATATACTTAAATTCCTATTGTTCCACAGGACACGGCATGCGCGCACCCA..

TIGRIS1   TACACGTATACACGTACACACGTACACACGTACACACGTACACACGTACACACGTATACACGTACACACGTACAC----- 15996
TIGRIS2   ..T...CG........T.....................................C.......T.......T..-----
SUMATRA1  ..T...CG.....................................................T..G.......--GTA
SUMATRA2  ..T...CG.....................................................C...................ACGTA
CORBETTI1 ..T...CGY.......T.......T.............T.......T.......C.......T.......T..-----
CORBETTI2 ---------------------------------------------------------------------------
ALTAICA4  ..T...CG........T.....................................C.......T.......T..-----
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ALTAICA1  ..T...CG.................................R.......R....C.--...GT..........-----

TIGRIS1   ---ACGTACACACGTACACACGTACACACGTAYACACGTATACACGTACAC------ACGTACACACGTACACACGTACA 16067
TIGRIS2   ---.............................C.......C.......T..------.......................
SUMATRA1  CAC.............................T..........G.......GTACAC.....................T.
SUMATRA2  TAC.............................C................T..ACGTAT.......................
CORBETTI1 ---.............T.......T.......C.......C..------..GTATAC.....................
CORBETTI2 ---------------------------------------------------------------------------------
ALTAICA4  ---.....T.......T.......T.......T..........------..GTATAC.....T.......T.......T.
ALTAICA1  ---.............................C..R....C..GT......GTACAC.....................

TIGRIS1   CACGTACACACGTATACACGTATA------CACGTACACACGTACACACGTACAC------ACGTACACACGTACACGCG 16135
TIGRIS2   ..............C.........------.......T.......Y..........------.................A..
SUMATRA1  ..............C.......C.------......T.......T..G.......GTACAC.................A..
SUMATRA2  ..............C.......C.------..............T.......T..GCGTAC.................A..
CORBETTI1 ......T.................CGCGTA.........................------.................A..
CORBETTI2 ---------------------------------------------------------------------------------
ALTAICA4  ..............C.......C.------..............T.......T..------.....T.......T.....
ALTAICA1  ..............C.......C.CGTGTA.........................------.................A..

TIGRIS1   TATACG?GTAYAC--GTACACACGTACACACGTACACACGTACACACGTACACACGTACACACGTATACACGTATACACG 16213
TIGRIS2   .....AC...T..--.CGT.....................................................................
SUMATRA1  ..C..AC...C..AC.....................................................C.......C.....
SUMATRA2  ..C..AC...C..AC.....................................................C.......C.....
CORBETTI1 ..C..AC...C..AC.....................................................C.......C.....
CORBETTI2 ---------------------------------------------------------------------------------
ALTAICA4  ..C.--C...C..AC.....................................................C.......C.....
ALTAICA1  ..C..AC...C..AC.....................................................C.......C.....

TIGRIS1   TATACACGTACACACGTACACACGTACACACGTACACACGTATACACGTATACACGTATACACGTATACACATGCAAAC- 16292
TIGRIS2   ..........T.....................................................G.CG....-
SUMATRA1  ..........T.......T..G....T.......T.....................................-
SUMATRA2  ..........T.......T.......T.......T.....................................-
CORBETTI1 ..C.....................T.......T.....................................G.AT.C..-
CORBETTI2 ---------------------------------------------------------------------------------
ALTAICA4  ..C..............T.......T.......T.....................................-
ALTAICA1  ..C.......T.......T.......T.......T.....................................G.AT.C..G

TIGRIS1   ------------------------TTTTTTGATTTAGTAAATAATTAGCTTAACCAAACCCCCCTTACCCCCCGTTAATCT 16349
TIGRIS2   ------------------------.....................................................
SUMATRA1  ------------------------.....................................................
SUMATRA2  ------------------------.....................................................
CORBETTI1 ---------------------------------------------------------------------------------
CORBETTI2 ---------------------------------------------------------------------------------
ALTAICA4  ------------------------.....................................................
ALTAICA1  TATACACGTATACACATGCAAAC.....................................................

TIGRIS1   TATTTATTATAGTACGTGTTTATTTCTGTCTTGCCAAACCCCAAAAACAAGACTAAACCCGTATCTAGGCACAAGGCCTA 16429
TIGRIS2   .....................................................................................
SUMATRA1  .....................................................................................
SUMATRA2  .....................................................................................
CORBETTI1 ---------------------------------------------------------------------------------
CORBETTI2 ---------------------------------------------------------------------------------
ALTAICA4  .....................................................................................
ALTAICA1  .....................................................................................

TIGRIS1   AGATTAACGTTTACAAACTCTACCAACCCCATCATTACCAATTATTAATACTAAATCATAACTTCGTTCGCAGTTATCTA 16529
TIGRIS2   .....................................................................................
SUMATRA1  .....................................................................................
SUMATRA2  .....................................................................................
CORBETTI1 ---------------------------------------------------------------------------------
CORBETTI2 ---------------------------------------------------------------------------------
ALTAICA4  .....................................................................................
ALTAICA1  .....................................................................................

TIGRIS1   TAGATACGACAACCCGATCTCTAATTCGTCCCTATCGAACAATATTTACATACCCAACAACCCTATGTCTTG 16599
TIGRIS2   ...........................................................
SUMATRA1  ...........................................................
SUMATRA2  ...........................................................
CORBETTI1 ---------------------------------------------------------
CORBETTI2 ---------------------------------------------------------
ALTAICA4  ...........................................................
ALTAICA1  ...........................................................
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6.3 Appendix 3: The alignment result of eight complete mitochondrial sequences from domestic cat (*Felis catus*) and five Panthera species (*Panthera uncia, Pantheara pardus, Panthera tigris, Neofelis nebulosa, Acinonyx jubatus*). The locations of the 26 Panthera-specific primer sets, amplified successfully the entire tiger mitochondrial genome, are shown on this alignment result.

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tRNA-Phe
Snow_Leopard1        GTTGATGTAGCTTAAGTACAT-AAAGCAAGGCACTGAAAATGCCTAGATGAGTCGCCAGA 59 23F
Snow_Leopard2        GTTGATGTAGCTTAAGTACAT-AAAGCAAGGCACTGAAAATGCCTAGATGAGTCGCCAGA 59
Leopard1             GTTGATGTAGCTTAAACACATTAAAGCAAGGCACTGAAAATGCCTAGATGAGTCACCAGA 60
Tiger1               GTTAATGTAGCTTAAATATATTAAAGCAAGGCACTGAAAATGCCTAGATGGGCCGCCAGG 60
Tiger2               GTTAATGTAGCTTAAATATATTAAAGCAAGGCACTGAAAATGCCTAGATGGGCCGCCAGG 60
Clouded_leopard      GTTAATGTAGCTTAA-TATACAAAGCAAAGGCACTGAAAATGCCTAGATGAGTCGCCAGA 59
cheetah              GTTAATGTAGCTTAAATACAT-AAAGCAAGGCACTGAAAATGCCTAGATGAGTCATCAAA 59
Cat                  GTTAATGTAGCTTAAACATAT-AAAGCAAGGCACTGAAAATGCCTAGATGAGTCGCCAGA 59
                     *** ***********  * *  **   ********************** * *  **

12S rRNA
Snow_Leopard1        CTCCATAAACATAACGGTTTGGTCCTAGCCTTTCCATTAGTTATTAATAAAATTACACAT 119
Snow_Leopard2        CTCCATAAACATAACGGTTTGGTCCTAGCCTTTCCATTAGTTATTAATAAAATTACACAT 119
Leopard1             CTCCATAAACATAAAGGTTTGGTCCTAGCCTTTCTATTAGTTATTAATAAAATTACACAT 120
Tiger1               CTCCATAAACATAAAGGTTTGGTCCTAGCCTTTCCATTAGTTGTTAATAAAATTACACAT 120
Tiger2               CTCCATAAACATAAAGGTTTGGTCCTAGCCTTTCCATTAGTTGTTAATAAAATTACACAT 120
Clouded_leopard      CTCCATAAACATAAAGGTTTGGTCCTGGCCTTTCTATTAGTTATTAATAAAATTACACAT 119
cheetah              CTCCATAAACACAAAGGTTTGGTCCTAGCCTTTCCATTAGTTATTAATAAGATTACACAT 119
Cat                  CTCCATAAACACAAAGGTTTGGTCCTGGCCTTTCCATTAGTTATTAATAAGATTACACAT 119
                     *********** ** *********** ******* ******* ******* *********

Snow_Leopard1        GCAAGCCTCCGCATCCCGGTGAAAATGCCCTCTAAATCACCCAGTGATCCAAAGGAGCTG 179 22R
Snow_Leopard2        GCAAGCCTCCGCATCCCGGTGAAAATGCCCTCTAAATCACCCAGTGATCCAAAGGAGCTG 179
Leopard1             GCAAGCCTCCGCATCCCGGTGAAAATGCCCTTTAAATCACCCAGTGATCCAAAGGAGCTG 180
Tiger1               GCAAGCCTCCGCATCCCGGTGAAAATGCCCTCTAAATCACCCAGTGATCCAAAGGAGCCG 180
Tiger2               GCAAGCCTCCGCATCCCGGTGAAAATGCCCTCTAAATCACCCAGTGATCCAAAGGAGCCG 180
Clouded_leopard      GCAAGCCTCCGCATCCCGGTGAAAATGCCCTCTAAATCA--CAGTGATCCAAAGGAGCTG 177
cheetah              GCAAGCTTCCGCATCCCGGTGAAAATGCCCTTCAAGTCACCTAGTGACCTAAAGGAGCTG 179
Cat                  GCAAGCCTCCGCATCCCGGTGAAAATGCCCTCTAAGTCACCCAGTGACCTAAAGGAGCTG 179
                     ****** ************************  ** ***   ***** * ******** *

Snow_Leopard1        GTATCAAGCACACAACCATTGTAGCTCATAACACCTTGCTCAGCCACACCCCCACGGGAT 239
Snow_Leopard2        GTATCAAGCACACAACCATTGTAGCTCATAACACCTTGCTCAGCCACACCCCCACGGGAT 239
Leopard1             GTATCAAGCACACAACCATTGTAGCTCACAACACCTTGCTCAGCCACACCCCCACGGGAT 240
Tiger1               GTATCAAGTACACAACCATTGTAGCTCATGACACCTTGCTCAGCCACACCCCCACGGGAC 240
Tiger2               GTATCAAGTACACAACCATTGTAGCTCATGACACCTTGCTCAGCCACACCCCCACGGGAC 240
Clouded_leopard      GTATCAAGCACACAACTATTGTAGCTCACAACACCTTGCTCAGCCACACCCCCACGGGAT 237
cheetah              GTATCAAGCACACAACCACAGTAGCTCATAACACCTTGCTCGGCCACACCCCCACGGGAC 239
Cat                  GTATCAAGCACACAACCACAGTAGCTCATAACACCTTGCTCAGCCACACCCCCACGGGAT 239
                     ******** ******* *  ********  *********** ****************

Snow_Leopard1        ACAGCAGTGATAAAAATTAAGCTATGAATGAAAGTTCGACTAAGCTATATTAAATCAGGG 299
Snow_Leopard2        ACAGCAGTGATAAAAATTAAGCTATGAATGAAAGTTCGACTAAGCTATATTAAATCAGGG 299
Leopard1             ACAGCAGTGATAAAAATTAAGCTATGAATGAAAGTTCGACTAAGCTATATTAAATCAGGG 300
Tiger1               ACAGCAGTGATAAAAATTAAGCCATGAATGAAAGTTCGACTAAGCTATATTAAATTAGGG 300
Tiger2               ACAGCAGTGATAAAAATTAAGCCATGAATGAAAGTTCGACTAAGCTATATTAAATTAGGG 300
Clouded_leopard      ACAGCAGTGATAAAAATTAAGCTATGAATGAAAGTTCGACTAAGCTATATTAAATAAGGG 297
cheetah              ACAGCAGTGATAAAAATTAAGCTATGAATGAAAGTTCGACTAAGCTATATTAAACAAGGG 299
Cat                  ACAGCAGTGATAAAAATTAAGCCATGAATGAAAGTTCGACTAAGCTATATTAAACAAGGG 299
                     ********************** ******************************  ****

Snow_Leopard1        TTGGTAAATTTCGTGCCAGCCACCGCGGTCATACGATTAACCCAAACTAATAGACCCACG 359
Snow_Leopard2        TTGGTAAATTTCGTGCCAGCCACCGCGGTCATACGATTAACCCAAACTAATAGACCCACG 359
Leopard1             TTGGTAAATTTCGTGCCAGCCACCGCGGTCATACGATTAACCCGGACTAATAGACCTACG 360
Tiger1               TTGGTAAATTTCGTGCCAGCCACCGCGGTCATACGATTAACCCAAACTAATAGACCCACG 360
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Tiger2              TTGGTAAATTTCGTGCCAGCCACCGCGGTCATACGATTAACCCAAACTAATAGACCCACG 360
Clouded_leopard     TTGGTAAATTTCGTGCCAGCCACCGCGGTCATACGATTAACCCAAACTAATAGACCTACG 357
cheetah             TTGGTAAATTTCGTGCCAGCCACCGCGGTCATACGATTAACCCAAACTAATAGACCCACG 359
Cat                 TTGGTAAATTTCGTGCCAGCCACCGCGGCCATACGATTAACCCAAACTAATAGACCCACG 359
                    **************************** **************  *********** ***

Snow_Leopard1       GCGTAAAGCGTGTTACAGA-AGAAAAATATACTAAAGTTAAACCTTAACTGGGCTGTAAA 418
Snow_Leopard2       GCGTAAAGCGTGTTACAGA-AGAAAAATATACTAAAGTTAAACCTTAACTGGGCTGTAAA 418
Leopard1            GCGTAAAGCGTGTTACAGA-AGAAAAACATACTAAAGTTAAGCCTTAACTAGGCTGTAAA 419
Tiger1              GCGTAAAGCGTGTTACAGA-A-AAAAGTATACTAAAGTTAAGCCTTAACTAGGCTGTAAA 418
Tiger2              GCGTAAAGCGTGTTACAGA-A-AAAAGTATACTAAAGTTAAGCCTTAACTAGGCTGTAAA 418
Clouded_leopard     GCGTAAAGCGTGTTACAGA-A-AAAAATATGCTAAAGTTAAACCTTAACTAGGCTGTAAA 415
cheetah             GCGTAAAGCGTGTTATAGAGAAAAAAAT-TACTAAAGTTAAACCTTAACTAGGCCGTAAA 418
Cat                 GCGTAAAGCGTGTTACAGAGAAAAAAATATACTAAAGTTAAATTTTAACTAGGCCGTAGA 419
                    *************** *** * ****   * **********   ****** *** *** *

Snow_Leopard1       AAGCTACAGTTAACATAAAAATATAGCACGAAAGTAACTTTAATATCTCCGACTACACGA 478
Snow_Leopard2       AAGCTACAGTTAACATAAAAATATAGCACGAAAGTAACTTTAATATCTCCGACTACACGA 478
Leopard1            AAGCTGCAGTTAATATAAAAATATGGCACGAAAGTAACTTTAATACCTCCGACCACACGA 479
Tiger1              AAGCCACAGTTAACGTAAAAATACAGCACGAAAGTAACTTTAATATTTCTGACCACACGA 478
Tiger2              AAGCCACAGTTAACGTAAAAATACAGCACGAAAGTAACTTTAATATTTCTGACCACACGA 478
Clouded_leopard     AAGCTACAGTTAATGTAAAAATATAACACGAAAGTAACTTTAACATCTCCGACCACACGA 475
cheetah             AAGCTATAGTTAACATGAAAATACAGCACGAAAGTAACTTTAATACCTCCAACTGCACGA 478
Cat                 AAGCTACAGTTAACATAAAAATACAGCACGAAAGTAACTTTAACACCTCCGACTACACGA 479
                    ****   ******  * ******   ***************** *  **  **  *****

Snow_Leopard1       TAGCTAAGATCCAAACTGGGATTAGATACCCCACTATGCTTAGCCCTAAACCTAGATAGT 538
Snow_Leopard2       TAGCTAAGATCCAAACTGGGATTAGATACCCCACTATGCTTAGCCCTAAACCTAGATAGT 538
Leopard1            TAGCTAAGATCCAAACTGGGATTAGATACCCCACTATGCTTAGCCCTAAACCTAGATAGT 539
Tiger1              TAGCTAAGACCCAAACTGGGATTAGATACCCCACTATGCTTAGCCCTAAACCTAGATAGT 538
Tiger2              TAGCTAAGACCCAAACTGGGATTAGATACCCCACTATGCTTAGCCCTAAACCTAGATAGT 538
Clouded_leopard     TAGCTAAGACCCAAACTGGGATTAGATACCCCACTATGCTTAGCCCTAAACCTAGATAGT 535
cheetah             TAGCTAAGACCCAAACTGGGATTAGATACCCCACTATGCTTAGCCCTAAACCTAGATAGT 538
Cat                 CAGCTAAGACCCAAACTGGGATTAGATACCCTACTATGCTTAGCCCTAAACTTAGATAGT 539
                     ******** ******************** ****************** ********

Snow_Leopard1       TAGCTCAAACAAAACTATCCGCCAGAGAACTACTAGCAACAGCTTAAAACTCAAAGG-AC 597
Snow_Leopard2       TAGCTCAAACAAAACTATCCGCCAGAGAACTACTAGCAACAGCTTAAAACTCAAAGG-AC 597
Leopard1            TAGCCCAAACAAAACTATCCGCCAGAGAACTACTAGCAACAGCTTAAAACTCAAAGG-AC 598
Tiger1              TAACCCAAACAAAACTATCCGCCAGAGAACTACTAGCAACAGCTTAAAACTCAAAGG-AC 597
Tiger2              TAACCCAAACAAAACTATCCGCCAGAGAACTACTAGCAACAGCTTAAAACTCAAAGG-AC 597
Clouded_leopard     TAGCTCGAACAAAACTATCCGCCAGAGAACTACTAGCAACAGCTTAAAACTCAAAGGGAC 595
cheetah             TAACTCAAACAAAACTATCCGCCAGAGAACTACTAGCAACAGCTTAAAACTCAAAGG-AC 597
Cat                 TACCCTAAACAAAACTATCCGCCAGAGAACTACTAGCAATAGCTTAAAACTCAAAGG-AC 598
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Snow_Leopard1       TTGGCGGTGCTTTACACCCCTCTAGAGGAGCCTGTTCTATAATCGATAAACCCCGATAAA 657
Snow_Leopard2       TTGGCGGTGCTTTACACCCCTCTAGAGGAGCCTGTTCTATAATCGATAAACCCCGATAAA 657
Leopard1            TTGGCGGTGCTTTATATCCCTCTAGAGGAGCCTGTTCTATAATCGATAAACCCCGATAAA 658
Tiger1              TTGGCGGTGCTTTATATCCCTCTAGAGGAGCCTGTTCCATAATCGATAAACCCCGATAAA 657
Tiger2              TTGGCGGTGCTTTATATCCCTCTAGAGGAGCCTGTTCCATAATCGATAAACCCCGATAAA 657
Clouded_leopard     TTGGCGGTGCTTTATATCCCTCTAGAGGAGCCTGTTCTATAATCGATAAACCCCGATAGA 655
cheetah             TTGGCGGTGCTTTACATCCCTCTAGAGGAGCCTGTTCTATAATCGATAAACCCCGATACA 657
Cat                 TTGGCGGTGCTTTACATCCCTCTAGAGGAGCCTGTTCTATAATCGATAAACCCCGATATA 658
                    ************** * ******************** ******************** *

Snow_Leopard1       CCTCACCATCTCTTGCTAATTCAGCCTATATACCGCCATCTTCAGCAAACCCTAAAAAGG 717 24F
Snow_Leopard2       CCTCACCATCTCTTGCTAATTCAGCCTATATACCGCCATCTTCAGCAAACCCTAAAAAGG 717
Leopard1            CCTCACCATCTCTTGTTAATTCAGCCTATATACCGCCATCTTCAGCAAACCCTAAAAAGG 718
Tiger1              CCTCACCATCTCTTGCTAATTCAGCCTATATACCGCCATCTTCAGCAAACCCTAAAAAGG 717
Tiger2              CCTCACCATCTCTTGCTAATTCAGCCTATATACCGCCATCTTCAGCAAACCCTAAAAAGG 717
Clouded_leopard     CCTCACCATCTCTTGCCAATTCAGCCTATATACCGCCATCTTCAGCAAACCCTAAAAAGG 715
cheetah             CCTCACCATCTCTTGCCAATTCAGCCTATATACCGCCATCTTCAGCAAACCCTAAAAAGG 717
Cat                 CCTCACCATCTCTTGCTAATTCAGCCTATATACCGCCATCTTCAGCAAACCCTAAAAAGG 718
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Snow_Leopard1       AAGAAAAGTAAGCACAAATGTCTTAACGCAAAAAAGTTAGGTCAAGGTGTAGCCCATGAG 777
Snow_Leopard2       AAGAAAAGTAAGCACAAATGTCTTAACGCAAAAAAGTTAGGTCAAGGTGTAGCCCATGAG 777
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Leopard1            AAGAAAAGTAAGCACAAGTGTCTTAACACAAAAAAGTTAGGTCAAGGTGTAGCCTATGAG 778
Tiger1              AAGAAAAGTAAGCACAAGTATCTTAACATAAAAAAGTTAGGTCAAGGTGTAGCCCATGAG 777
Tiger2              AAGAAAAGTAAGCACAAGTATCTTAACATAAAAAAGTTAGGTCAAGGTGTAGCCCATGAG 777
Clouded_leopard     AAGAAAAGTAAGCACAAGTGTCTTAACACAAAAAAGTTAGGTCAAGGTGTAGCCCATGAG 775
cheetah             AAGAAAAGTAAGCACAAGTATCTTAACACAAAAAAGTTAGGTCAAGGTGTAGCCCATGAG 777
Cat                 AAGAAAAGTAAGCACAAGTATCTTAACATAAAAAAGTTAGGTCAAGGTGTAGCTCATGAG 778
                    ***************** * *******  ************************  *****

Snow_Leopard1       ATGGG-AAGCAATGGGCTACATTTTCTACAACTAGAACACCCACGAAAATCCTTATGAAA 836 23R
Snow_Leopard2       ATGGG-AAGCAATGGGCTACATTTTCTACAACTAGAACACCCACGAAAATCCTTATGAAA 836
Leopard1            ATGGG-AAGCAATGGGCTACATTTTCTACAACTAGAACATCCACGAAAATCCTTATGAAA 837
Tiger1              ATGGGGAAGTAATGGGCTACATTTTCTATAACTAGAACATCCACGAAAATCCTTATGAAA 837
Tiger2              ATGGGGAAGTAATGGGCTACATTTTCTATAACTAGAACATCCACGAAAATCCTTATGAAA 837
Clouded_leopard     ATGGG-AAGCAATGGGCTACATTTTCTACAACTAGAATACCCACGAAAATCCTTATGAAA 834
cheetah             ATGGG-AAGTAATGGGCTACATTTTCTAAAACTAGAACACCTACGAAAATACTTATGAAA 836
Cat                 ATGGG-AAGCAATGGGCTACATTTTCTAAAATTAGAACACCCACGAAGATCCTTACGAAA 837
                    ***** *** ****************** ** ***** * * ***** ** **** ****

Snow_Leopard1       CTAAGCATTCAAGGAGGATTTAGTAGTAAATTTGAGAATAGAGAGCTTAATTGAATCGGG 896
Snow_Leopard2       CTAAGCATTCAAGGAGGATTTAGTAGTAAATTTGAGAATAGAGAGCTTAATTGAATCGGG 896
Leopard1            TTAAGTATTCAAGGAGGATTTAGTAGTAAATTTGAGAATAGAGAGCTCAATTGAATCGGG 897
Tiger1              TTAAGTATTAAAGGAGGATTTAGTAGTAAATTCGAGAATAGAGAGCTCGATTGAATCGGG 897
Tiger2              TTAAGTATTAAAGGAGGATTTAGTAGTAAATTCGAGAATAGAGAGCTCGATTGAATCGGG 897
Clouded_leopard     TTAAGTATTAAAGGAGGATTTAGTAGTAAATTTGAGAGTAGAGAGCTCAATTGAATCGGG 894
cheetah             CTAAGTATTAAAGGAGGATTTAGTAGTAAATTTGAGAATAGAGAGCTCAATTGAATCGGG 896
Cat                 CTAAGTATTAAAGGAGGATTTAGTAGTAAATTTGAGAATAGAGAGCTCAATTGAATCGGG 897
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Snow_Leopard1       CCATGAAGCACGCACACACCGCCCGTCACCCTCCTCAAGTGATTAAACCCCAAAGAAACC 956
Snow_Leopard2       CCATGAAGCACGCACACACCGCCCGTCACCCTCCTCAAGTGATTAAACCCCAAAGAAACC 956
Leopard1            CCATGAAGCACGCACACACCGCCCGTCACCCTCCTCAAGTGATTAGACCC-AAAGAAACC 956
Tiger1              CCATGAAGCACGCACACACCGCCCGTCACCCTCCTCAAGTGATTAGACCCCAAAGAAACC 957
Tiger2              CCATGAAGCACGCACACACCGCCCGTCACCCTCCTCAAGTGATTAGACCCCAAAGAAACC 957
Clouded_leopard     CCATGAAGCACGCACACACCGCCCGTCACCCTCCTCAAGTGACTAGGCCCTAAAGAAATC 954
cheetah             CCATGAAGCACGCACACACCGCCCGTCACCCTCCTCAAGTGACAATATCCAAAAAAAACC 956
Cat                 CCATGAAGCACGCACACACCGCCCGTCACCCTCCTCAAGTGGTAAC-TCCCAAAAAAACC 956
                    ****************************************   *   ** *** *** *

Snow_Leopard1       TATTCAAACCACTACACCCACAAGAGGAGACAAGTCGTAACAAGGTAAGCATACTGGAAA 1016
Snow_Leopard2       TATTCAAACCACTACACCCACAAGAGGAGACAAGTCGTAACAAGGTAAGCATACTGGAAA 1016
Leopard1            TATTCAAACCATCACATCCACAAGAGGAGACAAGTCGTAACAAGGTAAGCATACTGGAAA 1016
Tiger1              TATTCAAACCACTACACCCACAAGAGGAGACAAGTCGTAACAAGGTAAGCATACTGGAAA 1017
Tiger2              TATTCAAACCACTACACCCACAAGAGGAGACAAGTCGTAACAAGGTAAGCATACTGGAAA 1017
Clouded_leopard     TATTCAAACCACCACACCCACAAGAGGAGACAAGTCGTAACAAGGTAAGCATACTGGAAA 1014
cheetah             TATTTAAACCACTATACCCACAAGAGGAGACAAGTCGTAACAAGGTAAGCATACTGGAAA 1016
Cat                 TATTTAAATTATCACACCCACAAGAGGAGATAAGTCGTAACAAGGTAAGCATACTGGAAA 1016
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tRNA-Val
Snow_Leopard1       GTGTGCTTGGATGACAAGATGTAGCTTAAACAAAGCATCTGGCTTACACCCAGAAGATTT 1076
Snow_Leopard2       GTGTGCTTGGATGACAAGATGTAGCTTAAACAAAGCATCTGGCTTACACCCAGAAGATTT 1076
Leopard1            GTGTGCTTGGACGACAAGATGTAGCTTAAACAAAGCATCTGGCCTACACCCAGAAGATTT 1076
Tiger1              GTGTGCTTGGATAACAAGATGTAGCTTAAACAAAGCATCTGGCCTACACCCAGAAGATTT 1077
Tiger2              GTGTGCTTGGATAACAAGATGTAGCTTAAACAAAGCATCTGGCCTACACCCAGAAGATTT 1077
Clouded_leopard     GTGTGCTTGGATAACAAGATGTAGCTTAAACAAAGCATCTGGCTTACACCCAGAAGATTT 1074
cheetah             GTGTGCTTGGATAACAAGATGTAGCTTAAATAAAGCATCTGGCTTACACCCAGAAGATTT 1076
Cat                 GTGTGCTTGGATAACAAGATGTAGCTTAAACAAAGCATCTGGCTTACACCCAGAAGATTT 1076
                    ***********  ***************** ************ ****************

16S rRNA
Snow_Leopard1       CATATCAAACTGACCATCTTGAGCCAAAGCTAGCCCAATCACCCACAAACACAACTAATA 1136
Snow_Leopard2       CATATCAAACTGACCATCTTGAGCCAAAGCTAGCCCAATCACCCACAAACACAACTAATA 1136
Leopard1            CATATTAAACTGACCATCTTGAGCCAAAGCTAGCCCAATCACCCACAAACGCAACTAATA 1136
Tiger1              CATATTAAACTGACCATCTTGAGCTAGAGCTAGCCCAACTACCCATAAACACAACTAACA 1137
Tiger2              CATATTAAACTGACCATCTTGAGCTAGAGCTAGCCCAACTACCCATAAACACAACTAACA 1137
Clouded_leopard     CATATCAAACTGACCATCTTGAGCCAAAGCTAGCCCAACTACCCATAAACTCAACTAACA 1134
cheetah             CATATTAAACTGACCATCTTGAGCCAAAGCTAGCCCAAACACCCACAAACCCAACTAACA 1136
Cat                 CATATTAAACTGACCATCTTGAGCTAAAGCTAGCCCAAACATCTACAAACACAACTAACA 1136
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Snow_Leopard1       TTATGAAAGTAAAATAAAACATTTAGTCACCTCATAAAAGTATAGGAGATAGAAATTTAA 1196
Snow_Leopard2       TTATGAAAGTAAAATAAAACATTTAGTCACCTCATAAAAGTATAGGAGATAGAAATTTAA 1196
Leopard1            TTA-GAAAGTAAAATAAAACATTTAGTTACCCTATAAAAGTATAGGAGATAGAAATTTAA 1195
Tiger1              TTA-GAAAGTAAAACAAAACATTTAGTTACTCTA-AAAAGTATAGGAGATAGAAATTTAA 1195
Tiger2              TTA-GAAAGTAAAACAAAACATTTAGTTACTCTA-AAAAGTATAGGAGATAGAAATTTAA 1195
Clouded_leopard     TTA-AAAAATAAAACAAAACATTTAGTCGTTCTA-AAAAGTATAGGAGATAGAAATTTAA 1192
cheetah             CTA-AAAAATAAAACAAAACATTCAGTCAC-TTAAAAAAGTATAGGAGATAGAAATTTAA 1194
Cat                 CTA-GAAAATAAAACAAAACATTTAGTCACCTTATAAAAGTATAGGAGATAGAAATTTAA 1195
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Snow_Leopard1       CTTGGCGCTATAGAGAAAGTACCGCAAGGGAAAGATGAAAGAATAAAACTAAAAGCACTA 1256
Snow_Leopard2       CTTGGCGCTATAGAGAAAGTACCGCAAGGGAAAGATGAAAGAATAAAACTAAAAGCACTA 1256
Leopard1            CTTGGCGCTATAGAGAGAGTACCGCAAGGGAAAGATGAAAGAATAAA-CTAAAAGCACTG 1254
Tiger1              CTCGGCGCTATAGAAAAAGTACCGCAAGGGAATGATGAAAGAAAAAA-CTAAAAGCACTA 1254
Tiger2              CTCGGCGCTATAGAAAAAGTACCGCAAGGGAATGATGAAAGAAAAAA-CTAAAAGCACTA 1254
Clouded_leopard     CTTGGCGCTATAGAGAAAGTACCGTAAGGGAAAGATGAAAGAAAAAA-CTAAAAGCACCA 1251
cheetah             CTTGGCGCTATAGAGAGAGTACCGCAAGGGAAAGATGAAAGATAAAA-TTAAAAGCACCA 1253
Cat                 CTTGGCGCTATAGAGAAAGTACCGCAAGGGAAAGATGAAAGATAAAA-TTAAAAGCACCA 1254
                    ** *********** * ******* ******* *********  ***  *********

Snow_Leopard1       TACAGCAAAGATTACCCCTTGTACCTTTTGCATAATGAGTTAGCTAGTAATAACCTAACA 1316
Snow_Leopard2       TACAGCAAAGATTACCCCTTGTACCTTTTGCATAATGAGTTAGCTAGTAATAACCTAACA 1316
Leopard1            TACAGCAAAGATTACCCCTTGTACCTTTTGCATAATGAGTTAGCTAGTGACAGCCTAACA 1314
Tiger1              TACAGCAAAGATTACCCCTTGTACCTTTTGCATAATGAATTAGCTAG-AATAACCTAACA 1313
Tiger2              TACAGCAAAGATTACCCCTTGTACCTTTTGCATAATGAATTAGCTAG-AATAACCTAACA 1313
Clouded_leopard     TACAGCAAAGATTACCCCTTGTACCTTTTGCATAATGAGTTAGCTAGAATTAACCTAGCA 1311
cheetah             CACAGCAAAGATTACCCCTTGTACCTTTTGCATAATGAGTTAGCTAG-AACAACCTAACA 1312
Cat                 CACAGCAAAGATTACCCCTTGTACCTTTTGCATAATGAGTTAGCTAG-AACAACCTAACA 1313
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Snow_Leopard1       AAGAGAACTTCAGCTAGGCCCCCCGAAACCAGACGAGCTACCCACGAACAATCTATTGCA 1376
25F
Snow_Leopard2       AAGAGAACTTCAGCTAGGCCCCCCGAAACCAGACGAGCTACCCACGAACAATCTATTGCA 1376
Leopard1            AAGAGAACTTTAGCTAGGCCCCCCGAAACCAGACGAGCTACCCGCGAACAATCTATTACA 1374
Tiger1              AAGAGAACTTCAGCTAGGCCCCCCGAAACCAGACGAGCTACCCATAAACAATCTATTACA 1373
Tiger2              AAGAGAACTTCAGCTAGGCCCCCCGAAACCAGACGAGCTACCCATAAACAATCTATTACA 1373
Clouded_leopard     AAGAGAACTTTAGCTAGGTCCCCCGAAACCAGACGAGCTACCCATGAACAATCTATTACA 1371
cheetah             AAGAGAACTTCAGCTAGGCCCCCCGAAACCAGACGAGCTACCCATGAACAATCTATTACA 1372
Cat                 AAGAGAACTTCAGCTAGGCCCCCCGAAACCAGACGAGCTACCCATGAACAATCTATTACA 1373
                    ********** ******* ************************   *********** **

Snow_Leopard1       GGATGAACTCGTCTATGTTGCAAAATAGTGAGAAGATTTGTGGGTAGAGGTGAAAAGCCT 1436
Snow_Leopard2       GGATGAACTCGTCTATGTTGCAAAATAGTGAGAAGATTTGTGGGTAGAGGTGAAAAGCCT 1436
Leopard1            GGATGAACTCGTCTATGTTGCAAAATAGTGAGAAGATTTGCGGGTAGAGGTGAAAAGCCT 1434
Tiger1              GGATGAACTCGTCTATGTTGCAAAATAGTGAGAAGATTTATGGGTAGAGGTGAAAAGCCT 1433
Tiger2              GGATGAACTCGTCTATGTTGCAAAATAGTGAGAAGATTTATGGGTAGAGGTGAAAAGCCT 1433
Clouded_leopard     GGATGAACTCGTCTATGTTGCAAAATAGTGAGAAGATTTGTGGGTAGAGGTGAAAAGCCT 1431
cheetah             GGATGAACTCGTCTATGTTGCAAAATAGTGAGAAGATTTATGGGTAGAGGTGAAAAGCCT 1432
Cat                 GGATGAACTCGTCTATGTTGCAAAATAGTGAGAAGATTTGTGGGTAGAGGTGAAAAGCCT 1433
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Snow_Leopard1       AACGAGCCTGGTGATAGCTGGTTGCCCAGAACAGAATCTTAGTTCAACTTTAAACTTGCC 1496
24R
Snow_Leopard2       AACGAGCCTGGTGATAGCTGGTTGCCCAGAACAGAATCTTAGTTCAACTTTAAACTTGCC 1496
Leopard1            AACGAGCCTGGTGATAGCTGGTTGCCCAGAACAGAATCTTAGTTCAACTTTAAACTTACC 1494
Tiger1              AACGAGCCTGGTGATAGCTGGTTGCCCAGAACAGAATCTTAGTTCAGCTTTAAACTTACC 1493
Tiger2              AACGAGCCTGGTGATAGCTGGTTGCCCAGAACAGAATCTTAGTTCAGCTTTAAACTTACC 1493
Clouded_leopard     AACGAGCCTGGTGATAGCTGGTTGCCCAGAACAGAATCTCAGTTCGACTTTAAACTTGCC 1491
cheetah             AACGAGCCTGGTGATAGCTGGTTGCCCAGAATAGAATCTTAGTTCAACTTTAAACTTACC 1492
Cat                 AACGAGCCTGGTGATAGCTGGTTGCCCAGAACAGAATCTTAGTTCAACTTTAAACTTACC 1493
                    ******************************** ******* *****  ********** **

Snow_Leopard1       TCAAAA-CCCTAAAATTCCAATGTAAGTTTAAAACATAGTCTAAAGGGGTACAGCTTTTT 1555
Snow_Leopard2       TCAAAA-CCCTAAAATTCCAATGTAAGTTTAAAACATAGTCTAAAGGGGTACAGCTTTTT 1555
Leopard1            TCAAAAACCTTAAAATTCCAATGTAAGTTTAAATTATACTCTAAAAAGGTACAGCTTTTT 1554
Tiger1              TCAAAAACCCTAAAATTCCAATGTAAGTTTAAAATATAGTCTAAAAAGGTACAGCTTTTT 1553
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Tiger2              TCAAAAACCCTAAAATTCCAATGTAAGTTTAAAATATAGTCTAAAAAGGTACAGCTTTTT 1553
Clouded_leopard     TCAAAAACCCTAAAATTCCAATGTAAGTTTAAAATGTAGTCTAAAAAGGTACAGCTTTTT 1551
cheetah             TCAAAAACC-CATAATTCCAATGTAAGTTTAAAATATAGTCTAAAAAGGTACAGCTTTTT 1551
Cat                 TCAAAAACC-TAAAATTCCAATGTAAGTTTAAAATATAGTCTAAAAAGGTACAGCTTTTT 1552
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Snow_Leopard1       AGAAT-TAGGATACAGCCTTAATTAGAGAGTAAGCACATAACACTAAACCATAGTTGGCC 1614
Snow_Leopard2       AGAAT-TAGGATACAGCCTTAATTAGAGAGTAAGCACATAACACTAAACCATAGTTGGCC 1614
Leopard1            AGAAC-TAGGATACAGCCTTAATTAGAGAGTAAGCACA-AACAC-AAACCATAGTTGGCC 1611
Tiger1              AGAATCTAGGATACAGCCTTAATTAGAGAGTAAGCATATAACAC-AAACCATAGTTGGCC 1612
Tiger2              AGAATCTAGGATACAGCCTTAATTAGAGAGTAAGCATATAACAC-AAACCATAGTTGGCC 1612
Clouded_leopard     AGAAT-CAGGATACAGCCTTAATTAGAGAGTAAGCACA-AGTAT-AAACCATAGTTGGCC 1608
cheetah             AGAAT-TAGGATACAGCCTTTATTAGAGAGTAAGCATA-AACAA-GAACCATAGTTGGCC 1608
Cat                 AGACC-TAGGATACAGCCTTTATTAGAGAGTAAGCATA-AATAT-AAACCATAGTTGGCC 1609
                    ***    ************* *************** * *  *   **************

Snow_Leopard1       TAAAAGCAGCCACCAATTAAGAAAGCGTTCAAGCTCAACAATTAAAACATCTTAATGTCA 1674
Snow_Leopard2       TAAAAGCAGCCACCAATTAAGAAAGCGTTCAAGCTCAACAATTAAAACATCTTAATGTCA 1674
Leopard1            TAAAAGCAGCCACCAATTAAGAAAGCGTTCAAGCTCAACAATCAAAACATCTCAATGTCA 1671
Tiger1              TAAAAGCAGCCACCAATTAAGAAAGCGTTCAAGCTCAACAATCAAAACATCTCAATGTCA 1672
Tiger2              TAAAAGCAGCCACCAATTAAGAAAGCGTTCAAGCTCAACAATCAAAACATCTCAATGTCA 1672
Clouded_leopard     TAAAAGCAGCCACCAATTAAGAAAGCGTTCAAGCTCAACAATCAAAACATCTTAATGTCA 1668
cheetah             TAAAAGCAGCCATCAATTAAGAAAGCGTTCAAGCTCAACAATCAAAACATCTTAATGTCA 1668
Cat                 TAAAAGCAGCCATCAATTAAGAAAGCGTTCAAGCTCAACAATCAAAGCATCTTAATGTCA 1669
                    ************ ****************************** *** ***** *******

Snow_Leopard1       AAAT-AATGCAACCAACTCCTAATTTAAAACTGGGCTAATCTATTTGATAATAGAAGCAA 1733
Snow_Leopard2       AAAT-AATGCAACCAACTCCTAATTTAAAACTGGGCTAATCTATTTGATAATAGAAGCAA 1733
Leopard1            AAA--AACACAACCAACTC-TAACCTAAAACTGGGCTAATCTATTTAATAATAGAAGCAA 1728
Tiger1              AAA--AACGCAACCAACTCCTAATCTAAAACTGGGCTAATCTATTTAACAATAGAAGCAA 1730
Tiger2              AAA--AACGCAACCAACTCCTAATCTAAAACTGGGCTAATCTATTTAACAATAGAAGCAA 1730
Clouded_leopard     AAA--AACGCAACTAACTCCTAATTTAAAACTGGGCCAATCTATTTAAAAATAGAAGCAA 1726
cheetah             AAAATA-TGCAACCAACTCCTAATTTAAAACTGGGCTAATCTATTTAATAATAGAAGCAA 1727
Cat                 AAAATAATGCAACCAACTCCTAACCTAAAACTGGGCTAATCTATTTAATAATAGAAGCAA 1729
                    ***  *   **** ***** ***  ************ ********* * ************

Snow_Leopard1       TAATGCTAATATGAGTAACAAGAAGTATTTCTCCCGTGCATAAGCTTATATCAGAACGGA 1793
Snow_Leopard2       TAATGCTAATATGAGTAACAAGAAGTATTTCTCCCGTGCATAAGCTTATATCAGAACGGA 1793
Leopard1            TAATGCTAATATGAGTAACAAGAAGTATTTCTCCCGTGCATAAGCTTATATCAGAACGGA 1788
Tiger1              TAATGCTAATATGAGTAACAAGAAATACTTCTCCCGCGCATAAGCTTATATCAGAACGGA 1790
Tiger2              TAATGCTAATATGAGTAACAAGAAATACTTCTCCCGCGCATAAGCTTATATCAGAACGGA 1790
Clouded_leopard     TAATGCTAATATGAGTAACAAGAAACACTTCTCCCGTGCATAAGCTTATATCAGAGCGGA 1786
cheetah             TAATGCTAATATGAGTAACAAGAAACATTTCTCCC-TGCATAAGTTTATATCAGAACGGA 1786
Cat                 TAATGCTAATATGAGTAACAAGAAATATTTCTCCC-TGCATAAGCTTATATCAGAACGGA 1788
                    ************************  * *******  ******* ********** ****

Snow_Leopard1       TAACCACTGATAGTTAACAACAAGATAAATATAACCTAATTACAAGCAAAATATCAAACT 1853
Snow_Leopard2       TAACCACTGATAGTTAACAACAAGATAAATATAACCTAATTACAAGCAAAATATCAAACT 1853
Leopard1            TAACCACTGATAGTTAACAATAAGATATATACAACCTAACTACAAGCAAAATATCAA-CT 1847
Tiger1              TAACCACTGATAGTTAACAACAAGATATATATAACCTAACTACAAGCAAAATATCAGACT 1850
Tiger2              TAACCACTGATAGTTAACAACAAGATATATATAACCTAACTACAAGCAAAATATCAGACT 1850
Clouded_leopard     TAACCACTGATAGTTAACAACAAGATATCTATAAGCCAACTACAAGTAAAATATCAAACT 1846
cheetah             TAACCACTGATAGTTAACAACAAGATATATATAACCTAACCATAAATAAA-TATCAAACT 1845
Cat                 TAACCACTGATAGTTAACAACAAGATATATATAACCTAACCATAAACAAAATATCAAATT 1848
                    ******************** ******  ** ** * **  * **  *** *****   *

Snow_Leopard1       AATTGTTAACCCAACACAGGCATGCAATTC-AGGGAAAGATTAAAAGAAGTAAAAGGAAC 1912
Snow_Leopard2       AATTGTTAACCCAACACAGGCATGCAATTC-AGGGAAAGATTAAAAGAAGTAAAAGGAAC 1912
Leopard1            AATTGTTAACCCAACACAGGTATGCAACTC-AGGGAAAGATTAAAAGAAGTAAATGGAAC 1906
Tiger1              AATTGTTAACCCAACACAGGCATGCAATTT-AGGGAAAGATTAAAAGAAGTAAAAGGAAC 1909
Tiger2              AATTGTTAACCCAACACAGGCATGCAATTT-AGGGAAAGATTAAAAGAAGTAAAAGGAAC 1909
Clouded_leopard     AATTGTTAACCCAACACAGGCATGCAGTCT-AGGGAAAGATTAAAAGAAGTAAAAGGAAC 1905
cheetah             AATTGTTAATCCAACACAGGCATGCAAATTTAGGGAAAGATTAAAAGAAGTAAAAGGAAC 1905
Cat                 AATTGTTAACCCAACACAGGTATGCAAATT-AGGGAAAGATTAAAAGAAGTAAAAGGAAC 1907
                    ********* ********** *****     ********************** *****

Snow_Leopard1       TCGGCAAACACAAGCCCCGCCTGTTTACCAAAAACATCACCTCTAGCATTTTCAGTATTA 1972
26F
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Snow_Leopard2        TCGGCAAACACAAGCCCCGCCTGTTTACCAAAAACATCACCTCTAGCATTTTCAGTATTA 1972
Leopard1             TCGGCAAACACAAGCCCCGCCTGTTTACCAAAAACATCACCTCTAGCATTCCCAGTATTA 1966
Tiger1               TCGGCAAACACAAGCCCCGCCTGTTTACCAAAAACATCACCTCTAGCATTTCCAGTATTA 1969
Tiger2               TCGGCAAACACAAGCCCCGCCTGTTTACCAAAAACATCACCTCTAGCATTTCCAGTATTA 1969
Clouded_leopard      TCGGCAAACACAAGCCCCGCCTGTTTACCAAAAACATCACCTCTAGCATTTCTAGTATTA 1965
cheetah              TCGGCAAACACAAGCCCCGCCTGTTTACCAAAAACATCACCTCTAGCATTTCCAGTATTA 1965
Cat                  TCGGCAAACACAAGCCCCGCCTGTTTACCAAAAACATCACCTCTAGCATTTCCAGTATGA 1967
                     ************************************************   ***** *

Snow_Leopard1        GAGGCACTGCCTGCCCAGTGACACTAGTTAAACGGCCGCGGTATCCTGACCGTGCAAAGG 2032
Snow_Leopard2        GAGGCACTGCCTGCCCAGTGACACTAGTTAAACGGCCGCGGTATCCTGACCGTGCAAAGG 2032
Leopard1             GAGGCACTGCCTGCCCAGTGACATCAGTTAAACGGCCGCGGTATCCTGACCGTGCAAAGG 2026
Tiger1               GAGGCACTGCCTGCCCAGTGACATTAGTTAAACGGCCGCGGTATCCTGACCGTGCAAAGG 2029
Tiger2               GAGGCACTGCCTGCCCAGTGACATTAGTTAAACGGCCGCGGTATCCTGACCGTGCAAAGG 2029
Clouded_leopard      GAGGCACTGTCTGCCTGGTGACATTAGTTAAACGGCTGCAGTATCCTGACCGTGCAAAGG 2025
cheetah              GAGGCACTGCCTGCCCAGTGACACTAGTTAAACGGCCGCGGTATTCTGACCGTGCAAAGG 2025
Cat                  GAGGCACTGCCTGCCCGGTGACGCTAGTTAAACGGCCGCGGTATCCTGACCGTGCAAAGG 2027
                     ********* *****  *****   *********** ** **** ***************

Snow_Leopard1        TAGCATAATCATTTGTTCCCTAAATAGGGACTTGTATGAATGGCCACACGAGGGCTTTAC 2092
Snow_Leopard2        TAGCATAATCATTTGTTCCCTAAATAGGGACTTGTATGAATGGCCACACGAGGGCTTTAC 2092
Leopard1             TAGCATAATCATTCGTTCC-TAAATAGGGACTTGTATGAATGGCCACACGAGGGCTTTAC 2085
Tiger1               TAGCATAATCATTTGTTCCTTAAATAGGGACTTGTATGAATGGCCACACGAGGGCTTTAC 2089
Tiger2               TAGCATAATCATTTGTTCCTTAAATAGGGACTTGTATGAATGGCCACACGAGGGCTTTAC 2089
Clouded_leopard      TAGCATAATCACTTGTTCCCTAAATAGGGACTTGTACGAATGGCCACACGAGGGCTTTAC 2085
cheetah              TAGCATAATCATTTGTTCCCTAAATAGGGACTTGTATGAACGGCCACACGAGGGCTTTAC 2085
Cat                  TAGCATAATCATTTGTTCCCTAAATAGGGACTTGTATGAACGGCCACACGAGGGCTTTAC 2087
                     *********** * ***** **************** *** ******************

Snow_Leopard1        TGTCTCTTACCTCCGATCCGTGAAATTGACCTTCCCGTGAAGAGGCGGGAATATGACAAT 2152
25R
Snow_Leopard2        TGTCTCTTACCTCCGATCCGTGAAATTGACCTTCCCGTGAAGAGGCGGGAATATGACAAT 2152
Leopard1             TGTCTCTTACTTCCGATCCGTGAAATTGACCTTCCCGTGAAGAGGCGGGAATATGACAAT 2145
Tiger1               TGTCTCTTACTTCCAATCCGTGAAATTGACCTTCCCGTGAAGAGGCGGGAATACGACAAT 2149
Tiger2               TGTCTCTTACTTCCAATCCGTGAAATTGACCTTCCCGTGAAGAGGCGGGAATACGACAAT 2149
Clouded_leopard      TGTCTCTTACTTCCAATCCGTGAAATTGACCTTCCTGTGAAGAGGCGGGAATATTACAA- 2144
cheetah              TGTCTCTTACTTCCAATCCGTGAAATTGACCTTCCCGTGAAGAGGCGGGAATATAATAAT 2145
Cat                  TGTCTCTTACTTCCAATCCGTGAAATTGACCTTCCCGTGAAGAGGCGGGAATATAATAAT 2147
                     ********** *** ******************** ****************  * **

Snow_Leopard1        AAGACGAGAAGACCCTATGGAGCTTTAATTAACCAGCCCAAAGAGATC-TTAATAACCAA 2211
Snow_Leopard2        AAGACGAGAAGACCCTATGGAGCTTTAATTAACCAGCCCAAAGAGATC-TTAATAACCAA 2211
Leopard1             AAGACGAGAAGACCCTATGGAGCTTTAATTAACCGACCCAAAGAGATC-TTAACAACTAA 2204
Tiger1               AAGACGAGAAGACCCTGTGGAGCTTTAATTAATCGACCCAAAGAGACC-TTAATAACCAA 2208
Tiger2               AAGACGAGAAGACCCTGTGGAGCTTTAATTAATCGACCCAAAGAGACC-TTAATAACCAA 2208
Clouded_leopard      --GACGAGAAGACCCTATGGAGCTTTAATTAACTGACTCAAAGAGACC-TTATCAATCAA 2201
cheetah              AAGACGAGAAGACCCTATGGAGCTTTAATTAATTGACCCAAAGAGACCCATTAATTTCAA 2205
Cat                  AAGACGAGAAGACCCTATGGAGCTTTAATTAACCGACCCAAAGAGACC-ATATGAACCAA 2206
                       ************** ***************    * ******** *  *       **

Snow_Leopard1        CCGACAGGGTATAACAAACCTCTAC-CATGGGCTGACAATTTAGGTTGGGGTGACCTCGG 2270
Snow_Leopard2        CCGACAGGGTATAACAAACCTCTAC-CATGGGCTGACAATTTAGGTTGGGGTGACCTCGG 2270
Leopard1             CCGATAGGG-ACAACAAACCTCTAC-CATGGGTCGACAATTTAGGTTGGGGTGACCTCGG 2262
Tiger1               CCGACAGGA-ACAACAGACCTCTGC-CATGGGCCGACAATTTAGGTTGGGGTGACCTCGG 2266
Tiger2               CCGACAGGA-ACAACAGACCTCTGC-CATGGGCCGACAATTTAGGTTGGGGTGACCTCGG 2266
Clouded_leopard      CCGACAGGC-ACAACAGACCTCTCTACATGAGTCAACAATTTAGGTTGGGGTGACCTCGG 2260
cheetah              CCGACAGGA-ATAACAAACCTCTAT--ATGGGCCAACAATTTAGGTTGGGGTGACCTCGG 2262
Cat                  CCGACAGGA-ACAACAAACCTCTAT--ATGGGCCGGCAATTTAGGTTGGGGTGACCTCGG 2263
                     **** ***  * **** ******    *** *    ************************

Snow_Leopard1        AGAACAAAACAACCTCCGAGTGATTTAAATCTAGACTAACCAGTCGAAAGTATTACATCA 2330
Snow_Leopard2        AGAACAAAACAACCTCCGAGTGATTTAAATCTAGACTAACCAGTCGAAAGTATTACATCA 2330
Leopard1             AGAATAAAACAACCTCCGAGTGATTTAAATCTAGACTAACCAGTCGAAAGTACTACATCA 2322
Tiger1               AGAATAAAACAACCTCCGAGTGATTTAAATCTAGACTGACCAGTCGAAAGTATTACATCA 2326
Tiger2               AGAATAAAACAACCTCCGAGTGATTTAAATCTAGACTGACCAGTCGAAAGTATTACATCA 2326
Clouded_leopard      AGAAGAAAACAACCTCCGAGTGATTTACATCTAGACTAACCAGTCGAAAGCATCGCATCA 2320
cheetah              AGAACAGAACAACCTCCGAGTGATTTAAATCAAGACTAACCAGTCAAAAGTATTACATCA 2322
Cat                  AGAATAAAACAACCTCCGAGTGATTTAAATCTAGACTAACCAGTCGAAAGTACTACATCA 2323
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                    **** * ******************** *** ***** ******* **** *   *****

Snow_Leopard1       CTTATTGATCCAAAGAC-TTGATCAACGGAACAAGTTACCCTAGGGATAACAGCGCAATC 2389
Snow_Leopard2       CTTATTGATCCAAAGAC-TTGATCAACGGAACAAGTTACCCTAGGGATAACAGCGCAATC 2389
Leopard1            CTTATTGATCCAAAAAC-TTGATCAACGGAACAAGTTACCCTAGGGATAACAGCGCAATC 2381
Tiger1              CTTATTGATCCAAAG-C-TTGATCAACGGAACAAGTTACCCCAGGGATAACAGCGCAATC 2384
Tiger2              CTTATTGATCCAAAG-C-TTGATCAACGGAACAAGTTACCCCAGGGATAACAGCGCAATC 2384
Clouded_leopard     CTTATTGATCCAAAAAC-TTGATCAACGGAACAAGTTACCCTAGGGATAACAGCGCAATC 2379
cheetah             CTAATTGATCCAAAAAC-TTGATCAACGGAACAAGTTACCCTAGGGATAACAGCGCAATC 2381
Cat                 CTTATTGATCCAAAAACCTTGATCAACGGAACAAGTTACCCTAGGGATAACAGCGCAATC 2383
                    ** ***********  * ********************** ******************

Snow_Leopard1       CTATTTCAGAGTCCATATCGACAATAGGGTTTACGACCTCGATGTTGGATCAGGACATCC 2449
Snow_Leopard2       CTATTTCAGAGTCCATATCGACAATAGGGTTTACGACCTCGATGTTGGATCAGGACATCC 2449
Leopard1            CTATTTTAGAGTCCATATCGACAATAGGGTTTACGACCTCGATGTTGGATCAGGACATCC 2441
Tiger1              CTATTTCAGAGTCCATATCGACAATAGGGTTTACGACCTCGATGTTGGATCAGGACATCC 2444
Tiger2              CTATTTCAGAGTCCATATCGACAATAGGGTTTACGACCTCGATGTTGGATCAGGACATCC 2444
Clouded_leopard     CTATTTCAGAGTCCATATCAACAGTAGGGTTTACGACCTCGATGTTGGATCAGGACATCC 2439
cheetah             CTATTTTAGAGTCCATATCGACAATAGGGTTTACGACCTCGATGTTGGATCAGGACATCC 2441
Cat                 CTATTTCAGAGTCCATATCGACAATAGGGTTTACGACCTCGATGTTGGATCAGGACATCC 2443
                    ****** ************ *** ************************************

Snow_Leopard1       CGATGGTGCAGCAGCTATCAAAGGTTCGTTTGTTCAACGATTAAAGTCCTACGTGATCTG 2509
Snow_Leopard2       CGATGGTGCAGCAGCTATCAAAGGTTCGTTTGTTCAACGATTAAAGTCCTACGTGATCTG 2509
Leopard1            CGATGGTGCAGCAGCTATCAAAGGTTCGTTTGTTCAACGATTAAAGTCCTACGTGATCTG 2501
Tiger1              CGATGGTGCAGCAGCTATCAAAGGTTCGTTTGTTCAACGATTAAAGTCCTACGTGATCTG 2504
Tiger2              CGATGGTGCAGCAGCTATCAAAGGTTCGTTTGTTCAACGATTAAAGTCCTACGTGATCTG 2504
Clouded_leopard     CGATGGTGCAGCAGCTATCAAAGGTTCATTTGTTCAACAATTAAAGTCCTACGTGATCTG 2499
cheetah             CGATGGTGCAGCAGCTATCAAAGGTTCGTTTGTTCAACGATTAAAGTCCTACGTGATCTG 2501
Cat                 CGATGGTGCAGCAGCTATCAAAGGTTCGTTTGTTCAACGATTAAAGTCCTACGTGATCTG 2503
                    ************************** ********** ********************

Snow_Leopard1       AGTTCAGACCGGAGTAATCCAGGTCGGTTTCTATCTATTACATAATTTCTCCCAGTACGA 2569 1F
Snow_Leopard2       AGTTCAGACCGGAGTAATCCAGGTCGGTTTCTATCTATTACATAATTTCTCCCAGTACGA 2569
Leopard1            AGTTCAGACCGGAGTAATCCAGGTCGGTTTCTATCTATTAAATAATTTCTCCCAGTACGA 2561
Tiger1              AGTTCAGACCGGAGTAATCCAGGTCGGTTTCTATCTATTAAATAATTTCTCCCAGTACGA 2564
Tiger2              AGTTCAGACCGGAGTAATCCAGGTCGGTTTCTATCTATTAAATAATTTCTCCCAGTACGA 2564
Clouded_leopard     AGTTCAGATGAGAGTAATCCAGGTCGGTTTCTATCTATTAAATAATTTCTCCCAGTACAA 2559
cheetah             AGTTCAGACCGGAGCAATCCAGGTCGGTTTCTATCTATTAAATAATTTCTCCCAGTACGA 2561
Cat                 AGTTCAGACCGGAGTAATCCAGGTCGGTTTCTATCTATTTAATAACTTCTCCCAGTACGA 2563
                    ********   *** ************************  **** ************ *

Snow_Leopard1       AAGGACAAGAGAAATAGGGCCCACTTTACCAAAGCGCCCTTAACCAAATAGATGATACAA 2629
Snow_Leopard2       AAGGACAAGAGAAATAGGGCCCACTTTACCAAAGCGCCCTTAACCAAATAGATGATACAA 2629
Leopard1            AAGGACAAGAGAAATAAGGCCCACTTTACCAAAGCGCCTTTAACCAAATAGATGATATAA 2621
Tiger1              AAGGACAAGAGAAATAAGGCCCACTTTACCAAAGCGCCTTTAACCAAATAGATGATATAA 2624
Tiger2              AAGGACAAGAGAAATAAGGCCCACTTTACCAAAGCGCCTTTAACCAAATAGATGATATAA 2624
Clouded_leopard     AAGGACAAGAGAAATAAGGCCCACTTTACCAAAGTGCCTTTAACCAAATAGATGATATAA 2619
cheetah             AAGGACAAGAGAAATAAGGCCCACTTCATCAAAGCGCCTTTAACCTAATAGATGATATAA 2621
Cat                 AAGGACAAGAGAAGTGAGGCCCACTTCACCAAAGCGCCTTTAACCAAATAGATGATATAA 2623
                    ************* *  ********* * ***** *** ****** *********** **

tRNA-Leu
Snow_Leopard1       TCTCAATCTAGACAGTTTATCTAAATACATTACCCG-AGAGCTCGGGTTTGTTAGGGTGG 2688
Snow_Leopard2       TCTCAATCTAGACAGTTTATCTAAATACATTACCCG-AGAGCTCGGGTTTGTTAGGGTGG 2688
Leopard1            TCTCAATCTAGACAGTTTATCTAAACACACTACCCG-AGAGCTCGGGTTTGTTAGGGTGG 2680
Tiger1              TCTCAATCTAAACAGTTTATCTAAACATATCACCCGTAGAGCTCGGGTTTGTTAGGGTGG 2684
Tiger2              TCTCAATCTAAACAGTTTATCTAAACATATCACCCGTAGAGCTCGGGTTTGTTAGGGTGG 2684
Clouded_leopard     TCTTAATCTAGACAGTTTATTCAACAGCATCACCCATAGAGCTCGGGTTTGTTAGGGTGG 2679
cheetah             TCTTAATCTAAACAGTTTATCCAACTACACTACCCA-AGAACTCGGGTTTGTTAAGGTGG 2680
Cat                 TCTTAATCTAGACAGTTTATCCAAACACACTACCCG-AGAGCTCGGGTTTGTTAGGGTGG 2682
                    *** ****** *********  **    *  ****  *** ************* *****

Snow_Leopard1       CAGAGCCCGGCAATTGCATAAAACTTAAGCTTTTATTATCAGAGGTTCAACTCC--TCTC 2746
26R
Snow_Leopard2       CAGAGCCCGGCAATTGCATAAAACTTAAGCTTTTATTATCAGAGGTTCAACTCC--TCTC 2746
Leopard1            CAGAGCCCGGTAATTGCATAAAACTTAAGCTTTTATCATCAGAGGTTCAACTTCCTTCTC 2740
Tiger1              CAGAGCCCGGCAATTGCATAAAACTTAAGCTTTTACTATCAGAGGTTCAACTCC--TCTC 2742
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Tiger2              CAGAGCCCGGCAATTGCATAAAACTTAAGCTTTTACTATCAGAGGTTCAACTCC--TCTC 2742
Clouded_leopard     CAGAGCCCGGTAATTGCATAAAACTTAAACTTTTACTATCAGAGGTTCAATTCC--TCTT 2737
cheetah             CAGAGCCCGGTAACTGCATAAAACTTAAGCTTTTATTATCAGAGGTTCAATTCC--TCTC 2738
Cat                 CAGAGCCCGGTAACTGCATAAAACTTAAGCTTTTATTATCAGAGGTTCAATTCC--TCTC 2740
                    ********** ** ************** ******  ************* * *  ***

ND1
Snow_Leopard1       CCTAACAGCATGTTCATAATCAATATCCTCTCACTAATTATCCCCATTCTCCTCGCCGTA 2806
Snow_Leopard2       CCTAACAGCATGTTCATAATCAATATCCTCTCACTAATTATCCCCATTCTCCTCGCCGTA 2806
Leopard1            CCTAACAGCATGTTCATAATTAATATCCTCTCACTAATCGTCCCAATTCTCCTCGCCGTG 2800
Tiger1              CCTAACAGCATGTTTATAATCAATATTCTCTCATTAATTATCCCTATTCTCTTCGCCGTA 2802
Tiger2              CCTAACAGCATGTTTATAATCAATATTCTCTCATTAATTATCCCTATTCTCTTCGCCGTA 2802
Clouded_leopard     CCTAACAATATGTTCATAATCTATATCCTCTCATTAATTATCCCCATTCTCCTCGCCGTA 2797
cheetah             CTTAACAACATGTTTATAATTAATATCCTCTCACTAATTATCCCTATTCTCCTCGCCGTG 2798
Cat                 CTTAACAACATGTTTATAATTAATGTACTCTCACTAATTATTCCTATTCTCCTAGCTGTA 2800
                    * *****  ***** *****  ** * ****** ****  * ** ****** * ** **

Snow_Leopard1       GCCTTCCTAACCCTAGTTGAACGCAAAGTACTAGGCTACATGCAACTTCGCAAGGGGCCG 2866
Snow_Leopard2       GCCTTCCTAACCCTAGTTGAACGCAAAGTACTAGGCTACATGCAACTTCGCAAGGGGCCG 2866
Leopard1            GCCTTCCTAACTCTAGTTGAACGTAAAGTACTAGGCTACATGCAACTTCGTAAAGGGCCT 2860
Tiger1              GCCTTCCTAACCCTAGTTGAACGTAAAGTACTGGGCTACATACAACTCCGTAAAGGACCA 2862
Tiger2              GCCTTCCTAACCCTAGTTGAACGTAAAGTACTGGGCTACATACAACTCCGTAAAGGACCA 2862
Clouded_leopard     GCCTTTCTGACCCTAGTTGAACGCAAAGTACTAGGCTACATACAACTCCGCAAGGGACCA 2857
cheetah             GCTTTCCTAACCCTAGTTGAACGAAAAGTACTAGGCTACATACAACTTCGTAAAGGACCA 2858
Cat                 GCCTTCCTAACCCTAGTCGAACGAAAAGTGCTAGGCTATATGCAACTCCGCAAAGGACCA 2860
                    ** ** ** ** ***** ***** ***** ** ***** ** ***** ** ** ** **

Snow_Leopard1       AACATCGTAGGACCATATGGCCTGCTCCAACCCATTGCAGACGCCATGAAACTCTTCACT 2926
Snow_Leopard2       AACATCGTAGGACCATATGGCCTGCTCCAACCCATTGCAGACGCCATGAAACTCTTCACT 2926
Leopard1            AATGTCGTAGGGCCATATGGCCTACTTCAACCCATTGCAGACGCCATAAAACTCTTCACT 2920
Tiger1              AACGTCGTAGGACCATACGGCCTACTTCAGCCTATTGCAGACGCCATGAAACTCTTCACT 2922
Tiger2              AACGTCGTAGGACCATACGGCCTACTTCAGCCTATTGCAGACGCCATGAAACTCTTCACT 2922
Clouded_leopard     AACGTCGTAGGACCATACGGCCTACTTCAACCCATCGCAGACGCTGTGAAACTCTTTACT 2917
cheetah             AATGTCGTAGGACCATATGGCCTACTCCAACCTATTGCAGACGCCGTAAAACTCTTTACC 2918
Cat                 AATGTCGTAGGACCATACGGCCTACTTCAACCTATCGCAGATGCTGTAAAACTCTTTACC 2920
                    **  ******* ***** ***** ** ** ** ** ***** **  * ******** **

Snow_Leopard1       AAAGAGCCCCTCCGACCCCTCACATCATCCACATTCATATTTATTATAGCACCTATCCTA 2986
Snow_Leopard2       AAAGAGCCCCTCCGACCCCTCACATCATCCACATTCATATTTATTATAGCACCTATCCTA 2986
Leopard1            AAAGAACCTCTCCGACCCCTCACATCCTCCATATTCATATTTATTATAGCACCCATCCTA 2980
Tiger1              AAAGAACCCCTCCGACCCCTCACATCCTCCACATTCATATTCATCACAGCACCCATCCTA 2982
Tiger2              AAAGAACCCCTCCGACCCCTCACATCCTCCACATTCATATTCATCACAGCACCCATCCTA 2982
Clouded_leopard     AAAGAACCCCTCCGGCCCCTTACATCCTCTATATTCATATTCATCATAGCACCCATCCTA 2977
cheetah             AAAGAACCTCTCCGACCTCTCACATCCTCCATATTCATATTTATTATAGCACCAATTCTA 2978
Cat                 AAAGAGCCTCTCCGACCCCTTACATCCTCCATATTAATATTCATCATAGCACCAATCCTA 2980
                    ***** ** ***** ** ** ***** ** * *** ***** ** * ****** ** ***

Snow_Leopard1       GCCCTTACACTAGCCCTAACCATATGAATCCCATTGCCCATACCATACCCACTCATCAAT 3046
Snow_Leopard2       GCCCTTACACTAGCCCTAACCATATGAATCCCATTGCCCATACCATACCCACTCATCAAT 3046
Leopard1            GCCCTCACACTAGCCCTAACCATATGAATCCCACTACCCATACCATACCCGCTCATTAAC 3040
Tiger1              GCTCTTACACTAGCCCTAACCATATGAATCCCACTGCCCATACCATACCCACTCATTAAC 3042
Tiger2              GCTCTTACACTAGCCCTAACCATATGAATCCCACTGCCCATACCATACCCACTCATTAAC 3042
Clouded_leopard     GCTCTTACACTAGCCCTAACTATATGAATTCCACTGCCCATACCATATCCACTTATTAAC 3037
cheetah             GCCCTCACACTAGCACTAACTATGTGAATCCCACTACCCATGCCATATCCACTCATCAAT 3038
Cat                 GCCCTCACACTAGCCCTAACCATATGAATCCCACTACCCATACCATACCCGCTCATTAAC 3040
                    ** ** ******** ***** ** ***** *** * ***** ***** ** ** ** **

Snow_Leopard1       ATAAACCTGGGAGTACTATTCATACTAGCCATATCCAGCCTAGCTGTCTACTCCATTCTA 3106
Snow_Leopard2       ATAAACCTGGGAGTACTATTCATACTAGCCATATCCAGCCTAGCTGTCTACTCCATTCTA 3106
Leopard1            ATAAACCTAGGGGTGCTATTCATACTAGCCATATCCAGCCTAGCTGTTTACTCCATCCTA 3100
Tiger1              ATAAACTTAGGAGTGCTATTTATACTAGCTATGTCCAGCCTAGCTGTTTACTCCATTCTA 3102
Tiger2              ATAAACTTAGGAGTGCTATTTATACTAGCTATGTCCAGCCTAGCTGTTTACTCCATTCTA 3102
Clouded_leopard     ATAAACTTAGGAGTGCTATTCATACTAGCAATATCCAGCCTAGCTGTCTACTCCATCCTA 3097
cheetah             ATGAACCTAGGAGTACTATTCATACTAGCCATATCAAGCCTAGCCGTTTACTCTATCCTA 3098
Cat                 ATAAACCTGGGAGTACTATTTATGCTAGCTATATCAAGCCTAGCTGTTTATTCCATCCTA 3100
                    ** *** * ** ** ***** ** ***** ** ** ******** ** ** ** ** ***

Snow_Leopard1       TGATCCGGGTGGGCTTCAAACTCAAAGTACGCTCTAATCGGCGCCCTACGAGCCGTAGCC 3166 2F
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Snow_Leopard2        TGATCCGGGTGGGCTTCAAACTCAAAGTACGCTCTAATCGGCGCCCTACGAGCCGTAGCC 3166
Leopard1             TGATCCGGATGGGCTTCAAACTCAAAATATGCTCTAATCGGCGCCCTACGGGCCGTAGCT 3160
Tiger1               TGATCAGGATGGGCTTCAAACTCAAAATATGCCCTAATCGGAGCCCTACGAGCCGTAGCC 3162
Tiger2               TGATCAGGATGGGCTTCAAACTCAAAATATGCCCTAATCGGAGCCCTACGAGCCGTAGCC 3162
Clouded_leopard      TGATCGGGATGGGCCTCAAACTCAAAATACGCCCTAATCGGAGCCTTACGAGCTGTAGCT 3157
cheetah              TGATCAGGATGGGCTTCAAACTCAAAATATGCTCTAATCGGAGCCTTACGAGCCGTAGCC 3158
Cat                  TGATCAGGATGAGCCTCAAATTCAAAATACGCCCTAATCGGAGCCCTACGAGCCGTCGCC 3160
                     ***** ** ** ** ***** ***** ** ** ******** *** **** ** ** **

Snow_Leopard1        CAAACAATCTCATATGAAGTCACACTAGCTATTATCCTCTTATCTGTACTACTAATAAAC 3226
Snow_Leopard2        CAAACAATCTCATATGAAGTCACACTAGCTATTATCCTCTTATCTGTACTACTAATAAAC 3226
Leopard1             CAAACAATCTCATATGAAGTCACACTAGCTATTATCCTCTTATCAGTACTACTAATAAAT 3220
Tiger1               CAAACAATCTCATATGAAGTCACATTAGCTATCATTCTCTTATCAGTACTACTAATAAAT 3222
Tiger2               CAAACAATCTCATATGAAGTCACATTAGCTATCATTCTCTTATCAGTACTACTAATAAAT 3222
Clouded_leopard      CAGACAATCTCATATGAAGTCACACTAGCTATTATTCTCTTGTCAGTCCTATTAATAAAC 3217
cheetah              CAAACAATCTCATATGAAGTCACACTAGCCATCATCCTTTTATCAGTATTACTAATAAAT 3218
Cat                  CAAACAATCTCATATGAAGTCACACTAGCCATCATTCTCCTATCAGTACTACTAATAAAC 3220
                     ** ********************** **** ** ** **  * ** **  ** *******

Snow_Leopard1        GGATCCTTCACATTAGCCACACTAATTACCACTCAAGAATATATCTGACTTATTATCCCC 3286
Snow_Leopard2        GGATCCTTCACATTAGCCACACTAATTACCACTCAAGAATATATCTGACTTATTATCCCC 3286
Leopard1             GGATCATTCACATTAGCCACACTAATTACCACTCAAGAATACATCTGACTTATTATTCCC 3280
Tiger1               GGATCCTTCACATTAGCTGCACTAATTACCACCCAAGAATACATCTGGCTCATCATCCCT 3282
Tiger2               GGATCCTTCACATTAGCTGCACTAATTACCACCCAAGAATACATCTGGCTCATCATCCCT 3282
Clouded_leopard      GGATCCTTCACACTAGCTACACTAATTACCACTCAAGAATATATCTGACTTATTATCCCT 3277
cheetah              GGGTCCTTCACACTAGCCACACTAATTACCACCCAAGAACACACATGGCTAATTATCCCT 3278
Cat                  GGATCCTTCACACTAGCCATACTAATCACCACTCAAGAATATATATGACTAATCATTCCT 3280
                     ** ** ****** ****   ****** ***** ****** * *  ** ** ** ** **

Snow_Leopard1        GCATGACCCCTAGCTATAATATGATTCATCTCTACTCTAGCAGAAACCAACCGAGCCCCA 3346 1R
Snow_Leopard2        GCATGACCCCTAGCTATAATATGATTCATCTCTACTCTAGCAGAAACCAACCGAGCCCCA 3346
Leopard1             GCATGACCCCTAGCTATAATATGATTCATCTCTACACTAGCAGAAACCAACCGAGCCCCA 3340
Tiger1               GCATGACCCCTAGCCATAATATGATTCATCTCCACACTAGCAGAAACCAACCGAGCTCCA 3342
Tiger2               GCATGACCCCTAGCCATAATATGATTCATCTCCACACTAGCAGAAACCAACCGAGCTCCA 3342
Clouded_leopard      GCATGACCCCTGGCTATAATATGATTCATCTCTACACTAGCAGAAACCAACCGAGCACCA 3337
cheetah              GCATGACCCCTAGCCATGATATGATTTATCTCAACACTAGCAGAAACTAACCGAGCCCCA 3338
Cat                  GCATGACCCCTAGCCATAATATGATTTATCTCAACCCTAGCAGAGACCAACCGAGCCCCA 3340
                     *********** ** ** ******** ***** ** ******** ** ******** ***

Snow_Leopard1        TTTGACCTCACAGAAGGAGAATCAGAGCTTGTTTCCGGATTTAACGTAGAATATGCAGCA 3406
Snow_Leopard2        TTTGACCTCACAGAAGGAGAATCAGAGCTTGTTTCCGGATTTAACGTAGAATATGCAGCA 3406
Leopard1             TTTGACCTCACAGAAGGAGAATCGGAGCTTGTTTCCGGATTCAACGTAGAATACGCAGCA 3400
Tiger1               TTTGATCTAACAGAAGGAGAATCAGAACTCGTTTCCGGATTCAACGTAGAATACGCAGCA 3402
Tiger2               TTTGATCTAACAGAAGGAGAATCAGAACTCGTTTCCGGATTCAACGTAGAATACGCAGCA 3402
Clouded_leopard      TTCGACCTCACAGAGGGAGAGTCAGAGCTCGTTTCTGGATTCAACGTAGAATACGCAGCA 3397
cheetah              TTCGACCTAACAGAAGGGGAATCAGAATTAGTCTCCGGATTTAATGTAGAATACGCAGCA 3398
Cat                  TTCGACCTGACAGAAGGAGAATCAGAACTAGTCTCCGGATTCGATGTAGAATATGCAGCA 3400
                     ** ** ** ***** ** ** ** **  * ** ** *****  * ******** ******

Snow_Leopard1        GGCCCTTTCGCCCTGTTCTTTCTAGCAGAATACGCCAACATTATCATAATAAACATCCTC 3466
Snow_Leopard2        GGCCCTTTCGCCCTGTTCTTTCTAGCAGAATACGCCAACATTATCATAATAAACATCCTC 3466
Leopard1             GGTCCCTTTGCCCTATTCTTTCTAGCAGAATATGCCAACATTATCATAATAAACATCCTC 3460
Tiger1               GGCCCCTTTGCCCTATTTTTTCTAGCAGAATACGCTAATATTATCATAATAAACATCCTC 3462
Tiger2               GGCCCCTTTGCCCTATTTTTTCTAGCAGAATACGCTAATATTATCATAATAAACATCCTC 3462
Clouded_leopard      GGCCCCTTCGCCCTATTTTTTCTAGCAGAATATGCCAACATCATTATAATAAACATGCTT 3457
cheetah              GGCCCCTTCGCCCTATTCTTTCTAGCAGAATACGCCAACATCATCATAATAAATATCCTT 3458
Cat                  GGCCCCTTCGCCCTATTCTTCCTAGCAGAATATGCCAACATCATCATAATAAATATCCTC 3460
                     ** ** ** ***** ** ** *********** ** ** ** ** ******** ** **

Snow_Leopard1        ACAACAATCCTATTCTTCGGAGCATTTCATAGTCCCTACATACCAGAACTATACACCACC 3526
Snow_Leopard2        ACAACAATCCTATTCTTCGGAGCATTTCATAGTCCCTACATACCAGAACTATACACCACC 3526
Leopard1             ACAACAATCCTGTTCTTCGGAGCATTTCACAGCCCCTATATACCAGAGCTATACACCACC 3520
Tiger1               ACAACAATCTTATTTTTCGGAGCATTCCATAATCCCTATATACCAGAACTATATACTATC 3522
Tiger2               ACAACAATCTTATTTTTCGGAGCATTCCATAATCCCTATATACCAGAACTATATACTATC 3522
Clouded_leopard      ACAACAATACTATTTTTTGGAGCATTCCACAGCCCCTACATACCAGAACTACACACCATT 3517
cheetah              ACAACAATCCTATTTTTCGGAGCATTCCATAATCCTTATATACCAGAACTATATATTGTC 3518
Cat                  ACAACAATCCTATTCTTCGGAGCATTCCACAGCCCTTATATACCAGAGCTATATACCATT 3520
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Snow_Leopard1       AACTTCACTGTAAAAACCCTAATCCTAACAACCACCTTCCTATGGATCCGAGCATCCTAT 3586
Snow_Leopard2       AACTTCACTGTAAAAACCCTAATCCTAACAACCACCTTCCTATGGATCCGAGCATCCTAT 3586
Leopard1            AACTTCACTGTAAAAACTCTAATCCTAACAACCACCTTCCTATGAATCCGAGCATCTTAT 3580
Tiger1              AACTTCACTGTAAAAACCCTAATTCTAACAACCACCTTCCTATGGATCCGAGCATCTTAT 3582
Tiger2              AACTTCACTGTAAAAACCCTAATTCTAACAACCACCTTCCTATGGATCCGAGCATCTTAT 3582
Clouded_leopard     AACTTCACAGTAAAAACCCTACTCCTAACAACCACCTTCCTATGAATTCGAGCATCATAC 3577
cheetah             AACTTTACAGTAAAAACCCTGTTTTTAACAACCACTTTCCTATGAATCCGAGCATCATAT 3578
Cat                 AACTTTACAGTAAAGACCCTTCTCCTAACAACTACTTTCTTATGGATCCGAGCATCCTAC 3580
                    ***** ** ***** ** **  *  ******* ** *** **** ** ******** **

Snow_Leopard1       CCACGATTCCGATACGACCAATTAATACACCTCCTATGAAAAAGCTTTCTACCCCTTACC 3646
Snow_Leopard2       CCACGATTCCGATACGACCAATTAATACACCTCCTATGAAAAAGCTTTCTACCCCTTACC 3646
Leopard1            CCACGGTTCCGATACGACCAATTAATACACCTCCTATGAAAAAGCTTTCTACCCCTTACC 3640
Tiger1              CCACGATTCCGATATGACCAATTAATGCACCTCCTATGAAAAAACTTCCTACCCCTTACT 3642
Tiger2              CCACGATTCCGATATGACCAATTAATGCACCTCCTATGAAAAAACTTCCTACCCCTTACT 3642
Clouded_leopard     CCACGATTCCGATACGACCAATTAATGCACCTCCTATGAAAAAGCTTCCTACCCCTCACC 3637
cheetah             CCACGATTCCGATATGATCAATTAATACACCTTTTATGAAAAAATTTTCTCCCTCTTACC 3638
Cat                 CCACGATTCCGATATGACCAACTAATACACCTCCTATGAAAAAACTTTCTGCCTCTCACC 3640
                    ***** ******** ** *** **** *****  *********  ** ** ** ** **

Snow_Leopard1       CTAGCCCTATGTATATGACACGTCTCCCTGCCCATCATCACAGCAAGTATTCCACCTCAA 3706 3F
Snow_Leopard2       CTAGCCCTATGTATATGACACGTCTCCCTGCCCATCATCACAGCAAGTATTCCACCTCAA 3706
Leopard1            CTTGCCCTATGCATATGACATGTCTCCCTACCCATCATTACAGCAAGCATCCCACCCCAA 3700
Tiger1              CTAGCCCTATGCATATGACACGTCTCCCTACCCATCATTACAGCAAGCATTCCACCCCAA 3702
Tiger2              CTAGCCCTATGCATATGACACGTCTCCCTACCCATCATTACAGCAAGCATTCCACCCCAA 3702
Clouded_leopard     CTAGCCCTATGCATATGACATGTCTCCCTACCTATTATCACAGCAAGTATTCCACCTCAA 3697
cheetah             CTAGCTTTATGCATATGACACGTATCAATGCCTATTATCACAGCAAGCATCCCACCTCAA 3698
Cat                 CTAGCCCTATGCATATGACATGTATCCCTACCTATCATCACAGCAAGCATCCCACCTCAA 3700
                    ** **  **** ******** ** **  * ** ** ** ******** ** ***** ***

tRNA-Ile
Snow_Leopard1       ACATAAGAAATATGTCTGACAAAAGAGTTACTTTGATAGAGTAAAACATAGAGGTTTAAA 3766
Snow_Leopard2       ACATAAGAAATATGTCTGACAAAAGAGTTACTTTGATAGAGTAAAACATAGAGGTTTAAA 3766
Leopard1            ACATAAGAAATATGTCTGACAAAAGAGTTACTTTGATAGAGTAAAACATAGGGGTTTAAA 3760
Tiger1              ACATAAGAAATATGTCTGACAAAAGAATTACTTTGATAGAGTAAAACATAGAGGTTTAAG 3762
Tiger2              ACATAAGAAATATGTCTGACAAAAGAATTACTTTGATAGAGTAAAACATAGAGGTTTAAG 3762
Clouded_leopard     ACATAAGAAATATGTCTGACAAAAGAGTTACTTTGATAGAGTAAAACATAGAGGTTTAAA 3757
cheetah             ACATAAGAAATATGTCTGACAAAAGAGTTACTTTGATAGAGTAAAACATAGAGGTTTAAA 3758
Cat                 ACATAAGAAATATGTCTGACAAAAGAGTTACTTTGATAGAGTAAAACATAGAGGTTTAAA 3760
                    ************************** ********************** *******

tRNA-Gln
Snow_Leopard1       CCCTCTTATTTCTAGAATTATAGGAATCGAACCTAACCCTAAGAATCCAAAAATCTTCGT 3826
Snow_Leopard2       CCCTCTTATTTCTAGAATTATAGGAATCGAACCTAACCCTAAGAATCCAAAAATCTTCGT 3826
Leopard1            CCCCCTTATTTCTAGAATAATAGGAATCGAACCTAATCCTAAGAATCCAAAAATCTCCGT 3820
Tiger1              CCCTCTTATTTCTAGAATTATAGGAATCGAACCTAATCCTAAGAATCCAAAAATCTTCGT 3822
Tiger2              CCCTCTTATTTCTAGAATTATAGGAATCGAACCTAATCCTAAGAATCCAAAAATCTTCGT 3822
Clouded_leopard     CCCTCTTATTTCTAGAATTCTAGGGATCGAACCTAGTCTTAAGAATCCAAAAACCTTCGT 3817
cheetah             TCCCCTTATTTCTAGAATTATAGGAATCGAACCTAATCCTAAGAATCCAAAAATCTTCGT 3818
Cat                 CCCTCTTATTTCTAGAATAACAGGAATCGAACCTAATCCTAAGAATCCAAAAATCTTCGT 3820
                     ** **************   *** **********  * ************** ** ***

tRNA-Met
Snow_Leopard1       GCTACCAATACTACACCACATTCTAAAGTAAGGTCAGCTAAATAAGCTATCGGGCCCATA 3886 2R
Snow_Leopard2       GCTACCAATACTACACCACATTCTAAAGTAAGGTCAGCTAAATAAGCTATCGGGCCCATA 3886
Leopard1            GCTACCAATATTACACCACATTCTAAAGTAAGGTCAGCTAAATAAGCTATCGGGCCCATA 3880
Tiger1              GCTACCAATATTACACCACATTCTAA-GTAAGGTCAGCTAAATAAGCTATCGGGCCCATA 3881
Tiger2              GCTACCAATATTACACCACATTCTAA-GTAAGGTCAGCTAAATAAGCTATCGGGCCCATA 3881
Clouded_leopard     GCTACCATCATTACACCATATTCTAAAGTAAGGTCAGCTAAATAAGCTATCGGGCCCATA 3877
cheetah             GCTACCATTACTACACCACATTCTAAAGTAAGGTCAGCTAAATAAGCTATCGGGCCCATA 3878
Cat                 GCTACCATTATTACACCATATTCTAAAGTAAGGTCAGCTAAATAAGCTATCGGGCCCATA 3880
                    *******  * ******* ******* ********************************

ND2
Snow_Leopard1       CCCCGAAAATGTTGGTTTATACCCTTCCCATACTAATCAAACCCCCTATTTTCATTATCA 3946
Snow_Leopard2       CCCCGAAAATGTTGGTTTATACCCTTCCCATACTAATCAAACCCCCTATTTTCATTATCA 3946
Leopard1            CCCCGAAAATGTTGGTTTATACCCTTCCCATACTAATCAAACCCCCCATTTTTATCACCA 3940
Tiger1              CCCCGAAAATGTTGGTTTACACCCTTCCCATACTAATCAAACCCCCTATCCTCACCATCA 3941
Tiger2              CCCCGAAAATGTTGGTTTACACCCTTCCCATACTAATCAAACCCCCTATCCTCACCATCA 3941
Clouded_leopard     CCCCGAAAATGTTGGTTTATACCCTTCCCATACTAATTAAACCCCCTATCTTTATTATCA 3937
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cheetah              CCCCGAAAATGTTGGTTTACACCCTTCCCATACTAATTAAACCCTTTATTTTTATTATCA 3938
Cat                  CCCCGAAAATGTTGGTTTATACCCTTCCCATACTAATCAACCCCCCTATCTTTATTATTA 3940
                     ****************** ***************** ** ***   **  * *  *  *

Snow_Leopard1        TTATATTAACCGTTATCTCAGGAACTATGATCGTAATAACAACTTCCCACTGACTCATGG 4006
Snow_Leopard2        TTATATTAACCGTTATCTCAGGAACTATGATCGTAATAACAACTTCCCACTGACTCATGG 4006
Leopard1             TTATATTAACCGTTATCTCAGGAACTATAATCGTAATAACAACCTCCCACTGACTTATGG 4000
Tiger1               TTATACTAACCGTTATCTCAGGAACTATAATCGTAATAACAACTTCTCACTGACTTATAG 4001
Tiger2               TTATACTAACCGTTATCTCAGGAACTATAATCGTAATAACAACTTCTCACTGACTTATAG 4001
Clouded_leopard      TCATATTAACCGTCATTTCTGGGACTATGATCGTATTAACAACCTCCCACTGACTTATGG 3997
cheetah              TCATAACAACCGTTATTTCAGGAACTATTATCGTAATAACAACCTCCCACTGGCTTATAG 3998
Cat                  TTATATTAACCGTTATCTCAGGAACTATAATTGTAGTGACAACCTCCCACTGACTTCTAG 4000
                     * ***  ****** ** ** ** ***** ** *** * ***** ** ***** **  * *

Snow_Leopard1        TCTGAATCGGCTTCGAAATAAACCTACTAGCCATTATTCCTATCCTCATAAAAAAATACA 4066
Snow_Leopard2        TCTGAATCGGCTTCGAAATAAACCTACTAGCCATTATTCCTATCCTCATAAAAAAATACA 4066
Leopard1             TCTGAATTGGCTTCGAAATAAACCTACTAGCCGTCATTCCCATCCTTATAAAAAAATATA 4060
Tiger1               TCTGAATTGGCTTCGAAATAAACCTATTAGCTATTATTCCCATCCTCATGAAAAAATATA 4061
Tiger2               TCTGAATTGGCTTCGAAATAAACCTATTAGCTATTATTCCCATCCTCATGAAAAAATATA 4061
Clouded_leopard      TCTGAATTGGCCTTGAAATAAACCTGCTAGCCATCATTCCCGTCCTCATAAAAAAACATA 4057
cheetah              TCTGAGTTGGCTTTGAAATAAACCTACTAGCCATCATTCCTATTCTAATAAAAAAATACA 4058
Cat                  TCTGAATTGGCTTTGAAATGAACCTATTAGCCATCATCCCCATCCTCATGAAAAAATACA 4060
                     ***** * *** * ***** *****  ****  * ** **  * ** ** ****** * *

Snow_Leopard1        ACCCACGAGCCATAGAAGCAGCCACAAAATACTTCCTAACACAAGCAACTGCTTCCATGC 4126
Snow_Leopard2        ACCCACGAGCCATAGAAGCAGCCACAAAATACTTCCTAACACAAGCAACTGCTTCCATGC 4126
Leopard1             ATCCACGAGCCACAGAAGCAGCCACAAAATATTTCCTAACACAAGCAACTGCTTCAATAC 4120
Tiger1               ACCCACGAGCCATAGAAGCAGCCACAAAATACTTCCTGACACAAGCAACCGCTTCAATAC 4121
Tiger2               ACCCACGAGCCATAGAAGCAGCCACAAAATACTTCCTGACACAAGCAACCGCTTCAATAC 4121
Clouded_leopard      ATCCACGAGCCACAGAAGCAGCCACAAAATATTTCCTAACACAAGCAACTGCCTCAATAC 4117
cheetah              ACCCACGAGCCATAGAAGCAGCCACAAATATTTCCTAACACAAGCAACCGCCTCCATAA 4118
Cat                  ACCCACGAGCCATAGAAGCAGCCACAAAATATTTCTTAACACAAGCAGCCGCCTCCATAA 4120
                     * ********** ****************** *** * ********* * ** ** **

Snow_Leopard1        TCCTAATAATAGGAATCATCATCAACTTACTGCACTCAGGACAATGAACTGTCTCAAAAG 4186
Snow_Leopard2        TCCTAATAATAGGAATCATCATCAACTTACTGCACTCAGGACAATGAACTGTCTCAAAAG 4186
Leopard1             TCCTAATAATAGGAATCATCATCAACCTACTACACTCAGGACAGTGGACCGTATCAAAAG 4180
Tiger1               TCCTAATAATAGGAATTATCATCAACCTGCTGCACTCAGGACAATGAACCGTATCAAAAG 4181
Tiger2               TCCTAATAATAGGAATTATCATCAACCTGCTGCACTCAGGACAATGAACCGTATCAAAAG 4181
Clouded_leopard      TCCTAATAATAGGAATCATCATCAACTTACTACACTCAGGACAGTGGGCCATATCAAAAA 4177
cheetah              TCCTAATAATAGGAATCATCATTAACCTACTGCACTCAGGACAATGAACCGTATCAAAAG 4178
Cat                  TCCTAATAATATGAATCATTATCAATCTACTGCACTCGGGACAATGGACCGTACTAAAAG 4180
                     *********** **** ** ** **  * ** ***** ***** **  *  *   ****

Snow_Leopard1        ACCTGAACCCCATAGCATCCATTATAATAACAACCGCCCTAGCAATAAAACTAGGATTAG 4246
Snow_Leopard2        ACCTGAACCCCATAGCATCCATTATAATAACAACCGCCCTAGCAATAAAACTAGGATTAG 4246
Leopard1             ACCTCAACCCCATAGCATCCATTATAATAACAATTGCCCTGGCAATAAAACTAGGACTAG 4240
Tiger1               ACCTCAACCCCATGGCATCCATTATAATAACAACCGCCTTAGCAGTAAAACTAGGACTAG 4241
Tiger2               ACCTCAACCCCATGGCATCCATTATAATAACAACCGCCTTAGCAGTAAAACTAGGACTAG 4241
Clouded_leopard      ATCTTAACCCCGTAGCATCCGCCATAATAACAGCTGCCTTAGCAATAAAACTAGGACTAG 4237
cheetah              ACCTTAACCCCATAGCATCAATTATAATAACAACTGCCCTAGCAATAAAACTAGGACTAG 4238
Cat                  ACCTTAATCCCATAGCATCAATCATAATAACAACCGCTCTAGCAATAAAACTAGGACTAG 4240
                     * ** ** *** * *****    *********   **  * *** ************ ***

Snow_Leopard1        CCCCATTCCACTTCTGACTGCCCGAAGTCACACAAGGAATCTCCATGTCCTCGGGCCTAA 4306 4F
Snow_Leopard2        CCCCATTCCACTTCTGACTGCCCGAAGTCACACAAGGAATCTCCATGTCCTCGGGCCTAA 4306
Leopard1             CCCCATTCCACTTCTGAGTGCCCGAAGTCACACAAGGAATCTCCATGTCCTCAGGCCTAA 4300
Tiger1               CCCCATTCCACTTCTGAGTGCCCGAAGTTACACAAGGAATCTCCTTGTCTTCAGGCCTGA 4301
Tiger2               CCCCATTCCACTTCTGAGTGCCCGAAGTTACACAAGGAATCTCCTTGTCTTCAGGCCTGA 4301
Clouded_leopard      CCCCGTTCCACTTCTGAGTGCCCGAAGTCACACAAGGAATCTCTATATCCTCAGGCCTGA 4297
cheetah              CCCCCTTTCACTTCTGAGTACCTGAAGTCACACAAGGAATTTCCATGTCATCAGGCCTAA 4298
Cat                  CCCCATTCCACTTCTGAGTACCCGAAGTTACACAAGGAATTTCTATATCATCAGGCTTAA 4300
                     **** ** ********* * ** ***** ********** **  * ** ** *** * *

Snow_Leopard1        TCCTACTCACATGACAAAAAATCGCCCCACTATCAATTCTATACCAAATCTCACCTACCA 4366
Snow_Leopard2        TCCTACTCACATGACAAAAAATCGCCCCACTATCAATTCTATACCAAATCTCACCTACCA 4366
Leopard1             TCCTACTCACATGACAAAAAATCGCCCCACTATCAATCCTATACCAAATCTCACCCACCA 4360
Tiger1               TCCTACTCACATGACAAAAAATCGCACCACTATCAATTCTTTACCAAATTTCACCCACCA 4361
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Tiger2              TCCTACTCACATGACAAAAAATCGCACCACTATCAATTCTTTACCAAATTTCACCCACCA 4361
Clouded_leopard     TCCTGCTCACATGACAAAAAATTGCACCCCTATCAGTCCTCTACCAAATCTCACCTACCA 4357
cheetah             TCTTATTAACATGACAAAAAATCGCACCCCTATCTATCCTATACCAAATCTCATCCACTA 4358
Cat                 TTCTACTAACATGACAAAAAATTGCACCACTATCAATCCTCTACCAAATCTCATCCACCA 4360
                    *  *  * ************** ** ** *****  * ** ******** *** * ** *

Snow_Leopard1       TTAATCCTAACCTACTCCTAACAATAGCCATCATATCAGTTATAATCGGAGGCTGAGGGG 4426
Snow_Leopard2       TTAATCCTAACCTACTCCTAACAATAGCCATCATATCAGTTATAATCGGAGGCTGAGGGG 4426
Leopard1            TCAACCCCAGCCTACTCCTAACAATAGCCATCATATCAGTTATAGTCGGAGGTTGAGGAG 4420
Tiger1              TTAACCCCAACCTACTCCTAGCAATAGCCATTATATCAGTTATAATCGGAGGCTGAGGGG 4421
Tiger2              TTAACCCCAACCTACTCCTAGCAATAGCCATTATATCAGTTATAATCGGAGGCTGAGGGG 4421
Clouded_leopard     TCAACCCCGACTTACTCCTAACAATAGCCACCATATCAATTGCAATCGGAGGCTGAGGAG 4417
cheetah             TCAACCCTAGCCTACTCCTAACAATATCCATCATATCAGTTATGATTGGAGGCTGAGGAG 4418
Cat                 TTAACCCTAACCTAATCCTAACAATATCCATCTTATCAGTCATAATCGGAGGCTGAGGAG 4420
                    * ** **   * ** ***** ***** ***   ***** *     * ***** ***** *


Snow_Leopard1       GACTCAATCAGACCCAACTACGAAAAATCATAGCATATTCCTCAATCGCCCATATAGGCT 4486 3R
Snow_Leopard2       GACTCAATCAGACCCAACTACGAAAAATCATAGCATATTCCTCAATCGCCCATATAGGCT 4486
Leopard1            GACTTAATCAAACCCAACTACGAAAAATTATAGCATATTCCTCAATTGCCCACATAGGCT 4480
Tiger1              GACTTAACCAAACCCAGCTACGAAAAATCATAGCATACTCCTCAATCGCCCATATAGGTT 4481
Tiger2              GACTTAACCAAACCCAGCTACGAAAAATCATAGCATACTCCTCAATCGCCCATATAGGTT 4481
Clouded_leopard     GACTCAACCAAACCCAATTACGAAAAATCATAGCATACTCCTCAATCGCCCACATAGGTT 4477
cheetah             GCCTCAACCAAACACAACTACGAAAAATCATAGCGTACTCCTCAATCGCCCATATAGGCT 4478
Cat                 GCCTAAACCAAACACAACTACGAAAAATCATAGCATACTCCTCAATCGCCCATATAGGCT 4480
                    * ** ** ** ** **  ********** ***** ** ******** ***** ***** *

Snow_Leopard1       GAATAGCAGCTATCATAATATACAGCCCCACAATAATAATTTTAAACCTGATCATCTACA 4546
Snow_Leopard2       GAATAGCAGCTATCATAATATACAGCCCCACAATAATAATTTTAAACCTGATCATCTACA 4546
Leopard1            GAATAGCAGCCATCATAATATATAGCCCCACAATAATAATTTTAAACCTGACCATCTACA 4540
Tiger1              GAATAACAGCCATCATAATATATAGCCCCACAATAATAATTTTAAACCTGACTATCTATA 4541
Tiger2              GAATAACAGCCATCATAATATATAGCCCCACAATAATAATTTTAAACCTGACTATCTATA 4541
Clouded_leopard     GAATAACAGCTATCATAGTATACAGCCCCACGATAATAATTCTAAACCTAATAATCTATA 4537
cheetah             GAATAACAGCCATTATAATATATAATCCCACAATAATAATCCTAAACCTAACCATCTACA 4538
Cat                 GAATGACAGCTATCATAATGTACAGCCCCACAATAATAATCTTAAACCTAACTATCTATA 4540
                    ****  **** ** *** * ** *  ***** ********  ******* *  ***** *

Snow_Leopard1       TCACCATAACACTAACCACCTTTATACTATTCATATATAACTCAACCACAACAACATCAT 4606
Snow_Leopard2       TCACCATAACACTAACCACCTTTATACTATTCATATATAACTCAACCACAACAACATCAT 4606
Leopard1            TCATCATAACACTAACCACCTTCATATTATTCATACACAACTCCACCACCACAACATCAT 4600
Tiger1              TCATTATAACACTAACCACTTTCATGTTACTCATATACAACTCCACCACAACAACATTAT 4601
Tiger2              TCATTATAACACTAACCACTTTCATGTTACTCATATACAACTCCACCACAACAACATTAT 4601
Clouded_leopard     TCACCATAACACTAGCCACCTTCATGCTATTTATACACAACTCCACTACAACAGTATCAT 4597
cheetah             TTATCATAACACTAACCACCTTTATACTATTTATATACAACTCCACCACAACAACACTGT 4598
Cat                 TCATTATAACACTAACCACCTTCATACTATTTATACACAACTCCACCACAACAACAGCAT 4600
                    * *  ********* **** ** **  ** * *** * ***** ** ** ***  *   *

Snow_Leopard1       CCCTATCACAGACATGAAATAAAACTCCCCTAATCACCTCATTTATCCTAGTACTAATAA 4666
Snow_Leopard2       CCCTATCACAGACATGAAATAAAACTCCCCTAATCACCTCATTTATCCTAGTACTAATAA 4666
Leopard1            CCCTATCACAAACATGAAACAAAACACCCCTAATCACCTCATTTATCCTAGTACTAATAA 4660
Tiger1              CCTTATCACAAACATGAAACAAAACGCCCCTGATCACCTCACTTATCCTACTGCTAATAA 4661
Tiger2              CCTTATCACAAACATGAAACAAAACGCCCCTGATCACCTCACTTATCCTACTGCTAATAA 4661
Clouded_leopard     CTTTATCACAAACATGAAATAAAACACCCCTGGTCACCCTACTTATTCTAACACTAATAA 4657
cheetah             CCCTGTCACAAACATGAAACAAAACTCCCCTAATCACCTCACTCATTTTAGTATTAATAA 4658
Cat                 CCCTATCACAAACATGAAATAAAACCCCTCTAATCACCTCACTCATCCTAGTATTAATAA 4660
                    *  * ***** ******** ***** ** **  *****  * * **  **    ******

Snow_Leopard1       TATCTCTAAGCGGCCTTCCTCCACTCTCCGGCTTCATCCCAAAATGAATAATCATCCAAG 4726
Snow_Leopard2       TATCTCTAAGCGGCCTTCCTCCACTCTCCGGCTTCATCCCAAAATGAATAATCATCCAAG 4726
Leopard1            TGTCTCTAGGCGGCCTTCCTCCACTCTCCGGCTTCATCCCAAAATGAATAATCATTCAGG 4720
Tiger1              TGTCTCTGGGCGGCCTCCCCCCACTCTCTGGCTTCATCCCAAAATGAATAATCATTCAAA 4721
Tiger2              TGTCTCTGGGCGGCCTCCCCCCACTCTCTGGCTTCATCCCAAAATGAATAATCATTCAAA 4721
Clouded_leopard     TGTCCTTAGGCGGCCTTCCCCCACTCTCCGGCTTCATCCCAAAATGAATAATTATCCAAG 4717
cheetah             TATCCCTAGGTGGTCTCCCCCCACTTTCTGGCTTCACTCCAAAATGAATAATCATCCAAG 4718
Cat                 TATCCCTGGGAGGCCTCCCCCCACTCTCCGGATTTATCCCAAAATGAATAATCATCCAAG 4720
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Snow_Leopard1       AACTAACTAAAAATGAAATAATTATAATACCCACACTACTAGCTATAACAGCGCTACTTA 4786
Snow_Leopard2       AACTAACTAAAAATGAAATAATTATAATACCCACACTACTAGCTATAACAGCGCTACTTA 4786
Leopard1            GACTAACTAAAAACGAAATAATTATAATACCCACACTACTAGCTATAACAGCACTACTTA 4780
Tiger1              AACTAACCAAAAATGAAATAATCATAATACCCACACTACTAGCCATAACAGCACTACTTA 4781
Tiger2              AACTAACCAAAAATGAAATAATCATAATACCCACACTACTAGCCATAACAGCACTACTTA 4781
Clouded_leopard     AACTGACTAAGAACGAAATAATTATAATACCCACACTACTAGCTATAACAGCACTACTCA 4777
cheetah             AACTAACTAAAAATGAAATAATCATAATACCAACATTACTAGCCATAACAGCACTACTCA 4778
Cat                 AATTGACTAAAAATGAATTAATCATAATGCCAACATTACTAGCCATAACAGCACTACTCA 4780
                     * * ** ** ** *** **** ***** ** *** ******* ******** ***** *

Snow_Leopard1       ACCTATACTTCTACATACGACTAACATATACCACTGCACTAACTATATTCCCCTCAAATA 4846
Snow_Leopard2       ACCTATACTTCTACATACGACTAACATATACCACTGCACTAACTATATTCCCCTCAAATA 4846
Leopard1            ACCTGTACTTCTACATACGACTAACGTATACCACTGCACTGACTATATTCCCCTCAAACA 4840
Tiger1              ACCTGTACTTCTACATACGACTAACATATACCACTGCACTAACTATATTCCCCTCAAACA 4841
Tiger2              ACCTGTACTTCTACATACGACTAACATATACCACTGCACTAACTATATTCCCCTCAAACA 4841
Clouded_leopard     ATTTATACTTCTATATACGACTAACATACACCACCACACTAACTATATTCCCCTCAAGCA 4837
cheetah             ACCTATACTTCTACATACGATTAACATATTCCACTGCACTAACCATATTTCCCTCAAACA 4838
Cat                 ACCTATACTTCTACATACGACTAACATACACCACCGCACTAACCATGTTCCCCTCAAACA 4840
                    *  * ******** ****** **** **  ****  **** ** ** ** *******  *

Snow_Leopard1       ACTGCATAAAAATGAAATGACGATTCGAACGCACAAAAAAAACAATCCTTTTACCCCCCT 4906
Snow_Leopard2       ACTGCATAAAAATGAAATGACGATTCGAACGCACAAAAAAAACAATCCTTTTACCCCCCT 4906
Leopard1            ACTGTATAAAAATAAAATGACGATTCGAGTGCACAGAAAAAACAACCTTTTTACCCCCCT 4900
Tiger1              ACTGTATAAAAATAAAATGACGGTTCAAATGCACAAAAAAAAATAATCTTTTTACCCCCCT 4901
Tiger2              ACTGTATAAAAATAAAATGACGGTTCAAATGCACAAAAAAAAATAATCTTTTTACCCCCCT 4901
Clouded_leopard     ACAACATAAAAATAAAATGACGATTCGAACATACAAAAAAAATAATCTTCTTGCCCCCTC 4897
cheetah             ATAGCATAAAGATAAAATGACGATTCGAATGCACAAAAAAAATAACCTTCTTACCCCCTC 4898
Cat                 ACAGTATAAAAATAAAATGACGATTTGAATGCACAAAAAAAATAACCTTCCTACCCCCTC 4900
                    *    ***** ** ******** **  *    *** ****** ** * *  * *****

tRNA-Trp
Snow_Leopard1       TAATCGTAATATCTACCATACTACTACCACTCGCACCAATACTATCTGTCCTAGATTAGA 4966
Snow_Leopard2       TAATCGTAATATCTACCATACTACTACCACTCGCACCAATACTATCTGTCCTAGATTAGA 4966
Leopard1            TAATTGTAATATCCACCATGCTACTACCACTCGCACCAATACTATCCATCCTAGATTAGA 4960
Tiger1              TAATCGTAATGTCCACCATGCTACTCCCACTCACACCAATACTATCCGTCCTAGATTAGA 4961
Tiger2              TAATCGTAATGTCCACCATGCTACTCCCACTCACACCAATACTATCCGTCCTAGATTAGA 4961
Clouded_leopard     TTATCGTAATTTCTACCATACTACTGCCACTCACACCAATACTATCCATTCTGGATTAGA 4957
cheetah             TAATTGTAATATCAACTATAATACTCCCACTCACACCAATACTATCCATCCTGGATTAGA 4958
Cat                 TAGTTGTAATATCAACCATACTACTTCCACTCGCACCAATACTATCTATCCTGGATTAGA 4960
                    *  * ***** ** ** **  **** ****** *************  * ** *******

Snow_Leopard1       A-GTTTAGGTTAAATTAGACCAAGAGCCTTCAAAGCTCTAAGCAAGCCCTAGCAGACTTA 5025 5F
Snow_Leopard2       A-GTTTAGGTTAAATTAGACCAAGAGCCTTCAAAGCTCTAAGCAAGCCCTAGCAGACTTA 5025
Leopard1            A-GTTTAGGTTAAATTAGACCAAGAGCCTTCAAAGCTCTAAGTAAGCCCTAACAGACTTA 5019
Tiger1              AAGTTTAGGTTAAACTAGACCAAGAGCCTTCAAAGCTCTAAGTAAGCCCTA-TAGAATTA 5020
Tiger2              AAGTTTAGGTTAAACTAGACCAAGAGCCTTCAAAGCTCTAAGTAAGCCCTA-TAGAATTA 5020
Clouded_leopard     A-GTTTAGGTTAAACTAGACCAAGAGCCTTCAAAGCCCTAAGCAAGTCTCA-CAGACTTA 5015
cheetah             A-GTTTAGGTTAAATTAGACCAAGAGCCTTCAAAGCTCTAAGTAAGCCCCA-CAGACTTA 5016
Cat                 A-GTTTAGGTTAAACTAGACCAAGAGCCTTCAAAGCTCTAAGCAAGTCCTA-CAGACTTA 5018
                    * ************ ********************** ***** *** *  *  *** ***

tRNA-Ala
Snow_Leopard1       ACTTCTGCATACCAACTTAACCCTAAGGACTGCAAGAATCTATCTTACATCAATTGATTG 5085
Snow_Leopard2       ACTTCTGCATACCAACTTAACCCTAAGGACTGCAAGAATCTATCTTACATCAATTGATTG 5085
Leopard1            ACTTCTGCATATCCAATTAATCCTAAGGACTGCAAGAATCTATCTTACATCAATTGATTG 5079
Tiger1              ACTTCTGCATACCTA-TTAACTCTAAGGACTGGAAGAATCTATCTTACATCAATTGACTG 5079
Tiger2              ACTTCTGCATACCTA-TTAACTCTAAGGACTGGAAGAATCTATCTTACATCAATTGACTG 5079
Clouded_leopard     ACTTCTGTATATCAA-TAACCACTAAGGACTGCAAGAATCTATCTCACATCAATTGACTG 5074
cheetah             ACTTCTGCATACC-AAACTGCCTTAAGGACTGCAAGAACCTATCTCACATCAATTGACTG 5075
Cat                 ACTTCTGCACATCTAAACCATTCTAAGGACTGCAAGAATCTATCTTACATCAATTGATTG 5078
                    ******* * * * *        ********* ***** ****** *********** **

tRNA-Asn
Snow_Leopard1       CAAATCAAACACTTTAATTAAGCTAAGCCCTTACTAGATTGGTGGGCCCCAACCCCACGA 5145 4R
Snow_Leopard2       CAAATCAAACACTTTAATTAAGCTAAGCCCTTACTAGATTGGTGGGCCCCAACCCCACGA 5145
Leopard1            CAAATCAAACACTTTAATTAAGCTAAGCCCTTACTAGATTGGTGGGCCCCAACCCCACGA 5139
Tiger1              CAAATCAAACACTTTAATTAAGCTAAGCCCTTACTAGATTGGTGGGCCCTAACCCCACGA 5139
Tiger2              CAAATCAAACACTTTAATTAAGCTAAGCCCTTACTAGATTGGTGGGCCCTAACCCCACGA 5139
Clouded_leopard     CAAATCAAACACTTTAATTAAGCTAAGCCCTTACTAGATTGGTGGGCCCCAACCCCACGA 5134
cheetah             CAAATCAAACACTTTAATTAAGCTAAGTCCTCACTAGATTGGTGGGCTCCAACCCCACGA 5135
Cat                 CAAATCAAACACTTTAATTAAGCTAAGTCCTCACTAGATTGGTGGGCTCTAACCCCACGA 5138
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Snow_Leopard1       AATTTTAGTTAACAGCTAAATACCCTAGTCAACTGGCTTCAATCTACTTCTCCCGCCGTC 5205
Snow_Leopard2       AATTTTAGTTAACAGCTAAATACCCTAGTCAACTGGCTTCAATCTACTTCTCCCGCCGTC 5205
Leopard1            AATTTTAGTTAACAGCTAAATACCCTAGTCCACTGGCTTCAATCTACTTCTCCCGCCGTC 5199
Tiger1              AATTTTAGTTAACAGCTAAATACCCTAATCAACTGGCTTCAATCTACTTCTCCCGCCGCC 5199
Tiger2              AATTTTAGTTAACAGCTAAATACCCTAATCAACTGGCTTCAATCTACTTCTCCCGCCGCC 5199
Clouded_leopard     AATTTTAGTTAACAGCTAAATACCCTAATCAACTGGCTTCAATCTACTTCTCCCGCCGTC 5194
cheetah             AATTTTAGTTAACAGCTAAATACCCTAATCAACTGGCTTCAATCCACTTCTCCCGCCGTC 5195
Cat                 AATTTTAGTTAACAGCTAAATGCCCTAATCAACTGGCTTCAATCCACTTCTCCCGCCGTC 5198
                    ********************* ***** ** ************ ************* *

tRNA-cys
Snow_Leopard1       CGGAAAAAAAAGGCGGGAGAAGCCCCGGCAGCCTCAAGCTGCTTCTTTGAATTTGCAATT 5265
Snow_Leopard2       CGGAAAAAAAAGGCGGGAGAAGCCCCGGCAGCCTCAAGCTGCTTCTTTGAATTTGCAATT 5265
Leopard1            TAGAAAAAAAAGGCGGGAGAAGCCCCGGCAGCGTCAAGCTGCTTCTTTGAATTTGCAATT 5259
Tiger1              TGGAAAAAAAAGGCGGGAGAAGCCCCGGCAGCGTCAAGCTGCTTCTTTGAATTTGCAATT 5259
Tiger2              TGGAAAAAAAAGGCGGGAGAAGCCCCGGCAGCGTCAAGCTGCTTCTTTGAATTTGCAATT 5259
Clouded_leopard     CAGAAAAAAAAGGCGGGAGAAGCCCCGGCAGCGTCAAGCTGCTTCTTTGAATTTGCAATT 5254
cheetah             TAAAAAAAAAAGGCGGGAGAAGCCCCGGCAGCGTCAGGCTGCTTCTTTGAATTTGCAATT 5255
Cat                 TAGAAAAAAAAGGCGGGAGAAGCCCCGGCAGCGCCAAGCTGCTTCTTTGAATTTGCAATT 5258
                       ***************************  ** ***********************

tRNA-tyr
Snow_Leopard1       CAATATGACACTCACTGCAGGACTTGGTAAAA-GAGGACTAAA--CCTCTGTCTTTAGAT 5322
Snow_Leopard2       CAATATGACACTCACTGCAGGACTTGGTAAAA-GAGGACTAAA--CCTCTGTCTTTAGAT 5322
Leopard1            CAATATGACATTCACTGCAGGACTTGGTAAAAAGAGGACTGAA--CCTCTGTCTTTAGAT 5317
Tiger1              CAATATGACATTCACTACAGGACTTGGTAAAAAGAGGGTTAGAACCTCCTGTCTTTAGAT 5319
Tiger2              CAATATGACATTCACTACAGGACTTGGTAAAAAGAGGGTTAGAACCTCCTGTCTTTAGAT 5319
Clouded_leopard     CAATATGACATCCACCGCAGGGCTTGGTAAAAAGAGGGTTAAAA-CCTCTGTCTTTAGAT 5313
cheetah             CAACATGACGTTCACCGCAGGACTTGGTAAAAAGAGGGCTTAAA-CCTCTGTGCTTAGAT 5314
Cat                 CAACATGACATTCACCGCAGGACTTGGTAAAAAGAGGGCTCGAA-CCTCTGTCTTTAGAT 5317
                    *** *****   ***  **** ********** ****  *  *  *  ****  ******

CO1
Snow_Leopard1       TTACAGTCTAATGCTTACTCAGCCATTTTACCTATGTTCATAAACCGCTGACTATTTTCA 5382
Snow_Leopard2       TTACAGTCTAATGCTTACTCAGCCATTTTACCTATGTTCATAAACCGCTGACTATTTTCA 5382
Leopard1            TTACAGTCTAATGCTTACTCAGCCATTTTACCTATGTTCATAAACCGCTGACTATTTTCA 5377
Tiger1              TTACAGTCTAATGCTTACTCAGCCATTTTACCTATGTTCATAAACCGCTGACTATTTTCA 5379
Tiger2              TTACAGTCTAATGCTTACTCAGCCATTTTACCTATGTTCATAAACCGCTGACTATTTTCA 5379
Clouded_leopard     TTACAGTCTAATGCTTGCTCAGCCATTTTACCTATGTTCATAAACCGCTGACTATTTTCA 5373
cheetah             TTACAGTCTAATGCTTACTCAGCCATTTTACCTATGTTCATAATCCGCTGATTATTTTCA 5374
Cat                 TTACAGTCTAATGCTTACTCAGCCATTTTACCTATGTTCATAAACCGGTGACTATTTTCA 5377
                    *************** ************************** *** *** ********

Snow_Leopard1       ACCAATCACAAAGATATTGGAACTCTTTACCTTCTATTTGGCGCCTGAGCTGGTATGGTG 5442
Snow_Leopard2       ACCAATCACAAAGATATTGGAACTCTTTACCTTCTATTTGGCGCCTGAGCTGGTATGGTG 5442
Leopard1            ACCAATCACAAAGATATTGGAACTCTTTACCTTCTATTTGGTGCCTGGGCTGGCATGGTG 5437
Tiger1              ACCAATCACAAGGATATTGGAACTCTTTACCTTTTATTTGGCGCCTGGGCTGGTATAGTG 5439
Tiger2              ACCAATCACAAGGATATTGGAACTCTTTACCTTTTATTTGGCGCCTGGGCTGGTATAGTG 5439
Clouded_leopard     ACTAACCATAAAGATATTGGAACTCTTTACCTTTTATTTGGCGCTTGGGCCGGTATAGTA 5433
cheetah             ACTAATCATAAAGATATCGGTACTCTTTACCTCCTGTTTGGTGCTTGAGCTGGTATAGTA 5434
Cat                 ACTAATCACAAAGATATTGGTACTCTTTACCTTTTATTCGGTGCCTGAGCTGGCATGGTG 5437
                    ** ** ** ** ***** ** ***********  * ** ** ** ** ** ** ** **

Snow_Leopard1       GGGACTGCTCTCAGTCTCTTAATCCGAGCCGAGCTGGGTCAACCTGGCACACTGCTAGGG 5502
Snow_Leopard2       GGGACTGCTCTCAGTCTCTTAATCCGAGCCGAGCTGGGTCAACCTGGCACACTGCTAGGG 5502
Leopard1            GGGACTGCTCTCAGTCTCTTAATCCGAGCCGAACTGGGTCAACCTGGCACACTGCTAGGG 5497
Tiger1              GGGACTGCCCTCAGTCTCCTAATTCGAGCCGAACTGGGTCAACCTGGCACACTACTAGGA 5499
Tiger2              GGGACTGCCCTCAGTCTCCTAATTCGAGCCGAACTGGGTCAACCTGGCACACTACTAGGA 5499
Clouded_leopard     GGGACTGCTCTTAGTCTTTTAATTCGAGCTGAGCTGGGTCAACCTGGCACGCTACTAGGG 5493
cheetah             GGGACTGCTCTTAGTCTTCTAATCCGGGCCGAACTAGGTCAACCTGGCACACTACTAGGA 5494
Cat                 GGGACTGCTCTTAGTCTTCTAATCCGGGCCGAACTGGGCCAACCTGGTACACTACTAGGA 5497
                    ******** ** *****  **** ** ** ** ** ** ******** ** ** *****

Snow_Leopard1       GATGACCAGATTTATAATGTAGTCGTCACCGCCCATGCTTTTGTAATAATCTTCTTTATA 5562
Snow_Leopard2       GATGACCAGATTTATAATGTAGTCGTCACCGCCCATGCTTTTGTAATAATCTTCTTTATA 5562
Leopard1            GACGACCAAATTTATAATGTAGTCGTTACCGCCCATGCTTTTGTAATAATCTTCTTTATA 5557
Tiger1              GATGACCAAATTTATAATGTAGTAGTTACTGCCCATGCCTTTGTGATAATCTTTTTTATA 5559
Tiger2              GATGACCAAATTTATAATGTAGTAGTTACTGCCCATGCCTTTGTGATAATCTTTTTTATA 5559
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Clouded_leopard     GATGACCAGATTTATAATGTAGTCGTCACTGCTCATGCCTTCGTAATAATCTTTTTTATA 5553
cheetah             GATGATCAAATTTACAATGTAATCGTTACAGCCCATGCTTTTGTAATGATTTTCTTCATA 5554
Cat                 GATGATCAGATTTACAATGTAATCGTCACTGCCCATGCTTTTGTAATGATCTTTTTTATG 5557
                    ** ** ** ***** ****** * ** ** ** ***** ** ** ** ** ** ** **

Snow_Leopard1       GTGATGCCTATTATAATTGGAGGGTTTGGAAACTGATTAGTCCCATTAATAATCGGGGCC 5622 6F
Snow_Leopard2       GTGATGCCTATTATAATTGGAGGGTTTGGAAACTGATTAGTCCCATTAATAATCGGGGCC 5622
Leopard1            GTAATGCCCATCATGATTGGAGGATTCGGAAACTGATTGGTCCCATTAATAATTGGAGCC 5617
Tiger1              GTAATGCCTATTATAATTGGAGGATTCGGAAACTGGCTAGTTCCGTTAATAATCGGAGCC 5619
Tiger2              GTAATGCCTATTATAATTGGAGGATTCGGAAACTGGCTAGTTCCGTTAATAATCGGAGCC 5619
Clouded_leopard     GTAATACCCATTATGATTGGAGGGTTTGGAAACTGACTGGTCCCATTAATAATTGGGGCC 5613
cheetah             GTTATGCCTATTATAATTGGAGGATTCGGTAACTGATTGGTCCCATTAATGATTGGAGCT 5614
Cat                 GTGATGCCTATTATAATTGGAGGGTTCGGAAACTGATTGGTCCCATTAATAATTGGAGCT 5617
                    ** ** ** ** ** ******** ** ** *****  * ** ** ***** ** ** **

Snow_Leopard1       CCCGATATAGCATTCCCTCGAATGAATAATATGAGTTTCTGACTCCTCCCCCCGTCTTTC 5682
Snow_Leopard2       CCCGATATAGCATTCCCTCGAATGAATAATATGAGTTTCTGACTCCTCCCCCCGTCTTTC 5682
Leopard1            CCCGATATAGCATTCCCTCGAATGAATAATATGAGCTTTTGACTCCTTCCCCCATCTTTC 5677
Tiger1              CCCGATATGGCATTCCCTCGAATGAATAACATAAGCTTCTGACTCCTTCCCCCATCCTTC 5679
Tiger2              CCCGATATGGCATTCCCTCGAATGAATAACATAAGCTTCTGACTCCTTCCCCCATCCTTC 5679
Clouded_leopard     CCCGACATAGCATTCCCTCGAATAAATAACATAAGCTTCTGACTCCTTCCTCCGTCTTTC 5673
cheetah             CCTGACATAGCATTCCCCCGAATGAATAATATAAGCTTCTGGCTCCTTCCTCCCTCTTTC 5674
Cat                 CCTGACATAGCATTTCCCCGAATAAACAACATGAGCTTCTGACTCCTCCCTCCATCCTTT 5677
                    ** ** ** ***** ** ***** ** ** ** ** ** ** ***** ** ** ** **

Snow_Leopard1       CTGCTTTTGCTCGCATCATCTATGGTAGAGGCTGGGGCGGGGACTGGGTGGACAGTATAC 5742
Snow_Leopard2       CTGCTTTTGCTCGCATCATCTATGGTAGAGGCTGGGGCGGGGACTGGGTGGACAGTATAC 5742
Leopard1            CTACTTTTGCTCGCATCATCTATGGTAGAGGCTGGGGCAGGAACTGGATGAACAGTATAC 5737
Tiger1              CTACTTCTGCTCGCATCGTCTATGGTAGAAGCTGGGGCAGGAACTGGGTGGACAGTATAC 5739
Tiger2              CTACTTCTGCTCGCATCGTCTATGGTAGAAGCTGGGGCAGGAACTGGGTGGACAGTATAC 5739
Clouded_leopard     CTACTTTTGCTCGCATCGTCTATAGTAGAGGCCGGGGCAGGAACTGGGTGGACAGTGTAC 5733
cheetah             TTACTTCTACTCGCTTCATCTATAGTGGAGGCTGGGGCAGGGACTGGATGAACAGTGTAT 5734
Cat                 CTACTCTTACTCGCCTCATCTATGGTAGAAGCCGGAGCAGGAACTGGGTGAACAGTATAC 5737
                     * **  * ***** ** ***** ** ** ** ** ** ** ***** ** ***** **

Snow_Leopard1       CCGCCTCTAGCCGGCAACCTAGCTCATGCAGGAGCATCCGTAGACCTAACTATTTTCTCA 5802 5R
Snow_Leopard2       CCGCCTCTAGCCGGCAACCTAGCTCATGCAGGAGCATCCGTAGACCTAACTATTTTCTCA 5802
Leopard1            CCACCCCTAGCCGGCAACCTAGCCCATGCAGGGGCATCCGTAGATTTAACTATTTTTTCA 5797
Tiger1              CCACCCCTAGCTGGCAACCTAGCCCATGCAGGAGCATCCGTGGATCTAACTATTTTTTCA 5799
Tiger2              CCACCCCTAGCTGGCAACCTAGCCCATGCAGGAGCATCCGTGGATCTAACTATTTTTTCA 5799
Clouded_leopard     CCGCCCCTAGCCGGCAATCTGGCCCATGCAGGAGCATCTGTAGACTTGACTATCTTTTCA 5793
cheetah             CCACCCCTAGCTGGCAATCTGGCTCATGCAGGAGCATCCGTAGACCTGACTATCTTCTCA 5794
Cat                 CCACCCCTAGCCGGCAACCTGGCTCATGCAGGAGCATCCGTAGACCTAACTATTTTTTCA 5797
                    ** ** ***** ***** ** ** ******** ***** ** **  * ***** ** ***

Snow_Leopard1       CTACACTTGGCAGGTGTCTCCTCAATCTTAGGCGCTATTAATTTTATTACTACTATTATT 5862
Snow_Leopard2       CTACACTTGGCAGGTGTCTCCTCAATCTTAGGCGCTATTAATTTTATTACTACTATTATT 5862
Leopard1            CTACACCTGGCAGGTGTCTCCTCAATCTTAGGCGCTATTAATTTTATTACTACTATTATT 5857
Tiger1              CTACACCTAGCAGGCGTCTCCTCAATCTTAGGTGCTATTAATTTTATTACTACTATTATT 5859
Tiger2              CTACACCTAGCAGGCGTCTCCTCAATCTTAGGTGCTATTAATTTTATTACTACTATTATT 5859
Clouded_leopard     CTACATCTAGCGGGTGTTTCCTCTATCCTGGGCGCTATTAATTTTATTACTACTATTATT 5853
cheetah             CTTCACCTAGCAGGCGTTTCTTCAATTTTAGGTGCTATTAATTTTATTACAACTATCATT 5854
Cat                 CTACACCTGGCAGGTGTCTCCTCAATCTTGGGTGCTATTAATTTCATTACTACTATTATT 5857
                    ** **  * ** ** ** ** ** **  * ** *********** ***** ***** ***

Snow_Leopard1       AATATAAAACCCCCTGCTATATCCCAGTATCAAACACCTCTATTTGTCTGATCGGTCTTA 5922
Snow_Leopard2       AATATAAAACCCCCTGCTATATCCCAGTATCAAACACCTCTATTTGTCTGATCGGTCTTA 5922
Leopard1            AATATAAAACCCCCTGCTATATCCCAATACCAAACACCTCTATTCGTCTGATCGGTCTTA 5917
Tiger1              AATATAAAACCGCCCGCTATGTCCCAATACCAAACACCCCTGTTTGTTTGATCGGTTCTA 5919
Tiger2              AATATAAAACCGCCCGCTATGTCCCAATACCAAACACCCCTGTTTGTTTGATCGGTTCTA 5919
Clouded_leopard     AATATAAAACCTCCTGCCATATCTCAATACCAAACACCACTATTTGTCTGATCAGTCTTA 5913
cheetah             AATATAAAACCCCCTGCCATATCTCAATACCAAACACCTTTGTTTGTGTGATCAGTTCTA 5914
Cat                 AATATAAAACCTCCTGCCATGTCCCAATATCAAACACCTCTATTTGTCTGATCAGTCTTA 5917
                    ********** ** ** ** ** ** ** ********  * ** ** ***** **  **

Snow_Leopard1       ATCACTGCTGTATTACTACTCCTATCGCTGCCAGTTTTAGCAGCAGGCATCACTATGCTA 5982
Snow_Leopard2       ATCACTGCTGTATTACTACTCCTATCGCTGCCAGTTTTAGCAGCAGGCATCACTATGCTA 5982
Leopard1            ATCACTGCTGTATTGCTACTCCTATCACTGCCAGTTTTAGCAGCAGGCATCACTATGCTA 5977
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Tiger1              ATTACTGCTGTGTTGCTACTTCTATCACTGCCAGTTTTAGCAGCAGGCATCACCATGCTA 5979
Tiger2              ATTACTGCTGTGTTGCTACTTCTATCACTGCCAGTTTTAGCAGCAGGCATCACCATGCTA 5979
Clouded_leopard     ATCACTGCTGTATTACTGCTTTTATCACTGCCAGTTCTAGCAGCAGGTATTACTATGCTA 5973
cheetah             ATCACTGCAGTCCTGTTACTTCTATCACTCCCAGTTTTAGCAGCAGGAATCACCATGTTA 5974
Cat                 ATCACTGCTGTCTTACTACTTCTATCACTTCCAGTCTTAGCAGCGGGAATCACTATATTA 5977
                    ** ***** **  *  * **  **** ** *****  ******* ** ** ** **  **

Snow_Leopard1       CTGACAGATCGAAATCTGAACACCACATTTTTTGACCCCGCTGGAGGAGGGGATCCTATC 6042
Snow_Leopard2       CTGACAGATCGAAATCTGAACACCACATTTTTTGACCCCGCTGGAGGAGGGGATCCTATC 6042
Leopard1            CTGACAGATCGAAATCTGAACACCACATTCTTTGACCCTGCCGGAGGGGGGGATCCTATC 6037
Tiger1              CTGACAGATCGAAATCTAAATACCACATTTTTTGATCCTGCCGGGGGAGGAGACCCCATC 6039
Tiger2              CTGACAGATCGAAATCTAAATACCACATTTTTTGATCCTGCCGGGGGAGGAGACCCCATC 6039
Clouded_leopard     CTGACAGATCGAAATTTAAATACTACATTTTTCGACCCTGCTGGGGGAGGGGACCCTATC 6033
cheetah             TTAACAGATCGAAATTTAAATACCACATTCTTCGATCCTGCTGGAGGAGGAGATCCTATC 6034
Cat                 TTAACAGATCGAAACCTAAACACCACATTCTTTGACCCCGCTGGGGGAGGAGATCCTATC 6037
                     * ***********  * ** ** ***** ** ** ** ** ** ** ** ** ** ***

Snow_Leopard1       TTATATCAACACTTATTCTGATTTTTCGGTCACCCAGAAGTCTACATTTTAATTTTACCC 6102
Snow_Leopard2       TTATATCAACACTTATTCTGATTTTTCGGTCACCCAGAAGTCTACATTTTAATTTTACCC 6102
Leopard1            TTATACCAGCACCTATTCTGATTTTTTGGTCACCCAGAAGTTTATATTTTAATTTTACCC 6097
Tiger1              TTATATCAACACCTATTCTGATTCTTCGGTCACCCAGAAGTCTATATCTTAATCCTGCCC 6099
Tiger2              TTATATCAACACCTATTCTGATTCTTCGGTCACCCAGAAGTCTATATCTTAATCCTGCCC 6099
Clouded_leopard     CTATATCAACACTTATTCTGGTTTTTCGGTCATCCAGAGGTTTATATTTTAATTTTACCC 6093
cheetah             TTATACCAACATCTATTCTGATTTTTTGGCCACCCAGAGGTCTACATTTTAATTCTACCC 6094
Cat                 TTATACCAACACTTATTCTGATTCTTTGGCCATCCAGAAGTTTACATTTTAATCCTACCC 6097
                     **** ** **  ******* ** ** ** ** ***** ** ** ** *****  * ***

Snow_Leopard1       GGGTTTGGAATGATTTCACATATTGTCACCTATTACTCAGGTAAAAAAGAACCTTTTGGC 6162
Snow_Leopard2       GGGTTTGGAATGATTTCACATATTGTCACCTATTACTCAGGTAAAAAAGAACCTTTTGGC 6162
Leopard1            GGGTTCGGAATAATTTCACACATTGTCACCTATTACTCAGGTAAAAAAGAGCCTTTTGGC 6157
Tiger1              GGGTTTGGAATAATTTCACATATTGTCACCTACTACTCAGGCAAAAAAGAACCTTTTGGC 6159
Tiger2              GGGTTTGGAATAATTTCACATATTGTCACCTACTACTCAGGCAAAAAAGAACCTTTTGGC 6159
Clouded_leopard     GGGTTTGGAATAATTTCACATATCGTCACCTACTACTCCGGTAAAAAAGAGCCTTTTGGC 6153
cheetah             GGTTTTGGAATAATCTCGCACATTGTTACCTATTATTCAGGCAAAAAAGAACCATTTGGT 6154
Cat                 GGTTTTGGGATAATCTCACATATTGTTACCTATTATTCAGGTAAAAAAGAACCCTTTGGC 6157
                    ** ** ** ** ** ** ** ** ** ** ***** ** ** ** ******** ** *****

Snow_Leopard1       TACATGGGAATAGTTTGAGCTATAATATCAATTGGCTTTCTGGGCTTTATCGTATGGGCC 6222
Snow_Leopard2       TACATGGGAATAGTTTGAGCTATAATATCAATTGGCTTTCTGGGCTTTATCGTATGGGCC 6222
Leopard1            TATATGGGAATAGTTTGAGCTATAATATCGATTGGCTTCCTGGGCTTTATCGTGTGAGCC 6217
Tiger1              TACATGGGGATAGTCTGAGCCATAATGTCAATTGGCTTTCTGGGCTTTATCGTATGGGCC 6219
Tiger2              TACATGGGGATAGTCTGAGCCATAATGTCAATTGGCTTTCTGGGCTTTATCGTATGGGCC 6219
Clouded_leopard     TATATGGGAATGGTTTGAGCTATAATGTCAATTGGCTTTCTGGGCTTTATCGTATGAGCT 6213
cheetah             TACATGGGAATAGTTTGAGCCATAATATCAATTGGCTTCCTGGGCTTTATCGTATGAGCC 6214
Cat                 TACATGGGAATAGTTTGAGCCATGATATCAATCGGCTTCCTGGGCTTTATCGTATGAGCC 6217
                    ** ***** ** ** ***** ** ** ** ** ***** ************** ** **

Snow_Leopard1       CATCACATGTTTACTGTGGGGATAGATGTGGACACACGAGCATACTTTACATCAGCTACT 6282 7F
Snow_Leopard2       CATCACATGTTTACTGTGGGGATAGATGTGGACACACGAGCATACTTTACATCAGCTACT 6282
Leopard1            CACCACATGTTTACTGTAGGAATAGATGTGGACACACGAGCATACTTTACATCAGCTACT 6277
Tiger1              CATCACATGTTTACTGTAGGGATAGATGTGGATACACGAGCATACTTTACGTCAGCTACT 6279
Tiger2              CATCACATGTTTACTGTAGGGATAGATGTGGATACACGAGCATACTTTACGTCAGCTACT 6279
Clouded_leopard     CACCATATGTTTACTGTAGGAATAGACGTGGACACACGAGCATACTTTACATCAGCTACA 6273
cheetah             CATCACATGTTTACTGTTGGAATGGACGTAGACACACGAGCATACTTTACATCAGCTACC 6274
Cat                 CATCACATGTTTACTGTAGGAATGGATGTAGACACACGAGCATACTTTACATCAGCCACT 6277
                    ** ** *********** ** ** ** ** ** ***************** ***** **

Snow_Leopard1       ATAATTATTGCTATTCCCACAGGGGTAAAAGTATTTAGTTGACTGGCTACTCTTCATGGA 6342
Snow_Leopard2       ATAATTATTGCTATTCCCACAGGGGTAAAAGTATTTAGTTGACTGGCTACTCTTCATGGA 6342
Leopard1            ATAATTATTGCTATTCCCACTGGAGTAAAAGTATTTAGCTGACTAGCCACTCTTCATGGA 6337
Tiger1              ATAATTATCGCTATTCCTACTGGGGTAAAAGTATTTAGCTGATTGGCCACTCTTCACGGG 6339
Tiger2              ATAATTATCGCTATTCCTACTGGGGTAAAAGTATTTAGCTGATTGGCCACTCTTCACGGG 6339
Clouded_leopard     ATGATCATCGCTATCCCTACTGGAGTAAAAGTATTCAGTTGACTGGCCACCCTCCACGGA 6333
cheetah             ATAATTATCGCCATCCCTACTGGGGTAAAAGTATTTAGTTGACTAGCCACTCTCCATGGA 6334
Cat                 ATAATTATTGCCATTCCTACCGGGGTGAAAGTATTTAGTTGACTGGCTACTCTTCATGGA 6337
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Snow_Leopard1       GGTAATATTAAATGGTCTCCCGCTATGCTATGGGCCCTAGGATTTATTTTCTTATTCACT 6402
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Snow_Leopard2        GGTAATATTAAATGGTCTCCCGCTATGCTATGGGCCCTAGGATTTATTTTCTTATTCACT 6402
Leopard1             GGTAGTATCAAATGATCTCCCGCTATGCTATGAGCCCTAGGATTCATCTTTCTATTTACT 6397
Tiger1               GGTAATATTAAATGGTCTCCCGCTATACTATGGGCTTTGGGATTCATTTTCCTATTCACC 6399
Tiger2               GGTAATATTAAATGGTCTCCCGCTATACTATGGGCTTTGGGATTCATTTTCCTATTCACC 6399
Clouded_leopard      GGCAATATCAAATGGTCTCCTGCTATACTGTGAGCCCTGGGCTTTATTTTCCTGTTTACC 6393
cheetah              GGTAATATTAAATGATCTCCCGCCATACTATGGGCTTTAGGTTTTATTTTCCTGTTCACC 6394
Cat                  GGTAATATTAAATGGTCCCCTGCTATATTATGAGCCTTAGGCTTTATTTTCCTATTTACC 6397
                     ** * *** ***** ** ** ** **  * ** **  * ** ** ** **  * ** **

Snow_Leopard1        GTGGGGGGCCTAACAGGAATCGTACTAGCAAATTCCTCATTAGACATTGTCCTTCACGAC 6462 6R
Snow_Leopard2        GTGGGGGGCCTAACAGGAATCGTACTAGCAAATTCCTCATTAGACATTGTCCTTCACGAC 6462
Leopard1             GTAGGGGGCCTAACGGGAATTGTACTAGCAAATTCCTCATTAGACATTGTCCTTCATGAC 6457
Tiger1               GTAGGGGGCTTAACAGGAATTGTACTAGCAAACTCCTCATTGGATATTGTCCTTCACGAC 6459
Tiger2               GTAGGGGGCTTAACAGGAATTGTACTAGCAAACTCCTCATTGGATATTGTCCTTCACGAC 6459
Clouded_leopard      GTGGGAGGCTTAACAGGAATCGTACTAGCAAATTCCTCACTGGATATTGTTCTTCACGAC 6453
cheetah              GTAGGAGGCCTAACAGGAATTGTACTGGCTAACTCTTCACTAGATATTGTTCTCCATGAT 6454
Cat                  GTAGGAGGCCTAACGGGAATTGTACTAGCAAACTCTTCATTAGACATTGTTCTTCACGAC 6457
                     ** ** *** **** ***** ***** ** ** ** *** * ** ***** ** ** **

Snow_Leopard1        ACATACTACGTAGTAGCTCACTTCCACTATGTATTGTCAATAGGAGCAGTATTTGCTATC 6522
Snow_Leopard2        ACATACTACGTAGTAGCTCACTTCCACTATGTATTGTCAATAGGAGCAGTATTTGCTATC 6522
Leopard1             ACATACTACGTAGTAGCCCACTTCCACTACGTACTGTCAATAGGAGCAGTATTTGCTATT 6517
Tiger1               ACATACTACGTAGTAGCCCACTTCCACTACGTCTTGTCAATAGGAGCAGTATTTGCTATT 6519
Tiger2               ACATACTACGTAGTAGCCCACTTCCACTACGTCTTGTCAATAGGAGCAGTATTTGCTATT 6519
Clouded_leopard      ACGTATTACGTAGTAGCTCACTTCCACTACGTCTTGTCAATAGGAGCAGTATTCGCTATT 6513
cheetah              ACATATTACGTAGTAGCCCATTTCCACTATGTCTTATCAATAGGAGCAGTATTCGCTATC 6514
Cat                  ACATATTACGTAGTGGCCCACTTTCACTATGTCTTGTCAATAGGAGCAGTATTCGCTATC 6517
                     ** ** ******** ** ** ** ***** **  * ***************** *****

Snow_Leopard1        ATAGGGGGTTTTGTTCATTGATTCCCCCTATTCTCAGGATATACTCTCGATAATACTTGG 6582
Snow_Leopard2        ATAGGGGGTTTTGTTCATTGATTCCCCCTATTCTCAGGATATACTCTCGATAATACTTGG 6582
Leopard1             ATAGGAGGCTTCGTTCATTGATTCCCCCTATTCTCAGGGTATACTCTCGATAATACTTGG 6577
Tiger1               ATAGGGGGCTTCGTTCACTGATTCCCCTTATTCTCAGGGTATACTCTTGATAATACTTGG 6579
Tiger2               ATAGGGGGCTTCGTTCACTGATTCCCCTTATTCTCAGGGTATACTCTTGATAATACTTGG 6579
Clouded_leopard      ATAGGAGGCTTCGTCCATTGATTCCCCCTATTCTCAGGGTATACTCTCGACAATACTTGG 6573
cheetah              ATAGGAGGCTTCGTCCATTGATTCCCCTTATTCTCAGGATACACTCTTGATAATACTTGG 6574
Cat                  ATAGGAGGCTTCGTCCATTGATTCCCCCTATTCTCAGGATATACCCTTGACAACACTTGA 6577
                     ***** ** ** ** ** ********* ********** ** ** ** ** ** *****

Snow_Leopard1        GCAAAAATTCATTTCACTATTATATTCGTAGGTGTCAATATAACGTTTTTCCCTCAGCAT 6642
Snow_Leopard2        GCAAAAATTCATTTCACTATTATATTCGTAGGTGTCAATATAACGTTTTTCCCTCAGCAT 6642
Leopard1             GCAAAAATTCATTTTACAATTATGTTCGTGGGTGTCAATATAACGTTTTTCCCTCAGCAT 6637
Tiger1               GCAAAAGTTCATTTTACGATCATGTTCGTAGGTGTCAATATAACGTTTTTCCCTCAGCAT 6639
Tiger2               GCAAAAGTTCATTTTACGATCATGTTCGTAGGTGTCAATATAACGTTTTTCCCTCAGCAT 6639
Clouded_leopard      GCAAAAGTTCATTTCACGATTATGTTCGTAGGTGTCAACATAACGTTTTTCCCTCAGCAC 6633
cheetah              GCAAAAATTCACTTCACGATTATATTTGTAGGAGTCAACATAACATTCTTCCCTCAACAC 6634
Cat                  GCAAAGATTCACTTTACGATTATGTTTGTAGGAGTCAATATAACGTTCTTCCCTCAGCAC 6637
                     *****  **** ** ** ** ** ** ** ** ***** ***** ** ******** **

Snow_Leopard1        TTTCTAGGCTTGTCCGGAATGCCTCGACGTTATTCTGACTATCCAGATGCATATACAACT 6702
Snow_Leopard2        TTTCTAGGCTTGTCCGGAATGCCTCGACGTTATTCTGACTATCCAGATGCATATACAACT 6702
Leopard1             TTCCTAGGCTTGTCCGGAATGCCTCGACGTTATTCTGACTACCCAGACGCATATACAACT 6697
Tiger1               TTCCTAGGCCTGTCTGGGATGCCTCGACGTTATTCTGACTATCCAGACGCGTATACAACT 6699
Tiger2               TTCCTAGGCCTGTCTGGGATGCCTCGACGTTATTCTGACTATCCAGACGCGTATACAACT 6699
Clouded_leopard      TTCCTGGGCCTATCCGGAATGCCCCGACGTTATTCCGACTACCCAGACGCATATACAACT 6693
cheetah              TTCCTAGGCCTATCTGGAATGCCACGACGTTATTCTGATTACCCAGATGCATATACAACT 6694
Cat                  TTCCTAGGCCTGTCCGGAATGCCACGACGTTATTCTGACTATCCAGATGCATATACAACT 6697
                     ** ** *** * ** ** ***** ********** ** ** ***** ** *********

Snow_Leopard1        TGAAATACAGTCTCCTCAATAGGCTCTTTTATCTCACTAACAGCAGTAATATTAATGGTT 6762
Snow_Leopard2        TGAAATACAGTCTCCTCAATAGGCTCTTTTATCTCACTAACAGCAGTAATATTAATGGTT 6762
Leopard1             TGAAACACAGTTTCCTCAATAGGCTCTTTTATTTCACTAACAGCAGTAATATTAATGGTT 6757
Tiger1               TGAAACACAATCTCCTCAATAGGCTCTTTTATTTCACTAACAGCAGTAATATTAATAGTC 6759
Tiger2               TGAAACACAATCTCCTCAATAGGCTCTTTTATTTCACTAACAGCAGTAATATTAATAGTC 6759
Clouded_leopard      TGAAACACAATCTCCTCAATAGGTTCTTTCATTTCACTAACAGCAGTTATACTAATAGTC 6753
cheetah              TGAAACACAATTTCCTCAATAGGCTCTTTCATTTCATTAACAGCAGTCATACTTATAGTT 6754
Cat                  TGAAATACGATTTCCTCAATGGGCTCTTTCATCTCATTAACAGCAGTCATGTTAATAGTT 6757
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Snow_Leopard1       TTCATAGTGTGAGAAGCTTTTGCATCAAAGCGAGAAGTGGCCACAGTGGAACTAACCACA 6822
Snow_Leopard2       TTCATAGTGTGAGAAGCTTTTGCATCAAAGCGAGAAGTGGCCACAGTGGAACTAACCACA 6822
Leopard1            TTTATAGTATGAGAGGCTTTTGCATCAAAGCGAGAAGTGGCCATAGTGGAACTAACTACA 6817
Tiger1              TTTATAATGTGAGAAGCTTTCGCATCAAAGCGAGAAGTAGCCACAGTGGAACTAACCACA 6819
Tiger2              TTTATAATGTGAGAAGCTTTCGCATCAAAGCGAGAAGTAGCCACAGTGGAACTAACCACA 6819
Clouded_leopard     TTCATAGTGTGGGAAGCTTTCGCATCAAAACGAGAAGTGGCCATAGTGGAGTTAACCTCA 6813
cheetah             TTCATGGTATGAGAAGCCTTTGCATCCAAGCGAGAAGTGGCCATAGTAGAATTAACCACA 6814
Cat                 TTCATAGTGTGAGAAGCTTTCGCATCCAAGCGAGAAGTGGCCATAGTAGAACTAACCACA 6817
                    ** **  * ** ** ** ** ***** ** ******** **** *** **  ****  **

Snow_Leopard1       ACCAATCTTGAATGGCTGCATGCATGTCCCCCTCCGTATCACACATTTGAAGAACCAACC 6882 8F
Snow_Leopard2       ACCAATCTTGAATGGCTGCATGCATGTCCCCCTCCGTATCACACATTTGAAGAACCAACC 6882
Leopard1            ACTAATCTTGAATGATTACATGGATGTCCCCCTCCGTATCACACATTTGAAGAGCCAACT 6877
Tiger1              ACTAATCTCGAATGACTTCACGGATGTCCTCCTCCGTATCACACATTTGAAGAGCCAGCC 6879
Tiger2              ACTAATCTCGAATGACTTCACGGATGTCCTCCTCCGTATCACACATTTGAAGAGCCAGCC 6879
Clouded_leopard     ACCAATCTCGAATGACTACATGGATGTCCCCCTCCCTACCACACATTTGAAGAACCAACC 6873
cheetah             ACTAATCTTGAGTGATTACATGGATGTCCCCCTCCGTATCACACATTTGAAGAGCCAACT 6874
Cat                 ACTAATCTTGAATGATTGCATGGATGTCCTCCTCCGTACCACACATTTGAAGAGCCAACT 6877
                    ** ***** ** **  * ** * ****** ***** ** ************** *** *

tRNA-Ser
Snow_Leopard1       TATGTACTGTTAAAATAAGAAAGGAAGGAATCGAACCTCCTTAGATTGATTTCAAGCCAA 6942
Snow_Leopard2       TATGTACTGTTAAAATAAGAAAGGAAGGAATCGAACCTCCTTAGATTGATTTCAAGCCAA 6942
Leopard1            TATGTGTTATTAAAATAAGAAAGGAAGGAATCGAACCTCCTCAGACTGGTTTCAAGCCAA 6937
Tiger1              TACGTGCTGTTAAAATAAGAAAGGAAGGAATCGAACCTCCTTAGACTGGTTTCAAGCCAA 6939
Tiger2              TACGTGCTGTTAAAATAAGAAAGGAAGGAATCGAACCTCCTTAGACTGGTTTCAAGCCAA 6939
Clouded_leopard     TATGTGTTGTCAAAATAAGAGAGGAAGGAATCGAACCTTCTTGGACTGGTTTCAAGCCAA 6933
cheetah             TATGTATTACTAAAATAAGAAAGGAAGGAATCGAACCCTCTTTAACTGGTTTCAAGCCAA 6934
Cat                 TACGTACTATTAAAATAAGAAAGGAAGGAATCGAACCCTCTTTAACTGGTTTCAAGCCAA 6937
                    ** **  *   ********* ****************  **   * ** ***********

tRNA-Asp
Snow_Leopard1       TGCCATAACCACTATGTCTTTCTCAATCAAGAAGTATTAGTAAAACAATTACATAACTTT 7002
Snow_Leopard2       TGCCATAACCACTATGTCTTTCTCAATCAAGAAGTATTAGTAAAACAATTACATAACTTT 7002
Leopard1            TATCATAACCACTATGTCTTTCTCAATCAAGAAGTATTAGTAAAACAATTACATAACTCT 6997
Tiger1              TACCATAACCACTATGTCTTTCTCAATTAAGAAGTATTAGTAAAATAATTACATAACTTT 6999 7R
Tiger2              TACCATAACCACTATGTCTTTCTCAATTAAGAAGTATTAGTAAAATAATTACATAACTTT 6999
Clouded_leopard     TGTCATAACCACTATGTCTCTCTCAATCAAGAAGTATTAGTAAAATAATTACATAACTTT 6993
cheetah             TGCCATAACCATTATGTCTTTCTCAATTAAGAAGTATTAGTAAAATAATTACATAACTTT 6994
Cat                 TGCCATAACCATTATGTCTTTCTCAATTAAGAAGTATTAGTAAAACAATTACATAACTTT 6997
                    *  ******** ******* ******* ***************** ************ *

COII
Snow_Leopard1       GTCAAGGTTAAATTATAGGTTTAAGCCCTGTGTACTTCTATGGCATATCCTTTCCAACTA 7062
Snow_Leopard2       GTCAAGGTTAAATTATAGGTTTAAGCCCTGTGTACTTCTATGGCATATCCTTTCCAACTA 7062
Leopard1            GTCAAGGTTAAATTATAGGTTTAACCCCTATGTACTTCCATGGCATACCCCTTCCAACTA 7057
Tiger1              GTCAAAGTTAAATTATAGGTTTAAGCCCTATGTGCTTCCATGGCATACCCCTTCCAACTA 7059
Tiger2              GTCAAAGTTAAATTATAGGTTTAAGCCCTATGTGCTTCCATGGCATACCCCTTCCAACTA 7059
Clouded_leopard     GTCGAAGTTAAATTATAGGTCTAAGCCCTATATGCTTCCATGGCATACCCCCTCCAACTA 7053
cheetah             GTCAAAGTTAAATTATAGACTTGAATC-TATATACTTCCATGGCATACCCTTTCCAGCTA 7053
Cat                 GTCGAAGTTAAATTATAGGCTTGAATCCTATATGCTTCAATGGCGTACCCCTTTCAACTA 7057
                    *** * ************   * *  * * * * **** ***** ** **  * ** ***

Snow_Leopard1       GGTTTCCAAGATGCTACATCCCCTATCATAGAAGAGCTTCTACACTTTCACGATCACACA 7122
Snow_Leopard2       GGTTTCCAAGATGCTACATCCCCTATCATAGAAGAGCTTCTACACTTTCACGATCACACA 7122
Leopard1            GGTTTTCAAGATGCTACATCCCCCATCATAGAAGAGCTCCTACACTTCCATGATCACACA 7117
Tiger1              GGTTTTCAAGATGCTACATCCCCCATTATAGAAGAGCTTTTACACTTCCATGATCATACA 7119
Tiger2              GGTTTTCAAGATGCTACATCCCCCATTATAGAAGAGCTTTTACACTTCCATGATCATACA 7119
Clouded_leopard     GGCTTTCAAGATGCTACATCTCCCATTATAGAGGAACTCTTACACTTTCACGATCACACA 7113
cheetah             GGCTTTCAAGACGCCACATCCCCTATTATAGAAGAACTTCTACACTTCCATGACCATACA 7113
Cat                 GGTTTCCAAGATGCTACATCCCCCATTATAGAAGAACTCCTACACTTTCACGACCACACA 7117
                    ** ** ***** ** ***** ** ** ***** ** **  ******* ** ** ** ***

Snow_Leopard1       CTGATAATTGTATTCCTAATTAGCTCCCTAGTCCTTTACATCATCTCACTAATACTGACA 7182
Snow_Leopard2       CTGATAATTGTATTCCTAATTAGCTCCCTAGTCCTTTACATCATCTCACTAATACTGACA 7182
Leopard1            CTAATAATTGTATTCCTAATTAGCTCCCTAGTCCTTTATATCATCTCACTAATACTAACA 7177
Tiger1              TTAATAATTGTATTCCTAATTAGCTCCCTAGTCCTCTACATTATCTCATTAATACTGACA 7179
Tiger2              TTAATAATTGTATTCCTAATTAGCTCCCTAGTCCTCTACATTATCTCATTAATACTGACA 7179
Clouded_leopard     TTAATAATTGTATTTCTAATCAGCTCCCTAGTCCTCTATATCATCTCACTAATACTAACA 7173
cheetah             TTGATAATTGTATTCCTAATTAGCTCATTAGTCCTTTTATATTATTTCATTAATATTAACA 7173
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Cat                 CTAATAATTGTATTTTTAATCAGCTCTTTAGTTCTTTATATTATCTCGTTGATGCTAACA 7177
                     * ***********  **** *****  **** ** ** ** ** **  * **  * ***

Snow_Leopard1       ACCAAACTCACGCACACAAGTACAATAGATGCCCAGGAAGTAGAAACCATCTGAACTATT 7242
Snow_Leopard2       ACCAAACTCACGCACACAAGTACAATAGATGCCCAGGAAGTAGAAACCATCTGAACTATT 7242
Leopard1            ACCAAACTCACGCACACAAGCACAATGGATGCCCAAGAAGTAGAAACCATCTGAACCATT 7237
Tiger1              ACTAAACTTACGCATACAAGCACAATAGATGCCCAAGAAGTAGAAACTATCTGAACCATT 7239
Tiger2              ACTAAACTTACGCATACAAGCACAATAGATGCCCAAGAAGTAGAAACTATCTGAACCATT 7239
Clouded_leopard     ACCAAACTAACACACACAAGCACAATAGACGCCCAAGAAGTAGAAACCATCTGAACCATC 7233
cheetah             ACCAAGCTTACGCATACAAGCACAATGGATGCTCAAGAAGTAGAAACCGTCTGAACTATC 7233
Cat                 ACCAAGCTCACGCACACGAGTACAATAGATGCTCAAGAAGTAGAAACCATCTGAACCATC 7237
                    ** ** ** ** ** ** ** ***** ** ** ** ***********  ******* **

Snow_Leopard1       TTACCAGCCATCATCTTAATTCTCATTGCCCTGCCCTCCTTACGAATTCTCTACATAATA 7302
Snow_Leopard2       TTACCAGCCATCATCTTAATTCTCATTGCCCTGCCCTCCTTACGAATTCTCTACATAATA 7302
Leopard1            TTACCAGCTATCATCTTAATTCTCATTGCCCTACCCTCCTTACGAATTCTCTATATAATA 7297
Tiger1              TTACCAGCCATCATCTTAATTCTCATTGCCCTGCCTTCCTTACGAATTCTCTATATAATA 7299
Tiger2              TTACCAGCCATCATCTTAATTCTCATTGCCCTGCCTTCCTTACGAATTCTCTATATAATA 7299
Clouded_leopard     TTACCAGCTATCATTTTAATCCTCATCGCCCTGCCCTCTTTACGAATTCTCTATATAATA 7293
cheetah             CTGCCTGCTATCATCCTGATTCTCATCGCCCTGCCCTCCCTACGAATCCTTTATATAATA 7293
Cat                 CTACCTGCTATTATCCTGATTCTTATCGCCCTACCCTCCTTACGAATTCTCTATATAATG 7297
                     * ** ** ** **  * ** ** ** ***** ** **  ******* ** ** *****

Snow_Leopard1       GACGAGATTAATAACCCCTCTCTCACTGTAAAGACCATGGGACATCAATGATACTGAAGC 7362
Snow_Leopard2       GACGAGATTAATAACCCCTCTCTCACTGTAAAGACCATGGGACATCAATGATACTGAAGC 7362
Leopard1            GACGAGATTAATAGCCCCTCTCTTACTGTAAAGACCATGGGACATCAATGGTATTGAAGC 7357
Tiger1              GATGAGATTAATAATCCCTCCCTCACTGTAAAGACTATAGGACATCAGTGATACTGAAGT 7359
Tiger2              GATGAGATTAATAATCCCTCCCTCACTGTAAAGACTATAGGACATCAGTGATACTGAAGT 7359
Clouded_leopard     GATGAGATTAACAACCCCTCTCTTACCGTAAAAACCATAGGACATCAATGATATTGAAGC 7353
cheetah             GACGAAATTAATAACCCCTCCCTCACAGTAAAAACTATAGGGCATCAATGATATTGAAGT 7353
Cat                 GATGAAATCAACAACCCCTCCCTCACAGTAAAAACCATAGGACATCAATGATATTGAAGT 7357
                    ** ** ** ** *  ***** ** ** ***** ** ** ** ***** ** ** *****

Snow_Leopard1       TATGAATATACTGACTATGAGGACCTGAACTTTGACTCCTATATAATCCCTACTCAAGAA 7422
Snow_Leopard2       TATGAATATACTGACTATGAGGACCTGAACTTTGACTCCTATATAATCCCTACTCAAGAA 7422
Leopard1            TATGAATACACTGACTCTGAAGACCTAAGCTTTGACTCCTATATAATTCCCACTCAAGAG 7417
Tiger1              TATGAGTACACCGACTATGAGGACCTAAGCTTCGACTCCTACATAATCCCCACTCAAGAG 7419
Tiger2              TATGAGTACACCGACTATGAGGACCTAAGCTTCGACTCCTACATAATCCCCACTCAAGAG 7419
Clouded_leopard     TATGAGTACACTGACTATGAAGACCTAAACTTTGACTCCTATATAATCCCCACTCAAGAA 7413
cheetah             TACGAGTATACCGACTATGAAGACTTGAATTTTGACTCTTACATAGTCCCTACCCAAGAA 7413
Cat                 TATGAGTACACTGATTACGAAGACTTGAATTTTGACTCTTACATAATTCCTACCCAAGAG 7417
                    ** ** ** ** ** * *  ** *** * *  ** ***** ** *** * ** ** *****

Snow_Leopard1       CTAAAGCCCGGAGAACTCCGATTATTAGAAGTTGATAACCGAGTAGTGTTACCAATAGAA 7482
Snow_Leopard2       CTAAAGCCCGGAGAACTCCGATTATTAGAAGTTGATAACCGAGTAGTGTTACCAATAGAA 7482
Leopard1            CTAAAGCCCGGAGAACTCCGACTATTAGAAGTTGATAACCGAGTAGTACTACCAATGGAA 7477
Tiger1              TTAAAGCCCGGAGAGCTCCGACTACTAGAAGTTGATAACCGAGTAGTGTTGCCAATAGAA 7479
Tiger2              TTAAAGCCCGGAGAGCTCCGACTACTAGAAGTTGATAACCGAGTAGTGTTGCCAATAGAA 7479
Clouded_leopard     CTAAAACCCGGTGAACTTCGACTGCTAGAAGTTGATAATCGAGTGGTATTACCAATAGAA 7473
cheetah             CTAAAACCAGGAGAACTGCGGCTACTAGAAGTCGACAACCGAGTAGTTTTACCAATAGAA 7473
Cat                 CTAAAACCAGGAGAACTCCGGCTATTAGAAGTTGACAACCGAGTAGTTTTACCAATAGAA 7477
                     **** ** ** ** ** **  *  ******* ** ** ***** **  * ***** ***

Snow_Leopard1       ATGACTATTCGCATGTTAATCTCATCAGAAGACGTACTACACTCATGAGCCGTCCCATCC 7542
Snow_Leopard2       ATGACTATTCGCATGTTAATCTCATCAGAAGACGTACTACACTCATGAGCCGTCCCATCC 7542
Leopard1            GTGACCATTCGCGTGTTAATCTCATCAGAAGACGTACTACACTCATGAGCCGTCCCATCC 7537
Tiger1              GTGACTATTCGCATGTTAGTCTCATCAGAGGACGTACTGCACTCGTGAGCCATCCCATCC 7539
Tiger2              GTGACTATTCGCATGTTAGTCTCATCAGAGGACGTACTGCACTCGTGAGCCATCCCATCC 7539
Clouded_leopard     ATGACTATCCGCATATTAATCTCATCAGAAGATGTACTGCACTCATGAGCCATCCCGTCC 7533
cheetah             ATAACCATTCGCATACTAATTTCATCAGAAGACGTACTACACTCATGAGCTGTACCATCT 7533
Cat                 ATGACCATTCGCATGTTAATCTCATCAGAAGATGTGTTACACTCATGAGCCGTCCCATCC 7537
                     * ** ** *** *  ** * ******** ** **  * ***** *****  * ** **

Snow_Leopard1       CTGGGCCTAAAAACTGACGCCATTCCAGGCCGACTAAACCAAACAACCCTAATAGGTACA 7602
Snow_Leopard2       CTGGGCCTAAAAACTGACGCCATTCCAGGCCGACTAAACCAAACAACCCTAATAGGTACA 7602
Leopard1            CTGGGCCTAAAAACTGATGCTATTCCAGGCCGACTAAACCAAACAACCCTAATGGGTACA 7597
Tiger1              CTGGGCCTAAAAACTGACGCTATCCCAGGCCGACTAAACCAAACAACCCTAATAGGCACA 7599 9F
Tiger2              CTGGGCCTAAAAACTGACGCTATCCCAGGCCGACTAAACCAAACAACCCTAATAGGCACA 7599
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Clouded_leopard      CTGGGCCTAAAAACCGATGCTATTCCAGGTCGGTTAAACCAAACAACCCTAATGGGCACA 7593
cheetah              CTAGGTCTAAAAACTGACGCTATTCCAGGTCGACTAAACCAAACGACCCTAATGAGTACA 7593
Cat                  CTAGGCCTAAAAACTGATGCTATCCCAGGCCGATTAAATCAAACAACTCTAATAGCTACA 7597
                     ** ** ******** ** ** ** ***** **  **** ***** ** *****    ***

Snow_Leopard1        CGACCTGGGTTATACTATGGTCAATGCTCAGAGATCTGTGGCTCAAACCACAGTTTTATA 7662
Snow_Leopard2        CGACCTGGGTTATACTATGGTCAATGCTCAGAGATCTGTGGCTCAAACCACAGTTTTATA 7662
Leopard1             CGACCTGGACTCTATTATGGTCAGTGCTCAGAGATCTGCGGCTCAAACCACAGTTTTATG 7657
Tiger1               CGGCCTGGGCTATATTATGGTCAGTGCTCAGAAATCTGCGGCTCAAATCACAGTTTTATG 7659
Tiger2               CGGCCTGGGCTATATTATGGTCAGTGCTCAGAAATCTGCGGCTCAAATCACAGTTTTATG 7659
Clouded_leopard      CGACCTGGATTATATTATGGCCAATGCTCGGAAATCTGCGGCTCAAACCATAGCTTTATG 7653
cheetah              CGACCTGGATTATATTACGGTCAGTGCTCAGAAATCTGTGGCTCAAACCACAGCTTCATA 7653
Cat                  CGACCTGGTTTATATTATGGCCAATGCTCAGAAATCTGTGGCTCAAACCATAGCTTCATA 7657
                     ** *****  * ** ** ** ** ***** ** ***** ******** ** ** ** **

Snow_Leopard1        CCCATTGTTCTTGAACTAGTCCCACTATCATACTTTGAAGAATGATCTACGTCTATACTG 7722
Snow_Leopard2        CCCATTGTTCTTGAACTAGTCCCACTATCATACTTTGAAGAATGATCTACGTCTATACTG 7722
Leopard1             CCCATTGTTCTTGAACTAGTCCCATTAGCATATTTTGAAAAATGATCTGCGTCTATACTG 7717
Tiger1               CCCATTGTCCTTGAACTAGTCCCGCTGTCATATTTCGAAAAATGATCTGCATCTATGCTG 7719 8R
Tiger2               CCCATTGTCCTTGAACTAGTCCCGCTGTCATATTTCGAAAAATGATCTGCATCTATGCTG 7719
Clouded_leopard      CCCATTGTTCTTGAATTAGTTCCCCTGTCATATTTTGACAAATGATCTATATCTATACTA 7713
cheetah              CCCATTGTCCTCGAACTAGTCCCGCTGATATATTTTGAAAAATGATCTGCATCTATACTA 7713
Cat                  CCCATTGTTCTTGAATTAGTCCCACTAACGTACTTTGAAAAATGATCTGCATCTATACTG 7717
                     ******** ** *** **** **  *    ** ** **  ********   ***** **

tRNA-Lys
Snow_Leopard1        TAATTTCATTAAGAAGCTAAATTAGCGTTAACCTTTTAAGTTAAAAACTGGGAGTTTAAA 7782
Snow_Leopard2        TAATTTCATTAAGAAGCTAAATTAGCGTTAACCTTTTAAGTTAAAAACTGGGAGTTTAAA 7782
Leopard1             TAAATTCATTAAGAAGCTAAACTAGCGTTAACCTTTTAAGTTAAAAACTGGGAGTTTAGA 7777
Tiger1               TAATTTCACTAAGAAGCTAAATTAGCGTTAACCTTTTAAGTTAAAAACTGGGAGTTCAAA 7779
Tiger2               TAATTTCACTAAGAAGCTAAATTAGCGTTAACCTTTTAAGTTAAAAACTGGGAGTTCAAA 7779
Clouded_leopard      TAAATTCATTAAGAAGCTAAACTAGCATTAACCTTTTAAGTTAAAGACTGGAAGCTCAGA 7773
cheetah              TAAATTCATTGAGAAGCTAAACAAGCATTAACCTTTTAAGTTAAAGACTGGGAGTTTAGA 7773
Cat                  TAAATTCATTAAGAAGCTAAATAAGCATTAACCTTTTAAGTTAAAGACTGGGAGTTTAAA 7777
                     *** **** * **********  *** ****************** ***** ** * * *

ATP8

Snow_Leopard1        CCTCCCCTTAATGACATGCCACAGTTAGATACATCAACCTGATTTATTACTATTACTTCC 7842
Snow_Leopard2        CCTCCCCTTAATGACATGCCACAGTTAGATACATCAACCTGATTTATTACTATTACTTCC 7842
Leopard1             CCTCCCCTTAATGGCATGCCACAGTTAGATACATCAACCTGATTCATTACTATCATTTCA 7837
Tiger1               CCTCCCCTTAGTGACATGCCACAGTTAGACACATCAACCTGATTTATTACTATTATTTCA 7839
Tiger2               CCTCCCCTTAGTGACATGCCACAGTTAGACACATCAACCTGATTTATTACTATTATTTCA 7839
Clouded_leopard      CCTTCCCTTAATGATATGCCACAGCTAGATACATCCACCTGATTTGTTACCATTGTATCT 7833
cheetah              CCTCCCCTTAATGGTATGCCACAACTAGATACATCAACCTGATTTATTACTATTATATCA 7833
Cat                  TCTCCCCTTAATGACATGCCACAACTAGATACATCCACCTGATCCATCACTATTATATCA 7837
                      ** ****** **  ********  **** ***** *******   * ** **    **

Snow_Leopard1        ATAATTATAACACTATTTATTATATTTCAACTAAAAATCTCAAAACACCTGTATCCATCA 7902
Snow_Leopard2        ATAATTATAACACTATTTATTATATTTCAACTAAAAATCTCAAAACACCTGTATCCATCA 7902
Leopard1             ATAATTATAACACTATTTATTATATTTCAGCTAAAAATCTCAAAATACTCATATCCATCA 7897
Tiger1               ATAATCATGACACTGTTCGTTATATTTCAACTAAAAATCTCAAAACATCTGTACCCATCA 7899
Tiger2               ATAATCATGACACTGTTCGTTATATTTCAACTAAAAATCTCAAAACATCTGTACCCATCA 7899
Clouded_leopard      ATAATTATAACACTATTTATTGTATTTCAACTAAAAATCTCAAAACACCTGTATCTATCG 7893
cheetah              ATAATTATAACACTATTTATCGTATTCCAACTAAAAATCTCAAAACACCTGTATCCGTCA 7893
Cat                  ATAATTATAACACTATTTATTGTATTCCAACTAAAAATCTCAAAATACTTATATCCATCA 7897
                     ***** ** ***** **  *  **** ** *************** *    ** *  **

ATP6
Snow_Leopard1        AGCCCGGAGCTCAAATCTACGGCCGCACTAAAACAACCTAGTCCTTGAGAAAAAAAATGA 7962
Snow_Leopard2        AGCCCGGAGCTCAAATCTACGGCCGCACTAAAACAACCTAGTCCTTGAGAAAAAAAATGA 7962
Leopard1             AGCCCAGAACCTAAATCCACAGCTACACTAAAACAACCTAATCCTTGAGAAAAAAAATGA 7957
Tiger1               AGCCCAGAACCCAAATCTACAGCTGCATTAAAACAGCCGAGTCCCTGAGAAAAAAAATGA 7959
Tiger2               AGCCCAGAACCCAAATCTACAGCTGCATTAAAACAGCCGAGTCCCTGAGAAAAAAAATGA 7959
Clouded_leopard      AACCCAGAACCTAAGCCTATGGCTATGCTGAAACAGCCTAATCCTTGAGAAAAAAAATGA 7953
cheetah              AATCCAGAACCTAAATCCATAATCACACTAGAACAACCTAATCCCTGAGAAAAAAAATGA 7953
Cat                  AACCCAGAACCTAAATCCATAACCACACTAAAACAACGGAATCCCTGAGAAAAAAAATGA 7957
                     *  ** ** *  **  * *         *  **** *  * *** ***************

Snow_Leopard1        ACGAAAATCTATTCACCTCTTTCACTACCCCAACAATAATAGGACTGCCTATTGTCGTAT 8022
Snow_Leopard2        ACGAAAATCTATTCACCTCTTTCACTACCCCAACAATAATAGGACTGCCTATTGTCGTAT 8022
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Leopard1            ACGAAAATCTATTCACCTCTTTCACTACCCCAACAATAATAGGACTGCCTATTGTCGTAT 8017
Tiger1              ACGAAAATCTATTCACCTCTTTTACTACCCCAACAATAATAGGACTGCCTGTTGTTGTGT 8019
Tiger2              ACGAAAATCTATTCACCTCTTTTACTACCCCAACAATAATAGGACTGCCTGTTGTTGTGT 8019
Clouded_leopard     ACGAAAATCTATTCGCCTCTTTCACTACCCCAACAATAATAGGATTACCCATTGTTGTGT 8013
cheetah             ACGAAAATCTATTCGCCTCTTTCATTACCCCAACAATAATAGGACTGCCTATTGTTATAT 8013
Cat                 ACGAAAATCTATTCGCCTCTTTCACTACCCCAACAATAATAGGATTACCTATTGTTATTT 8017
                    ************** ******* * ****************** * **  ****  * *

Snow_Leopard1       TAATTATTATGTTCCCCAGCATTCTATTCCCTTCACCTAATCGACTAATTAATAACCGCC 8082
Snow_Leopard2       TAATTATTATGTTCCCCAGCATTCTATTCCCTTCACCTAATCGACTAATTAATAACCGCC 8082
Leopard1            TAATTATTATATTCCCCAGCATTCTATTCCCCTCGCCCAATCGACTAATTAATAACCGCC 8077
Tiger1              TAATCGTTATGTTCCCCAGCATTCTATTTCCCTCGCCTAACCGACTAATTAATAACCGCC 8079
Tiger2              TAATCGTTATGTTCCCCAGCATTCTATTTCCCTCGCCTAACCGACTAATTAATAACCGCC 8079
Clouded_leopard     TAATTATTATATTCCCTAGTATTCTGTTTCCCTCACCTAACCGACTGGTCAACAATCGCC 8073
cheetah             TAATCATTATATTCCCAAGTATTCTATTTCCATCGCCCAACCGACTGATTAATAACCGCC 8073
Cat                 TAATTATTATATTTCCAAGCATTTTATTCCCTTCACCTAACCGACTAATTAATAACCGTC 8077
                    ****  **** ** ** ** *** * ** ** ** ** ** *****  * ** ** ** *

Snow_Leopard1       TAGTCTCACTCCAGCAGTGATTAGTACAACTAACGTCAAAACAAATATTAGCCATTCACA 8142
Snow_Leopard2       TAGTCTCACTCCAGCAGTGATTAGTACAACTAACGTCAAAACAAATATTAGCCATTCACA 8142
Leopard1            TAGTCTCACTCCAGCAGTGACTAGTACAACTAACATCAAAACAAATACTAGCTATTCACA 8137
Tiger1              TAGTCTCACTCCAACAATGATTAGTACAACTTACATTAAAGCAAATACTGATTACCCACA 8139
Tiger2              TAGTCTCACTCCAACAATGATTAGTACAACTTACATTAAAGCAAATACTGATTACCCACA 8139
Clouded_leopard     TAGTTTCACTACAACAGTGACTAGTACAACTAACATCAAAACAAATACTGGCCATCCACA 8133
cheetah             TAATCTCACTGCAACAATGACTAGTACAACTAACATCAAAGCAAATATTGGCCATTCATA 8133
Cat                 TAGTTTCACTCCAACAATGACTAGTACAACTAACATCAAAACAAATACTGGCTATTCATA 8137
                    ** * ***** ** ** *** ********** ** * *** ****** *    *  ** *

Snow_Leopard1       ATCGCAAAGGACAAACTTGGGCCCTAATACTCATGTCCCTCATTCTATTTATTGGATCAA 8202
Snow_Leopard2       ATCGCAAAGGACAAACTTGGGCCCTAATACTCATGTCCCTCATTCTATTTATTGGATCAA 8202
Leopard1            GCCATAAAGGACAAACTTGAGCCCTGATACTTATGTCTCTCATTTTATTTATTGGGTCGA 8197
Tiger1              ATTACAAAGGACAAACCTGGGCCCTAATACTTATGTCTCTCATTTTATTTATTGGGTCAA 8199
10F
Tiger2              ATTACAAAGGACAAACCTGGGCCCTAATACTTATGTCTCTCATTTTATTTATTGGGTCAA 8199
Clouded_leopard     ACCACAAAGGACAAACTTGGGCCCTAATACTTATGTCTCTCATTCTATTTATCGGGTCAA 8193
cheetah             ACTACAAAGGACAGACCTGAGCTCTAATACTGATGTCCCTTATCCTATTTATTGGATCAA 8193
Cat                 ATCATAAAGGACAAACCTGAGCCCTAATACTAATGTCCCTAATTCTATTTATTGGGTCAA 8197
                         ******** ** ** ** ** ***** ***** ** **  ******* ** ** *

Snow_Leopard1       CAAACCTGTTAGGCCTACTGCCCCACTCATTTACCCCAACTACCCAACTATCAATAAACT 8262
Snow_Leopard2       CAAACCTGTTAGGCCTACTGCCCCACTCATTTACCCCAACTACCCAACTATCAATAAACT 8262
Leopard1            CAAACCTATTGGGTCTACTGCCCCACTCATTTACTCCAACTACTCAATTATCAATAAACC 8257
Tiger1              CAAATCTGCTAGGTCTACTACCTCACTCATTTACTCCAACTACCCAATTATCAATAAACC 8259
Tiger2              CAAATCTGCTAGGTCTACTACCTCACTCATTTACTCCAACTACCCAATTATCAATAAACC 8259
Clouded_leopard     CAAACCTGTTAGGTCTACTACCTCACTCATTTACTCCAACTACCCAATTATCAATAAACT 8253
cheetah             CAAACCTACTAGGCCTATTACCCCACTCATTTACTCCAACCACCCAATTATCAATAAACC 8253
Cat                 CAAACTTATTAGGCCTATTACCCCACTCATTCACCCCAACTACCCAATTATCAATAAATT 8257
                    ****  *  * ** *** * ** ******** ** ***** ** *** **********

Snow_Leopard1       TAGGAATAGCTATTCCCCTATGAGCCGGTGCCGTAATCACCGGATTTCGCCACAAAACTA 8322
Snow_Leopard2       TAGGAATAGCTATTCCCCTATGAGCCGGTGCCGTAATCACCGGATTTCGCCACAAAACTA 8322
Leopard1            TAGGAATAGCTATTCCCCTATGGGCCGGCGCCGTAGTCACCGGGTTTCGCTACAAAACTA 8317
Tiger1              TAGGCATAGCCATCCCCTTGTGAGCCGGCACCGTAATCACTGGATTCCGTCACAAAACTA 8319
Tiger2              TAGGCATAGCCATCCCCTTGTGAGCCGGCACCGTAATCACTGGATTCCGTCACAAAACTA 8319
Clouded_leopard     TAGGGATAGCTATCCCCCTGTGAGCTGGCACCGTGATCACCGGGTTTCGCCGCAAAACTA 8313
cheetah             TAGGAATAGCTATCCCACTATGAGCCGGTACTGTAATTACCGGGTTTCGCCATAAAACTA 8313
Cat                 TAGGAATAGCTATCCCGCTATGAGCCGGCACTGTAATTACCGGGTTTCGCCACAAGACTA 8317
                    **** ***** ** **  * ** ** **  * **  * ** ** ** **    ** ****

Snow_Leopard1       AAGCATCCCTAGCCCACTTTCTACCACAAGGAACACCAATCCCCCTGATCCCCATACTTG 8382 9R
Snow_Leopard2       AAGCATCCCTAGCCCACTTTCTACCACAAGGAACACCAATCCCCCTGATCCCCATACTTG 8382
Leopard1            AAGCGTCTCTAGCCCACTTTCTACCACAGGGAACACCAATCCCCCTGATCCCTATGCTTG 8377
Tiger1              AAGCATCCTTGGCCCACTTTCTACCACAAGGAACACCAGTCCCCTTAATCCCTATGCTCG 8379
Tiger2              AAGCATCCTTGGCCCACTTTCTACCACAAGGAACACCAGTCCCCTTAATCCCTATGCTCG 8379
Clouded_leopard     AAGCATCCCTGGCCCACTTTCTACCACAAGGAACACCAGGCCCTCTGATCCCTATGCTTG 8373
cheetah             AAGCATCCCTAGCTCACTTCTTACCACAAGGAACACCCATTCCCCTAATTCCTATGCTTG 8373
Cat                 AAGCATCTCTGGCCCACTTTCTACCACAAGGAACACCTGTCCCCCTAATTCCTATGCTTG 8377
                    **** **  * ** *****  ******* ********    **  * ** ** ** ** *
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Snow_Leopard1        TAATTATTGAAACTATTAGCCTTTTTATCCAGCCCGTGGCTCTGGCCGTACGACTAACAG 8442
Snow_Leopard2        TAATTATTGAAACTATTAGCCTTTTTATCCAGCCCGTGGCTCTGGCCGTACGACTAACAG 8442
Leopard1             TAATTATTGAGACCATTAGCCTTTTTATCCAGCCCGTAGCTCTGGCCGTACGACTTACAG 8437
Tiger1               TAATTATCGAAACTATCAGCCTTTTTATCCAGCCCGTAGCCCTAGCCGTACGACTCACAG 8439
Tiger2               TAATTATCGAAACTATCAGCCTTTTTATCCAGCCCGTAGCCCTAGCCGTACGACTCACAG 8439
Clouded_leopard      TAATTATCGAAACCATCAGTCTCTTCATTCAGCCCGTAGCCCTGGCCGTACGACTCACAG 8433
cheetah              TAGTTATCGAAACTATTAGTCTCTTTATTCAACCTATAGCCTTAGCCGTACGACTTACAG 8433
Cat                  TAGTCATTGAGACTATCAGCCTCTTTATCCAACCTATAGCTCTCGCCGTACGACTTACAG 8437
                     ** * ** ** ** ** ** ** ** ** ** **  * **  * *********** ****

Snow_Leopard1        CTAACATTACTGCAGGCCACTTATTAATACACTTAATTGGAGGGGCTGCTCTGGCTCTAG 8502
Snow_Leopard2        CTAACATTACTGCAGGCCACTTATTAATACACTTAATTGGAGGGGCTGCTCTGGCTCTAG 8502
Leopard1             CTAACATTACTGCAGGCCACTTATTAATACACTTAATTGGAGGAGCTGCTCTAGTCCTAA 8497
Tiger1               CTAATATTACTGCAGGCCATTTATTAATACACCTAATCGGAGGAGCTGCTTTAGCCCTAA 8499
Tiger2               CTAATATTACTGCAGGCCATTTATTAATACACCTAATCGGAGGAGCTGCTTTAGCCCTAA 8499
Clouded_leopard      CTAACATTACTGCAGGTCACTTATTAATACACCTAATCGGAGGAGCTGCTTTAGCCTTGA 8493
cheetah              CTAACATTACTGCAGGTCACTTACTAATACACCTAATTGGAGGGGCCACTCTAGCCTTAA 8493
Cat                  CCAACATCACCGCAGGTCACTTATTAATACATCTAATTGGAGGGGCCGCCCTAGCCCTGA 8497
                     * ** ** ** ***** ** *** *******  **** ***** **  *  * *   *

Snow_Leopard1        CAAATATTAATGCCTCTATTGCTCTAATTACCTTTATTATTCTCATCCTACTAACAATCC 8562
Snow_Leopard2        CAAATATTAATGCCTCTATTGCTCTAATTACCTTTATTATTCTCATCCTACTAACAATCC 8562
Leopard1             TAAACATTAGTGCCTCTATTGCTTTAATTACCTTTATTATCCTCATCCTGCTGACAATCC 8557
Tiger1               CAAATATTAGTGCCCCTACTGCTTTAATTACCTTTATCATCCTCATCCTACTGACAATTC 8559
Tiger2               CAAATATTAGTGCCCCTACTGCTTTAATTACCTTTATCATCCTCATCCTACTGACAATTC 8559
Clouded_leopard      TAAACATTAGCACTCCCGTTGCCCTAATCACCTTTATCATCCTTATCCTGCTGACAATCC 8553
cheetah              CAAACATTACTGTCCCTGCTGCTTTAATTACTTTCATTATTCTTATTCTACTAACAATCC 8553
Cat                  TAAACATTAGCACCTCTATTGCCTTAATCACCTTTACCATTCTCATTTTACTAACAATCC 8557
                      *** ****      *   ***  **** ** ** *  ** ** **  * ** ***** *

Snow_Leopard1        TTGAGTTCGCTGTAGCCCTAATCCAAGCCTACGTCTTTACCCTACTTGTAAGTCTATATC 8622
Snow_Leopard2        TTGAGTTCGCTGTAGCCCTAATCCAAGCCTACGTCTTTACCCTACTTGTAAGTCTATATC 8622
Leopard1             TTGAATTCGCTGTGGCCCTGATCCAAGCCTACGTCTTTACTCTACTTGTAAGCCTGTATC 8617
Tiger1               TTGAATTCGCTGTAGCTCTAATCCAAGCCTATGTTTTTACCCTACTTGTGAGCCTGTATT 8619
Tiger2               TTGAATTCGCTGTAGCTCTAATCCAAGCCTATGTTTTTACCCTACTTGTGAGCCTGTATT 8619
Clouded_leopard      TCGAATTTGCTGTGGCTCTAATCCAAGCCTACGTCTTTACTTTACTTGTAAGCCTATACC 8613
cheetah              TTGAGTTTGCTGTAGCCCTAATCCAAGCCTATGTCTTCACCCTACTAGTAAGCCTATATT 8613
Cat                  TTGAATTTGCCGTAGCCCTAATCCAAGCCTATGTTTTTACCCTGCTAGTAAGCCTATACT 8617
                     * ** ** ** ** ** ** ********** ** ** **  * ** ** ** ** **

COX3
Snow_Leopard1        TACATGACAATACCTAATGACCCATCAAACCCACGCATACCATATAGTTAACCCCAGCCC 8682
Snow_Leopard2        TACATGACAATACCTAATGACCCATCAAACCCACGCATACCATATAGTTAACCCCAGCCC 8682
Leopard1             TACACGATAATACTTAATGACCCATCAAACCCACGCATACCATATGGTTAACCCCAGTCC 8677
Tiger1               TACATGATAATACTTAATGACCCACCAAACCCACGCATATCACATGGTTAATCCCAGCCC 8679
Tiger2               TACATGATAATACTTAATGACCCACCAAACCCACGCATATCACATGGTTAATCCCAGCCC 8679
Clouded_leopard      TACACGATAATACCTAATGACCCACCAAACCCACGCATACCACATGGTTAATCCCAGTCC 8673
cheetah              TACATGATAACACCTAATGACCCACCAAACCCATGCATACCACATAGTTAACCCCAGCCC 8673
Cat                  TACATGATAACACCTAATGACCCACCAAACCCATGCATACCACATAGTCAACCCTAGCCC 8677
                     **** ** ** ** ********** ******** ***** ** ** ** ** ** ** **

Snow_Leopard1        ATGGCCACTTACGGGGGCACTTTCAGCTCTATTAATAACTTCAGGCCTGGCTATATGATT 8742
Snow_Leopard2        ATGGCCACTTACGGGGGCACTTTCAGCTCTATTAATAACTTCAGGCCTGGCTATATGATT 8742
Leopard1             ATGGCCACTTACAGGGGCCCTTTCAGCTCTACTGATAACTTCAGGTCTGGCTATATGATT 8737
Tiger1               ATGGCCACTTACAGGGGCCCTTTCGGCCCTACTAATAACCTCAGGCCTGGCTATATGATT 8739
Tiger2               ATGGCCACTTACAGGGGCCCTTTCGGCCCTACTAATAACCTCAGGCCTGGCTATATGATT 8739
Clouded_leopard      ATGACCACTTACAGGGGCCCTTTCAGCCCTACTAATAACCTCAGGCCTAGCTATATGATT 8733
cheetah              ATGACCGCTTACAGGGGCCCTTTCAGCCCTCCTTATAACCTCAGGCCTAGCTATATGATT 8733
Cat                  ATGGCCACTTACAGGAGCCCTTTCAGCCCTCTTAATAACCTCAGGCCTGGCTATATGATT 8737
                     *** ** ***** ** ** ***** ** **  * ***** ***** ** ***********

Snow_Leopard1        TCACCACAACTCAATATTACTACTAACTCTAGGTATAACCACCAATCTGCTCACTATGTA 8802
Snow_Leopard2        TCACCACAACTCAATATTACTACTAACTCTAGGTATAACCACCAATCTGCTCACTATGTA 8802
Leopard1             TCACCATAACTCAATATTACTATTAACCCTAGGTATAACCACCAACCTGCTAACTATGTA 8797
Tiger1               TCACTATAACTCAATACTACTATTAACTCTAGGAATAACCACTAACCTATTGACTATATA 8799
Tiger2               TCACTATAACTCAATACTACTATTAACTCTAGGAATAACCACTAACCTATTGACTATATA 8799
Clouded_leopard      TCACCACAACTCAATACTACTACTAACTTTAGGGATAACTACTAACCTATTGACTATATA 8793
cheetah              TCACTATAACTCAACACTACTATTAACCCTTGGAATAACTACTAATCTATTAACAATATA 8793
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Cat                 CCACTACAACTTAACACTGCTGTTAACCCTTGGAATAACTACCAACTTACTAACTATATA 8797
                     *** * **** ** * * **  ****  * ** ***** ** **  *  * ** ** **

Snow_Leopard1       TCAATGATGACGAGATATTATTCGGGAAAGCACATTCCAAGGTCACCACACACCCACCGT 8862
Snow_Leopard2       TCAATGATGACGAGATATTATTCGGGAAAGCACATTCCAAGGTCACCACACACCCACCGT 8862
Leopard1            TCAGTGGTGACGAGATATTATTCGGGAAAGCACATTCCAAGGCCACCACACGCCTATCGT 8857
Tiger1              CCAATGGTGACGAGACATCATTCGGGAGAGCACATTCCAAGGCCACCACACACCCATTGT 8859
Tiger2              CCAATGGTGACGAGACATCATTCGGGAGAGCACATTCCAAGGCCACCACACACCCATTGT 8859
Clouded_leopard     TCAATGGTGACGAGACATTATCCGAGAAAGCACATTCCAAGGCCATCACACACCCATCGT 8853
11F
cheetah             TCAATGATGACGAGACATCGTTCGAGAAAGCACATTTCAAGGCCATCATACGCCCATCGT 8853
Cat                 TCAATGATGACGAGACATTATCCGAGAAAGCACATTCCAAGGCCATCATACACCTATCGT 8857
                     ** ** ******** **  * ** ** ******** ***** ** ** ** ** *  **

Snow_Leopard1       TCAAAAAGGTCTCCGTTACGGGATAATTCTCTTTATCATCTCAGAAGTATTCTTCTTCGC 8922
Snow_Leopard2       TCAAAAAGGTCTCCGTTACGGGATAATTCTCTTTATCATCTCAGAAGTATTCTTCTTCGC 8922
Leopard1            TCAAAAAGGTCTCCGTTATGGAATAATTCTCTTTATCATCTCAGAAGTATTCTTCTTCGC 8917
Tiger1              TCAAAAAGGCCTCCGATACGGAATAATCCTTTTCATCATCTCAGAAGTATTCTTCTTCGC 8919
Tiger2              TCAAAAAGGCCTCCGATACGGAATAATCCTTTTCATCATCTCAGAAGTATTCTTCTTCGC 8919
Clouded_leopard     CCAAAAAGGCCTCCGATATGGGATAATCCTTTTTTATTGTCTCAGAAGTATTCTTCTTTGC 8913
cheetah             TCAAAAAGGCCTCCGATATGGAATAATCCTCTTTATCGTCTCAGAAGTATTCTTTTTTGC 8913
Cat                 TCAAAAAGGCCTTCGATACGGAATAATCCTCTTTATCATCTCAGAAGTATTCTTTTTCGC 8917
                     ******** ** ** ** ** ***** ** ** **  ***************** ** **

Snow_Leopard1       AGGATTTTTCTGGGCCTTCTACCACTCAAGCCTAGCCCCAACTCCCGAACTAGGAGGATG 8982
Snow_Leopard2       AGGATTTTTCTGGGCCTTCTACCACTCAAGCCTAGCCCCAACTCCCGAACTAGGAGGATG 8982
Leopard1            AGGCTTTTTCTGGGCCTTCTACCACTCAAGCCTAGCCCCAACCCCCGAGTTAGGAGGATG 8977
Tiger1              AGGTTTTTTCTGGGCCTTCTATCACTCAAGCCTGGCCCCGACCCCCGAATTGGGAGGATG 8979
Tiger2              AGGTTTTTTCTGGGCCTTCTATCACTCAAGCCTGGCCCCGACCCCCGAATTGGGAGGATG 8979
10R
Clouded_leopard     AGGCTTCTTTTGGGCCTTCTACCACTCAAGCCTAGCCCCAACCCCCGAATTAGGGGGATG 8973
cheetah             AGGCTTCTTCTGGGCCTTTTACCACTCAAGCCTAGCCCCAACCCCCGAACTAGGAGGATG 8973
Cat                 AGGCTTCTTCTGGGCCTTCTACCACTCAAGCCTAGCCCCAACCCCCGAGCTAGGAGGATG 8977
                    *** ** ** ******** ** ********** ***** ** *****  * ** *****

tRNA-Gly
Snow_Leopard1       CTGGCCACCTACAGGTATCACCCTGCTCAACCCCCTAGAAGTCCCACTACTCAACACTTC 9042
Snow_Leopard2       CTGGCCACCTACAGGTATCACCCTGCTCAACCCCCTAGAAGTCCCACTACTCAACACTTC 9042
Leopard1            CTGGCCACCAACAGGTATTATTCCCTTAAACCCTCTAGAAGTCCCCCTGCTTAATACCTC 9037
Tiger1              CTGGCCACCAACAGGTATTATTCCCCTAAACCCCCTAGAAGTCCCACTACTCAATACTTC 9039
Tiger2              CTGGCCACCAACAGGTATTATTCCCCTAAACCCCCTAGAAGTCCCACTACTCAATACTTC 9039
Clouded_leopard     CTGGCCACCAACAGGTATTACCCCTCTAAACCCCCTGGAGGTTCCACTACTTAACACTTC 9033
cheetah             CTGACCACCAACAGGCATTATTCCCCTAAACCCCTTAGAAGTTCCACTACTTAATACTTC 9033
Cat                 CTGACCACCAACAGGCATTATTCCCCTGAACCCCCTGGAAGTTCCACTACTTAATACCTC 9037
                    *** ***** ***** ** *  *   * *****  * ** ** ** ** ** ** ** **

Snow_Leopard1       CGTACTATTAGCTTCCGGAGTAGCAACCACCTGAGCTCACCACAGCCTAATAAAAGGTAA 9102
Snow_Leopard2       CGTACTATTAGCTTCCGGAGTAGCAACCACCTGAGCTCACCACAGCCTAATAAAAGGTAA 9102
Leopard1            CGTACTTTTAGCTTCCGGAGTGTCAATCACCTGAGCCCACCATAGCTTAATGGAAGGGAA 9097
Tiger1              TGTGCTCTTAGCTTCCGGAGTGTCAATCACCTGAGCCCATCATAGCCTAATAGAAGGAAA 9099
Tiger2              TGTGCTCTTAGCTTCCGGAGTGTCAATCACCTGAGCCCATCATAGCCTAATAGAAGGAAA 9099
Clouded_leopard     TGTACTTTTAGCCTCCGGAGTGTCAATCACCTGGGCCCACCATAGTCTAATAGAAGGGAA 9093
cheetah             AGTTCTTCTAGCCTCTGGAGTATCTATCACCTGAGCTCACCATAGCCTAATAGAAGGAAA 9093
Cat                 CGTGCTTCTAGCCTCCGGAGTATCAATCACCTGAGCTCACCACAGTTTGATGGAGGGAAA 9097
                     ** **  **** ** *****  * * ****** ** ** ** **  * **  * ** **

Snow_Leopard1       CCGAAAACATATGCTTCAAGCCCTATTCACCACAATCTCTTTAGGGATATACTTGACACT 9162
Snow_Leopard2       CCGAAAACATATGCTTCAAGCCCTATTCACCACAATCTCTTTAGGGATATACTTGACACT 9162
Leopard1            CCGAAAACATATACTCCAAGCACTATTTATTACAATCTCCCTAGGAGTCTACTTTACCCT 9157
Tiger1              TCGAAAACACATGCTCCAAGCACTATTTATTACAATCTCCCTAGGAGTCTATTTTACCCT 9159
Tiger2              TCGAAAACACATGCTCCAAGCACTATTTATTACAATCTCCCTAGGAGTCTATTTTACCCT 9159
Clouded_leopard     TCGAAAACACATACTCCAGGCGCTATTAATCACAATTTCTTTAGGAATTTATTTTACCCT 9153
cheetah             CCGAAAACACATGCTCCAAGCACTACTCATTACAATCTCCCTAGGAGTCTATTTTACACT 9153
Cat                 TCGAAAACACATGCTTCAAGCACTATTTATTACAATCTCTTTAGGGGTCTACTTTACACT 9157
                     ******** ** ** ** ** *** * *  ***** **  ****  * ** ** ** **

Snow_Leopard1       ACTTCAAGCCTCAGAATACTGTGAAGCATCATTCACAATCTCAGACGGGGTCTATGGATC 9222
Snow_Leopard2       ACTTCAAGCCTCAGAATACTGTGAAGCATCATTCACAATCTCAGACGGGGTCTATGGATC 9222
Leopard1            TCTCCAGGCCTCCGAATACTATGAAACATCATTTACAATCTCAGACGGAGTCTACGGATC 9217
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Tiger1              CCTCCAAGCCTCTGAGTACTATGAAACATCATTTACAATCTCGGACGGAGTTTATGGGTC 9219
Tiger2              CCTCCAAGCCTCTGAGTACTATGAAACATCATTTACAATCTCGGACGGAGTTTATGGGTC 9219
Clouded_leopard     CCTCCAAGCCTCTGAATATTATGAAACATCATTTACAATCTCAGACGGAGTTTATGGATC 9213
cheetah             CCTCCAAGCCTCCGAATATTACGAAACACCATTTACGATCTCAGATGGGATTTACGGATC 9213
Cat                 CCTCCAAGCCTCCGAATACTATGAAACATCATTCACGATCTCGGACGGAGTATACGGATC 9217
                     ** ** ***** ** ** *  *** ** **** ** ***** ** **  * ** ** **

Snow_Leopard1       CACTTTCTTTATGGCCACAGGATTTCATGGACTCCATGTGATTATTGGCTCTATTTTCCT 9282
Snow_Leopard2       CACTTTCTTTATGGCCACAGGATTTCATGGACTCCATGTGATTATTGGCTCTATTTTCCT 9282
Leopard1            TACCTTCTTCATAGCTACAGGATTCCACGGCCTACACGTAATTATTGGCTCCACCTTCTT 9277
Tiger1              CACCTTTTTCATAGCCACAGGGTTCCACGGACTACACGTAATTATTGGCTCTACCTTCCT 9279
Tiger2              CACCTTTTTCATAGCCACAGGGTTCCACGGACTACACGTAATTATTGGCTCTACCTTCCT 9279
Clouded_leopard     CACCTTCTTCATAGCCACAGGATTCCACGGACTGCATGTAATTATTGGCTCTACTTTTCT 9273
cheetah             CACCTTCTTTATAGCTACAGGATTCCACGGACTACATGTAATTATTGGTTCCACCTTCCT 9273
Cat                 TACCTTCTTCATGGCCACAGGATTCCATGGGCTACATGTAATTATTGGCTCTACTTTCCT 9277
                     ** ** ** ** ** ***** ** ** ** ** ** ** ******** ** *  **  *

Snow_Leopard1       CATCGTCTGCTTCCTACACCAATTAAAATATCATTTCATATCCAACTACCATTTTGGATA 9342
Snow_Leopard2       CATCGTCTGCTTCCTACACCAATTAAAATATCATTTCATATCCAACTACCATTTTGGATA 9342
Leopard1            AATTGTATGCTTCTTGCGCCAACTAAAATATCACTTCACATCGAGCCATCACTTCGGATT 9337
Tiger1              AATCGTATGTTTCTTGCGCCAACTAAAATACCACTTCACATCGAGCCACCATTTTGGATT 9339
Tiger2              AATCGTATGTTTCTTGCGCCAACTAAAATACCACTTCACATCGAGCCACCATTTTGGATT 9339
Clouded_leopard     GGTTGTGTGCTTCTTACGCCAACTAAAATACCACTTCACATCAAGCCACCATTTTGGATT 9333
cheetah             AATTGTATGCTTCTTACGCCAATTAAAATATCACTTTACATCAAATCATCATTTCGGGTT 9333
Cat                 AATTGTATGCTTCTTACGCCAATTAAAATATCACTTTACATCAAATCACCACTTCGGATT 9337
                      * ** ** *** * * **** ******* ** ** * *** *   * ** ** ** *

Snow_Leopard1       TGAAGCTGCTGCCTGATACTGACATTTCGTAGGTGTAGTGTGACTATTCTTGTAAGTTTC 9402
Snow_Leopard2       TGAAGCTGCTGCCTGATACTGACATTTCGTAGGTGTAGTGTGACTATTCTTGTAAGTTTC 9402
Leopard1            CGAAGCCGCTGCTTGATATTGACACTTCGTAGATGTGGTTTGACTATTCCTATACGTTTC 9397
Tiger1              CGAAGCCGCTGCTTGATATTGACATTTCGTAGACGTGGTTTGACTGTTCTTATACGTTTC 9399
Tiger2              CGAAGCCGCTGCTTGATATTGACATTTCGTAGACGTGGTTTGACTGTTCTTATACGTTTC 9399
Clouded_leopard     TGAAGCCGCTGCTTGATACTGGCATTTTGTAGACGTAGTTTGATTGTTCCTATACGTTTC 9393
cheetah             CGAAGCCGCTGCTTGATATTGACATTTCGTAGATGTAGTTTGACTATTCTTATACGTTTC 9393
Cat                 TGAAGCCGCCGCCTGATATTGACACTTCGTAGACGTAGTTTGACTATTCCTATACGTTTC 9397
                     ***** ** ** ***** ** ** ** ****  ** ** *** * *** * ** *****

Snow_Leopard1       TATTTATTGATGAGGACACCATTCCTTTAGTATTACCTAGTACAGTTGACTTCCAATCAA 9462
Snow_Leopard2       TATTTATTGATGAGGACACCATTCCTTTAGTATTACCTAGTACAGTTGACTTCCAATCAA 9462
Leopard1            CATTTATTGATGAGGATCCTATTCCTTTAGTATTAACAAGTACAGTTGATTTCCAATCAA 9457
Tiger1              CATTTATTGATGAGGATCCTATTCCCTTAGTATCAACAAGTACAGTTGACTTCCAATCAA 9459
Tiger2              CATTTATTGATGAGGATCCTATTCCCTTAGTATCAACAAGTACAGTTGACTTCCAATCAA 9459
Clouded_leopard     TATCTATTGATGAGGATCCTGTTCCTTTAGTATTAATAAGTACAGTTGACTTCCAATCAA 9453
cheetah             CATTTATTGATGAGGATCTTATTCCTTTAGTATTAATAAGTACAGTTGACTTCCAATTAA 9453
Cat                 TATTTATTGATGAGGATCCTATTCCTTTAGTATTAATAAGTACAGTTGACTTCCAATCAA 9457
                     ** ************     **** ******* *   *********** ******* **

ND3
Snow_Leopard1       CCAATTTCGGTACAATCCGAAAAGGAATAATACATGTAATACTAACTCTGCTTACCAACA 9522
Snow_Leopard2       CCAATTTCGGTACAATCCGAAAAGGAATAATACATGTAATACTAACTCTGCTTACCAACA 9522
Leopard1            CCAGTTTCGGTATAATCCGAAAAGGAATAATAAACGTAATACTCGCCCTACTCACCAATA 9517
Tiger1              CCAGTTTCGGTATAATCCGAAAGGGAATAATAAACATAATACTCGCTCTACTCACCAACA 9519
Tiger2              CCAGTTTCGGTATAATCCGAAAGGGAATAATAAACATAATACTCGCTCTACTCACCAACA 9519
Clouded_leopard     CCAGTTTCGGTGTAATCCGAAAAGGAATAATAAACGTAATACTCGCCCTACTTACCAACA 9513
cheetah             CCAGTTTCGGTATAGCCCGAAAAGGAATAATAAACATTATACTCGCCCTACTCACTAACA 9513
Cat                 CCAGTTTCGGTATAACCCGAAAAGGAATAATAAATGTAATACTTGCCTTACTTACCAATA 9517
                    *** *******  *  ****** ********* *  * *****  *  * ** ** ** *

Snow_Leopard1       CACTTCTATCCACACTACCTGTATTAATCGCATTCTGATTACCCCAATTAAACACCTATG 9582
Snow_Leopard2       CACTTCTATCCACACTACCTGTATTAATCGCATTCTGATTACCCCAATTAAACACCTATG 9582
Leopard1            CACTTCTATCTACGCTGCTTGTATTTATTGCATTCTGACTGCCCCAGCTAAATATTTATG 9577
Tiger1              CACTTCTATCCACACTACTTGTACTCATCGCGTTCTGACTACCCCAACTAAACACCTATG 9579
Tiger2              CACTTCTATCCACACTACTTGTACTCATCGCGTTCTGACTACCCCAACTAAACACCTATG 9579
Clouded_leopard     CACTTTTATCCACGCTACTTGTACTCATCGCATTTTGATTACCCCAATCAAATATCTACG 9573
cheetah             CGCTCCTATCCACACTACTTGTACTTATCGCATTTTGACTGCCCCAACTGAATATTTACG 9573
Cat                 CACTCCTGTCCACACTACTTGTACTCATCGCATTCTGATTACCCCAACTAAACATCTATG 9577
                    * **  * ** ** ** * **** * ** ** ** *** * *****    ** *  ** *

Snow_Leopard1       CAGAAAAAGCAAGCCCTTATGAGTGTGGATTTGACCCCATAGGATCCGCCCGCCTACCCT 9642
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Snow_Leopard2        CAGAAAAAGCAAGCCCTTATGAGTGTGGATTTGACCCCATAGGATCCGCCCGCCTACCCT 9642
Leopard1             CAGAAAAAGCAAGCCCTTATGAATGTGGATTTGACCCCATAGGATCTGCCCGCCTACCCT 9637
Tiger1               CAGAAAAAGCAAGTCCTTATGAATGTGGATTTGACCCCATAGGATCCGCTCGCCTGCCCT 9639
12F
Tiger2               CAGAAAAAGCAAGTCCTTATGAATGTGGATTTGACCCCATAGGATCCGCTCGCCTGCCCT 9639
Clouded_leopard      CAGAAAAAGTAAGCCCCTATGAATGTGGATTTGACCCCATGGGATCTGCTCGTTTGCCTT 9633
cheetah              CAGAAAAAGTAAGCCCCTATGAGTGCGGATTTGACCCTATAGGATCTGCCCGTTTGCCCT 9633
Cat                  CAGAAAAAGCAAGCCCCTATGAGTGCGGATTTGATCCTATAGGGTCCGCCCGCCTACCCT 9637
                     ********* *** ** ***** ** ******** ** ** ** ** ** **  * ** *

Snow_Leopard1        TCTCTATAAAATTTTTCCTAGTAGCTATTACATTCCTACTATTCGATCTAGAAATTGCAC 9702
Snow_Leopard2        TCTCTATAAAATTTTTCCTAGTAGCTATTACATTCCTACTATTCGATCTAGAAATTGCAC 9702
Leopard1             TCTCCATAAAATTTTTCTTAGTAGCTATTACATTCTTACTATTCGACCTAGAAATTGTAC 9697
Tiger1               TCTCCATAAAATTCTTCCTAGTAGCTATCACATTCTTGCTATTCGACCTAGAAATTGCAC 9699
Tiger2               TCTCCATAAAATTCTTCCTAGTAGCTATCACATTCTTGCTATTCGACCTAGAAATTGCAC 9699
Clouded_leopard      TCTCCATAAAATTTTTCTTAGTAGCTATTACATTCCTGCTATTTGACCTAGAAATTGCAC 9693
cheetah              TTTCCATGAAATTCTTCCTAGTAGCCATCACATTCCTGCTATTTGACCTAGAAATTGCCC 9693
Cat                  TCTCCATAAAATTCTTCCTGGTAGCCATTACATTCTTGCTATTTGATCTAGAAATTGCAC 9697
                     * ** ** ***** *** * ***** ** ****** * ***** ** **********  *

Snow_Leopard1        TACTACTCCCCCTTCCCTGGGCCTCACAAACAAACAAATTATCAACCATACTTATCATAG 9762
11R
Snow_Leopard2        TACTACTCCCCCTTCCCTGGGCCTCACAAACAAACAAATTATCAACCATACTTATCATAG 9762
Leopard1             TACTACTCCCCCTTCCCTGGGCCTCACAAACAAACAAACTATCAACCATACTTATCACAG 9757
Tiger1               TACTGCTCCCTCTTCCCTGAGCCTCACAAACAAACAAACTGTCAACCATGCTTATCACAG 9759
Tiger2               TACTGCTCCCTCTTCCCTGAGCCTCACAAACAAACAAACTGTCAACCATGCTTATCACAG 9759
Clouded_leopard      TACTACTGCCCCTTCCTTGAGCCTCACAAACAAACAAACTACCAACTATACTCTCCATGG 9753
cheetah              TACTACTCCCCCTTCCCTGAGCCTCACAAACGAATAATCTACCAACTATACTCACCATAG 9753
Cat                  TACTACTCCCCCTTCCCTGAGCCTCACAAACAGACAAACTACCAACCATACTCACTATAG 9757
                     **** ** ** ***** ** ***********  * **  *  **** ** **    *  *

Snow_Leopard1        CCCTCCTACTAATCTCTCTACTAGCCGCGAGCCTAGCCTACGAATGAACCCAAAAAGGAC 9822
Snow_Leopard2        CCCTCCTACTAATCTCTCTACTAGCCGCGAGCCTAGCCTACGAATGAACCCAAAAAGGAC 9822
Leopard1             CTCTCCTACTAATCTCCCTACTAGCCGTAAGCCTGGCCTATGAATGAACTCAAAAAGGAC 9817
Tiger1               CCCTTCTACTAATCTCCCTATTAGCCGCAAGCCTAGCCTACGAGTGAACCCAAAAAGGAT 9819
Tiger2               CCCTTCTACTAATCTCCCTATTAGCCGCAAGCCTAGCCTACGAGTGAACCCAAAAAGGAT 9819
Clouded_leopard      CTCTCCTACTAATCTCCCTGCTGGCCGCAAGTCTAGCCTATGAATGAACCCAAAAAGGAC 9813
cheetah              CCCTTATACTGATCTCACTATTAGCTGTAAGCCTAGCCTATGAATGAACCCAAAAAGGAT 9813
Cat                  CCCTTCTACTAATCTCATTACTAGCCGCAAGCCTAGCCTACGAATGAACCCAAAAAGGAC 9817
                     * **  **** *****  *  * ** *  ** ** ***** ** ***** *********

tRNA-Arg
Snow_Leopard1        TAGAGTGAACTGAATATGATAATTAGTTTAAACCAAAACAAATGATTTCGACTCATTAGA 9882
Snow_Leopard2        TAGAGTGAACTGAATATGATAATTAGTTTAAACCAAAACAAATGATTTCGACTCATTAGA 9882
Leopard1             TAGAGTGAACTGAATATGATAATTAGTTTAAACTAAAACAAATGATTTCGACTCATTAGA 9877
Tiger1               TAGAATGAACTGAATATGATAATTAGTTTAAACTAAAACAAATGATTTCGACTCATTAGA 9879
Tiger2               TAGAATGAACTGAATATGATAATTAGTTTAAACTAAAACAAATGATTTCGACTCATTAGA 9879
Clouded_leopard      TAGAATGAACTGAATATGATAATTAGTTTAAACCAAAACAAATGATTTCGACTCATTAGA 9873
cheetah              TAGAATGAACTGAATATGATAATTAGTTTAAACTAAAATAAATGATTTCGACTCATTAGA 9873
Cat                  TAGAATGAACTGAATATGATAATTAGTTTAAACCAAAACAAATGATTTCGACTCATTAGA 9877
                     **** ***************************** **** ********************

Snow_Leopard1        TTGTAGCTTGCCCTATAATTATCAGATGTCCATAGTCTATATTAATATATTCCTGGCTTT 9942
Snow_Leopard2        TTGTAGCTTGCCCTATAATTATCAGATGTCCATAGTCTATATTAATATATTCCTGGCTTT 9942
Leopard1             TTGTAGCTTACCCTATAATTATCAGATGTCCATAGTCTATGTTAATATATTTCTAGCTTT 9937
Tiger1               TTGTAGCTTACCCTATAATTATCAAATGTCCATAGTCTATGTTAACATCTTCCTGGCTTT 9939
Tiger2               TTGTAGCTTACCCTATAATTATCAAATGTCCATAGTCTATGTTAACATCTTCCTGGCTTT 9939
Clouded_leopard      TTGTAGCTTGCCCTATAATTATCAAATGTCCACAGTCTATATTAACATCTTTTTGGCTTT 9933
cheetah              CTATAGTTCACCCTATAATTATCAAATGTCCATAGTCTACATTAACATCTTCCTAGCTTT 9933
Cat                  TTATAGCTCACCCTATAATTATCAAATGTCCATAGTCTACATTAATATTTTCCTGGCTTT 9937
                      * *** *  ************** ******* ******  **** ** **  * *****

Snow_Leopard1        CATCATATCACTTATAGGACTATTGATGTACCGATCCCACTTAATATCCTCTCTCCTATG 10002
Snow_Leopard2        CATCATATCACTTATAGGACTATTGATGTACCGATCCCACTTAATATCCTCTCTCCTATG 10002
Leopard1             CATCATGTCACTCATAGGACTATTAATGTACCGATCCCACTTAATATCCTCCCTCCTATG 9997
Tiger1               CATCGTATCACTCATAGGACTATTAATGTACCGATCCCACTTAATATCCTCCCTTCTATG 9999
Tiger2               CATCGTATCACTCATAGGACTATTAATGTACCGATCCCACTTAATATCCTCCCTTCTATG 9999
Clouded_leopard      CACTATGTCACTTATAGGACTGTTAATGTATCGATCTCACCTAATGTCCTCCCTCCTATG 9993
cheetah              CATCATATCACTCATAGGTCTATTAATATATCGATCCCACCTAATGTCTTCTCTCTTATG 9993
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Cat                 CATCATGTCGCTCATAGGACTACTAATATATCGATCCCACTTAATGTCTTCCCTCCTATG 9997
                    **   * ** ** ***** **  * ** ** ***** *** **** ** ** **  ****

Snow_Leopard1       TCTGGAAGGCATAATGCTATCCCTATTTATCATAATAACCGTAGCAATCCTAAATAACCA 10062
Snow_Leopard2       TCTGGAAGGCATAATGCTATCCCTATTTATCATAATAACCGTAGCAATCCTAAATAACCA 10062
Leopard1            CCTAGAAGGTATAATACTATCCCTATTTATCATAATAACCGTGACAATTCTAAATAATCA 10057
Tiger1              CCTAGAAGGCATAATACTATCCCTATTTATTATGATAACCATGGCAGTTCTAAACAATCA 10059
Tiger2              CCTAGAAGGCATAATACTATCCCTATTTATTATGATAACCATGGCAGTTCTAAACAATCA 10059
Clouded_leopard     TCTAGAAGGTATAATATTATCCTTATTCATCATAATAACCGTAGCAATCCTGAATAATCA 10053
cheetah             TTTAGAAGGCATGATATTATCTCTATTCATTATAATAACGATAGTAGTCCTGAACAATCA 10053
Cat                 TCTAGAAGGCATGATATTATCCCTATTCATTATAATAGCCGTAGCCATCCTAAACAACCA 10057
                      * ***** ** **  ****  **** ** ** *** *  *     * ** ** ** **

Snow_Leopard1       TTTCACACTAGCTAGCATGACTCCTATCATCCTGCTAGTATTTGCAGCCTGCGAGGCGGC 10122
Snow_Leopard2       TTTCACACTAGCTAGCATGACTCCTATCATCCTGCTAGTATTTGCAGCCTGCGAGGCGGC 10122
Leopard1            TTTCACACTAGCCAACATGACTCCCATTATCTTGCTAGTATTTGCAGCCTGCGAGGCGGC 10117
Tiger1              CTTTACACTAGCTAGCATGACCCCCATTATCCTGCTAGTATTTGCAGCCTGCGAGGCAGC 10119
Tiger2              CTTTACACTAGCTAGCATGACCCCCATTATCCTGCTAGTATTTGCAGCCTGCGAGGCAGC 10119
Clouded_leopard     CTTCACACTAGCTAGCATAACTCCCATTATCTTACTAGTATTTGCAGCCTGCGAGGCAGC 10113
cheetah             CTTTACACTAGCTAGTATAACTCCTATTATCTTGCTAGTATTCGCAGCCTGCGAGGCAGC 10113
Cat                 TCTCACACTAGCCAGCATAACCCCCATTATCCTATTAGTATTTGCAGCTTGTGAGGCAGC 10117
                      * ******** *  ** ** ** ** *** *  ******* ***** ** ***** **

Snow_Leopard1       ACTGGGCTTATCCTTACTAGTAATGGTATCAAACACATATGGTACTGATTATGTACAAAA 10182
Snow_Leopard2       ACTGGGCTTATCCTTACTAGTAATGGTATCAAACACATATGGTACTGATTATGTACAAAA 10182
Leopard1            ACTAGGCTTATCCTTACTAGTAATGGTATCAAACACATACGGTACCGACTATGTACAAAA 10177
Tiger1              ACTGGGCTTGTCCCTACTAGTAATGGTATCAAATACATATGGTACCGACTATGTACAAAA 10179
Tiger2              ACTGGGCTTGTCCCTACTAGTAATGGTATCAAATACATATGGTACCGACTATGTACAAAA 10179
Clouded_leopard     ACTGGGCCTATCTCTACTAGTAATAGTATCAAACACATATGGCACCGACTACGTACAAAA 10173
cheetah             ACTAGGCTTATCCCTGCTAGTAATAGTATCAAACACATATGGTACCGACTATGTACAAAA 10173
Cat                 ACTAGGTTTATCTCTACTAGTAATAGTATCAAATACATATGGCACTGACTATGTACAAAA 10177
                    *** **  * **  * ******** ******** ***** ** ** ** ** ********
ND4
Snow_Leopard1       CCTAAACCTCCTGCAATGCTAAAAATTATTATCCCTACTGCCATACTCATACCGATAACA 10242
Snow_Leopard2       CCTAAACCTCCTGCAATGCTAAAAATTATTATCCCTACTGCCATACTCATACCGATAACA 10242
Leopard1            CCTAAACCTCCTACAATGCTAAAAATTATTGTCCCTACTGCCATACTCATACCAATAACA 10237
Tiger1              CCTAAACCTCTTGCAATGCTAAAAATTATTATCCCCACTGCCATACTCATACCAATAACA 10239
Tiger2              CCTAAACCTCTTGCAATGCTAAAAATTATTATCCCCACTGCCATACTCATACCAATAACA 10239
Clouded_leopard     CCTAAATCTCCTACAATGCTAAAAATTATTATTCCCACTGCCATACTCATACCAATGACA 10233
cheetah             CCTAAACCTCCTACAATGCTAAAAATTATTATCCCTACTGCTATACTTATACCAATAATA 10233
Cat                 CCTAAACCTCCTACAATGCTAAAAATTATTATCCCCACTGCCATACTCATACCAATAACA 10237
                    ****** *** * ***************** * ** ***** ***** ***** ** * *

Snow_Leopard1       TGACTATCAAAACCCAACATAATCTGAATTAACTCAACTACCTACAGCCTCCTGATCAGC 10302
Snow_Leopard2       TGACTATCAAAACCCAACATAATCTGAATTAACTCAACTACCTACAGCCTCCTGATCAGC 10302
Leopard1            TGACTATCAAAACCCAACATAATCTGAATTAACTCAACTACCTATAGCCTTCTGATCAGC 10297
Tiger1              TGATTATCAAAACCCAGCATAATCTGAATTAACTCAACCACCTATAGTTTTCTGATCAGC 10299
Tiger2              TGATTATCAAAACCCAGCATAATCTGAATTAACTCAACCACCTATAGTTTTCTGATCAGC 10299
Clouded_leopard     TGACTATCAAAGCCCAATATAATCTGAATCAACTCAACTATTTACAGCTTACTAATTAGC 10293
cheetah             TGATTATCAAAACCTAATATAATCTGAATTAACTCAACAACCTACAGCCTACTAATCAGT 10293
Cat                 TGCCTATCGAAACCTAACATAATCTGAATCAACTCAACAACCTACAGCCTACTAATTAGT 10297
                    **  **** ** ** *  *********** ******** *  ** **  * ** ** **

Snow_Leopard1       CTTATTAGCCTTTCCTATTTAAATCAACTAGGCGACAACAGCCTAAATCTCTCATTACTA 10362
Snow_Leopard2       CTTATTAGCCTTTCCTATTTAAATCAACTAGGCGACAACAGCCTAAATCTCTCATTACTA 10362
Leopard1            CTTATTAGCCTCTCCTATTTAAACCAACTAGGCGACAACAGCCTAAATCTTTCATTACTA 10357
Tiger1              CTTGTTAGCCTGTCCTACTTAAATCAACTAGGCGACAACAGCCTAAATCTCTCATTACTA 10359
Tiger2              CTTGTTAGCCTGTCCTACTTAAATCAACTAGGCGACAACAGCCTAAATCTCTCATTACTA 10359
Clouded_leopard     CTTATCAGCCTATCCTATTTAAACCAACTAGGCGACAATAGCCTAAACTTCTCGCTACTG 10353
cheetah             CTTGTTAGTCTGTCCTACCTAAATCAACCAGGTGATAATAGTCTAAACTCTTCATTATTA 10353
Cat                 CTTATTAGCCTCTCCTATCTAAACCAACTAGGTGGCCATAGTCTAAATTTTTCACTGTTA 10357
                    *** * ** ** *****  **** **** *** *   * ** *****    **  *  *

Snow_Leopard1       TTCTTCTCAGACTCACTTTCTGCACCTCTACTAGTATTAACAACATGACTCCTGCCACTA 10422
Snow_Leopard2       TTCTTCTCAGACTCACTTTCTGCACCTCTACTAGTATTAACAACATGACTCCTGCCACTA 10422
Leopard1            TTTTTCTCAGACTCACTTTCTGCACCTCTGCTAGTCTTAACAACATGACTCCTACCGCTA 10417
Tiger1              TTTTTCTCAGACTCACTCTCTGCACCCCTACTAGTATTAACAACATGACTCTTACCACTA 10419
13F
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Tiger2              TTTTTCTCAGACTCACTCTCTGCACCCCTACTAGTATTAACAACATGACTCTTACCACTA 10419
Clouded_leopard     TTTTTCTCAGACCCACTCTCTGCACCTCTACTAGTACTAACAACATGACTCCTGCCACTA 10413
cheetah             TTTTTCTCAGACTCACTCTCTGCACCCTTATTAGTACTAACAACATGACTTCTACCATTA 10413
Cat                 TTTTTCTCAGACTCACTCTCCGCACCTTTACTAGTACTAACAACATGACTCCTACCGCTA 10417
                    ** ********* **** ** *****  *  ****  *************  * **  **

Snow_Leopard1       ATACTTGTGGCTAGTCAGTCACACCTATCAAAAGAGACCTTGGCCCGAAAAAAACTATAC 10482
Snow_Leopard2       ATACTTGTGGCTAGTCAGTCACACCTATCAAAAGAGACCTTGGCCCGAAAAAAACTATAC 10482
Leopard1            ATGCTCATGGCTAGTCAATCCCACCTGTCAAAGGAGACCCCATCTCGAAAAAAACTATAC 10477
12R
Tiger1              ATGCTCATGGCTAGTCAATCACACCTGTCAAAAGAGACCCTAGCCCGAAAAAAACTATAC 10479
Tiger2              ATGCTCATGGCTAGTCAATCACACCTGTCAAAAGAGACCCTAGCCCGAAAAAAACTATAC 10479
Clouded_leopard     ATACTTATGGCTAGTCAGTCGCACCTATCAAAAGAGACCCTGACCCGAAAAAAACTATAC 10473
cheetah             ATACTAATAGCCAGCCAATCACACCTATCAAAAGAGATCTTAGCTCGAAAAAAACTATAT 10473
Cat                 ATACTCATAGCCAGCCAATCACACCTATCAAAAGAAACTCCTAGTCGAAAAAAACTATAC 10477
                    ** **  * ** ** ** ** ***** ***** ** *        **************

Snow_Leopard1       ATCACGATACTTATTACTTTACAACTTCTCCTAATTATAACATTCACCGCCACAGAACTA 10542
Snow_Leopard2       ATCACGATACTTATTACTTTACAACTTCTCCTAATTATAACATTCACCGCCACAGAACTA 10542
Leopard1            ATCACAATACTCATCATCTTGCAGCTTCTCTTAATTATAACATTCACTGCCACAGAACTG 10537
Tiger1              ATTACAATACTTATTATCCTACAACTCCTCTTAATTATAACATTCACCGCTACAGAACTG 10539
Tiger2              ATTACAATACTTATTATCCTACAACTCCTCTTAATTATAACATTCACCGCTACAGAACTG 10539
Clouded_leopard     ATCACAATACTCACTACCTTGCAGCTCCTCTTAATTATAACATTCACCGCCACAGAATTA 10533
cheetah             ATCACAATACTGATCCTCCTACAACTCCTCCTGATCATAACATTTACCGCCACAGAGCTA 10533
Cat                 ATCACAATACTCACTCTCCTGCAGCTTCTTTTGATTATAACATTTACCGCTACAGAACTA 10537
                    ** ** ***** *      * ** ** **  * ** ******** ** ** *****  *

Snow_Leopard1       ATTATATTTTATATCCTATTTGAAGCCACATTAATCCCCACCCTTATTATTATTACCCGA 10602
Snow_Leopard2       ATTATATTTTATATCCTATTTGAAGCCACATTAATCCCCACCCTTATTATTATTACCCGA 10602
Leopard1            ATCATATTCTATATTCTATTTGAAGCCACATTAATCCCCACTCTCATCATCATTACTCGA 10597
Tiger1              ATTATATTCTACATTCTATTCGAAGCTACATTAATCCCTACTCTTATTATTATCACTCGA 10599
Tiger2              ATTATATTCTACATTCTATTCGAAGCTACATTAATCCCTACTCTTATTATTATCACTCGA 10599
Clouded_leopard     ATTATATTTTACATCCTATTTGAAGCCACATTAATCCCTACTCTCATTATCATCACCCGA 10593
cheetah             ATTATATTTTACATCTTATTCGAAGCCACATTAATCCCTACTTTAATCATTATTACCCGA 10593
Cat                 ATTATATTTTACATTTTATTTGAAGCCACATTAATCCCCACCTTAATCATCATTACCCGA 10597
                    ** ***** ** **  **** ***** ********** **  * ** ** ** ** ***

Snow_Leopard1       TGGGGCAATCAAACGGAGCGACTAAACGCTGGCCTATACTTTCTACTCTACACCTTGGTA 10662
Snow_Leopard2       TGGGGCAATCAAACGGAGCGACTAAACGCTGGCCTATACTTTCTACTCTACACCTTGGTA 10662
Leopard1            TGGGGCAATCAAACAGAACGACTAAACGCTGGCCTATATTTTCTATTCTATACCCTGATA 10657
Tiger1              TGAGGCAATCAAACAGAGCGACTAAACGCTGGTCTGTACTTTCTATTCTACACCCTGGTA 10659
Tiger2              TGAGGCAATCAAACAGAGCGACTAAACGCTGGTCTGTACTTTCTATTCTACACCCTGGTA 10659
Clouded_leopard     TGAGGTAATCAAACGGAACGACTAAATGCTGGCTTATACTTTCTATTCTATACCTTGATG 10653
cheetah             TGGGGTAACCAAACAGAACGACTAAACGCTGGCCTGTATTTCCTATTCTACACTCTAGTA 10653
Cat                 TGGGGTGACCAGACAGAGCGATTAAACGCCGGCCTATACTTTCTATTTTACACTCTAGTA 10657
                    ** **  * ** ** ** *** **** ** **  * ** ** *** * ** **  *  *

Snow_Leopard1       GGCTCACTGCCCCTCCTAGTCGCACTGCTATACATTCAAAACACAACGGGAACTTTAAAT 10722
Snow_Leopard2       GGCTCACTGCCCCTCCTAGTCGCACTGCTATACATTCAAAACACAACGGGAACTTTAAAT 10722
Leopard1            GGCTCACTGCCCCTTCTAGTCGCACTACTATACATTCAAAACACAACAGGGACTTTAAAT 10717
Tiger1              GGCTCACTACCCCTCCTAGTCGCACTACTATACATCCAAAACACAACAGGAACTCTGAAC 10719
Tiger2              GGCTCACTACCCCTCCTAGTCGCACTACTATACATCCAAAACACAACAGGAACTCTGAAC 10719
Clouded_leopard     GGCTCTCTGCCCCTTCTAGTCGCATTATTATATATCCAAAACACAACAGGAACCCTAAAT 10713
cheetah             GGCTCACTACCCCTTCTAGTTGCACTATTATATATCCAAAATACAATAGGGACCTTAAAC 10713
Cat                 GGCTCACTACCCCTTTTAGTCGCACTACTGTATATCCAGAATACAACAGGAACTTTAAAT 10717
                    ***** ** *****  **** *** *  * ** ** ** ** ****  ** **  * **

Snow_Leopard1       TTCCTAATCATTCAATACTGAACCAAACCAATCTCAACCACCTGGTCTAACATCTTTCTC 10782
Snow_Leopard2       TTCCTAATCATTCAATACTGAACCAAACCAATCTCAACCACCTGGTCTAACATCTTTCTC 10782
Leopard1            TTTCTAGTCATCCAATACTGAGCCAAACCAATCTCAGCCACTTGATCTAACATTTTTCTC 10777
Tiger1              TTCCTAATTATTCAATACTGAGCCAAACCAATTTCAGCCACCTGATCTAATATCTTTCTC 10779
Tiger2              TTCCTAATTATTCAATACTGAGCCAAACCAATTTCAGCCACCTGATCTAATATCTTTCTC 10779
Clouded_leopard     TTCCTAATCATTCAATACTGGGCCAAGCCAATCTCGACCACCTGATCTAATATCTTCCTC 10773
cheetah             TTTTTAATTATCCAGTATTGAGCCAAACCTATCTCAACTACCTGATCCAATATTTTCCTG 10773
Cat                 TTCCTGATCATCCAATACTGAGCCAAGCCCATCTCAACCACCTGGTCCAATATTTTCCTC 10777
                    **  *  * ** ** ** **  **** ** ** **  * ** ** ** ** ** ** **

Snow_Leopard1       TGACTAGCATGCATAATAGCATTTGTAGTAAAAATACCTCTATATGGACTCCACCTGTGA 10842
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Snow_Leopard2         TGACTAGCATGCATAATAGCATTTGTAGTAAAAATACCTCTATATGGACTCCACCTGTGA 10842
Leopard1              TGACTAGCATGCATAATAGCATTTATAGTAAAAATACCCCTATATGGACTCCACCTATGG 10837
Tiger1                TGACTAGCATGCATAATAGCATTCATAGTAAAAATACCTCTATATGGGCTCCACCTGTGA 10839
Tiger2                TGACTAGCATGCATAATAGCATTCATAGTAAAAATACCTCTATATGGGCTCCACCTGTGA 10839
Clouded_leopard       TGACTAGCATGCATAATAGCATTTATAGTAAAAATACCTCTATATGGCCTCCATCTATGA 10833
cheetah               TGACTAGCATGTATAATAGCATTCATAGTAAAAATACCCCTATACGGACTTCACCTCTGA 10833
Cat                   TGACTAGCATGCATGATAGCATTTATAGTAAAAATACCTCTATATGGACTCCACCTATGA 10837
                      ********** ** ********  ************* ***** ** ** ** ** **

Snow_Leopard1         TTACCAAAAGCACATGTCGAAGCCCCCATTGCCGGCTCAATAGTACTTGCTGCCGTACTG 10902
Snow_Leopard2         TTACCAAAAGCACATGTCGAAGCCCCCATTGCCGGCTCAATAGTACTTGCTGCCGTACTG 10902
Leopard1              CTACCGAAAGCACATGTCGAAGCCCCCATTGCCGGCTCAATAGTGCTTGCCGCCGTACTG 10897
Tiger1                CTACCAAAAGCACATGTCGAAGCTCCCATTGCCGGCTCAATAGTCCTTGCTGCTGTACTG 10899
Tiger2                CTACCAAAAGCACATGTCGAAGCTCCCATTGCCGGCTCAATAGTCCTTGCTGCTGTACTG 10899
Clouded_leopard       CTACCAAAAGCCCATGTTGAAGCCCCCATTGCCGGCTCAATAGTACTTGCTGCCGTGTTG 10893
cheetah               CTACCAAAAGCACACGTTGAAGCCCCTATCGCTGGTTCAATGGTACTTGCTGCTGTGCTA 10893
Cat                   TTGCCAAAAGCACATGTTGAAGCTCCCATCGCTGGTTCAATAGTACTTGCCGCCGTATTA 10897
                       * ** ***** ** ** ***** ** ** ** ** ***** ** ***** ** **  *

Snow_Leopard1         TTAAAACTAGGGGGATATGGAATGATACGTATTACAATTCTACTCAACCCCACAACAAAC 10962
Snow_Leopard2         TTAAAACTAGGGGGATATGGAATGATACGTATTACAATTCTACTCAACCCCACAACAAAC 10962
Leopard1              TTAAAACTAGGGGGGTATGGAATAATACGCATTACAATTCTACTCAACCCCACAACAAAC 10957
Tiger1                TTGAAGCTAGGAGGATATGGAATGATACGCATTACAATCCTACTCAACCCCACAACAAAC 10959
Tiger2                TTGAAGCTAGGAGGATATGGAATGATACGCATTACAATCCTACTCAACCCCACAACAAAC 10959
Clouded_leopard       CTAAAATTAGGGGGATATGGAATAATGCGCATTACAATTCTACTTAACCCCACAACAAAC 10953
cheetah               TTAAAACTAGGGGGATACGGGATAATACGCATCACAATTCTACTAAACCCCACAACTAGT 10953
Cat                   CTAAAACTAGGGGGATACGGGATAATGCGTATTACAGTCCTACTTAACCCCGCAACGAAC 10957
                       * **  **** ** ** ** ** ** ** ** *** * ***** ****** **** *

Snow_Leopard1         CAAATAGCATATCCTTTCATGATGCTGTCCCTATGGGGAATAGTTATAACAAGTTCTATC 11022
Snow_Leopard2         CAAATAGCATATCCTTTCATGATGCTGTCCCTATGGGGAATAGTTATAACAAGTTCTATC 11022
Leopard1              CAAATAGCATACCCCTTCATAATGCTATCCCTATGAGGAATAGTTATAACAAGTTCTATC 11017
Tiger1                CAAATGGCATACCCCTTCATAATGCTATCCCTATGGGGAATAATTATAACAAGCTCTATT 11019
Tiger2                CAAATGGCATACCCCTTCATAATGCTATCCCTATGGGGAATAATTATAACAAGCTCTATT 11019
Clouded_leopard       CAAATGGCATACCCCTTCATAATGCTATCCCTGTGAGGAATAGTTATAACAAGCTCTGTC 11013
cheetah               CAAATAGCGTACCCCTTTATAATATTATCCCTATGAGGAATAATTATAACAAGCTCTATT 11013
Cat                   CAAATGGCATACCCCTTTATAATACTATCCCTGTGAGGAATGGTTATAACAAGCTCCATT 11017
                      ***** ** ** ** ** ** **  * ***** ** *****  ********** **  *

Snow_Leopard1         TGTTTACGTCAGACAGACCTGAAATCCGTAATCGCATATTCATCCGTAAGCCATATAGCC 11082
14F
Snow_Leopard2         TGTTTACGTCAGACAGACCTGAAATCCGTAATCGCATATTCATCCGTAAGCCATATAGCC 11082
Leopard1              TGTTTGCGCCAGACAGACCTGAAATCCTTAATCGCATACTCATCAGTAAGCCACATAGCC 11077
Tiger1                TGTCTACGCCAGACAGACCTAAAATCCCTAATCGCATATTCATCCGTAAGCCATATGGCC 11079
Tiger2                TGTCTACGCCAGACAGACCTAAAATCCCTAATCGCATATTCATCCGTAAGCCATATGGCC 11079
Clouded_leopard       TGCTTACGCCAGACAGACCTAAAATCCTTAATCGCATACTCATCTGTAAGCCACATAGCC 11073
cheetah               TGCCTACGTCAAACAGATCTAAAATCACTAATCGCATACTCATCTGTAAGCCACATAGCC 11073
Cat                   TGCCTGCGCCAAACAGACCTAAAATCCCTAATCGCATACTCATCCGTAAGTCACATGGCC 11077
                      **  * ** ** ***** ** *****  ********** ***** ***** ** ** ***

Snow_Leopard1         CTAGTAATTGTAGCTGTGCTAATCCAAACACCCTGAAGTTATATAGGAGCTACAGCCCTT 11142
Snow_Leopard2         CTAGTAATTGTAGCTGTGCTAATCCAAACACCCTGAAGTTATATAGGAGCTACAGCCCTT 11142
Leopard1              CTAGTAATTGTAGCTGTATTAATCCAAACACCCTGAAGCTATATAGGAGCCACAGCCCTT 11137
Tiger1                CTAGTAATCGTGGCCGTACTAATTCAAACACCTTGGAGTTACATAGGAGCCACAGCTCTT 11139
Tiger2                CTAGTAATCGTGGCCGTACTAATTCAAACACCTTGGAGTTACATAGGAGCCACAGCTCTT 11139
Clouded_leopard       CTGGTAATCGTAGCAGTACTAATTCAGACACCCTGAAGTTATATAGGAGCTACAGCCCTC 11133
cheetah               CTAGTAATTGTAGCAGTACTGATCCAAACACCCTGAAGTTATATAGGAGCCACAGCTCTA 11133
Cat                   CTAGTAATTGTAGCAGTACTGATCCAAACACCCTGAAGCTATATAGGAGCTACAGCCTTA 11137
                      ** ***** ** ** **  * ** ** ***** ** ** ** ******** *****  *

Snow_Leopard1         ATAATCGCCCGCGGACTAACCTCCTCAATATTATTTTGCCTCGCAAACTCAAACGACGAA 11202
Snow_Leopard2         ATAATCGCCCGCGGACTAACCTCCTCAATATTATTTTGCCTCGCAAACTCAAACGACGAA 11202
Leopard1              ATAATTGCTCACGGACTAACCTCCTCAATACTATTCTGTCTTGCAAACTCAAACTACGAA 11197
13R
Tiger1                ATAATCGCCCACGGACTAACTTCCTCAGTGCTATTTTGCCTTGCAAACTCAAACTACGAA 11199
Tiger2                ATAATCGCCCACGGACTAACTTCCTCAGTGCTATTTTGCCTTGCAAACTCAAACTACGAA 11199
Clouded_leopard       ATAATTGCCCACGGACTAACTTCATCAATACTATTCTGCCTTGCAAACTCAAACTATGAG 11193
cheetah               ATAATCGCTCACGGGCTAACTTCATCTATATTATTCTGCCTCGCAAACTCAAACTATGAA 11193
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Cat                 ATAATTGCTCATGGACTGACCTCATCTATGCTATTCTGCCTTGCAAACTCAAACTATGAA 11197
                    ***** ** *  ** ** ** ** **  *  **** ** ** ************ * **

Snow_Leopard1       CGAGTCCATAGCCGAACAATAATTCTAGCACGAGTCCTACAAGCCATCCTCCCTCTGATA 11262
Snow_Leopard2       CGAGTCCATAGCCGAACAATAATTCTAGCACGAGTCCTACAAGCCATCCTCCCTCTGATA 11262
Leopard1            CGAGTCCACAGCCGAACAATAATTCTAGCACGAGGCCTACAAACCATTCTTCCTCTGATA 11257
Tiger1              CGAATCCATAGCCGAACAATAATTCTCGCACGAGGCCTACAAACCATCCTCCCCCTAATA 11259
Tiger2              CGAATCCATAGCCGAACAATAATTCTCGCACGAGGCCTACAAACCATCCTCCCCCTAATA 11259
Clouded_leopard     CGAGTCCATAGCCGGACAATAATTTTAGCACGAGGCCTACAAACCATCCTTCCCTTAATG 11253
cheetah             CGAGTGCATAGCCGAACCATAATTTTAGCACGAGGCCTACAAACTATTCTTCCCCTAATA 11253
Cat                 CGAGTACATAGCCGAACAATAATCCTAGCCCGGGGGCTACAGACTATCCTCCCCCTAATA 11257
                    *** * ** ***** ** *****  * ** ** *  *****  * ** ** **  * **

Snow_Leopard1       GCTGCCTGATGGCTACTAGCCAGTCTCGCGAACCTAGCCCTGCCTCCTACCATTAACCTA 11322
Snow_Leopard2       GCTGCCTGATGGCTACTAGCCAGTCTCGCGAACCTAGCCCTGCCTCCTACCATTAACCTA 11322
Leopard1            GCTGCCTGATGGCTACTAGCCAGCCTCGCAAACCTAGCCCTGCCCCCTACCATTAACTTA 11317
Tiger1              GCTGCTTGATGACTACTGGCCAGCCTCGCAAACCTGGCCCTACCTCCTACTATTAACCTA 11319
Tiger2              GCTGCTTGATGACTACTGGCCAGCCTCGCAAACCTGGCCCTACCTCCTACTATTAACCTA 11319
Clouded_leopard     GCTGCCTGATGGTTACTAGCCAGCCTTGCAAATTTAGCCCTGCCTCCTACCATTAACCTA 11313
cheetah             GCTGCTTGATGACTACTAGCCAGCCTTGCAAACCTAGCCCTACCACCCACAATTAACCTA 11313
Cat                 GCTGCCTGATGACTACTAGCTAGCCTCGCAAACCTAGCCCTACCACCCACAATTAATCTA 11317
                    ***** *****  **** ** ** ** ** **  * ***** ** ** ** *****  **

Snow_Leopard1       ATCGGAGAGCTATTTGTAGTAATAGCTTCCTTCTCATGATCCAACATAACTATCGTCCTC 11382
Snow_Leopard2       ATCGGAGAGCTATTTGTAGTAATAGCTTCCTTCTCATGATCCAACATAACTATCGTCCTC 11382
Leopard1            ATCGGAGAACTATTCGTAGTGGTGGCCTCCTTCTCATGATCTAACATAACTATTGTCCTT 11377
Tiger1              ATTGCAGAGCTATTTGTAGTAGTGGCCTCCTTTTCATGATCTAACATAACCATTACTCTC 11379
Tiger2              ATTGCAGAGCTATTTGTAGTAGTGGCCTCCTTTTCATGATCTAACATAACCATTACTCTC 11379
Clouded_leopard     ATCGGAGAGCTATTTGTAGTAATAGCCTCTTTCTCATGATCTAACATAACCATTATCCTC 11373
cheetah             GTCGGAGAATTATTTGTAGTAGTGGCCTCCTTCTCATGATCTAATATAACCATTATCCTT 11373
Cat                 ATCGGAGAGCTATTTGTAGTAATAGCCTCCTTCTCATGATCAAACATAACCATTATCCTA 11377
                     * * ***  **** *****  * ** ** ** ******** ** ***** **    **

Snow_Leopard1       ATGGGTACAAATATTATCATCACAGCCCTATATACCCTCTATATGCTCACTACAACCCAA 11442
Snow_Leopard2       ATGGGTACAAATATTATCATCACAGCCCTATATACCCTCTATATGCTCACTACAACCCAA 11442
Leopard1            ATAGGCACAAATATTATCATCACAGCCTTATATACCCTCTATATACTCACCACAACCCAA 11437
Tiger1              ATGGGCACAAATATCATCATCACAGCCCTATATACCCTCTACATACTCATTACAACCCAA 11439
Tiger2              ATGGGCACAAATATCATCATCACAGCCCTATATACCCTCTACATACTCATTACAACCCAA 11439
Clouded_leopard     ATAGGTACAAATATTATTATCACAGCCCTATATACTCTCTACATGCTTATCACAACTCAA 11433
cheetah             ATAGGTACAAACATTATTATTACAGCCCTATACTCTCTCTATATACTCATTACAACCCAA 11433
Cat                 ATGGGTACTAATATCATCATTACAGCCCTATACTCCCTCTACATACTTATTATAACTCAA 11437
                    ** ** ** ** ** ** ** ****** ****  * ***** ** ** *  * *** ***

Snow_Leopard1       CGAGGTAAATATACACACCACATTAAAAACATCAATCCATCATTCACACGAGAAAACACC 11502
Snow_Leopard2       CGAGGTAAATATACACACCACATTAAAAACATCAATCCATCATTCACACGAGAAAACACC 11502
Leopard1            CGAGGTAAATACACGCACCATATCAAAAATATCAACCCATCATTCACACGAGAAAACGCC 11497
Tiger1              CGAGGCAAATATACACACCACATTAAAAACATCAATCCATCATTCACACGAGAAAATGCC 11499
Tiger2              CGAGGCAAATATACACACCACATTAAAAACATCAATCCATCATTCACACGAGAAAATGCC 11499
Clouded_leopard     CGAGGCAAACATACGCACCACATTAAAAACATCAACCCATCATTTACGCGGGAGAATGCT 11493
cheetah             CGAGGCAAGTATACACATCACATTAAAAATATTAACCCATCATTTACACGAGAAAATACC 11493
Cat                 CGAGGCAAATACACACACCACATTAAAAATATCAACCCATCATTTACACGAGAAAACGCC 11497
                    ***** **  * ** ** ** ** ***** ** ** ******** ** ** ** **  *

Snow_Leopard1       CTAATAGCCCTTCACCTGCTCCCACTCCTTCTCTTATCACTCAACCCCAAAATCGCACTA 11562
Snow_Leopard2       CTAATAGCCCTTCACCTGCTCCCACTCCTTCTCTTATCACTCAACCCCAAAATCGCACTA 11562
Leopard1            CTAATGGCCCTTCATCTACTCCCACTCCTTCTCTTATCCCTCAACCCCAAAATCGTACTA 11557
Tiger1              CTAATAACACTTCATCTGCTCCCACTTTTTCTCTTATCTCTCAACCCCAAAATCGTACTA 11559
Tiger2              CTAATAACACTTCATCTGCTCCCACTTTTTCTCTTATCTCTCAACCCCAAAATCGTACTA 11559
Clouded_leopard     CTAATAACCCTTCACCTACTTCCACTTCTTCTCCTATCACTCAACCCTAAAACCGTACTA 11553
cheetah             CTAATAACCCTTCACCTACTCCCCCTTCTTCTCCTATCACTTAACCCCAAAATTGTACTA 11553
Cat                 CTAATAGCCCTCCACCTACTCCCCCTTCTCCTCCTATCACTTAACCCTAAGATTGTACTA 11557
                    *****  * ** ** ** ** ** **  * *** **** ** ***** ** *  * ****

tRNA-His
Snow_Leopard1       GGTCCTATTTATTGTAAATATAGTTTAATAAAAACATTAGCTTGTGGATCTAATAATAGA 11622
Snow_Leopard2       GGTCCTATTTATTGTAAATATAGTTTAATAAAAACATTAGCTTGTGGATCTAATAATAGA 11622
Leopard1            GGCCCTATTTATTGTAAATATAGTCTAACAAAAACATTAGATTGTGAATCTAATAATGGA 11617
Tiger1              GGTCCTATTTACTGTAAATATAGTTTAATAAAAACATTAGATTGTGAATCTAATAATAGA 11619
Tiger2              GGTCCTATTTACTGTAAATATAGTTTAATAAAAACATTAGATTGTGAATCTAATAATAGA 11619
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Clouded_leopard      GGTCCTATTTACTGTAAATATAGTTTAATAGAAACATTAGATTGTGAATCTGACAATAGA 11613
cheetah              GGACCCATTTACTGTAAATATAGTTTAACAAAAACATTAGATTGTGAATCTAATAATAGA 11613
Cat                  GGCCCCATTTACTGTAAATATAGTTTAATAAAAACATTAGATTGTGAATCTAATAATGGA 11617
                     ** ** ***** ************ *** * ********* ***** **** * *** **

tRNA-Ser
Snow_Leopard1        AGTGCAAATCTTCCTATTTAC-CGAAAAAGTATGCAAGAACTGCTAATTCATGCCCCCAC 11681
Snow_Leopard2        AGTGCAAATCTTCCTATTTAC-CGAAAAAGTATGCAAGAACTGCTAATTCATGCCCCCAC 11681
Leopard1             AGTGCAAATCTTCTTATTTAC-CGAAAAAGTATGCAAGAACTGCTAATTCATGCCTCCGC 11676
Tiger1               AGTGCAAATCTTCCTATTTAAACGAAAAAGTATGCAAGAGCTGCTAACTCATGCCCCCAC 11679
Tiger2               AGTGCAAATCTTCCTATTTAAACGAAAAAGTATGCAAGAGCTGCTAACTCATGCCCCCAC 11679
Clouded_leopard      AGTGCAAACCTTCTTATCTAC-CGAAAAAGTATGCAAGAACTGCTAATTCATGCCTCCAC 11672
cheetah              AGTGTAAACCTTTTTATTTAC-CGAAAAAGTATGCAAGAACTGCTAATTCATGCCTCCAC 11672
Cat                  AGTGCAAGTCTTCTTATTTAC-CGAAAAAGTATGCAAGAACTGCTAATTCATGCCTCCAC 11676
                     **** **  ***  *** **  ***************** ******* ******* ** *

tRNA-Leu
Snow_Leopard1        GTATGAAAGCGTGGCTTTTTCAACTTTTATAGGATAGAAGTAATCCATTGGTCTTAGGAG 11741
Snow_Leopard2        GTATGAAAGCGTGGCTTTTTCAACTTTTATAGGATAGAAGTAATCCATTGGTCTTAGGAG 11741
Leopard1             GTATAAAAACGTGGCTTTTTCAACTTTTATAGGATAGAAGTAATCCATTGGTCTTAGGAA 11736
Tiger1               GTATAAAAACGTGGCTTTTTCAACTTTTATAGGATAGAAGTAATCCATTGGTCTTAGGAG 11739
Tiger2               GTATAAAAACGTGGCTTTTTCAACTTTTATAGGATAGAAGTAATCCATTGGTCTTAGGAG 11739
Clouded_leopard      GTATAAAAACGTGGCTTTTTCAACTTTTATAGGATAGAAGTAACACATTGGTCTTAGGAG 11732
cheetah              GTATAAAAACGTGGCTTTTTCAACTTTTATAGGATAGAAGTGATCCATTGGCCTTAGGAA 11732
Cat                  GTATAAAAACGTGGCTTTTTCAACTTTTATAGGATAGAAGTAATCCATTGGTCTTAGGAA 11736
                     **** *** ********************************* *  ****** *******

ND5
Snow_Leopard1        CCAAAAAATTGGTGCAACTCCAAATAAAAGTAATAAACCTATTTACCTTCTCTATACTCA 11801
15F
Snow_Leopard2        CCAAAAAATTGGTGCAACTCCAAATAAAAGTAATAAACCTATTTACCTTCTCTATACTCA 11801
Leopard1             CCAAAAAATTGGTGCAACTCCAAGTAAAAGTAATAAACCTATTTATCTTCTTTATACTCA 11796
Tiger1               CCAAAAAATTGGTGCAACTCCAAATAAAAGTAATAAACCTACTTACCTCCTCTATACTCA 11799
Tiger2               CCAAAAAATTGGTGCAACTCCAAATAAAAGTAATAAACCTACTTACCTCCTCTATACTCA 11799
Clouded_leopard      CCAAAAAATTGGTGCAACTCCAAATAAAAGTAATAAACCTATTTACCTCTCTCACACTCA 11792
cheetah              CCAAAAAATTGGTGCAACTCCAAATAAAAGTAATAAACTTATCTACCTCATTTACACTAA 11792
Cat                  CCAAAAAATTGGTGCAACTCCAAATAAAAGTAATAAACCTATTTACCCCACTCATACTAA 11796
                     ********************** ************** **  ** *      * *** *

Snow_Leopard1        CCACAGTATCCATTCTATTCCTGCCCATCATCATATCCAATACTCAACTATACAAAAATA 11861
Snow_Leopard2        CCACAGTATCCATTCTATTCCTGCCCATCATCATATCCAATACTCAACTATACAAAAATA 11861
Leopard1             CTGCAATATTTATTCTACTCCTACCTATCATTATATCCAACACTCAACTATACAAAAATA 11856
Tiger1               CTGCGATATTTATCCTACTCCTACCTATCATTACATCCAACACTCAATTATATAAAAGTA 11859
Tiger2               CTGCGATATTTATCCTACTCCTACCTATCATTACATCCAACACTCAATTATATAAAAGTA 11859
Clouded_leopard      CCGCAATGTTTATTCTACTCTTACCTATTATTATATCTAACACTCAATTATATAAAAACA 11852
cheetah              CTGCAATATTTATCCTACTATTACCCATCATCATATCTAACACCCGATTATATAAAGGCA 11852
Cat                  CTGCAATATTTATTCTACTCCTGCCCATCATTATATCTAACACCCAACTGTATAAAAACA 11856
                     *  *  * *  ** *** *  * ** ** ** * *** ** ** * * * ** ***   *

Snow_Leopard1        ACCTATACCCCCATTATGTAAAAACCACAATCTCTTATGCCTTCACCATCAGCACAATTC 11921
14R
Snow_Leopard2        ACCTATACCCCCATTATGTAAAAACCACAATCTCTTATGCCTTCACCATCAGCACAATTC 11921
Leopard1             ACCTATACCCCCACTATGTAAAAACCACAATCTCTTACGCCTTCACCATCAGCATAATCC 11916
Tiger1               ACCTATACCCTCACTATGTAAAAACCACAATCTCTTACGCCTTTACCATTAGTATAATCC 11919
Tiger2               ACCTATACCCTCACTATGTAAAAACCACAATCTCTTACGCCTTTACCATTAGTATAATCC 11919
Clouded_leopard      GTCTATATCCCCACTATGTAAAAACTACAATCTCATATGCCTTTACCATCAGTATAGTTC 11912
cheetah              ACTTATACCCCCACTATGTAAAAACCACAATCTCATACGCCTTCACTATCAGCATAATCC 11912
Cat                  GCCTATATCCCCACTATGTAAAAACCACAATCTCTTACGCCTTCATCATCAGCATAATCC 11916
                        **** ** ** *********** ******** ** ***** *  ** ** * * * *

Snow_Leopard1        CGGCTATAATATTTATTTCCTCCGGACAAGAAACAATTGTCTCAAACTGACACTGACTAT 11981
Snow_Leopard2        CGGCTATAATATTTATTTCCTCCGGACAAGAAACAATTGTCTCAAACTGACACTGACTAT 11981
Leopard1             CGGCTATAATATTCGTTTCCTCCGGACAAGAAACAATTGTCTCAAACTGACATTGACTAT 11976
Tiger1               CAGCCATAATATTCATTTCCTCCGGACAAGAGATAACCATCTCAAACTGATGTTGACTAT 11979
Tiger2               CAGCCATAATATTCATTTCCTCCGGACAAGAGATAACCATCTCAAACTGATGTTGACTAT 11979
Clouded_leopard      CAACTATAATATTTATTTCCTCTGGACAAGAAACAATTATCTCAAACTGACACTGACTAT 11972
cheetah              CAACCATAATATTTATCTCTTCTGGACAGGAAACAGTCATCTCAAACTGACACTGATTAT 11972
Cat                  CAACTATAATATTTATCTCCTCAGGACAAGAAGCAATTATCTCAAACTGACACTGACTAT 11976
                     *  * ********  * ** ** ***** **   *    ***********   *** ***

Snow_Leopard1        CAGTCCAAACCCTCAAATTGTCACTAAGCTTTAAACTAGATTATTTCTCGATCATCTTCA 12041
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Snow_Leopard2        CAGTCCAAACCCTCAAATTGTCACTAAGCTTTAAACTAGATTATTTCTCGATCATCTTCA 12041
Leopard1             CAATTCAAACCCTCAAATTGTCACTAAGCTTTAAACTAGATTACTTCTCGATCATCTTCA 12036
Tiger1               CAATTCAAACCCTTAAATTATCACTAAGCTTCAAACTAGATTATTTCTCGATCATCTTCA 12039
Tiger2               CAATTCAAACCCTTAAATTATCACTAAGCTTCAAACTAGATTATTTCTCGATCATCTTCA 12039
Clouded_leopard      CAATCCAAACCCTCAAGTTGTCACTAAGCTTTAAACTAGATTATTTCTCAATCATCTTTA 12032
cheetah              CAATCCAAACCCTTAATCTATCACTAAGCTTTAAAATAGACTACTTTTCAATCATCTTCA 12032
Cat                  CAATCCAAACTCTCAAGCTATCACTAAGCTTTAAAATAGATTATTTCTCAACCATCTTTA 12036
                     ** * ***** ** **  * *********** *** **** ** ** ** * ****** *

Snow_Leopard1        TCCCTGTGGCACTTTTCGTTACATGATCAATCATAGAATTCTCAATATGATATATACACA 12101
Snow_Leopard2        TCCCTGTGGCACTTTTCGTTACATGATCAATCATAGAATTCTCAATATGATATATACACA 12101
Leopard1             TCCCTGTAGCGCTTTTCGTTACATGATCGATCATAGAATTCTCAATATGATACATACACA 12096
Tiger1               TCCCAGTAGCACTTTTCGTTACATGGTCGATCATAGAATTCTCAATGTGATACATACACA 12099
Tiger2               TCCCAGTAGCACTTTTCGTTACATGGTCGATCATAGAATTCTCAATGTGATACATACACA 12099
Clouded_leopard      TCCCTGTGGCGCTTTTTGTCACATGATCTATCATGGAGTTCTCAATATGATACATGCACA 12092
cheetah              CCCCCGTAGCACTATTTGTTACATGATCAATCATAGAATTCTCAATATGATATATACACT 12092
Cat                  TCCCTGTAGCGCTTTTCGTCACATGGTCCATCATAGAATTCTCAATGTGGTACATGCACT 12096
                      *** ** ** ** ** ** ***** ** ***** ** ******** ** ** ** ***

Snow_Leopard1        CAGATCCTCATATCAATCGATTCTTCAAATATCTCCTCATATTTCTAATCACTATAATAA 12161
Snow_Leopard2        CAGATCCTCATATCAATCGATTCTTCAAATATCTCCTCATATTTCTAATCACTATAATAA 12161
Leopard1             CAGACCCTTATATCAACCGATTTTTCAAGTATCTCCTCATATTTCTAATCACTATAATAA 12156
Tiger1               CAGATCCCTATATTAACCAGTTCTTTAAGTACCTCCTTATATTCCTAATCACTATAATGA 12159
Tiger2               CAGATCCCTATATTAACCAGTTCTTTAAGTACCTCCTTATATTCCTAATCACTATAATGA 12159
Clouded_leopard      TAGACCCCTATATCAATCGATTCTTTAAATATCTCCTCATATTTCTAATCACCATGATAA 12152
cheetah              CAGATCCATACATTAACCGATTCTTCAAATATCTCCTCATATTTCTAATTACCATAATAA 12152
Cat                  CAGACCCATACATCAACCGATTCTTTAAATATCTCCTCATATTCCTAATCACTATGATAA 12156
                      *** **  * ** ** * ** ** ** ** ***** ***** ***** ** ** ** *

Snow_Leopard1        TCCTAGTGACCGCCAATAACCTGTTCCAACTATTTATCGGTTGAGAGGGAGTAGGAATTA 12221
Snow_Leopard2        TCCTAGTGACCGCCAATAACCTGTTCCAACTATTTATCGGTTGAGAGGGAGTAGGAATTA 12221
Leopard1             TCCTAGTAACCGCCAACAACCTGTTCCAACTGTTTATTGGTTGAGAAGGAGTAGGAATCA 12216
Tiger1               TCTTAGTGACCGCCAATAATCTATTTCAGCTGTTTATTGGATGGGAGGGAGTAGGAATTA 12219
Tiger2               TCTTAGTGACCGCCAATAATCTATTTCAGCTGTTTATTGGATGGGAGGGAGTAGGAATTA 12219
Clouded_leopard      TTCTAGTAACAGCCAACAACCTATTTCAACTGTTCATTGGTTGAGAGGGAGTCGGGATCA 12212
cheetah              TCCTAGTAACCGCCAACAACCTATTCCAACTATTTATTGGCTGAGAAGGAGTAGGCATTA 12212
Cat                  TTCTAGTTACCGCTAACAATCTATTTCAACTATTCATCGGCTGAGAGGGAGTAGGAATCA 12216
                     *  **** ** ** ** ** ** ** ** ** ** ** ** ** ***** ** ** *

Snow_Leopard1        TATCCTTCCTGCTCATCGGATGATGATATGGTCGAGCAGACGCAAACACTGCCGCCCTAC 12281
Snow_Leopard2        TATCCTTCCTGCTCATCGGATGATGATATGGTCGAGCAGACGCAAACACTGCCGCCCTAC 12281
Leopard1             TATCCTTCCTGCTCATCGGATGATGATATGGTCGAGCAGACGCAAACACCGCCGCCCTAC 12276
Tiger1               TATCTTTCCTACTTATCGGATGATGATATGGTCGAGCAGACGCAAACACTGCCGCCCTGC 12279
Tiger2               TATCTTTCCTACTTATCGGATGATGATATGGTCGAGCAGACGCAAACACTGCCGCCCTGC 12279
Clouded_leopard      TATCCTTCCTACTTATCGGGTGGTGATATGGCCGAGCAGACGCAAATACTGCCGCCCTAC 12272
cheetah              TATCCTTCTTACTTATTGGGTGATGATATGGCCGAACAGACGCAAATACTGCCGCCCTAC 12272
Cat                  TATCTTTTCTACTTATCGGATGATGATATGGCCGAGCAGATGCAAACACTGCCGCCCTAC 12276
                     **** **  * ** ** ** ** ******** *** **** ***** ** ******** *

Snow_Leopard1        AAGCGATTCTCTACAACCGCATCGGAGACGTAGGATTTATCACGGCCATAGCATGATTCC 12341
Snow_Leopard2        AAGCGATTCTCTACAACCGCATCGGAGACGTAGGATTTATCACGGCCATAGCATGATTCC 12341
Leopard1             AGGCAATTCTCTACAACCGCATCGGAGATGTAGGATTTATCACAGCCATAGCATGATTCC 12336
Tiger1               AAGCAATTCTCTACAACCGTATTGGTGATGTAGGATTTATCATGGCCATAGCATGATTCC 12339
Tiger2               AAGCAATTCTCTACAACCGTATTGGTGATGTAGGATTTATCATGGCCATAGCATGATTCC 12339
Clouded_leopard      AAGCGATTCTCTATAACCGCATTGGAGACGTAGGTTTTATTACGGCCATAGCATGATTTC 12332
cheetah              AAGCAATCCTCTATAATCGCATTGGAGACGTAGGCTTTATTATAGCTATAGCATGGTTCC 12332
Cat                  AAGCAATCCTCTACAACCGCATTGGAGACGTAGGCTTCATCATAGCCATAGCATGATTTC 12336
                     * ** ** ***** ** ** ** ** ** ***** ** ** *  ** ******** ** *

Snow_Leopard1        TTGCCAACATAAATGCATGAGACTTTCAACAGATCTTTATTACCCAGCATGAAAACCTAA 12401
Snow_Leopard2        TTGCCAACATAAATGCATGAGACTTTCAACAGATCTTTATTACCCAGCATGAAAACCTAA 12401
Leopard1             TCGCCAATATAAATGCATGAGACTTCCAACAAATCTTTATTACCCAACACGAAAACCTAA 12396
Tiger1               TTACCAACCTAAATGCATGAAACCTCCAACAAATCTTTATCACTCAACATGAAAGCCTGA 12399
Tiger2               TTACCAACCTAAATGCATGAAACCTCCAACAAATCTTTATCACTCAACATGAAAGCCTGA 12399
Clouded_leopard      TCGCCAACCTAAATGCATGAGATTTCCAACAAATCTTTATCGTCCAACATGAAAACCTAA 12392
cheetah              TTACCAATTTAAACGCATGAAACCTACAACAAATTTTTATCACCCAACATGACAACCTAA 12392
Cat                  TCACCAACTCAAACGCATGGGACTTCCAACAAATCTTTATCACCCAACACGAGAACCTAA 12396
                     *  ****   *** *****  *  * ***** ** *****    ** ** ** * *** *
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Snow_Leopard1       ATGTCCCATTGCTAAGTCTTCTCCTAGCAGCGACAGGCAAGTCTGCTCAATTTGGCCTAC 12461
16F
Snow_Leopard2       ATGTCCCATTGCTAAGTCTTCTCCTAGCAGCGACAGGCAAGTCTGCTCAATTTGGCCTAC 12461
Leopard1            ATATTCCATTACTAGGGCTTCTTCTAGCAGCCACAGGCAAGTCTGCCCAATTTGGTCTAC 12456
Tiger1              ATATGCCATTACTAGGACTCCTCCTAGCCGCCACAGGCAAGTCCGCCCAATTTGGCCTAC 12459
Tiger2              ATATGCCATTACTAGGACTCCTCCTAGCCGCCACAGGCAAGTCCGCCCAATTTGGCCTAC 12459
Clouded_leopard     ACATCCCACTGCTAGGACTTCTCCTTGCAGCCACAGGCAAATCCGCCCAATTTGGCCTAC 12452
cheetah             ACATTCCCCTACTAGGCCTCCTCCTAGCAGCCACAGGCAAATCTGCCCAATTTGGCCTAC 12452
Cat                 ATATTCCATTACTAGGGCTTCTATTAGCAGCCACAGGTAAATCCGCCCAATTCGGCCTAC 12456
                    *  * **  * *** * ** **  * ** ** ***** ** ** ** ***** ** ****

Snow_Leopard1       ACCCATGACTACCATCAGCCATAGAGGGTCCAACCCCCGTTTCCGCCCTACTCCACTCAA 12521
Snow_Leopard2       ACCCATGACTACCATCAGCCATAGAGGGTCCAACCCCCGTTTCCGCCCTACTCCACTCAA 12521
Leopard1            ACCCATGACTACCGTCAGCCATAGAGGGTCCAACCCCTGTCTCTGCTCTACTTCACTCAA 12516
Tiger1              ACCCATGATTGCCATCAGCCATAGAAGGTCCAACTCCCGTCTCCGCCCTACTCCACTCAA 12519
Tiger2              ACCCATGATTGCCATCAGCCATAGAAGGTCCAACTCCCGTCTCCGCCCTACTCCACTCAA 12519
Clouded_leopard     ACCCATGACTACCATCAGCCATAGAAGGTCCGACCCCTGTCTCCGCCCTACTCCACTCAA 12512
cheetah             ATCCATGACTACCATCAGCCATAGAAGGCCCAACCCCCGTCTCCGCCCTACTCCACTCAA 12512
Cat                 ATCCGTGACTGCCATCAGCCATAGAAGGCCCAACTCCTGTCTCCGCCCTACTCCACTCAA 12516
                    * ** *** * ** *********** ** ** ** ** ** ** ** ***** *******

Snow_Leopard1       GTACAATGGTTGTAGCCGGAGTCTTTTTACTAATCCGCTTCCACCCACTCATAGAACAAA 12581
Snow_Leopard2       GTACAATGGTTGTAGCCGGAGTCTTTTTACTAATCCGCTTCCACCCACTCATAGAACAAA 12581
Leopard1            GTACAATAGTTGTAGCCGGAGTCTTTTTATTAATCCGCTTCTACCCACTCATAGAACATA 12576
Tiger1              GCACAATAGTTGTAGCCGGAGTCTTCTTATTAATCCGCTTCCACCCACTCATAGAACAAA 12579
Tiger2              GCACAATAGTTGTAGCCGGAGTCTTCTTATTAATCCGCTTCCACCCACTCATAGAACAAA 12579
Clouded_leopard     GCACAATAGTTGTAGCTGGAGTTTTCTTATTAATCCGCTTTCACCCACTCACAGAACAAA 12572
cheetah             GTACAATAGTCGTAGCCGGGGTCTTCCTACTAATTCGCTTCCACCCGCTTATAGAACAAA 12572
Cat                 GTACAATAGTCGTAGCAGGGGTCTTCTTACTTATCCGGTTTTACCCGCTCATAGAACAAA 12576
                    * ***** ** ***** ** ** **  ** * ** ** **  **** ** * ****** *

Snow_Leopard1       ATAAAACCATACAAACTCTCACCCTATGCCTAGGGGCCATCACAACCTTATTCACAGCTA 12641
Snow_Leopard2       ATAAAACCATACAAACTCTCACCCTATGCCTAGGGGCCATCACAACCTTATTCACAGCTA 12641
Leopard1            ACAAAACCATACAAACCCTCACTCTATGCCTAGGGGCCATCACAACCCTATTTACAGCCA 12636
Tiger1              ATAAAGCCATACAAACCCTCACTCTATGCCTGGGGGCCATCACAACCCTATTCACAGCCA 12639
15R
Tiger2              ATAAAGCCATACAAACCCTCACTCTATGCCTGGGGGCCATCACAACCCTATTCACAGCCA 12639
Clouded_leopard     ATAAGACCATACAAACCCTCACTCTATGCCTGGGAGCTATCACAACCCTATTCACAGCCA 12632
cheetah             ACAAAACTATACAAACCCTCACCCTATGCCTAGGAGCTATCACAACCCTATTTACAGCTA 12632
Cat                 ACAAAACTATACAAACTCTCACCCTATGTTTAGGAGCTATTACAACCTTGTTCACAGCTA 12636
                    * **  * ******** ***** *****  * ** ** ** ****** * ** ***** *

Snow_Leopard1       TCTGCGCCCTCACACAAAATGACATCAAAAAAATCGTTGCCTTCTCAACTTCAAGCCAAT 12701
Snow_Leopard2       TCTGCGCCCTCACACAAAATGACATCAAAAAAATCGTTGCCTTCTCAACTTCAAGCCAAT 12701
Leopard1            TCTGTGCCCTCACACAAAATGACATCAAAAAAATCGTCGCCTTCTCAACCTCGAGCCAAT 12696
Tiger1              TCTGTGCCCTCACACAAAATGATATTAAAAAAATTGTTGCTTTCTCAACTTCAAGCCAAT 12699
Tiger2              TCTGTGCCCTCACACAAAATGATATTAAAAAAATTGTTGCTTTCTCAACTTCAAGCCAAT 12699
Clouded_leopard     TCTGTGCCCTCACACAAAATGATATCAAAAAAATCGTTGCCTTCTCAACCTCAAGTCAAC 12692
cheetah             TCTGTGCTCTCACACAAAACGACATTAAAAAAATCGTTGCCTTCTCAACCTCAAGCCAAC 12692
Cat                 TTTGTGCTCTCACACAAAATGATATCAAAAAAGTTGTTGCCTTTTCAACCTCAAGCCAAC 12696
                    * ** ** *********** ** ** ****** * ** ** ** ***** ** ** ***

Snow_Leopard1       TAGGTCTAATAATCGTTACTATCGGAATCAACCAACCCTACCTTGCATTCCTTCACATCT 12761
Snow_Leopard2       TAGGTCTAATAATCGTTACTATCGGAATCAACCAACCCTACCTTGCATTCCTTCACATCT 12761
Leopard1            TGGGCCTAATAATCGTCACTATCGGAGTCAACCAACCCCACCTTGCATTCCTTCATATCT 12756
Tiger1              TAGGCCTGATAATCGTTACTATCGGAATTAACCAACCCTACCTTGCATTCCTGCATATCT 12759
Tiger2              TAGGCCTGATAATCGTTACTATCGGAATTAACCAACCCTACCTTGCATTCCTGCATATCT 12759
Clouded_leopard     TGGGCCTAATAATCGTTACTATCGGAATCAATCAACCTTACCTTGCGTTTCTACATATCT 12752
cheetah             TGGGCCTAATAATCGTAACCATCGGAATTAACCAACCCTACCTCGCATTCCTACACATCT 12752
Cat                 TGGGCCTAATAATTGTAACCATTGGGATTAACCAACCTTACCTCGCATTTCTACACATTT 12756
                    * ** ** ***** ** ** ** **  * ** *****  **** ** ** ** ** ** *

Snow_Leopard1       GTACGCACGCATTTTTCAAAGCTATATTATTTATGTGCTCTGGATCAATTATTCACAGCC 12821
Snow_Leopard2       GTACGCACGCATTTTTCAAAGCTATATTATTTATGTGCTCTGGATCAATTATTCACAGCC 12821
Leopard1            GTACGCACGCATTTTTCAAAGCTATATTATTCATGTGCTCTGGGTCAATTATTCATAGTC 12816
Tiger1              GCACACACGCATTTTTTAAAGCCATATTATTCATGTGCTCCGGATCAATTATCCACAGTC 12819
Tiger2              GCACACACGCATTTTTTAAAGCCATATTATTCATGTGCTCCGGATCAATTATCCACAGTC 12819
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Clouded_leopard      GTACCCACGCATTCTTCAAAGCCATACTATTTATATGCTCGGGATCAATCATCCATAGTT 12812
cheetah              GCACCCACGCATTCTTTAAAGCCATATTATTTATATGCTCAGGATCAATCATTCACAGCC 12812
Cat                  GCACACACGCATTCTTCAAAGCCATGCTATTCATATGTTCAGGATCAATTATCCACAGTC 12816
                     * ** ******** ** ***** **  **** ** ** ** ** ***** ** ** **

Snow_Leopard1        TAAATGATGAACAAGACATTCGAAAGATAGGCGGATTATATAAACCCATACCTTTCACCA 12881
Snow_Leopard2        TAAATGATGAACAAGACATTCGAAAGATAGGCGGATTATATAAACCCATACCTTTCACCA 12881
Leopard1             TGAACGATGAACAAGACATTCGAAAAATAGGCGGACTATACAAACCAATACCTTTCACCA 12876
Tiger1               TAAACGACGAGCAAGATATTCGAAAAATAGGCGGACTATATAAACCAATACCCTTTACTA 12879
Tiger2               TAAACGACGAGCAAGATATTCGAAAAATAGGCGGACTATATAAACCAATACCCTTTACTA 12879
Clouded_leopard      TAAATGACGAACAAGACATTCGAAAAATAGGCGGACTGTACAAACCGATACCCTTCACCA 12872
cheetah              TAAATGACGAGCAGGATATCCGAAAAATAGGCGGATTATATAAACCAATACCCTTTACCA 12872
Cat                  TGAACGACGAACAAGACATTCGAAAAATAGGCGGATTATACAAACCAATGCCCTTCACCA 12876
                     * ** ** ** ** ** ** ** ***** ********* * ** ***** ** ** ** ** *

Snow_Leopard1        CCTCCTCCCTCATCATCGGAAGTCTCGCATTAACAGGAATACCTTTCCTAACAGGCTTTT 12941
Snow_Leopard2        CCTCCTCCCTCATCATCGGAAGTCTCGCATTAACAGGAATACCTTTCCTAACAGGCTTTT 12941
Leopard1             CCTCCTCCCTCATCATTGGAAGTCTCGCATTAACAGGTATACCTTTCCTAACAGGCTTTT 12936
Tiger1               CCACCTCCCTTATTATCGGAAGCCTCGCATTAACAGGCATGCCATTCCTAACAGGCTTTT 12939
Tiger2               CCACCTCCCTTATTATCGGAAGCCTCGCATTAACAGGCATGCCATTCCTAACAGGCTTTT 12939
Clouded_leopard      CCACCTCCCTCATTATTGGAAGCCTCGCACTAACAGGTATACCCTTCCTAACAGGCTTTT 12932
cheetah              CTACCTCCCTCATTATCGGAAGCCTCGCATTAACAGGTATACCATTCCTAACAGGCTTTT 12932
Cat                  CTACCTCCCTAATCATTGGAAGCCTCGCACTCACAGGTATACCTTTCCTAACAGGTTTTT 12936
                     *  ******* ** ** ***** ****** * ***** ** ** ********** ****

Snow_Leopard1        ACTCTAAAGACCTGATTATCGAGACAGCCAATACGTCGTATACCAACGCCTGAGCCCTAT 13001
Snow_Leopard2        ACTCTAAAGACCTGATTATCGAGACAGCCAATACGTCGTATACCAACGCCTGAGCCCTAT 13001
Leopard1             ACTCCAAAGACCTAATCATCGAGACAGCCAACACGTCGTATACCAACGCCTGAGCCCTAT 12996
Tiger1               ACTCCAAAGACCTAATCATCGAGACAGCCAATACGTCGTATACCAACGCCTGAGCCCTAT 12999
Tiger2               ACTCCAAAGACCTAATCATCGAGACAGCCAATACGTCGTATACCAACGCCTGAGCCCTAT 12999
Clouded_leopard      ACTCCAAAGACCTAATCATCGAGACAGCCAACACGTCGTATACCAACGCCTGAGCCCTAT 12992
cheetah              ATTCCAAAGACCTAATCATCGAGACAGCCAACACGTCGTATACCAACGCCTGAGCCCTAT 12992
Cat                  ATTCCAAAGACCTAATCATCGAGACAGCCAACACGTCGTATACCAACGCCTGAGCCCTAC 12996
                     * ** ******** ** ************** **************************

Snow_Leopard1        CGGTCACTCTCATCGCTACATCTCTCACGGCTGCCTATAGTACTCGAATCATATTCTTTG 13061
Snow_Leopard2        CGGTCACTCTCATCGCTACATCTCTCACGGCTGCCTATAGTACTCGAATCATATTCTTTG 13061
Leopard1             TGGTCACTCTCATTGCTACATCCCTCACGGCCGCCTATAGTACTCGAATCATATTCTTTG 13056
Tiger1               TGGTCACTCTCATTGCTACATCCCTCACAGCCGCCTATAGTACTCGAATCATATTCTTTG 13059
Tiger2               TGGTCACTCTCATTGCTACATCCCTCACAGCCGCCTATAGTACTCGAATCATATTCTTTG 13059
Clouded_leopard      TAATTACTCTCATTGCCACATCCCTTACAGCCGCCTACAGCACCCGAATTATGTTCTTCA 13052
cheetah              TAATTACTCTCATTGCCACATCCCTCACAGCTGCCTACAGTACTCGAATTATATTCTTTG 13052
Cat                  TAATTACTCTCATTGCCACATCCCTTACAGCTGCCTACAGTACTCGAATTATATTCTTTG 13056
                        * ******** ** ***** ** ** ** ***** ** ** ***** ** *****

Snow_Leopard1        CACTCCTAGGACAGCCCCGATTTAACTCCCTAAGTCCAATCAATGAAAATAACCCCCACC 13121
Snow_Leopard2        CACTCCTAGGACAGCCCCGATTTAACTCCCTAAGTCCAATCAATGAAAATAACCCCCACC 13121
Leopard1             CACTCCTAGGGCAACCTCGGTTTAACTCCCTAAGTCCAATCAATGAAAACAACCCCCACC 13116
Tiger1               CACTCCTGGGGCAACCCCGATTCAACTCCCTAAGCCCAATCAATGAAAACAACCCCCACC 13119
Tiger2               CACTCCTGGGGCAACCCCGATTCAACTCCCTAAGCCCAATCAATGAAAACAACCCCCACC 13119
Clouded_leopard      CACTCCTAGGACAGCCCCGATTCAACCCCTTGAGCCCAATCAATGAGAATAACCCCTACC 13112
cheetah              TACTTCTAGGACAACCACGATTCAACGCCTTGAATCCAATCAATGAAAATAATACCTACC 13112
Cat                  TGCTACTAGGACAACCACGATTCAATACCTTGAATCTAATCAATGAAAATAATACCCACC 13116
                       ** ** ** ** ** ** ** **  ** * *  * ********* ** **  ** ***

Snow_Leopard1        TAATCAACTCCATTAAACGTCTCTTAATTGGAAGCATTTTTGCAGGGTACTTGATTTCCC 13181
17F
Snow_Leopard2        TAATCAACTCCATTAAACGTCTCTTAATTGGAAGCATTTTTGCAGGGTACTTGATTTCCC 13181
Leopard1             TCATTAACTCCATTAAACGTCTCTTAATTGGAAGTATTTTTGCAGGATACTTGATTTCCC 13176
Tiger1               TCATCAACTCCATTAAACGTCTCTTAATTGGAAGCATTTTTGCAGGATACTTGATCTCCC 13179
Tiger2               TCATCAACTCCATTAAACGTCTCTTAATTGGAAGCATTTTTGCAGGATACTTGATCTCCC 13179
Clouded_leopard      TTATCAACTCCATTAAACGTCTCTTGATTGGAAGCATCTTTGCAGGATACCTGATTTCCT 13172
cheetah              TTATCAATTCCATTAAACGTCTCTTAATTGGAAGTATCTTTGCAGGATATTTAATTTCTT 13172
Cat                  TCATCAACTCCATTAAACGTCTCTTAATCGGAAGTATCTTTGCAGGATATCTAATTTCTT 13176
                     * ** ** ***************** ** ***** ** ******** **  * ** **

Snow_Leopard1        ACAACATTCCCCCAATAACCACCCCACAAATAACCATACCCCACTATCTAAAACTAACTG 13241
Snow_Leopard2        ACAACATTCCCCCAATAACCACCCCACAAATAACCATACCCCACTATCTAAAACTAACTG 13241
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Leopard1            ATAATATCCCCCCAACAACCATCCCACAAATAACTATGCCCCACTATCTAAAACTAACTG 13236
Tiger1              ATAACATCCCCCCAACGACCATCCCACAAATGACCATACCCTGCCACCTAAAACTAACTG 13239
Tiger2              ATAACATCCCCCCAACGACCATCCCACAAATGACCATACCCTGCCACCTAAAACTAACTG 13239
Clouded_leopard     ATAATATTCCCCCAACAACCATCCCGCAAATAACTATACCCTACTACCTAAAACTAACGG 13232
cheetah             ATAACATCCCTCCAATAACCATCCCACAAATAACTATACCCCATCACCTGAAACTAACTG 13232
Cat                 ACAACATCCCCCCAACAACTATCCCACAAATAACTATACCCTACTATCTAAAACTAACTG 13236
                    * ** ** ** ****  ** * *** ***** ** ** ***    * ** ******** *

Snow_Leopard1       CTCTCGCCGTAACCATCACAGGCTTCATCTTAGCATTAGAACTTAACCTTGCAACTAAAA 13301
Snow_Leopard2       CTCTCGCCGTAACCATCACAGGCTTCATCTTAGCATTAGAACTTAACCTTGCAACTAAAA 13301
Leopard1            CTCTCGCTGTAACTATCACAGGCTTTATCTTAGCATTAGAACTCAACCTCGCAGCCAAAA 13296
Tiger1              CTCTCGCCATGACCATCATAGGCTTTATCCTGGCATTAGAGCTTAACCTCGTGGCTAAAA 13299
16R
Tiger2              CTCTCGCCATGACCATCATAGGCTTTATCCTGGCATTAGAGCTTAACCTCGTGGCTAAAA 13299
Clouded_leopard     CCCTCGCCGTAACCATTACAGGCTTCATCCTAGCATTAGAACTCAACCTCGCGACTAAAA 13292
cheetah             CCCTTGCCGTGACTATCACAGGCTTTATCCTGGCATTAGAACTCAACCTTGTGGCCAAAA 13292
Cat                 CTCTTGCCGTGACTATCGCAGGCTTCATCCTAGCATTAGAACTTAATCTCGCGGCTAAAA 13296
                    * ** **  * ** **   ****** *** * ******** ** ** ** *   * ****

Snow_Leopard1       ACTTAAAATTCAAATACCCCTCGAACCTCTTTAAGTTTTCTAGCTTCCTAGGGTACTTTC 13361
Snow_Leopard2       ACTTAAAATTCAAATACCCCTCGAACCTCTTTAAGTTTTCTAGCTTCCTAGGGTACTTTC 13361
Leopard1            ACTTAAAATTTAAATACCCCTCGAATCTCTTTAAGTTTTCTAACCTCCTAGGGTACTTTC 13356
Tiger1              ACTTAAAATTTAAATACCCCTCAAATCTTTTTAAGTTTTCTAACCTCCTCGGGTACTTTC 13359
Tiger2              ACTTAAAATTTAAATACCCCTCAAATCTTTTTAAGTTTTCTAACCTCCTCGGGTACTTTC 13359
Clouded_leopard     ACTTAAAATTTAAATACCCCTCAAACCTCTTTAAGTTTTCTAGCCTCCTGGGGTACTTTC 13352
cheetah             ACTTAAAACTCAAATACCCCTCAAACCTTTTTAAGTTCTCTAACCTCCTAGGGTATTTTC 13352
Cat                 ACTTAAAATTTATATACCCTTCAAACCTCTTTAAGTTTTCCAACCTCTTAGGGTACTTTC 13356
                    ******** * * ****** ** ** ** ******** ** * * ** * ***** ****

Snow_Leopard1       CAATTGTAATACACCGCCTCCCATCAACAATAGGCCTAACTATAAGCCAAAAGTCCGCAT 13421
Snow_Leopard2       CAATTGTAATACACCGCCTCCCATCAACAATAGGCCTAACTATAAGCCAAAAGTCCGCAT 13421
Leopard1            CAATTGTAATACACCGCCTCCCATCAACAATAAGCTTAACTATAAGCCAAAAATCTGCAT 13416
Tiger1              CAATCGTAATTCACCGCCTCCCATCGATAATAAGCCTAACCATAAGCCAAAAATCCGCAT 13419
Tiger2              CAATCGTAATTCACCGCCTCCCATCGATAATAAGCCTAACCATAAGCCAAAAATCCGCAT 13419
Clouded_leopard     CAATCGTAATGCACCGGCTCCCATCAACAATAAGCTTAACTATAAGCCAAAAATCCGCAT 13412
cheetah             CAACCGTAATACACCGCCTCCCACCAAAAATAAGCCTAACTATGAGCCAAAAATCCGCAT 13412
Cat                 CAATTGTAATACACCGCCTCCCATCAAAAATGAGCCTAACTATGAGCCAAAAGTCCGCAT 13416
                    ***  ***** ***** ****** * * ***  ** **** ** ******** ** ****

Snow_Leopard1       CGATACTATTAGATATAATCTGACTAGAAAATGTATTACCAAAATCCATCTCCCACTTCC 13481
Snow_Leopard2       CGATACTATTAGATATAATCTGACTAGAAAATGTATTACCAAAATCCATCTCCCACTTCC 13481
Leopard1            CGATACTATTAGATATAATCTGGCTAGAAAATGTATTGCCAAAATCCATCTCTCACTTCC 13476
Tiger1              CGATACTATTAGATATAATCTGGCTAGAAAATGTAATACCAAAATCCATCTCCCACTTCC 13479
Tiger2              CGATACTATTAGATATAATCTGGCTAGAAAATGTAATACCAAAATCCATCTCCCACTTCC 13479
Clouded_leopard     CGATACTACTAGATATAATCTGACTAGAAAATGTATTACCAAAATCCATCTCCTACTTCC 13472
cheetah             CGATACTACTAGACATAATTTGACTAGAAAATGTATTACCAAAATCCATCTCCTACTTCC 13472
Cat                 CGATACTATTAGACATAATTTGACTAGAAAATGTATTACCCAAATCCATCTCCTTATTCC 13476
                    ******** **** ***** ** ************ * ** ***********    ****

Snow_Leopard1       AAATAAAAATATCAACCATCGTATCTAATCAGAAAGGGCTAGTTAAGCTCTACTTCTTAT 13541
Snow_Leopard2       AAATAAAAATATCAACCATCGTATCTAATCAGAAAGGGCTAGTTAAGCTCTACTTCTTAT 13541
Leopard1            AAATAAAAATATCAACCACTGTATCTAATCAGAAAGGACTAGTTAAACTCTACTTCTTAT 13536
Tiger1              AAATAAAAATATCAACCGCCGTATCTAATCAGAAGGGACTAGTTAAGCTCTACTTCCTAT 13539
Tiger2              AAATAAAAATATCAACCGCCGTATCTAATCAGAAGGGACTAGTTAAGCTCTACTTCCTAT 13539
Clouded_leopard     AAATAAAAATATCAACTATTGTATCTAATCAGAAAGGATTAGTTAAGCTCTACTTCTTAT 13532
cheetah             AAATAAAAATATCAACCACCGTATCTAATCAGAAAGGACTAGTTAAACTCTACTTCCTAT 13532
Cat                 AAATAAAAATGTCAACTACTGTATCTAATCAGAAAGGACTAGTTAAACTCTACTTTTTAT 13536
                    ********** *****    ************** **  ******* ********  ***

ND6
Snow_Leopard1       CCTTCATAATCACCTTGACCCTTAGCCTGCTCTTACTTAATTTCCACGAGTAATCTCTAT 13601
Snow_Leopard2       CCTTCATAATCACCTTGACCCTTAGCCTGCTCTTACTTAATTTCCACGAGTAATCTCTAT 13601
Leopard1            CTTTCATAATCACCTTGACCCTTAGCCTACTCTTACTTAGTTTCCACGAGTAACCTCTAT 13596
Tiger1              CCTTCATAATCACCCTGACCCTTAGCCTACTCTTACTTAGTTTCCACGAGTAACCTCTAT 13599
Tiger2              CCTTCATAATCACCCTGACCCTTAGCCTACTCTTACTTAGTTTCCACGAGTAACCTCTAT 13599
Clouded_leopard     CTTTCATAATCACCTTGACCCTCAGCTTACTCTTACTTAATTTCCACGCGTAACCTCCAT 13592
cheetah             CCTTCATAATCACCCTAACCCTTAGCCTACTCTTATTTAATTACCACGAGTAACTTCTAT 13592
Cat                 CTTTCATAATCACCCTAGCCCTCAGCCTAATCTTACTTAATTCCCACGAGTAACTTCCAT 13596
                    * ************ *  **** *** *  ***** *** ** ***** ****  ** **
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Snow_Leopard1       AATCACCAATACACCAATAAGCAAGGATCAACCAGTAACAACTACCAACCAAGTTCCATA 13661
Snow_Leopard2       AATCACCAATACACCAATAAGCAAGGATCAACCAGTAACAACTACCAACCAAGTTCCATA 13661
Leopard1            AATTACTAATACACCAATAAGCAAGGACCAACCAGTAACAACTACCAGCCAGGTTCCATA 13656
Tiger1              AATCACCAATACACCAATAAGCAAAGACCAACCAGTGACAACCACTAGCCAGGTTCCATA 13659
Tiger2              AATCACCAATACACCAATAAGCAAAGACCAACCAGTGACAACCACTAGCCAGGTTCCATA 13659
Clouded_leopard     GATCACTAACACGCCTACAAATAAAGATCAGCCAGCAACAACTACTAGCCAAGTTCCATA 13652
cheetah             AATTACCAACACACCAATAAGCAATGACCAGCCTGTAACAACTACCAACCAGGTCCCGTA 13652
Cat                 AATCACCAACACACCAATAAGCAAAGATCAGCCGGTGACAACCACTAATCAAGTTCCATA 13656
                     ** ** ** ** ** * **  ** ** ** ** *  ***** ** *  ** ** ** **

Snow_Leopard1       ACTATACAATGCTGCAATCCCCATGGCCTCCTCACTAAAAAACCCCGAATCACCCGTATC 13721
Snow_Leopard2       ACTATACAATGCTGCAATCCCCATGGCCTCCTCACTAAAAAACCCCGAATCACCCGTATC 13721
Leopard1            ACTATACAGTGCTGCAATTCCCATGGCCTCCTCACTAAAAAACCCCGAATCACCCGTATC 13716
Tiger1              ACTATACAGTGCTGCAATTCCTATGGCCTCCTCACTAAAAAACCCCGAGTCACCCGTATC 13719
Tiger2              ACTATACAGTGCTGCAATTCCTATGGCCTCCTCACTAAAAAACCCCGAGTCACCCGTATC 13719
Clouded_leopard     ACTATATAGTGCTGCAATCCCCATGGCTTCTTCACTAAAAAACCCTGAATCACCCGTATC 13712
cheetah             GCTATACAATGCTGCAATTCCCATGGCCTCCTCACTAAAAAACCCCGAATCACCTGTATC 13712
Cat                 ACTATATAGCGCCGCAATTCCCATGGCCTCCTCACTAAAGAACCCTGAGTCACCTGTATC 13716
                     ***** *  ** ***** ** ***** ** ******** ***** ** ***** *****

Snow_Leopard1       ATAAATTACCCAATCACCCGCACCATTAAACTTAAACACAACCTCAACCTCATCTTCTTT 13781
Snow_Leopard2       ATAAATTACCCAATCACCCGCACCATTAAACTTAAACACAACCTCAACCTCATCTTCTTT 13781
Leopard1            ATAAATTACCCAATCACCCGCACCATTAAACTTAAATACAACTTCAACCTCATCCTCTTT 13776
Tiger1              ATAGATCACTCAATCACCCGCACCATTAAACTTAAACACAACCTCAACCTCATCTTCCTT 13779
Tiger2              ATAGATCACTCAATCACCCGCACCATTAAACTTAAACACAACCTCAACCTCATCTTCCTT 13779
Clouded_leopard     ATAAACCACCCAATCACCCGCACCATTAAACTTAAACACAACCTCAACCTCATCTTCTTT 13772
cheetah             ATAAATTACTCAATCCCCCGCACCATTAAACTTAAACACAACCTCAACCTCCTCTTCTTT 13772
Cat                 ATAAATCACCCAATCACCTGCACCATTAAACTTAAATACGACTTCTACCTCATCTTCCTT 13776
                    *** *  ** ***** ** ****************** ** ** ** ***** ** ** **

Snow_Leopard1       TAAAATATAACAAGCAGTTAATAACTCCGCTAGCACCCCCGTAATGAATGCACCCAACAC 13841
Snow_Leopard2       TAAAATATAACAAGCAGTTAATAACTCCGCTAGCACCCCCGTAATGAATGCACCCAACAC 13841
Leopard1            TAAAATATAGCAAGCAGTTAATAGCTCCGCTAACACCCCCGTAATAAATGCACCCAACAC 13836
Tiger1              TAAAATATAGCAAGCAGTCAACAACTCCGCTAATACCCCCGTAATAAACGCACCTAATAC 13839
Tiger2              TAAAATATAGCAAGCAGTCAACAACTCCGCTAATACCCCCGTAATAAACGCACCTAATAC 13839
Clouded_leopard     TAAAATATAACAGGCAGTTAACAATTCTGCCAGTACCCCTGTAATAAACATCCCTAGTAC 13832
cheetah             CAAAATATAGCAAGCAGTTAATAATTCTGCCAATACTCCCGTAATAAACATTCCTAACAC 13832
Cat                 TAAAATATAACAAGCAGTTAATAATTCTGCTAACACCCCCGTAATAAACATTGCTAATAC 13836
                     ******** ** ***** ** *  ** ** *  ** ** ***** **     * *  **

Snow_Leopard1       GGCCTTATTAGACGTCCACGCCTCGGGGTAAGGCTCAGTAGCCATAGCTGTAGTATACCC 13901
Snow_Leopard2       GGCCTTATTAGACGTCCACGCCTCGGGGTAAGGCTCAGTAGCCATAGCTGTAGTATACCC 13901
Leopard1            AGCTTTATTAGATGTCCATGCCTCAGGATAGGGCTCAGTAGCCATAGCCGTAGTATACCC 13896
Tiger1              GGCTTTATTAGATGTCCACGCCTCGGGGTAGGGCTCAGTAGCCATAGCTGTAGTGTACCC 13899
18F
Tiger2              GGCTTTATTAGATGTCCACGCCTCGGGGTAGGGCTCAGTAGCCATAGCTGTAGTGTACCC 13899
Clouded_leopard     AGCCTTATTAGATGTCCACGCCTCAGGATAAGGCTCAGTGGCCATAGCTGTAGTATACCC 13892
cheetah             AGCTTTATTGGATGTCCACGCCTCAGGATAAGGCTCAGTGGCCATAGCCGTAGTATATCC 13892
Cat                 AGCCTTATTAGACGTCCACGCCTCAGGATAAGGCTCAGTAGCCATAGCCGTAGTATATCC 13896
                     ** ***** ** ***** ***** ** ** ******** ******** ***** ** **

Snow_Leopard1       AAACACCACAAGCATGCCCCCTAAATAAATTAAAAAGACCATTAAACCTAAAAACGACCC 13961
Snow_Leopard2       AAACACCACAAGCATGCCCCCTAAATAAATTAAAAAGACCATTAAACCTAAAAACGACCC 13961
Leopard1            AAATACCACAAGCATGCCTCCCAAATAAATTAAAAAGACCATTAACCCTAAAAATGACCC 13956
Tiger1              AAACACCACAAGCATGCCCCCCAAATAAATTAAAAAAACTATTAAACCTAAAAATGACCC 13959
Tiger2              AAACACCACAAGCATGCCCCCCAAATAAATTAAAAAAACTATTAAACCTAAAAATGACCC 13959
Clouded_leopard     AAATACCACAAGCATGCCCCCTAAATAAATTAAAAAAACTATTAAACCTAAGAACGACCC 13952
cheetah             AAACACTACAAGCATACCTCCCAAATAAATTAAAAAAACCATTAAGCCCAAAAACGATCC 13952
Cat                 AAACACTACGAGTATACCCCCTAAATAAATTAAGAAAACCATTAAACCTAAAAATGATCC 13956
                    *** ** ** ** ** ** ** *********** ** ** ***** ** ** ** ** **

Snow_Leopard1       TCCAAAATTCAATACAATACCACAACCAACACCACCGGCCACAATCAAACCAAACCCACC 14021
Snow_Leopard2       TCCAAAATTCAATACAATACCACAACCAACACCACCGGCCACAATCAAACCAAACCCACC 14021
Leopard1            CCCAAAATTTAATACAATGCCACAACCAACACCACCAGCCACAATCAAACCAAATCCACC 14016
Tiger1              CCCAAAATTCAATACAATACCGCAACCAACACCACCAGCCACAATCAATCCAAGCCCACC 14019
Tiger2              CCCAAAATTCAATACAATACCGCAACCAACACCACCAGCCACAATCAATCCAAGCCCACC 14019
Clouded_leopard     CCCAAAATTTAACACAATGGCGCAACCAACACCACCAGCCACAATTAAACCAAACCCGCC 14012
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cheetah              TCCAAAATTTAATACAATACCACAACCAATACCACCTGCCACAATCAAACCAAACCCACC 14012
Cat                  CCCAAAATTCAACACAATACCACAACCAGTACCACCAGCCACAATTAAACCAAACCCACC 14016
                      ******** ** *****  * ******  ****** ******** ** ****  ** **

Snow_Leopard1        ATAAATAGGAGAAGGCTTTGAAGAAAAACTTACAAAGCTCACCACGAAAATTGTACTTAA 14081
17R
Snow_Leopard2        ATAAATAGGAGAAGGCTTTGAAGAAAAACTTACAAAGCTCACCACGAAAATTGTACTTAA 14081
Leopard1             ATAAATAGGAGAGGGCTTTGAAGAAAAACTTACAAAGCTCACCACGAAAATTGTACTTAA 14076
Tiger1               ATAAATAGGAGAAGGCTTTGAAGAAAAACTCACAAAGCTCACCACGAAAATTGTACTTAA 14079
Tiger2               ATAAATAGGAGAAGGCTTTGAAGAAAAACTCACAAAGCTCACCACGAAAATTGTACTTAA 14079
Clouded_leopard      ATAGATGGGAGAAGGCTTTGAAGAAAAACTTACAAAGCTCACCACGAAAATTGTACTTAA 14072
cheetah              ATAAATTGGAGAAGGCTTTGAAGAAAAACTCACAAAGCTCACCACAAAAATTGTACTTAA 14072
Cat                  ATAAATTGGAGAAGGCTTTGAAGAAAAACTTACAAAGCTCACTACAAAAACTGTACTTAA 14076
                     *** ** ***** ***************** ********** ** **** *********

tRNA-Glu
Snow_Leopard1        AATAAACACAATATATATTATCATAATTCTCACATGGAATCTAACCATGACTAATGATAT 14141
Snow_Leopard2        AATAAACACAATATATATTATCATAATTCTCACATGGAATCTAACCATGACTAATGATAT 14141
Leopard1             AATAAATACAATATATGTTATCATAATTCTCACATGGAATCTAACCATGACTAATGATAT 14136
Tiger1               AATAAATACAATGTATGTTATCATAATTCTCACATGGATTCTAACCACGACCAATGATAT 14139
Tiger2               AATAAATACAATGTATGTTATCATAATTCTCACATGGATTCTAACCACGACCAATGATAT 14139
Clouded_leopard      AATAAATACAATGTATGTTATCATTATTCCCACATGGAATCTAACCATGACTAATGATAT 14132
cheetah              AATAAACACAATATATGTTATCATCATTCTTACATGGAATCTAACCATGACCAATGACAT 14132
Cat                  AATAAATACAATGTATGTTATCATTATTCTCACATGGAATTTAACCATGACTAATGATAT 14136
                     ****** ***** *** ******* ****  ******* * ****** *** ***** **

CtyB
Snow_Leopard1        GAAAAACCATTGTTGTATTTCAACTATAAGAACCTAATGACCAACATTCGAAAATCACAC 14201
Snow_Leopard2        GAAAAACCATTGTTGTATTTCAACTATAAGAACCTAATGACCAACATTCGAAAATCACAC 14201
Leopard1             GAAAAACCATTGTTGTATTTCAACTATAAGAACTTAATGACCAACATTCGAAAATCACAC 14196
Tiger1               GAAAAACCATCGTTGTATTTCAACTATAAGAACTTAATGACCAACATTCGAAAATCACAC 14199
Tiger2               GAAAAACCATCGTTGTATTTCAACTATAAGAACTTAATGACCAACATTCGAAAATCACAC 14199
Clouded_leopard      GAAAAACCATCGTTGTATTTCAACTATAAGAACCTAATGACCAACATTCGAAAATCACAC 14192
cheetah              GAAAAACCATCGTTGTACTTCAACTATAAGAACTTAATGACCAACATTCGAAAATCACAC 14192
Cat                  GAAAAACCATCGTTGTATTTCAACTATAAGAACTTAATGACCAACATTCGAAAATCACAC 14196
                     ********** ****** *************** *************************

Snow_Leopard1        CCCCTTATCAAAATTATCAATCACTCATTCATTGATCTTCCCACTCCATCCAACATCTCA 14261
Snow_Leopard2        CCCCTTATCAAAATTATCAATCACTCATTCATTGATCTTCCCACTCCATCCAACATCTCA 14261
Leopard1             CCCCTCATCAAAATTATTAATCACTCATTCATTGATCTCCCCGCTCCATCCAACATCTCA 14256
Tiger1               CCCCTTATCAAAATTATTAATCACTCATTTATTGACCTACCCGCCCCATCCAATATTTCA 14259
Tiger2               CCCCTTATCAAAATTATTAATCACTCATTTATTGACCTACCCGCCCCATCCAATATTTCA 14259
Clouded_leopard      CCCCTCATTAAAATTATCAATCACTCATTCATTGATTTACCTGCACCATCTAACATCTCC 14252
cheetah              CCCCTTATCAAAATCGTTAATCACTCATTCATCGATTTACCCACCCCACCTAACATTTCA 14252
Cat                  CCCCTTATCAAAATTATTAATCACTCATTCATCGATCTACCCGCCCCATCTAACATCTCA 14256
                     ***** ** *****  * ********** ** **  * **  * *** * ** ** **



Snow_Leopard1        GCATGATGAAACTTTGGCTCCCTGTTAGGAGTATGTTTAATCCTACAAATTCTCACCGGC 14321
Snow_Leopard2        GCATGATGAAACTTTGGCTCCCTGTTAGGAGTATGTTTAATCCTACAAATTCTCACCGGC 14321
Leopard1             ACATGATGGAACTTTGGCTCCCTATTAGGGGTATGTTTAATCCTACAAATTCTCACCGGC 14316
Tiger1               GCATGATGAAACTTTGGCTCCTTACTAGGGGTGTGCTTAATCTTACAAATCCTCACTGGC 14319
Tiger2               GCATGATGAAACTTTGGCTCCTTACTAGGGGTGTGCTTAATCTTACAAATCCTCACTGGC 14319
Clouded_leopard      GCGTGATGAAACTTTGGCTCCTTGCTAGGAGTATGTTTAATCTTACAAATTCTCACCGGC 14312
cheetah              GCATGATGAAACTTCGGCTCCCTACTAGGAGTCTGCCTAGTCCTACAGATCCTAACCGGC 14312
Cat                  GCATGATGAAACTTCGGCTCCCTTCTAGGAGTCTGCCTAACCTTACAAATCCTCACCGGC 14316
                      * ***** ***** ****** *  **** ** **  **  * **** ** ** ** ***

Snow_Leopard1        CTCTTTCTAGCCATACACTATACATCAGACACAATAACCGCTTTCTCGTCAGTCACCCAC 14381
Snow_Leopard2        CTCTTTCTAGCCATACACTATACATCAGACACAATAACCGCTTTCTCGTCAGTCACCCAC 14381
Leopard1             CTCTTTCTAGCCATACATTATACATCAGACACAACAACCGCTTTCTCATCAGTTACCCAT 14376
Tiger1               CTCTTTCTAGCCATACACTACACATCAGACACAATAACCGCTTTCTCATCAGTTACCCAC 14379
Tiger2               CTCTTTCTAGCCATACACTACACATCAGACACAATAACCGCTTTCTCATCAGTTACCCAC 14379
Clouded_leopard      CTCTTCCTGGCCATACACTACACATCAGATACAATAACTGCTTTCTCATCTGTCACCCAT 14372
cheetah              CTTTTCCTAGCCATACACTACACATCAGACACAATAACCGCCTTTTCATCAGTTACTCAC 14372
Cat                  CTCTTTTTGGCCATACACTACACATCAGACACAATAACCGCCTTTTCATCAGTTACCCAC 14376
                     ** **  * ******** ** ******** **** *** ** ** ** ** ** ** **

Snow_Leopard1        ATCTGCCGCGACGTAAATTATGGCTGAATTATCCGATACCTACACGCCAACGGAGCCTCC 14441
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Snow_Leopard2       ATCTGCCGCGACGTAAATTATGGCTGAATTATCCGATACCTACACGCCAACGGAGCCTCC 14441
Leopard1            ATCTGCCGCGATGTAAATTATGGCTGAATTATCCGGTATCTACACGCCAATGGAGCCTCC 14436
Tiger1              ATTTGCCGCGACGTAAACTACGGCTGGATTATCCGATATCTACATGCCAACGGAGCCTCC 14439
Tiger2              ATTTGCCGCGACGTAAACTACGGCTGGATTATCCGATATCTACATGCCAACGGAGCCTCC 14439
Clouded_leopard     ATTTGCCGCGACGTAAACTATGGTTGAATCATCCGATACCTACATGCCAACGGAGCCTCC 14432
cheetah             ATCTGCCGCGACGTCAACTACGGCTGAATTATTCGATACATGCACGCCAACGGAGCCTCT 14432
Cat                 ATCTGTCGCGACGTTAATTATGGCTGAATCATCCGATATTTACACGCCAACGGAGCTTCT 14436
                    ** ** ***** ** ** ** ** ** ** ** ** **  * ** ***** ***** **

Snow_Leopard1       ATATTCTTTATCTGCCTATACATACACGTAGGACGAGGAATGTACTACGGCTCCTACACC 14501
Snow_Leopard2       ATATTCTTTATCTGCCTATACATACACGTAGGACGAGGAATGTACTACGGCTCCTACACC 14501
Leopard1            ATATTCTTTATCTGCCTATACATACATGTAGGACGAGGGGTATACTATGGCTCCTACACT 14496
Tiger1              ATATTCTTTATCTGTCTATACATGCACGTAGGACGAGGAATATACTACGGCTCCTACACC 14499
Tiger2              ATATTCTTTATCTGTCTATACATGCACGTAGGACGAGGAATATACTACGGCTCCTACACC 14499
Clouded_leopard     ATATTTTTTATCTGCCTATACATGCACGTAGGACGAGGAATATATTACGGCTCCTACACC 14492
cheetah             ATATTCTTTATCTGCCTATACATGCATGTAGGACGAGGAATATACTACGGCTCCTACACC 14492
Cat                 ATATTCTTTATCTGCCTGTACATACATGTAGGACGGGGAATATACTACGGCTCCTACACC 14496
                    ***** ******** ** ***** ** ******** **  * ** ** ************

Snow_Leopard1       TTCTCAGAAACATGAAACATTGGAGCCGTACTATTGCTCGCAGTCATGGCTACAGCCTTC 14561
19F
Snow_Leopard2       TTCTCAGAAACATGAAACATTGGAGCCGTACTATTGCTCGCAGTCATGGCTACAGCCTTC 14561
Leopard1            TTCTCAGAGACATGGAACATTGGAGTCGTATTATTGCTCACGGTTATGGCCACAGCCTTC 14556
Tiger1              TTCTCAAAAACATGAAATATCGGGATTGTGCTATTGTTTACGGTCATGGCTACAGCCTTC 14559
Tiger2              TTCTCAAAAACATGAAATATCGGGATTGTGCTATTGTTTACGGTCATGGCTACAGCCTTC 14559
Clouded_leopard     TTCTCAGAAACATGAAACATTGGAATCGTATTACTATTTACAGTCATAGCCACAGCCTTC 14552
cheetah             TTCTCAGAAACATGAAATATTGGAATCATACTACTACTCACAGTCATAGCCACAGCCTTC 14552
Cat                 TTCTCAGAGACATGAAACATTGGAATCATACTATTATTTACAGTCATAGCCACAGCTTTT 14556
                    ****** * ***** ** ** **     *  ** *  *  * ** ** ** ***** **

Snow_Leopard1       ATGGGATATGTCTTACCCTGAGGCCAAATATCCTTCTGAGGAGCAACCGTGATCACCAAT 14621
Snow_Leopard2       ATGGGATATGTCTTACCCTGAGGCCAAATATCCTTCTGAGGAGCAACCGTGATCACCAAT 14621
Leopard1            ATAGGATATGTCTTACCGTGGGGCCAAATATCCTTTTGAGGGGCAACCGTAATTACCAAC 14616
Tiger1              ATAGGATATGTCTTACCATGAGGACAAATATCATTCTGAGGGGCAACCGTAATCACCAAC 14619
Tiger2              ATAGGATATGTCTTACCATGAGGACAAATATCATTCTGAGGGGCAACCGTAATCACCAAC 14619
Clouded_leopard     ATGGGATACGTCCTACCATGAGGCCAAATATCCTTCTGAGGGGCAACTGTAATTACCAAC 14612
cheetah             ATAGGATATGTCTTACCATGAGGTCAAATATCTTTCTGAGGAGCAACTGTAATTACCAAC 14612
Cat                 ATGGGATACGTCCTACCATGAGGCCAAATGTCCTTCTGAGGAGCAACCGTAATCACTAAC 14616
                    ** ***** *** **** ** ** ***** ** ** ***** ***** ** ** ** **

Snow_Leopard1       CTCCTATCATCAATCCCATACATTGGGAGCAACCTAGTAGAATGGATCTGAGGGGGCTTC 14681
Snow_Leopard2       CTCCTATCATCAATCCCATACATTGGGAGCAACCTAGTAGAATGGATCTGAGGGGGCTTC 14681
Leopard1            CTCCTATCAGCAATCCCATACATTGGGATTGACCTAGTAGAATGAATCTGAGGGGGCTTC 14676
Tiger1              CTCCTGTCAGCAATCCCATATATTGGGACCGACCTAGTAGAGTGAATCTGAGGGGGTTTC 14679
Tiger2              CTCCTGTCAGCAATCCCATATATTGGGACCGACCTAGTAGAGTGAATCTGAGGGGGTTTC 14679
Clouded_leopard     CTCCTATCAGCAATCCCATACATTGGGGCCGACCTAGTAGAATGAATCTGAGGGGGCTTC 14672
cheetah             CTCCTATCAGCAATTCCTTACATCGGCACTAATCTAGTAGAGTGAATTTGAGGAGGTTTC 14672
Cat                 CTCCTGTCAGCAATTCCATACATCGGGACTGAACTAGTAGAATGAATCTGAGGGGGGTTC 14676
                    ***** *** **** ** ** ** **     * ******** ** ** ***** ** ***

Snow_Leopard1       TCAGTAGATAAAGCCTCCTTGACACGATTCTTTGCCTTCCACTTTATCCTTCCATTCATC 14741
18R
Snow_Leopard2       TCAGTAGATAAAGCCTCCTTGACACGATTCTTTGCCTTCCACTTTATCCTTCCATTCATC 14741
Leopard1            TCAGTAGACAAAGCTACCTTGACACGATTCTTTGCCTTCCACTTCATCCTTCCATTTATC 14736
Tiger1              TCAGTAGACAAAGCTACCCTGACACGATTCTTTGCCTTCCACTTCATCCTTCCGTTTATC 14739
Tiger2              TCAGTAGACAAAGCTACCCTGACACGATTCTTTGCCTTCCACTTCATCCTTCCGTTTATC 14739
Clouded_leopard     TCAGTAGACAAAGCCACCCTGACACGATTTTTCGCCTTCCACTTCATCCTCCCATTTATC 14732
cheetah             TCGGTAGACAAAGCTACCCTGACACGATTCTTTGCCTTCCACTTTATCCTTCCATTCATC 14732
Cat                 TCAGTAGACAAAGCCACCCTAACACGATTCTTTGGCTTCCACTTCATTCTTCCATTCATT 14736
                    ** ***** *****  ** * ******** ** * ********* ** ** ** ** **

Snow_Leopard1       ATCTCAGCCCTAGCAGAAATCCACCTCCTATTCCTTCATGAAACAGGATCTAACAACCCC 14801
Snow_Leopard2       ATCTCAGCCCTAGCAGAAATCCACCTCCTATTCCTTCATGAAACAGGATCTAACAACCCC 14801
Leopard1            ATCTCAGCTCTAGCAGCAGTCCACCTCCTATTCCTTCACGAGACAGGATCTAACAACCCC 14796
Tiger1              GTCTCAGCCCTAGCAGCAGTCCACCTCCTATTCCTTCACGAAACAGGATCCAATAACCCC 14799
Tiger2              GTCTCAGCCCTAGCAGCAGTCCACCTCCTATTCCTTCACGAAACAGGATCCAATAACCCC 14799
Clouded_leopard     ATCTCAGCCTTAGCAGCAGTTCACCTTCTATTTCTCCATGAAACAGGATCCAATAACCCC 14792
cheetah             ATCTCAGCCCTAGCAGCAGTACACCTCTTATTTCTCCACGAGACAGGATCCAATAACCCC 14792
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Cat                 ATCTCAGCCTTAGCAGGAGTACACCTCTTATTCCTTCATGAAACAGGATCTAACAACCCC 14796
                     *******  ****** * * *****  **** ** ** ** ******** ** ******

Snow_Leopard1       TCAGGAATGGTATCTGACTCAGACAAAATCCCATTCCACCCGCACTACACAGTCAAAGAC 14861
Snow_Leopard2       TCAGGAATGGTATCTGACTCAGACAAAATCCCATTCCACCCGCACTACACAGTCAAAGAC 14861
Leopard1            TCAGGAATAGTATCTGACTCAGACAAAATTCCATTCCACCCATACTACACAATCAAAGAT 14856
Tiger1              TCAGGAATGGTGTCCGACTCAGACAAAATCCCATTCCACCCATACTACACAATTAAAGAT 14859
Tiger2              TCAGGAATGGTGTCCGACTCAGACAAAATCCCATTCCACCCATACTACACAATTAAAGAT 14859
Clouded_leopard     TCAGGAATGGTATCCGATTCAGACAAAATCCCGTTCCACCCGTACTATACAATCAAAGAT 14852
cheetah             TCAGGAATCACATCCGACTCAGACAAAATTCCATTCCACCCATACTACATAATCAAGGAC 14852
Cat                 TCAGGAATTACATCCGATTCAGACAAAATCCCATTCCACCCATACTATACAATCAAAGAC 14856
                    ********    ** ** *********** ** ********  **** * * * ** **

Snow_Leopard1       ATCCTAGGCCTTTTAACACTAACCCTAACGCTCATGCTACTTGTCCTATTCTCACCAGAC 14921
Snow_Leopard2       ATCCTAGGCCTTTTAACACTAACCCTAACGCTCATGCTACTTGTCCTATTCTCACCAGAC 14921
Leopard1            ATCCTGGGCCTTCTAGTACTAATCTTAGCACTCATACTACTCGTCCTATTCTCACCAGAC 14916
Tiger1              ATCTTAGGCCTCTTAGTACTAATCCTAACCCTCACACTACTCGTCCTATTCTCACCAGAC 14919
Tiger2              ATCTTAGGCCTCTTAGTACTAATCCTAACCCTCACACTACTCGTCCTATTCTCACCAGAC 14919
Clouded_leopard     ATCCTAGGCCTCCTAGTTCTAATTCTAGCGCTCACACTACTTGTTCTATTCTCCCCAGAC 14912
cheetah             ATTCTAGGTCTCCTAATACTAATTTTAATACTCACACTACTCGTCCTCTTCTCACCAGAC 14912
Cat                 ATCCTAGGTCTTCTAGTACTAGTTTTAACACTCATACTACTCGTCCTATTTTCACCAGAC 14916
                    **  * ** **  **   ***    **   ****  ***** ** ** ** ** ******

Snow_Leopard1       CTATTAGGAGACCCTGATAACTACATCCCCGCCAATCCTCTAAACACCCCTCCTCATATC 14981
Snow_Leopard2       CTATTAGGAGACCCTGATAACTACATCCCCGCCAATCCTCTAAACACCCCTCCTCATATC 14981
Leopard1            CTGTTAGGAGACCCCGATAATTACATCCCCGCCAACCCTCTAAATACCCCTCCCCATATC 14976
Tiger1              CTATTAGGAGACCCTGATAACTACATCCCCGCCAACCCCCTAAATACCCCTCCCCATATT 14979
Tiger2              CTATTAGGAGACCCTGATAACTACATCCCCGCCAACCCCCTAAATACCCCTCCCCATATT 14979
Clouded_leopard     CTACTAGGAGACCCTGACAATTACACTCCCGCCAACCCTCTAAATACCCCTCCCCATATC 14972
cheetah             CTGTTAGGAGATCCAGACAACTACATCCCCGCCAACCCCCTAAACACTCCTCCCCATATT 14972
Cat                 CTGCTAGGAGACCCAGACAACTACATCCCAGCCAACCCTTTAAATACCCCTCCCCATATT 14976
                    **  ******* ** ** ** **** ** ***** **  **** ** ***** *****

Snow_Leopard1       AAGCCTGAGTGGTACTTCCTATTCGCATACGCAATCCTTCGATCTATCCCCAATAAACTA 15041
Snow_Leopard2       AAGCCTGAGTGGTACTTCCTATTCGCATACGCAATCCTTCGATCTATCCCCAATAAACTA 15041
Leopard1            AAGCCTGAATGATACTTCCTATTTGCATACGCAATCCTCCGATCCATTCCCAACAAACTA 15036
Tiger1              AAGCCCGAATGGTATTTCCTATTCGCATACGCAATCCTCCGATCTATTCCCAATAAACTA 15039
Tiger2              AAGCCCGAATGGTATTTCCTATTCGCATACGCAATCCTCCGATCTATTCCCAATAAACTA 15039
Clouded_leopard     AAGCCTGAATGATACTTCCTATTTGCATACGCAATTCTCCGATCTATCCCCAACAAACTA 15032
cheetah             AAACCCGAATGATATTTTTTATTCGCATACGCAATCCTCCGATCCATCCCTAACAAATTA 15032
Cat                 AAACCTGAATGATACTTCCTATTCGCATACGCAATTCTCCGATCCATCCCTAACAAACTA 15036
                    ** ** ** ** ** **  **** *********** ** ***** ** ** ** *** **

Snow_Leopard1       GGGGGAGTCCTAGCCCTAGTCCTATCCATCTTAATCCTAACAATTATCCCCGCCCTCCAC 15101
Snow_Leopard2       GGGGGAGTCCTAGCCCTAGTCCTATCCATCTTAATCCTAACAATTATCCCCGCCCTCCAC 15101
Leopard1            GGAGGAGTCTTAGCCCTAGTCCTATCCATCCTAATCTTAGCAGTTATCCCCGCTCTCCAC 15096
Tiger1              GGAGGAGTTCTAGCCCTAGTCTTATCCATCTTAATCTTAGCCACTATCCCTGCCCTCCAC 15099
Tiger2              GGAGGAGTTCTAGCCCTAGTCTTATCCATCTTAATCTTAGCCACTATCCCTGCCCTCCAC 15099
Clouded_leopard     GGAGGAGTTCTAGCCTTAGTGCTCTCTATCTTAGTCCTAGCAATCATCCCTGCCCTTCAC 15092
cheetah             GGAGGAGTCCTAGCCCTAATATTCTCCATCCTAATCCTAGCAATCATTCCAATTTTCCAC 15092
Cat                 GGGGGAGTCCTAGCCCTAGTACTCTCCATCCTAGTACTAGCAATCATTCCAATCCTCCAC 15096
                    ** *****  ***** ** *  * ** *** ** *  ** *    ** **     * ***

Snow_Leopard1       ACTTCCAAACAACGGGGGATAATGTTTCGACCACTAAGCCAGTGCTTATTCTGATTCCTA 15161
Snow_Leopard2       ACTTCCAAACAACGGGGGATAATGTTTCGACCACTAAGCCAGTGCTTATTCTGATTCCTA 15161
Leopard1            ACTTCCAAACAACGAGGGATAATGTTTCGACCATTAAGCCAGTGCTTATTCTGATTCCTA 15156
Tiger1              ACATCCAAACAACGAGGAATAATGTTTCGACCGCTAAGCCAATGCTTATTCTGACTCTTA 15159
Tiger2              ACATCCAAACAACGAGGAATAATGTTTCGACCGCTAAGCCAATGCTTATTCTGACTCTTA 15159
Clouded_leopard     ACTTCTAAGCAGCGAGGAATAATATTCCGACCAATAAGCCAATGCTTATTCTGATTCCTA 15152
cheetah             ACCTCCAAACAACGAGGAATAATATTTCGACCACTAAGCCAATGCTTATTCTGACTCCTA 15152
Cat                 ACCTCCAAACAACGAGGAATAATGTTTCGACCACTAAGCCAATGTCTATTCTGACTCCTA 15156
                    ** ** ** ** ** ** ***** ** *****  ******* **  ******** ** **

Snow_Leopard1       GTAGCAGACCTTCTGACCCTGACATGAATTGGCGGCCAGCCCGTAGAATATCCTTTCATC 15221
Snow_Leopard2       GTAGCAGACCTTCTGACCCTGACATGAATTGGCGGCCAGCCCGTAGAATATCCTTTCATC 15221
Leopard1            GTAGCGGACCTTCTAGCCCTGACGTGAATTGGTGGCCAACCTGTAGAACACCCCTTCATT 15216
Tiger1              GTGGCAGACCTTCTAACCCTAACATGAATTGGTGGCCAACCTGTAGAACACCCCTTTATT 15219
Tiger2              GTGGCAGACCTTCTAACCCTAACATGAATTGGTGGCCAACCTGTAGAACACCCCTTTATT 15219
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Clouded_leopard      GTAGCAGACCTTCTGACCCTAACATGAATTGGTGGCCAACCTGTAGAACACCCTTTTACC 15212
cheetah              GTAGCAGACCTCCTCACCCTAACATGAATTGGCGGCCAACCTGTAGAACACCCCTTTATT 15212
Cat                  GTAGCGGATCTCCTAACCCTAACATGAATCGGTGGCCAACCTGTAGAACATCCGTTCATC 15216
                     ** ** ** ** **  **** ** ***** ** ***** ** ****** * ** ** *

Snow_Leopard1        ACCATCGGGCAACTAGCCTCCATCCTATATTTCTCTATTCTCCTAGTCCTAATACCCATC 15281
20F
Snow_Leopard2        ACCATCGGGCAACTAGCCTCCATCCTATATTTCTCTATTCTCCTAGTCCTAATACCCATC 15281
Leopard1             ACCATCGGCCAACTAGCCTCCATCCTATACTTCTCCATCCTCCTAGTCCTAATACCTATC 15276
Tiger1               GCCATCGGCCAACTAGCCTCTATCCTATACTTCTTCATCCTCCTAGTCTTAATCCCCATC 15279
Tiger2               GCCATCGGCCAACTAGCCTCTATCCTATACTTCTTCATCCTCCTAGTCTTAATCCCCATC 15279
Clouded_leopard      ACTATCGGCCAACTAGCCTCCATTCTATACTTCTTCACTCTCCTAGTTTTAATGCCCATC 15272
cheetah              ACCATCGGCCAACTAGCCTCCATTCTATACTTCTCAACCCTCCTAGTTCTAATACCTATT 15272
Cat                  ACCATCGGGCAACTAGCCTCCATCCTATATTTCTCAACCCTCCTAATCCTAATACCCATC 15276
                      * ***** *********** ** ***** ****  *  ****** *  **** ** **

tRNA-Thr
Snow_Leopard1        TCAGGCATTATTGAAAACCGCCTCCTTAAATGAAGAGTCTTCGTAGTATATAGAATACCT 15341
Snow_Leopard2        TCAGGCATTATTGAAAACCGCCTCCTTAAATGAAGAGTCTTCGTAGTATATAGAATACCT 15341
Leopard1             TCAGGCATTATTGAAAACCGCCTCCTTAAATGAAGAGTCTTCGTAGTATATAAAATACCT 15336
Tiger1               TCAGGCATTATTGAAAACCGCCTCCTTAAATGAAGAGTCTTCGTAGTATATAAATTACTT 15339
Tiger2               TCAGGCATTATTGAAAACCGCCTCCTTAAATGAAGAGTCTTCGTAGTATATAAATTACTT 15339
Clouded_leopard      TCAGGTATAATTGAAAACCGCCTCCTTAAATGAAGAGTCTTTGTAGTATATAAAATACCC 15332
cheetah              TCAGGCATCATCGAAAACCGCCTCCTAAAATGAAGAGTCTTTGTAGTATATAAAATACTT 15332
Cat                  TCAGGCATTATTGAAAACCGTCTACTCAAATGAAGAGTCTTTGTAGTATATAAAATACTT 15336
                     ***** ** ** ******** ** ** ************** ********** * ***

tRNA-Pro
Snow_Leopard1        TGGTCTTGTAAACCAAAAAAGGAGAATATGCACCCTCCCTAAGACTTCAAGGAAGAAGCA 15401
19R
Snow_Leopard2        TGGTCTTGTAAACCAAAAAAGGAGAATATGCACCCTCCCTAAGACTTCAAGGAAGAAGCA 15401
Leopard1             TGGTCTTGTAAACCAAAAAAGGAGAACATGTGCCCTCCCTAAGACTTCAAGGAAGAAGCA 15396
Tiger1               TGGTCTTGTAAACCAAAAAAGGAGAATATGTACTCTCCCTAAGACTTCAAGGAAGAAGCA 15399
Tiger2               TGGTCTTGTAAACCAAAAAAGGAGAATATGTACTCTCCCTAAGACTTCAAGGAAGAAGCA 15399
Clouded_leopard      TGGTCTTGTAAACCAAAAAAGGAGAATA--CATCCTCCCTAAGACTTCAAGGAAGAAGCA 15390
cheetah              TGGTCTTGTAAGCCAAAAAAGGAGAACTCACACCCTCCCTAAGACTTCAAGGAAGAAGCA 15392
Cat                  TGGTCTTGTAAACCAAAAAAGGAGAACATATGCCCTCCCTAAGACTTCAAGGAAGAAGCA 15396
                     ********** **************        *************************

Snow_Leopard1        ACAGCCCCGCCATCAGCACCCAAAGCTGATATTCTTTCTTAAACTATTCCTTGTTAATAC 15461
Snow_Leopard2        ACAGCCCCGCCATCAGCACCCAAAGCTGATATTCTTTCTTAAACTATTCCTTGTTAATAC 15461
Leopard1             ACAGCCCCACCATCAGCACCCAAAGCTGAAATTCTTTCTTAAACTATTCCTTGTCAATAC 15456
Tiger1               ATAGCCCCACCATCAGCACCCAAAGCTGAAATTCTTTCTTAAACTATTCCTTGCCAATAC 15459
Tiger2               ATAGCCCCACCATCAGCACCCAAAGCTGAAATTCTTTCTTAAACTATTCCTTGCCAATAC 15459
Clouded_leopard      ACAGCCCCACCATCAGCACCCAAAGCTGAAATTCTTTCTTAAACTACTCCTTGCCAATAC 15450
cheetah              ACAGCCCCACCATCAGCACCCAAAGCTGAAATTCTTTCTTAAACTATTCCCTGCTAATAC 15452
Cat                  ACAGCCCCACTATCAGCACCCAAAGCTGAAATTCTTTCTTAAACTATTCCTTGGCAATAC 15456
                     * ****** * ****************** *************** *** **  *****

Snow_Leopard1        CAAAAAACAACTCCATAGCTTCCATAATTCATATATTGCATATACTCATACTGTGCTTGC 15521
Snow_Leopard2        CAAAAAACAACTCCATAGCTTCCATAATTCATATATTGCATATACTCATACTGTGCTTGC 15521
Leopard1             CAAAAAACAACTCCATGACTTTCATAATT--------GCACATACCCATACTGTGCTTGC 15508
Tiger1               CAAAAAACAACCCCATGACTTTCATAATTCATATATTGCATATACCCGTACTGTGCTTGC 15519
Tiger2               CAAAAAACAACCCCATGACTTTCATAATTCATATATTGCATATACCCGTACTGTGCTTGC 15519
Clouded_leopard      TAAAAA-TAACCCCACAAATTCCATGATTCATATATTGCATATACCCATGCTGTGCTTGC 15509
cheetah              CAGAAACCAACCCTATAACTTCCATAATTCATATATTGCATATACCCATACTGTGCTTGC 15512
Cat                  CAGAAAGCAACCCCATAACTTTCATAATTCATATATTGCATATACCCATACTGTGCTTGG 15516
                      * ***  *** * *    ** *** ***        *** **** * * *********

Snow_Leopard1        CCAGTATGTCCTCATTTTC-CATAAAAACAAGTGAAA----AACCCCTAACTCCCACAAC 15576
Snow_Leopard2        CCAGTATGTCCTCATTTTC-CATAAAAACAAGTGAAA----AACCCCTAACTCCCACAAC 15576
Leopard1             CCAGTATGTCCTTATCTCCACAAAAAAGCAAATAAACCCTCAACACCCCCCCCCCTTCCC 15568
Tiger1               CCAGTATGTCCTCATCCCCACA-AAAAATAAGTGAAAAA--ATCCTCAATCCCCGTTAAT 15576
Tiger2               CCAGTATGTCCTCATCCCCACA-AAAAATAAGTGAAAAA--ATCCTCAATCCCCGTTAAT 15576
Clouded_leopard      CCAGTATGTCCTTATCCTC-TACAAAAACAAGCAAGA----AACTCCTAAT--------- 15555
cheetah              CCAGTATGTCCTCACTTCC--AACAAAACAAACCAAGTAAAAACTCCCTATTACCAACAT 15570
Cat                  CCAGTATGTCCTTATTTCC--CACAAAA-AAACCAAGTAAAAACCCCCAAACACCACAAC 15573
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Snow_Leopard1        ACAGA-CGCACAGTGTAAAA--AACCGATCAACTGCCCCCCCCTCCCCCC---------- 15623
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Snow_Leopard2       ACAGA-CGCACAGTGTAAAA--AACCGATCAACTGCCCCCCCCTCCCCCC---------- 15623
Leopard1            CCCCC-CCCCCGG-GTGAAA--CACTAATCAACT----------CTCTCT---------- 15604
Tiger1              ACAGAACACACAACACGAAAT-AACCTGTTAACTACCGGACCCCCCCCCTCCCCC----- 15630
Tiger2              ACAGAACACACAACACGAAAT-AACCTGTTAACTACCGGACCCCCCCCCTCCCCC----- 15630
Clouded_leopard     ------CACATAA-----------------CACA---------------A---------- 15567
cheetah             CCAAGACATATGATGTAAAATTAATCTATCAACCACCCCGTCTCCATAAACATTAGGCAT 15630
Cat                 CCAAAACACACAATGTAAAATCACTCTATTAACCACCAACTCACCCCAGGGGGTA----- 15628
                          *                       **

Snow_Leopard1       ------------------------------------------------------------
Snow_Leopard2       ------------------------------------------------------------
Leopard1            ------------------------------------------------------------
Tiger1              ------------------------------------------------------------
Tiger2              ------------------------------------------------------------
Clouded_leopard     ------------------------------------------------------------
cheetah             GTACAGTTATTCACATATATTACATAAGACATACTATGTATATCGTGCATTAGTTGCTAG 15690
Cat                 ------TTATACACCCATAT-ACATAAGACATACTATGTACATCGTGCATTAATTGCTAG 15681


Snow_Leopard1       ------------------------------------------------------ATGTA 15628
Snow_Leopard2       ------------------------------------------------------ATGTA 15628
Leopard1            ------------------------------------------------------ATGTA 15609
Tiger1              -----------------------------CGTTAACACATTACGTAGGGCATACTATGTA 15661
Tiger2              -----------------------------CGTTAACACATTACGTAGGGCATACTATGTA 15661
Clouded_leopard     ------------------------------------------------------------
cheetah             TCCCCATGAATATTAAGCATGTACAGTTATTCACATATATTACATAAGACATACTATGTA 15750
Cat                 TCCCCATGAATATTAAGCATGTACAGGAGTTTATATATATTACATAAGACATACTATGTA 15741


Snow_Leopard1       TATCGTGCATTAATCGCTAGTCCCCATGGATATTAGGCATGTACAATAATCTATATATAT 15688
Snow_Leopard2       TATCGTGCATTAATCGCTAGTCCCCATGGATATTAGGCATGTACAATAATCTATATATAT 15688
Leopard1            CGTCGTGCATTAACTGCTTGTCCCCATGAATATTAAGCATGTACAGTAGTTTATATATAT 15669
Tiger1              TATCGGGCATTAATCGCCTGTCCCCATGAATATTAAGCATGTACAGTAGTTTATATATTT 15721
Tiger2              TATCGGGCATTAATCGCCTGTCCCCATGAATATTAAGCATGTACAGTAGTTTATATATTT 15721
Clouded_leopard     TGCCG----------------CCCCGTA-----TAGGTATGTACAGCGATCCATACATAT 15606
cheetah             TATCGTGCATTAGTTGCTAGTCCCCATGAATATTAAGCATGTACAGTTATTCATATATAT 15810
Cat                 TATCGTGCATTAATTGCTAGTCCCCATGAATATTAAGCATGTACAGTAGTTTATATATAT 15801
                       **               **** *      ** * *******    *  *** ** *

Snow_Leopard1       TACATAAGACATACTATGTATATCGTGCATTAATCGCTAGTCCCCATGAATATTAAGCAT 15748
Snow_Leopard2       TACATAAGACATACTATGTATATCGTGCATTAATCGCTAGTCCCCATGAATATTAAGCAT 15748
Leopard1            TGCATAAAACATACTATGTATATCGTGCATTAACTGCTTGTCCCCATGAATATTAAGCAT 15729
Tiger1              TACATAAGGCATACTATGTATATCGTGCATTAATCCCTTGTCCCCATGAATATTAAGCAT 15781
Tiger2              TACATAAGGCATACTATGTATATCGTGCATTAATCCCTTGTCCCCATGAATATTAAGCAT 15781
Clouded_leopard     TACGTAAGACATACTATGTATATCGTGCATTAATTGCTTGTCCCCATGAATATTAAGCAT 15666
cheetah             TACATAAGACATACTATGTATATCGTGCATTAATTGCTAGTCCCCATGAATATTAAGCAT 15870
Cat                 TACATAAGACATACTATGTATATCGTGCATTAATTGCTAGTCCCCATGAATATTAAGCAT 15861
                    * * ***  ************************   ** ********************

Snow_Leopard1       GTACAATAGTTTATATATATTACATAAGACATAATAGTGCTTAATCGTGCAT-ATTTATG 15807
Snow_Leopard2       GTACAATAGTTTATATATATTACATAAGACATAATAGTGCTTAATCGTGCAT-ATTTATG 15807
Leopard1            GTACAATAATTTATATATATTACATAAGACATATAAGTGCTTTATCGTGCAT-ATTCATG 15788
Tiger1              GTACAGTAGTTCATATATATTACATAAAACATAATAGTGCTTAATCGTGCAT-ATTCATG 15840
Tiger2              GTACAGTAGTTCATATATATTACATAAAACATAATAGTGCTTAATCGTGCAT-ATTCATG 15840
Clouded_leopard     GTACAGTAATCTATATATATTACATAAGACATAATAGTGCTTGGTCGTGCAT-ACCTCTA 15725
cheetah             GTACAATCATTCATATATATTACATAAGACATTACAGTGTTTGGTCGTGCATTATAACTT 15930
Cat                 GTACAGTAGTTTATATATATTACATAAGACATAATAGTGCTTAATCGTGCATTCACCTTA 15921
                    ***** *  *  *************** ****   **** **  ********     *

Snow_Leopard1       ATTTAACAATGTTCTTCTATGGACCTCAACTGTCCGAAAGAGCTTAA-TCACCTGGCCTC 15866
Snow_Leopard2       ATTTAACAATGTTCTTCTATGGACCTCAACTGTCCGAAAGAGCTTAA-TCACCTGGCCTC 15866
Leopard1            ATCTA-CACCAATCTCTTATGGACCTCAACTGTCCGAAAGAGCTTGA-TCACCTGGCCTC 15846
Tiger1              ATTTAAAACAGTTCTTTCATGGATCTCAACTATCCGAAAAAGCTTAA-TCACCTGGCCTC 15899
Tiger2              ATTTAAAACAGTTCTTTCATGGATCTCAACTATCCGAAAAAGCTTAA-TCACCTGGCCTC 15899
Clouded_leopard     ATCCAGAACAG-TCTCTTATGGACCTCAACTGTCCGAAAGAGCTTGA-TCACCTGGCCTC 15783
cheetah             GTTACGGGACAATTCTCTATGGACCTCAACTATCCAAAGGAACCTAAATCACCTAGCTTC 15990
Cat                 ATTCTAGGACAGTCTTCTATGGACCTCAACTATTCCAAAGAGCTTAA-TCACCTGGCCTC 15980
                     *          *     ***** ******* * * **  * * * * ****** ** **
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Snow_Leopard1       GAGAAACCAGCAATCCTTGCTTGAACGTGTACCTCTTCTCGCTCCGGGCCCATTTCAACG 15926
21F
Snow_Leopard2       GAGAAACCAGCAATCCTTGCTTGAACGTGTACCTCTTCTCGCTCCGGGCCCATTTCAACG 15926
Leopard1            GAGAAACCAGCAATCCTTGCCTGAGCGTGTACCTCTTCTCGCTCCGGGCCCATTTCAATG 15906
Tiger1              GAAAAACCAACAACCCTTGCTCGAGCGTGTACCTCTTCTCGCTCCGGGCCCATTTCAACG 15959
Tiger2              GAAAAACCAACAACCCTTGCTCGAGCGTGTACCTCTTCTCGCTCCGGGCCCATTTCAACG 15959
Clouded_leopard     GAGAAACCAACAATCCTTGCTTGAACGTGTATCTCTTCTCGCTCCGGGCCCATTTTAATG 15843
cheetah             GAGAAACCAGCAATCCTTGCCTGAACGTGTACCTCTTCTCGCTCCGGGCCCATTTCAACG 16050
Cat                 GAGAAACCAGCAATCCTTGCTCGAACGTGTACCTCTTCTCGCTCCGGGCCCATTTCAACG 16040
                    ** ****** *** ******  ** ****** ********************** ** *

Snow_Leopard1       TGGGGGTGTCTATAACGGAACTATATCTGGCATCTGGTTCTTACTTCAGGGTCATGACGT 15986
Snow_Leopard2       TGGGGGTGTCTATAACGGAACTATATCTGGCATCTGGTTCTTACTTCAGGGTCATGACGT 15986
Leopard1            TGGGGGTGTCTATAATGGAACTATATCTGGCATCTGGTTCTTACTTCAGGGCCATGACGT 15966
Tiger1              TGGGGGTGTCTATAGTGAAACTATACCTGGCATCTGGTTCTTACTTCAGGGTCATGACAT 16019
Tiger2              TGGGGGTGTCTATAGTGAAACTATACCTGGCATCTGGTTCTTACTTCAGGGTCATGACAT 16019
Clouded_leopard     TGGGGGTTTCTATAGCGGAACTATATCTGGCATCTGGTTCTTACTTCAGGGTCATAAAAT 15903
cheetah             TGGGGGTTTCTATAACGGAACTATACCTGGCATCTGGTTCTTACCTCAGGGCCATGGAAT 16110
Cat                 TGGGGGTTTCTATAACGGAACTATACCTGGCATCTGGTTCTTACTTCAGGGCCATAAAAT 16100
                    ******* ******  * ******* ****************** ****** ***    *

Snow_Leopard1       -TCTTAAATCCAATCCTTCAACTTTCTCAAATAGGACATCTCGATGGGTTAATGACTAAT 16045
20R
Snow_Leopard2       -TCTTAAATCCAATCCTTCAACTTTCTCAAATAGGACATCTCGATGGGTTAATGACTAAT 16045
Leopard1            -TCTTGAATCCAATCCTTCAACTTTCTCAAATAGGACATCTCGATGGGTTAGTGACTAAT 16025
Tiger1              -TCTTAAATCCAATCCTTCAACTTTCTCAAATAGGACATCTCGATGGGTTAATGACTAAT 16078
Tiger2              -TCTTAAATCCAATCCTTCAACTTTCTCAAATAGGACATCTCGATGGGTTAATGACTAAT 16078
Clouded_leopard     -CCTTGAATCCAATCCTTCAACTTTCTCAAATAGGACATCTCGATGGATTAGTGACTAAT 15962
cheetah             ACCTTGAATCCAATCCTTCAACTTTCTCAAATAGGACATCTCGATGGATTAATGACTAAT 16170
Cat                 -CCTTGAAACCAATCCTTCAGTTCTCTCAAATGGGACATCTCGATGGACTAATGACTAAT 16159
                      *** ** ***********  * ******** **************  ** ********

Snow_Leopard1       CAGCCCATGATCACACATAACTGTGGTGTCATGCATTTGGTATTTTTAATTTTTAGGGGG 16105
Snow_Leopard2       CAGCCCATGATCACACATAACTGTGGTGTCATGCATTTGGTATTTTTAATTTTTAGGGGG 16105
Leopard1            CAGCCCATGATCACACATAACTGTGGTGTCATGCATTTGGTATTTTTAATTTTTAGGGGG 16085
Tiger1              CAGCCCATGATCACACATAACTGTGGTGTCATGCATTTGGTATTTTTAATTTTTAGGGGG 16138
Tiger2              CAGCCCATGATCACACATAACTGTGGTGTCATGCATTTGGTATTTTTAATTTTTAGGGGG 16138
Clouded_leopard     CAGCCCATGATCACACATAACTGTGGTGTCATGCATTTGGTATCTTTTAATTTTTAGGGGG 16022
cheetah             CAGCCCATGATCACACATAACTGTGGTGTCATGCATTTGGTATCTTTAATTTTTAGGGGG 16230
Cat                 CAGCCCATGATCACACATAACTGTGGTGTCATGCATTTGGTATTTTTTATTTTTAGGGGG 16219
                    ****************************************** *** * **********

Snow_Leopard1       TGGAACTTGCTATGACTCAGCTATGACCTAAAGGTCCTGACTCAGTCAAATATAATGTAG 16165
Snow_Leopard2       TGGAACTTGCTATGACTCAGCTATGACCTAAAGGTCCTGACTCAGTCAAATATAATGTAG 16165
Leopard1            TCGAACTTGCTATGACTCAGCTATGACCTAAAGGTCCTGACTCAGTCAAATATAATGTAG 16145
Tiger1              TCGAACTTGCTATGACTCAGCTATGACCTAAAGGTCCCGACTCAGTCAAATATAATGTAG 16198
Tiger2              TCGAACTTGCTATGACTCAGCTATGACCTAAAGGTCCCGACTCAGTCAAATATAATGTAG 16198
Clouded_leopard     TCGAGCTTGCTATGACTCAGCTATGACCTAAAGGTCCTGACTCAGTCAAGTGTAATGTAG 16082
cheetah             TCGAACTTGCTATGACTCAGCTATGACCTAAAGGTCCTGACTCAGTCAAATATATTGTAG 16290
Cat                 TCGAACTTGCTATGACTCAGCTATGACCTAAAGGTCCTGACTCAGTCAAATATATTGTTG 16279
                    * ** ********************************** *********** * ** *** *

Snow_Leopard1       CTGGACTTATTCTCTATGCGGGGGTTCCACACGTACA-ACAAACAAGGTGTTATTCAGTC 16224
Snow_Leopard2       CTGGACTTATTCTCTATGCGGGGGTTCCACACGTACA-ACAAACAAGGTGTTATTCAGTC 16224
Leopard1            CTGGACTTATTCTCTATGCGGGGGTTCCACACGTACA-ACAAACAAGGTGTTATTCAGTC 16204
Tiger1              CTGGACTTATTCTCTATGCGGGGGTTCCACACGTACA-ACAAACAAGGTGTTATTCAGTC 16257
Tiger2              CTGGACTTATTCTCTATGCGGGGGTTCCACACGTACA-ACAAACAAGGTGTTATTCAGTC 16257
Clouded_leopard     CTGGACTTATTCTCTATGCGGGGGTTCCACACGTACA-ACATACAGGGTGCTATTCAGTC 16141
cheetah             CTGGGCTTATTCTCTATGCGGGGTCTCCACACGAACAAACAGTCAAGGTGCTATTCAGTC 16350
Cat                 CTGGGCTTATTCTCTATGCGGGGTCTCCACACGCACAGACAGTCAGGGTGCTATTCAGTC 16339
                    **** ******************  ******** *** ***  ** **** *********

Snow_Leopard1       AATGGTCACAGGACTTATACTTAAATTCCTATTGCTCCACAGGACACGGCATGCGCGCAC 16284
Snow_Leopard2       AATGGTCACAGGACTTATACTTAAATTCCTATTGCTCCACAGGACACGGCATGCGCGCAC 16284
Leopard1            AATGGTCACAGGACATATACTTAAATCCCTATTGCTCCACAGGACACGGCGTGCGCGCAC 16264
Tiger1              AATGGTCACAGGACATATACTTAAATTCCTATTGTTCCACAGGACACGGCATGCGCGCAC 16317
22F
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Tiger2              AATGGTCACAGGACATATACTTAAATTCCTATTGTTCCACAGGACACGGCATGCGCGCAC 16317
Clouded_leopard     AATGGTCACAGGACATATACTTAAATTCCTAATGTTCCACAGGACACGGCATGCGCGCTC 16201
cheetah             AATGGTCACAGGACATATACTTAAATTCCCAATGTTTCACAGGACACGGCATGCGCGCAC 16410
Cat                 AATGGTCACAGGACATATACTTAAATTCCTATTGTTCCACAGGACACGGGATGCGCGCAC 16399
                    ************** *********** ** * ** * ************  ******* *

Snow_Leopard1       CCACGTATACGCGTACACG------TACACGTATACACGTATACACGCATACACGTACAC 16338
Snow_Leopard2       CCACGTATACGCGTACACG------TACACGTATACACGTATACACGCATACACGTACAC 16338
Leopard1            CCACGTATACGTGTACACGC----GTACACGTACACACGTACACACGTACACACGTACAC 16320
Tiger1              CCACGTATACGCGTACACGT----ATACACGTATACACGTACACACGTACACACGTACAC 16373
Tiger2              CCACGTATACGCGTACACGT----ATACACGTATACACGTACACACGTACACACGTACAC 16373
Clouded_leopard     CCACGTATACGCGTACACAC----GTACACGTACACACGTA--CGCGTACACACGTACAC 16255
cheetah             CCACGTATACGCGTACACGTACACGTACACGTACACGTACACGTACACGTACACGTACAC 16470
Cat                 CCACGTTTGCGTGCACACGT----GTACACGTACACACGTACACACGTACACACGTACAC 16455
                    ****** * ** * ****       ******** **    *    *    **********

Snow_Leopard1       ACGTAC------------------------------------------------------ 16344
Snow_Leopard2       ACGTAC------------------------------------------------------ 16344
Leopard1            ACGTACGCGTACACGTACACACGTACACACGTACACACGTACACACGTACACACGTACAC 16380
Tiger1              ACGTAC----ACACGTACACACGTATACACGTATACACGTATACACGTATACACGTATAC 16429
Tiger2              ACGTAC----ACACGTACACACGTATACACGTATACACGTATACACGTATACACGTATAC 16429
Clouded_leopard     GTACACACGTACACGTACACACGTACACGTACACACGTACGCGTACACACGTACACGTAC 16315
cheetah             GTACAC------------------------GTACACGTACACGTACACGTACACGTACAC 16506
Cat                 ----AC------------------------GTAC----ACACGTACA----CACGTACAC 16479
                        **

Snow_Leopard1       ------------------------------------------------------------
Snow_Leopard2       ------------------------------------------------------------
Leopard1            ACGTACACACGTACACACGTACACACGTACGCGTACACGTACACACGTACACACGTACAC 16440
Tiger1              ACGTATACACGTATACACGTATACACGTATACACGTATACACGTACACACGTACACACGT 16489
Tiger2              ACGTATACACGTATACACGTATACACGTATACACGTATACACGTACACACGTACACACGT 16489
Clouded_leopard     ACACGTACACGTACACACGTACACGTACACACGTACACGTACACGTACACGTACACACGT 16375
cheetah             GTACACGTACACGTACACGTACACGTACACGTACACGTACACGTACACGTACACGTACAC 16566
Cat                 ACGTACACACGTACACACGTACACACGTACACACGTACACACGTACACACGTACACACGT 16539


Snow_Leopard1       ------------------------------------ACGTATACACGTACACACGTACAC 16368
Snow_Leopard2       ------------------------------------ACGTATACACGTACACACGTACAC 16368
Leopard1            ACGTACACACGTACGCGTACACGTACACACGTACACACGTACACACGTACACACGTACAC 16500
Tiger1              ACACACGTACACACGTATACACGTATACACGTATACACGTATACACGTATACGCGTACAC 16549
Tiger2              ACACACGTACACACGTATACACGTATACACGTATACACGTATACACGTATACGCGTACAC 16549
Clouded_leopard     ACG--CGTACACACGTACACGTACACGTACACACGTACGCGTACACACGTACACGTACAC 16433
cheetah             GTACACGTACACGTACACGTACACGTACACGTACACGTACACGTACACGTACACGTACAC 16626
Cat                 ACACACGTACACACGTACACACGTGTACACGTACACACGTACACACGTGTACACGTACAC 16599
                                                             **    ** *******

Snow_Leopard1       GTA----------TACACGTACACGTACACGTACACGTATACACGTACACACGTACACGT 16418
Snow_Leopard2       GTA----------TACACGTACACGTACACGTACACGTATACACGTACACACGTACACGT 16418
Leopard1            GTACACGTACACGTACACGTACACGTACACGTACACACGTACACACGTACACACGTACAC 16560
Tiger1              GTACAC----ACGTACACACGTACACACGTACACACGTACACACGTACACACGTACACAC 16605
Tiger2              GTACAC----ACGTACACACGTACACACGTACACACGTACACACGTACACACGTACACAC 16605
Clouded_leopard     GTACAC----GTACACACGTACACGTACACGTACACACGTACACACGTACACACGTACAC 16489
cheetah             GTACAC------GTACACGTACACGTACACGTACACGTACACGTACACGTACACGTACAC 16680
Cat                 ----AC------GTACACACGTACACACGTGTACACGTACACACGTACACACGTACACAC 16649
                                 ****    **  **    ******* **    **  **    **

Snow_Leopard1       ----ACACGTACACACGTACACACGTACA----CACGTACACACGTACAC---------- 16460
Snow_Leopard2       ----ACACGTACACACGTACACACGTACA----CACGTACACACGTACAC---------- 16460
Leopard1            GTACACACGTACACACGTACACACGTACA----CACGTACACACGTACACACGTATACAC 16616
Tiger1              GTACACACGTACACACGTACACACGTACA----CACGTACACACGTACACACGTAC---- 16657
Tiger2              GTACACACGTACACACGTACACACGTACA----CACGTACACACGTACACACGTAC---- 16657
Clouded_leopard     --ACACACGCGCACACACGGACTCGTACA----CACGTACACACGCACAC---------- 16533
cheetah             GTACACGTACACGTACACGTACACGTACACGTACACACGTATACAC-------- 16732
Cat                 GTACACACGTACACACGTGTACACGTACA----CACGTACACACGTACACAC-------- 16697
                        **     *  **    ** ******    ************ * **

Snow_Leopard1       ---------------------------------------GTATACACGTATACACATGC 16480
Snow_Leopard2       ---------------------------------------GTATACACGTATACACATGC 16480
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Leopard1            GTATACACGTATACACGTATACACGTATACACGTATACACGTATACACGTACACACATGC 16676
Tiger1              --------------------ACACGTATACACGTATACACGTATACACGTATACACATGC 16697
Tiger2              --------------------ACACGTATACACGTATACACGTATACACGTATACACATGC 16697
Clouded_leopard     ----------------------------------------GTACACACGTACACACATGC 16553
cheetah             ----------------------------------------GTATACACGTATACACATGC 16752
Cat                 ----------------------------------------GTACACACGTATACAC--GC 16715
                                                            *** ******* ****  **

Snow_Leopard1       AAACTTTT--TTGATTTAGTAAATAATTAGCTTA-AACAAACCCCCCTTACCCCCCGTTA 16537
21R
Snow_Leopard2       AAACTTTT--TTGATTTAGTAAATAATTAGCTTA-AACAAACCCCCCTTACCCCCCGTTA 16537
Leopard1            AAACTTTT--T-GATTTAGTAAACAATTAGCTTA-AACAAACCCCCCTTACCCCCCGTTA 16732
Tiger1              AAACTTTT--TTGATTTAGTAAATAATTAGCTTA-ACCAAACCCCCCTTACCCCCCGTTA 16754
Tiger2              AAACTTTT--TTGATTTAGTAAATAATTAGCTTA-ACCAAACCCCCCTTACCCCCCGTTA 16754
Clouded_leopard     ATACATTTGTTTGATTCGATTC-TAGTTATCTTATATCAAACCCCCCTTACCCCCCGATA 16612
cheetah             AAACACTT--ATGATTTAGTAAACAACTAGCTTA-ATCAAACCCCCCTTACCCCCCGTTA 16809
Cat                 GAACGCTT--TAATTTAAGTAAATAACTAGCTTA-ATCAAACCCCCCTTACCCCCCGTTA 16772
                      **  **      **   *    *  ** **** * ******************** **

Snow_Leopard1       ACCTTATTTATTACAATACGTGTCTATTTCTGTCTTGCCAAACCCCAAAAACAAGACTAA 16597
Snow_Leopard2       ACCTTATTTATTACAATACGTGTCTATTTCTGTCTTGCCAAACCCCAAAAACAAGACTAA 16597
Leopard1            ATCTTATTTATTATAATACGTGTCTATTTCTGTCTTGCCAAACCCCAAAAACAAGACTAA 16792
Tiger1              ATCTTATTTATTATAGTACGTGTTTATTTCTGTCTTGCCAAACCCCAAAAACAAGACTAA 16814
Tiger2              ATCTTATTTATTATAGTACGTGTTTATTTCTGTCTTGCCAAACCCCAAAAACAAGACTAA 16814
Clouded_leopard     ACCTTACTTATGACAATACGTGTCTCACAATGTCTTGCCTAACCC-AAATACGAGACTAA 16671
cheetah             ACCTTATTTATAATAATACGTGTCTATTTATGTCCTGCCAAACCCCAAAAACAAGACTAG 16869
Cat                 ACCTTATTTATAATAATACGTGCCTATTTATGTCTTGCCAAACCCCACAAACAAGACTAG 16832
                    * **** **** * * ******  *     **** **** ***** * * ** ******

Snow_Leopard1       ACC-GTATCCAAGCATAAGGCCTAAGAATTAACGTTTATA-AACTTTACCAACCCC--AT 16653
Snow_Leopard2       ACC-GTATCCAAGCATAAGGCCTAAGAATTAACGTTTATA-AACTTTACCAACCCC--AT 16653
Leopard1            ACC-GTATTTAAGCGCAAGGCCTAAGAATTAACGTTTACA-AACTTTACCAACCCC--AT 16848
Tiger1              ACCCGTATCTAGGCACAAGGCCTAAGA-TTAACGTTTACA-AACTCTACCAACCCC--AT 16870
Tiger2              ACCCGTATCTAGGCACAAGGCCTAAGA-TTAACGTTTACA-AACTCTACCAACCCC--AT 16870
Clouded_leopard     ACACGTCTCCTGATGTAGTGACTAAGACATAACGTGTATAGAACTTGACCAAGCCC--AG 16729
cheetah             ACC-GTACCTAAACATAAGGCCTAAGA--AAACGCTTATA-AGCTTTACCAATCCCCTAT 16925
Cat                 ACC-GTACCTAAATATAAGGCCTAAGA--AAACGCTTATA-AGCTT-ACCAATCCCCTAT 16887
                    **  **          *  * ******   ****  ** * * **  ***** ***  *

Snow_Leopard1       CATTACCAATTATTGACACTAAATCATAACTTTGTTCGCAGTTATCTATAGATACGTCAA 16713
Snow_Leopard2       CATTACCAATTATTGACACTAAATCATAACTTTGTTCGCAGTTATCTATAGATACGTCAA 16713
Leopard1            TATTGCTAATTACTAATACTAAATCACAACTTTGTTCGCAGT-ATCTATAGATACGCCAA 16907
Tiger1              CATTACCAATTATTAATACTAAATCATAACTTCGTTCGCAGTTATCTATAGATACGACAA 16930
Tiger2              CATTACCAATTATTAATACTAAATCATAACTTCGTTCGCAGTTATCTATAGATACGACAA 16930
Clouded_leopard     GTGATACAACTAATAATACTAAATCATA-CTTTGTT-GCAGT-ATCTATAGATACGCCGA 16786
cheetah             CATCGCTAATCATTAGTACCAAATCATAACTCTGTTCGCAGTTATCTATAGATACGCCAA 16985
Cat                 TATTACTAGCTACTAATACTAAATCATAACTCTGTTCGCAGTTATCTATAGATATACCGA 16947
                           *   * *   ** ****** * **  *** ***** ***********   * *

Snow_Leopard1       CCCGATCTCTAACTCGTCCCTATCGAACAATA-TTTACACACCCAA--CAATCCTACATC 16770
Snow_Leopard2       CCCGATCTCTAACTCGTCCCTATCGAACAATA-TTTACACACCCAA--CAATCCTACATC 16770
Leopard1            CCCGATCTCTAATTCGTCCCTATTGAACAATA-CTTACACACCCGA--CAATCCACCCTA 16964
Tiger1              CCCGATCTCTAATTCGTCCCTATCGAACAATA-TTTACATACCCAA--CAACCCTATGTC 16987
Tiger2              CCCGATCTCTAATTCGTCCCTATCGAACAATA-TTTACATACCCAA--CAACCCTATGTC 16987
Clouded_leopard     CCTGATCTCTAATTCG-CCCTATCGAGCAACA-CTCACGCACC-AA--TATCTCGCATCC 16841
cheetah             CCGGC-CTCTGATTCGTCCCTATCGAACAACATCTTACACATCCAAATCAACCCTGCGTC 17044
Cat                 CCTGA-CTCTAATTCGTCCCTATCGAACAACATTTTACATGTCTACGTTAGCCCCACATC 17006
                    ** *  **** * *** ****** ** *** *  * **    *     *   *

Snow_Leopard1       TTG 16773
Snow_Leopard2       TTG 16773
Leopard1            ---
Tiger1              TTG 16990
Tiger2              TTG 16990
Clouded_leopard     TTA 16844
cheetah             TCA 17047
Cat                 CCA 17009
```

6.4 Appendix 4: The alignments of tiger sequences, obtained from GenBank and this study, for each mitochondrial genes.

12S rRNA

```
ALTAICA      AAAGGTTTGGTCCTAGCCTTTCCATTAGTTGTTAATAAAATTACACATGCAAGCCTCCGCATCCCGGTGAAAATGCCCTC
ALTAICA4     -...............................................................................
ALT          --------------------------------------------------------------------------------
Pta          --------------------------------------------------------------------------------
Pta.FM179471 --------------------------------------------------------------------------------
TIGRIS1      ................................................................................
TIGRIS2      ................................................................................
TIG1         --------------------------------------------------------------------------------
TIG2         --------------------------------------------------------------------------------
TIG3         --------------------------------------------------------------------------------
TIG4         --------------------------------------------------------------------------------
TIG5         --------------------------------------------------------------------------------
TIG6         --------------------------------------------------------------------------------
TIG*7        --------------------------------------------------------------------------------
TIG*8        --------------------------------------------------------------------------------
TIG*9        --------------------------------------------------------------------------------
TIG*10       --------------------------------------------------------------------------------
Ptt          --------------------------------------------------------------------------------
Ptt.FM179470 --------------------------------------------------------------------------------
SUMATRA1     ................................................................................
SUMATRA2     ................................................................................
SUM1         --------------------------------------------------------------------------------
SUM2         --------------------------------------------------------------------------------
SUM3         --------------------------------------------------------------------------------
SUM4         --------------------------------------------------------------------------------
SUM5         --------------------------------------------------------------------------------
SUM6         --------------------------------------------------------------------------------
SUM7         --------------------------------------------------------------------------------
SUM8         --------------------------------------------------------------------------------
AMO1         --------------------------------------------------------------------------------
AMO2         --------------------------------------------------------------------------------
AMO3/COR1    --------------------------------------------------------------------------------
COR2         --------------------------------------------------------------------------------
COR3         --------------------------------------------------------------------------------
COR4         --------------------------------------------------------------------------------
COR5         --------------------------------------------------------------------------------
COR6         --------------------------------------------------------------------------------
COR7         --------------------------------------------------------------------------------
COR8         --------------------------------------------------------------------------------
CORBETTI1    ------------------------.......................................................
CORBETTI2    ................................................................................

ALTAICA      TAAATCACCCAGTGATCCAAAGGAGCCGGTATCAAGTACACAACCATTGTAGCTCATGACACCTTGCTCAGCCACACCCC
ALTAICA4     ................................................................................
ALT          --------------------------------------------------------------------------------
Pta          -------........C.T........T.........C.........C....A........--..................
Pta.FM179471 --------------------------------------------------------------------------------
TIGRIS1      ................................................................................
TIGRIS2      ................................................................................
TIG1         --------------------------------------------------------------------------------
TIG2         --------------------------------------------------------------------------------
TIG3         --------------------------------------------------------------------------------
TIG4         --------------------------------------------------------------------------------
TIG5         --------------------------------------------------------------------------------
TIG6         --------------------------------------------------------------------------------
TIG*7        --------------------------------------------------------------------------------
TIG*8        --------------------------------------------------------------------------------
TIG*9        --------------------------------------------------------------------------------
TIG*10       --------------------------------------------------------------------------------
Ptt          -------........C.T........T..C......CT...................A.....................
Ptt.FM179470 --------------------------------------------------------------------------------
SUMATRA1     ................................................................................
SUMATRA2     ................................................................................
SUM1         --------------------------------------------------------------------------------
SUM2         --------------------------------------------------------------------------------
```

```
SUM3          ----------------------------------------------------------------------------------
SUM4          ----------------------------------------------------------------------------------
SUM5          ----------------------------------------------------------------------------------
SUM6          ----------------------------------------------------------------------------------
SUM7          ----------------------------------------------------------------------------------
SUM8          ----------------------------------------------------------------------------------
AMO1          ----------------------------------------------------------------------------------
AMO2          ----------------------------------------------------------------------------------
AMO3/COR1     ----------------------------------------------------------------------------------
COR2          ----------------------------------------------------------------------------------
COR3          ----------------------------------------------------------------------------------
COR4          ----------------------------------------------------------------------------------
COR5          ----------------------------------------------------------------------------------
COR6          ----------------------------------------------------------------------------------
COR7          ----------------------------------------------------------------------------------
COR8          ----------------------------------------------------------------------------------
CORBETTI1     ..................................................................................
CORBETTI2     ..................................................................................

ALTAICA       CACGGGATACAGCAGTGATAAAAATTAAGCCATGAATGAAAGTTCGACTAAGCTATATTAAATTAGGGTTGGTAAATTTC
ALTAICA4      .......C..........................................................................
ALT           ----------------------------------------------------------------------------------
Pta           ............................T.....................G........CA.....................
Pta.FM179471  ----------------------------------------------------------------------------------
TIGRIS1       ..................................................................................
TIGRIS2       ..................................................................................
TIG1          ----------------------------------------------------------------------------------
TIG2          ----------------------------------------------------------------------------------
TIG3          ----------------------------------------------------------------------------------
TIG4          ----------------------------------------------------------------------------------
TIG5          ----------------------------------------------------------------------------------
TIG6          ----------------------------------------------------------------------------------
TIG*7         ----------------------------------------------------------------------------------
TIG*8         ----------------------------------------------------------------------------------
TIG*9         ----------------------------------------------------------------------------------
TIG*10        ----------------------------------------------------------------------------------
Ptt           ............................T.....................................................
Ptt.FM179470  ----------------------------------------------------------------------------------
SUMATRA1      ..................................................................................
SUMATRA2      ..................................................................................
SUM1          ----------------------------------------------------------------------------------
SUM2          ----------------------------------------------------------------------------------
SUM3          ----------------------------------------------------------------------------------
SUM4          ----------------------------------------------------------------------------------
SUM5          ----------------------------------------------------------------------------------
SUM6          ----------------------------------------------------------------------------------
SUM7          ----------------------------------------------------------------------------------
SUM8          ----------------------------------------------------------------------------------
AMO1          ----------------------------------------------------------------------------------
AMO2          ----------------------------------------------------------------------------------
AMO3/COR1     ----------------------------------------------------------------------------------
COR2          ----------------------------------------------------------------------------------
COR3          ----------------------------------------------------------------------------------
COR4          ----------------------------------------------------------------------------------
COR5          ----------------------------------------------------------------------------------
COR6          ----------------------------------------------------------------------------------
COR7          ----------------------------------------------------------------------------------
COR8          ----------------------------------------------------------------------------------
CORBETTI1     .......C..........................................................................
CORBETTI2     .......C..........................................................................

ALTAICA       GTGCCAGCCACCGCGGTCATACGATTAACCCAAACTAATAGACCCACGGCGTAAAGCGTGTTACAGA--AAAAAGTATAC
ALTAICA4      ...............................................................--...........
ALT           ----------------------------------------------------------------------------------
Pta           ......................A.................................A.........GA....CTC....
Pta.FM179471  ----------------------------------------------------------------------------------
TIGRIS1       ...............................................................--...........
TIGRIS2       ...............................................................--...........
TIG1          ----------------------------------------------------------------------------------
TIG2          ----------------------------------------------------------------------------------
TIG3          ----------------------------------------------------------------------------------
TIG4          ----------------------------------------------------------------------------------
TIG5          ----------------------------------------------------------------------------------
TIG6          ----------------------------------------------------------------------------------
TIG*7         ----------------------------------------------------------------------------------
TIG*8         ----------------------------------------------------------------------------------
TIG*9         ----------------------------------------------------------------------------------
```

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TIG*10       ----------------------------------------------------------------------------------
Ptt          ..........................................T.....................-AG...CA.....
Ptt.FM179470 ----------------------------------------------------------------------------------
SUMATRA1     ..............................................................--..........
SUMATRA2     ..............................................................--..........
SUM1         ----------------------------------------------------------------------------------
SUM2         ----------------------------------------------------------------------------------
SUM3         ----------------------------------------------------------------------------------
SUM4         ----------------------------------------------------------------------------------
SUM5         ----------------------------------------------------------------------------------
SUM6         ----------------------------------------------------------------------------------
SUM7         ----------------------------------------------------------------------------------
SUM8         ----------------------------------------------------------------------------------
AMO1         ----------------------------------------------------------------------------------
AMO2         ----------------------------------------------------------------------------------
AMO3/COR1    ----------------------------------------------------------------------------------
COR2         ----------------------------------------------------------------------------------
COR3         ----------------------------------------------------------------------------------
COR4         ----------------------------------------------------------------------------------
COR5         ----------------------------------------------------------------------------------
COR6         ----------------------------------------------------------------------------------
COR7         ----------------------------------------------------------------------------------
COR8         ----------------------------------------------------------------------------------
CORBETTI1    ..............................................................--..........
CORBETTI2    ..............................................................--..........

ALTAICA      TAAAGTTA---AGCCTTAACTAGGCTGTAAAAAGCCACAGTTAACGTAAAAATACAGCACGAAAGTAACTTTAATATTTC
ALTAICA4     ........---.....................................................................
ALT          ----------------------------------------------------------------------------------
Pta          ........ACT.......................T.....................................C..C..
Pta.FM179471 ----------------------------------------------------------------------------------
TIGRIS1      ........---.....................................................................
TIGRIS2      ........---.....................................................................
TIG1         ----------------------------------------------------------------------------------
TIG2         ----------------------------------------------------------------------------------
TIG3         ----------------------------------------------------------------------------------
TIG4         ----------------------------------------------------------------------------------
TIG5         ----------------------------------------------------------------------------------
TIG6         ----------------------------------------------------------------------------------
TIG*7        ----------------------------------------------------------------------------------
TIG*8        ----------------------------------------------------------------------------------
TIG*9        ----------------------------------------------------------------------------------
TIG*10       ----------------------------------------------------------------------------------
Ptt          ........---CA.....................TG........A........T.....................C..
Ptt.FM179470 ----------------------------------------------------------------------------------
SUMATRA1     ........---.....................................................................
SUMATRA2     ........---.....................................................................
SUM1         ----------------------------------------------------------------------------------
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SUM7         ----------------------------------------------------------------------------------
SUM8         ----------------------------------------------------------------------------------
AMO1         ----------------------------------------------------------------------------------
AMO2         ----------------------------------------------------------------------------------
AMO3/COR1    ----------------------------------------------------------------------------------
COR2         ----------------------------------------------------------------------------------
COR3         ----------------------------------------------------------------------------------
COR4         ----------------------------------------------------------------------------------
COR5         ----------------------------------------------------------------------------------
COR6         ----------------------------------------------------------------------------------
COR7         ----------------------------------------------------------------------------------
COR8         ----------------------------------------------------------------------------------
CORBETTI1    ........---.....................................................................
CORBETTI2    ........---.....................................................................

ALTAICA      TGACCACACGATAGCTAAGACCCAAACTGGGATTAGATACCCCACTATGCTTAGCCCTAAACCTAGATAGTTAACCCAAA
ALTAICA4     .....................................................................................
ALT          -------.....................................................................
Pta          C.....................................................................T.A.T...
Pta.FM179471 ----------------------.....................................-.........-......
TIGRIS1      .....................................................................
TIGRIS2      .....................................................................
TIG1         -------.....................................................................
TIG2         -------.....................................................................
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TIG3         -------.....................................................................
TIG4         -------.....................................................................
TIG5         -------.....................................................................
TIG6         -------.....................................................................
TIG*7        ---------------------------------------------------------------------------
TIG*8        ---------------------------------------------------------------------------
TIG*9        ---------------------------------------------------------------------------
TIG*10       ---------------------------------------------------------------------------
Ptt          C.....................................................................T....
Ptt.FM179470 ----------------------.....................................-.................
SUMATRA1     .....................................................................................
SUMATRA2     .....................................................................................
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AMO1         -------.....................................................................
AMO2         -------.....................................................................
AMO3/COR1    -------.....................................................................
COR2         -------.....................................................................
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COR4         -------.....................................................................
COR5         -------.....................................................................
COR6         -------.....................................................................
COR7         -------.....................................................................
COR8         -------.....................................................................
CORBETTI1    .....................................................................................
CORBETTI2    .....................................................................................

ALTAICA      CAAAACTATCCGCCAGAGAACTACTAGCAACAGCTTAAAACTCAAAGGACTTGGCGGTGCTTTATATCCCTCTAGAGGAG
ALTAICA4     .....................................................................................
ALT          .....................................................................................
Pta          ...........T.....................................A.....................
Pta.FM179471 .....................................................................................
TIGRIS1      .....................................................................................
TIGRIS2      .....................................................................................
TIG1         .....................................................................................
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TIG3         .....................................................................................
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TIG6         .....................................................................................
TIG*7        ---------------------------------------------------------------------------
TIG*8        ---------------------------------------------------------------------------
TIG*9        ---------------------------------------------------------------------------
TIG*10       ---------------------------------------------------------------------------
Ptt          .....................................................................................
Ptt.FM179470 .....................................................................................
SUMATRA1     .....................................................................................
SUMATRA2     .....................................................................................
SUM1         ......C..............................................................................
SUM2         .....................................................................................
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SUM6         .....................................................................................
SUM7         .....................................................................................
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AMO1         .....................................................................................
AMO2         .....................................................................................
AMO3/COR1    .....................................................................................
COR2         .....................................................................................
COR3         .....................................................................................
COR4         .....................................................................................
COR5         .....................................................................................
COR6         .....................................................................................
COR7         .....................................................................................
COR8         .....................................................................................
CORBETTI1    .....................................................................................
CORBETTI2    .....................................................................................

ALTAICA      CCTGTTCCATAATCGATAAACCCCGATAAACCTCACCATCTCTTGCTAATTCAGCCTATATACCGCCATCTTCAGCAAAC
ALTAICA4     .....................................................................................
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ALT             ..........................................................................
Pta             .......T.C...T.............T.................................................
Pta.FM179471    ..........................................................................
TIGRIS1         ..........................................................................
TIGRIS2         ..........................................................................
TIG1            ..........................................................................
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TIG*7           --------------------------------------------------------------------------
TIG*8           --------------------------------------------------------------------------
TIG*9           --------------------------------------------------------------------------
TIG*10          --------------------------------------------------------------------------
Ptt             .......T.....................................C.........GC.....................
Ptt.FM179470    ..........................................................................
SUMATRA1        ..........................................................................
SUMATRA2        ..........................................................................
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AMO1            ..........................................................................
AMO2            ..........................................................................
AMO3/COR1       ..........................................................................
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COR4            ..........................................................................
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COR6            ..........................................................................
COR7            ..........................................................................
COR8            ..........................................................................
CORBETTI1       ..........................................................................
CORBETTI2       ..........................................................................

ALTAICA         CCTAAAAA-GGAAGAAAAGTAAGCACAAGTATCTTAACATAAAAAAGTTAGGTCAAGGTGTAGCCCATGAGATGGGGAAG
ALTAICA4        .........-................................................................
ALT             .........-................................................................
Pta             .........A..............................C.................T...................-...
Pta.FM179471    .........-................................................................A..C
TIGRIS1         .........-................................................................
TIGRIS2         .........-................................................................
TIG1            .........-................................................................
TIG2            .........-................................................................
TIG3            .........-................................................................
TIG4            .........-................................................................
TIG5            .........-................................................................
TIG6            .........-................................................................
TIG*7           ------------------------------------------.................................
TIG*8           ------------------------------------------.................................
TIG*9           ------------------------------------------.................................
TIG*10          ------------------------------------------.................................
Ptt             .........-....................GC.......C.....................................-...
Ptt.FM179470    .........-................................................................
SUMATRA1        .........-................................................................
SUMATRA2        .........-................................................................
SUM1            ...G....-................................................................
SUM2            .........-................................................................
SUM3            .........-................................................................
SUM4            ...G....-................................................................
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SUM6            .........-................................................................
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SUM8            .........-................................................................
AMO1            .........-................................................................
AMO2            .........-................................................................
AMO3/COR1       .........-................................................................
COR2            .........-................................................................
COR3            .........-................................................................
COR4            .........-................................................................
COR5            .........-................................................................
COR6            .........-................................................................
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COR7          ........-.....................................................................
COR8          ........-.....................................................................
CORBETTI1     ........-.....................................................................
CORBETTI2     ........-.....................................................................

ALTAICA       TAATGGGCTACATTTTCTACAACTAGAACATCCACG-AAAATCCTTATGAAATTAAGTATTAAAGGAGGATTTAGTAGTA
ALTAICA4      ...................T.............-.....................................................
ALT           ...................T.............-.....................................................
Pta           C.................GT........T.C.....-.............C....G.C.....................
Pta.FM179471  ...G.......T.......T.....A.........T-.....................................................
TIGRIS1       ....................................-.....................................................
TIGRIS2       ....................................-.....................................................
TIG1          ....................................-.....................................................
TIG2          ....................................-.....................................................
TIG3          ....................................-.....................................................
TIG4          ...................T.............-.....................................................
TIG5          ....................................-.....................................................
TIG6          ....................................-.....................................................
TIG*7         ....................................-.....................................................
TIG*8         ....................................-.....................................................
TIG*9         ....................................-.....................................................
TIG*10        ...................T.............-.....................................................
Ptt           C...................................CT.....................................................
Ptt.FM179470  ....................................-.....................................................
SUMATRA1      ....................................-.....................................................
SUMATRA2      ....................................-.....................................................
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SUM7          ....................................-.....................................................
SUM8          ....................................-.....................................................
AMO1          ....................................-.....................................................
AMO2          ...................T.............-.....................................................
AMO3/COR1     ...................T.............-.....................................................
COR2          ...................T.............-.....................................................
COR3          ...................T.............-.....................................................
COR4          ....................................-.....................G.................
COR5          ....................................-.....................G.................
COR6          ....................................-.....................................................
COR7          ....................................-.....................................................
COR8          ....................................-.....................................................
CORBETTI1     ...................T.............-.....................................................
CORBETTI2     ...................T.............-.....................................................

ALTAICA       AATTCGAGAATAGAGAGCTCGATTGAATCGGGCCATGAAGCACGCACACACCGCCCGTCACCCTCCTCAAGTGATTAGAC
ALTAICA4      .....................................................................................
ALT           .....................................................................................
Pta           ....-.............A.....................----------------------------------
Pta.FM179471  .................A.....................................----------------
TIGRIS1       .....................................................................................
TIGRIS2       .....................................................................................
TIG1          .....................................................................................
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TIG5          .....................................................................................
TIG6          .....................................................................................
TIG*7         ..............................----------------------------------------------
TIG*8         .............................-----------------------------------------------
TIG*9         ..............................----------------------------------------------
TIG*10        .............................-----------------------------------------------
Ptt           ....T....G.........A.....................----------------------------------
Ptt.FM179470  ..........................................----------------------------------
SUMATRA1      .....................................................................................
SUMATRA2      .....................................................................................
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SUM7          .....................................................................................
SUM8          .....................................................................................
AMO1          .....................................................................................
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AMO3/COR1     ...........................................................................
COR2          ...........................................................................
COR3          ...........................................................................
COR4          ...........................................................................
COR5          ...........................................................................
COR6          ...........................................................................
COR7          ...........................................................................
COR8          ...........................................................................
CORBETTI1     ...........................................................................
CORBETTI2     ...........................................................................

ALTAICA       CCCAAAGAAACCTATTCAAACCACTACACCCACAAGAGGAGACAAGTCGTAACAAGGTAAGCATACTGGAAAGTGTGCTT
ALTAICA4      ...........................................................................
ALT           ........................----------------------------------------------------------
Pta           ---------------------------------------------------------------------------
Pta.FM179471  ---------------------------------------------------------------------------
TIGRIS1       ...........................................................................
TIGRIS2       ...........................................................................
TIG1          ........................----------------------------------------------------------
TIG2          ........................----------------------------------------------------------
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TIG5          ........................----------------------------------------------------------
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TIG*7         ---------------------------------------------------------------------------
TIG*8         ---------------------------------------------------------------------------
TIG*9         ---------------------------------------------------------------------------
TIG*10        ---------------------------------------------------------------------------
Ptt           ---------------------------------------------------------------------------
Ptt.FM179470  ---------------------------------------------------------------------------
SUMATRA1      ...........................................................................
SUMATRA2      ...........................................................................
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AMO3/COR1     ........................----------------------------------------------------------
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COR6          ........................----------------------------------------------------------
COR7          ........................----------------------------------------------------------
COR8          ........................----------------------------------------------------------
CORBETTI1     ...........................................................................
CORBETTI2     ...........................................................................

ALTAICA       GGATAA
ALTAICA4      ......
ALT           ------
Pta           ------
Pta.FM179471  ------
TIGRIS1       ......
TIGRIS2       ......
TIG1          ------
TIG2          ------
TIG3          ------
TIG4          ------
TIG5          ------
TIG6          ------
TIG*7         ------
TIG*8         ------
TIG*9         ------
TIG*10        ------
Ptt           ------
Ptt.FM179470  ------
SUMATRA1      ......
SUMATRA2      ......
SUM1          ------
SUM2          ------
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SUM3          ------
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SUM8          ------
AMO1          ------
AMO2          ------
AMO3/COR1     ------
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COR5          ------
COR6          ------
COR7          ------
COR8          ------
CORBETTI1     ......
CORBETTI2     ......
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ALTAICA4   AGCTAGAGCTAGCCCAACTACCCATAAACACAACTAACATTAGAAAGTAAAACAAAACATTTAGTTACTCTAAAAAGTAT
ALTAICA    ................................................................................
TIGRIS1    ................................................................................
TIGRIS2    ................................................................................
PttMenghu12 --------------------------------------------------------------------------------
SUMATRA1   ................................................................................
SUMATRA2   ................................................................................

ALTAICA4   AGGAGATAGAAATTTAACTCGGCGCTATAGAAAAAGTACCGCAAGGGAATGATGAAAGAAAAAACTAAAAGCACTATACA
ALTAICA    ................................................................................
TIGRIS1    ................................................................................
TIGRIS2    ................................................................................
PttMenghu12 --------------------------------------------------------------------------------
SUMATRA1   ................................................................................
SUMATRA2   ................................................................................

ALTAICA4   GCAAAGATTACCCCTTGTACCTTTTGCATAATGAATTAGCTAGAATAACCTAACAAAGAGAACTTCAGCTAGGCCCCCCG
ALTAICA    ................................................................................
TIGRIS1    ................................................................................
TIGRIS2    ................................................................................
PttMenghu12 --------------------------------------------------------------------------------
SUMATRA1   ................................................................................
SUMATRA2   ................................................................................

ALTAICA4   AAACCAGACGAGCTACCCATAAACAATCTATTACAGGATGAACTCGTCTATGTTGCAAAATAGTGAGAAGATTTATGGGT
ALTAICA    ................................................................................
TIGRIS1    ................................................................................
TIGRIS2    ................................................................................
PttMenghu12 --------------------------------------------------------------------------------
SUMATRA1   ................................................................................
SUMATRA2   ................................................................................

ALTAICA4   AGAGGTGAAAAGCCTAACGAGCCTGGTGATAGCTGGTTGCCCAGAACAGAATCTTAGTTCAGCTTTAAACTTACCTCAAA
ALTAICA    ................................................................................
TIGRIS1    ................................................................................
TIGRIS2    ................................................................................
PttMenghu12 --------------------------------------------------------------------------------
SUMATRA1   ................................................................................
SUMATRA2   ................................................................................

ALTAICA4   AACCCTAAAATTCCAATGTAAGTTTAAAATATAGTCTAAAAAGGTACAGCTTTTTAGAATCTAGGATACAGCCTTAATTA
ALTAICA    ................................................................................
TIGRIS1    ................................................................................
TIGRIS2    ................................................................................
PttMenghu12 --------------------------------------------------------------------------------
SUMATRA1   ...........................C....................................................
SUMATRA2   ...........................C....................................................

ALTAICA4   GAGAGTAAGCATATAACACAAACCATAGTTGGCCTAAAAGCAGCCACCAATTAAGAAAGCGTTCAAGCTCAACAATCAAA
ALTAICA    ................................................................................
TIGRIS1    ................................................................................
TIGRIS2    ................................................................................
PttMenghu12 --------------------------------------------------------------------------------
SUMATRA1   ................................................................................
SUMATRA2   ................................................................................

ALTAICA4   ACATCTCAATGTCAAAAAACGCAACCAACTCCTAATCTAAAACTGGGCTAATCTATTTAACAATAGAAGCAATAATGCTA
ALTAICA    ................................................................................
TIGRIS1    ..............................................C.................................
TIGRIS2    ..............................................C.................................
PttMenghu12 --------------------------------------------------------------------------------
SUMATRA1   ................................................................................
SUMATRA2   ................................................................................

ALTAICA4   ATATGAGTAACAAGAAATACTTCTCCCGCGCATAAGCTTATATCAGAACGGATAACCACTGATAGTTAACAACAAGATAT
ALTAICA    ................................................................................
TIGRIS1    ................................................................................
TIGRIS2    ................................................................................
PttMenghu12 --------------------------------------------------------------------------------
SUMATRA1   ................................................................................
SUMATRA2   ................................................................................

ALTAICA4   ATATAACCTAACTACAAGCAAAATATCAGACTAATTGTTAACCCAACACAGGCATGCAATTTAGGGAAAGATTAAAAGAA
ALTAICA    ................................................................................
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TIGRIS1     ....................................................................................
TIGRIS2     ....................................................................................
PttMenghu12 ------------------------------------------------------------------------------------
SUMATRA1    ........C...........................................................................
SUMATRA2    ........C...........................................................................

ALTAICA4    GTAAAAGGAACTCGGCAAACACAAGCCCCGCCTGTTTACCAAAAACATCACCTCTAGCATTTCCAGTATTAGAGGCACTG
ALTAICA     ....................................................................................
TIGRIS1     ....................................................................................
TIGRIS2     ....................................................................................
PttMenghu12 ------------------------------------------------------------------------------------
SUMATRA1    ....................................................................................
SUMATRA2    ....................................................................................

ALTAICA4    CCTGCCCAGTGACATTAGTTAAACGGCCGCGGTATCCTGACCGTGCAAAGGTAGCATAATCATTTGTTCCTTAAATAGGG
ALTAICA     ....................................................................................
TIGRIS1     ....................................................................................
TIGRIS2     ....................................................................................
PttMenghu12 ------------------------------------------------------------------------.........
SUMATRA1    ....................................................................................
SUMATRA2    ....................................................................................

ALTAICA4    ACTTGTATGAATGGCCACACGAGGGCTTTACTGTCTCTTACTTCCAATCCGTGAAATTGACCTTCCCGTGAAGAGGCGGG
ALTAICA     ....................................................................................
TIGRIS1     ....................................................................................
TIGRIS2     ....................................................................................
PttMenghu12 ....................................................................................
SUMATRA1    ....................................................................................
SUMATRA2    ....................................................................................

ALTAICA4    AATACGACAATAAGACGAGAAGACCCTGTGGAGCTTTAATTAATCGACCCAAAGAGACCTTAATAACCAACCGACAGGAA
ALTAICA     ....................................................................................
TIGRIS1     ....................................................................................
TIGRIS2     ....................................................................................
PttMenghu12 ....................................................................................
SUMATRA1    ....................................................................................
SUMATRA2    ....................................................................................

ALTAICA4    CAACAGACCTCTGCCATGGGCCGACAATTTAGGTTGGGGTGACCTCGGAGAATAAAACAACCTCCGAGTGATTTAAATCT
ALTAICA     ....................................................................................
TIGRIS1     ....................................................................................
TIGRIS2     ....................................................................................
PttMenghu12 ....................................................................................
SUMATRA1    ....................................................................................
SUMATRA2    ....................................................................................

ALTAICA4    AGACTGACCAGTCGAAAGTATTACATCACTTATTGATCCAAAGCTTGATCAACGGAACAAGTTACCCCAGGGATAACAGC
ALTAICA     .....A..............................................................................
TIGRIS1     .....A..............................................................................
TIGRIS2     .....A..............................................................................
PttMenghu12 .....A..............................................................................
SUMATRA1    .....A..............................................................................
SUMATRA2    .....A..............................................................................

ALTAICA4    GCAATCCTATTTCAGAGTCCATATCGACAATAGGGTTTACGACCTCGATGTTGGATCAGGACATCCCGATGGTGCAGCAG
ALTAICA     ....................................................................................
TIGRIS1     ....................................................................................
TIGRIS2     ....................................................................................
PttMenghu12 .........C.....................----------------------------------------------
SUMATRA1    ....................................................................................
SUMATRA2    ....................................................................................

ALTAICA4    CTATCAAAGGTTCGTTTGTTCAACGATTAAAGTCCTACGTGATCTGAGTTCAGACCGGAGTAATCCAGGTCGGTTTCTAT
ALTAICA     ....................................................................................
TIGRIS1     ....................................................................................
TIGRIS2     ....................................................................................
PttMenghu12 ------------------------------------------------------------------------------------
SUMATRA1    ....................................................................................
SUMATRA2    ....................................................................................

ALTAICA4    CTATTAAATAATTTCTCCCAGTACGAAAGGACAAGAGAAATAAGGCCCACTTTACCAAAGCGCCTTTAACCAAATAGATG
ALTAICA     ....................................................................................
TIGRIS1     ....................................................................................
TIGRIS2     ....................................................................................
PttMenghu12 ------------------------------------------------------------------------------------
SUMATRA1    ....................................................................................
SUMATRA2    ....................................................................................
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ALTAICA4    ATATAATCTCAATCTAAACAGTTTATCTAAACATATCACCCGTAGAGCTCGGGTTT
ALTAICA     ...........................................................
TIGRIS1     ...........................................................
TIGRIS2     ...........................................................
PttMenghu12 -----------------------------------------------------------
SUMATRA1    ...........................................................
SUMATRA2    ...........................................................
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ALTAICA4        ATGTTTATAATCAATATTCTCTCATTAATTATCCCTATTCTTCTCGCCGTAGCCTTCCTAACCCTAGTTGAACGTAAAGT
ALTAICA         ...............................................................................
ALT             -------------------------------------------------------------------------------
TIGRIS1         ...............................................................................
TIGRIS2         ...............................................................................
TIG1            -------------------------------------------------------------------------------
TIG2            -------------------------------------------------------------------------------
TIG3            -------------------------------------------------------------------------------
TIG4            -------------------------------------------------------------------------------
TIG5            -------------------------------------------------------------------------------
TIG6            -------------------------------------------------------------------------------
Ptt_Rajput_2007 -------------------------------------------------------------------------------
SUMATRA1        ...............................................................................
SUMATRA2        ...............................................................................
SUM1            -------------------------------------------------------------------------------
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SUM6            -------------------------------------------------------------------------------
SUM7            -------------------------------------------------------------------------------
SUM8            -------------------------------------------------------------------------------
AMO1            -------------------------------------------------------------------------------
AMO2            -------------------------------------------------------------------------------
AMO3/COR1       -------------------------------------------------------------------------------
COR2            -------------------------------------------------------------------------------
COR3            -------------------------------------------------------------------------------
COR4            -------------------------------------------------------------------------------
COR5            -------------------------------------------------------------------------------
COR6            -------------------------------------------------------------------------------
COR7            -------------------------------------------------------------------------------
COR8            -------------------------------------------------------------------------------
CORBETTI1       ...............................................................................
CORBETTI2       ...............................................................................

ALTAICA4        ACTGGGCTACATACAACTCCGTAAAGGACCAAACGTCGTAGGACCATACGGCCTACTTCAGCCTATTGCAGACGCCATGA
ALTAICA         ...............................................................................
ALT             -------------------------------------------------------------------------------
TIGRIS1         ...............................................................................
TIGRIS2         ...............................................................................
TIG1            -------------------------------------------------------------------------------
TIG2            -------------------------------------------------------------------------------
TIG3            -------------------------------------------------------------------------------
TIG4            -------------------------------------------------------------------------------
TIG5            -------------------------------------------------------------------------------
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Ptt_Rajput_2007 -------------------------------------------------------------------------------
SUMATRA1        ...............................................................................
SUMATRA2        ...............................................................................
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AMO1            -------------------------------------------------------------------------------
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AMO3/COR1       -------------------------------------------------------------------------------
COR2            -------------------------------------------------------------------------------
COR3            -------------------------------------------------------------------------------
COR4            -------------------------------------------------------------------------------
COR5            -------------------------------------------------------------------------------
COR6            -------------------------------------------------------------------------------
COR7            -------------------------------------------------------------------------------
COR8            -------------------------------------------------------------------------------
CORBETTI1       ...............................................................................
CORBETTI2       ...............................................................................

ALTAICA4        AACTCTTCACTAAAGAACCCCTCCGACCCCTCACATCCTCCACATTCATATTCATCACAGCACCCATCCTAGCTCTTACA
ALTAICA         ...............................................................................C...
ALT             -------------------------------------------------------------------------------
TIGRIS1         ...............................................................................C...
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TIGRIS2          ..........................................................................C...
TIG1             --------------------------------------------------------------------------------
TIG2             --------------------------------------------------------------------------------
TIG3             --------------------------------------------------------------------------------
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TIG6             --------------------------------------------------------------------------------
Ptt_Rajput_2007  -.........................................................-................C...
SUMATRA1         ................................................................................
SUMATRA2         ................................................................................
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AMO2             --------------------------------------------------------------------------------
AMO3/COR1        --------------------------------------------------------------------------------
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COR5             --------------------------------------------------------------------------------
COR6             --------------------------------------------------------------------------------
COR7             --------------------------------------------------------------------------------
COR8             --------------------------------------------------------------------------------
CORBETTI1        ................................................................................
CORBETTI2        ................................................................................

ALTAICA4         CTAGCCCTAACCATATGAATCCCACTGCCCATACCATACCCACTCATTAACATAAACTTAGGAGTGCTATTTATACTAGC
ALTAICA          ................................................................................
ALT              --------------------------------------------------------------------------------
TIGRIS1          ................................................................................
TIGRIS2          ................................................................................
TIG1             --------------------------------------------------------------------------------
TIG2             --------------------------------------------------------------------------------
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Ptt_Rajput_2007  ..............................................C.................................
SUMATRA1         ................................................................................
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AMO3/COR1        --------------------------------------------------------------------------------
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COR8             --------------------------------------------------------------------------------
CORBETTI1        ................................................................................
CORBETTI2        ................................................................................

ALTAICA4         TATGTCCAGCCTAGCTGTTTACTCCATTCTATGATCAGGATGGGCTTCAAACTCAAAATATGCCCTAATCGGAGCCCTAC
ALTAICA          ................................................................................
ALT              --------------------------------------------------------------------------------
TIGRIS1          ................................................................................
TIGRIS2          ................................................................................
TIG1             --------------------------------------------------------------------------------
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TIG6             --------------------------------------------------------------------------------
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Ptt_Rajput_2007 ..........................................................................
SUMATRA1        ..........................................................................
SUMATRA2        ..........................................................................
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AMO3/COR1       --------------------------------------------------------------------------
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COR8            --------------------------------------------------------------------------
CORBETTI1       ..........................................................................
CORBETTI2       ..........................................................................

ALTAICA4        GAGCCGTAGCCCAAACAATCTCATATGAAGTCACATTAGCTATCATTCTCTTATCAGTACTACTAATAAATGGATCCTTC
ALTAICA         ..........................................................................
ALT             --------------------------------------------------------------------------
TIGRIS1         ..........................................................................
TIGRIS2         ..........................................................................
TIG1            --------------------------------------------------------------------------
TIG2            --------------------------------------------------------------------------
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TIG4            --------------------------------------------------------------------------
TIG5            --------------------------------------------------------------------------
TIG6            --------------------------------------------------------------------------
Ptt_Rajput_2007 ..........................................................................
SUMATRA1        ..........................................................................
SUMATRA2        ..........................................................................
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AMO3/COR1       --------------------------------------------------------------------------
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COR4            --------------------------------------------------------------------------
COR5            --------------------------------------------------------------------------
COR6            --------------------------------------------------------------------------
COR7            --------------------------------------------------------------------------
COR8            --------------------------------------------------------------------------
CORBETTI1       ..........................................................................
CORBETTI2       ..........................................................................

ALTAICA4        ACATTAGCTGCACTAATTACCACCCAAGAATACATCTGGCTCATCATCCCTGCATGACCCCTAGCCATAATATGATTCAT
ALTAICA         ..........................................................................
ALT             --------------------------------------------------------------------------
TIGRIS1         ..........................................................................
TIGRIS2         ..........................................................................
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Ptt_Rajput_2007 ..........................................................................
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AMO3/COR1       ----------------------------------------------------------------------------------
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COR7            ----------------------------------------------------------------------------------
COR8            ----------------------------------------------------------------------------------
CORBETTI1       ..................................................................................
CORBETTI2       ..................................................................................

ALTAICA4        CTCCACACTAGCAGAAACCAACCGAGCTCCATTTGATCTAACAGAAGGAGAATCAGAACTCGTTTCCGGATTCAACGTAG
ALTAICA         ..................................................................................
ALT             --------------------------.........T.....................................
TIGRIS1         ..................................................................................
TIGRIS2         ..................................................................................
TIG1            --------------------------.........T.....................................
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Ptt_Rajput_2007 ...................................T.............C.G...?????????........-.....
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AMO3/COR1       --------------------------.........T.....................................
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COR7            --------------------------.........T.....................................
COR8            --------------------------.........T.....................................
CORBETTI1       ..................................................................................
CORBETTI2       ..................................................................................

ALTAICA4        AATACGCAGCAGGCCCCTTTGCCCTATTTTTTCTAGCAGAATACGCTAATATTATCATAATAAACATCCTCACAACAATC
ALTAICA         ..................................................................................
ALT             ..................................................................................
TIGRIS1         ..................................................................................
TIGRIS2         ..................................................................................
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Ptt_Rajput_2007 ..................................................................................
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AMO1            ..................................................................................
AMO2            ..................................................................................
AMO3/COR1       ..................................................................................
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COR2            ..........................................................................
COR3            ..........................................................................C.
COR4            ..........................................................................
COR5            ..........................................................................
COR6            ..........................................................................
COR7            ..........................................................................
COR8            ..........................................................................
CORBETTI1       ..........................................................................
CORBETTI2       ..........................................................................

ALTAICA4        TTATTTTTCGGAGCATTCCATAATCCCTATATACCAGAACTATATACTATCAACTTCACTGTAAAAACCCTAATTCTAAC
ALTAICA         ..........................................................................
ALT             ..........................................................................
TIGRIS1         ..........................................................................
TIGRIS2         ..........................................................................
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Ptt_Rajput_2007 ..........................................................................
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SUM8            ..........................................................................G.....
AMO1            ......................G...................................................
AMO2            ..........................................................................
AMO3/COR1       ..........................................................................
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COR6            ..........................................................................
COR7            ..........................................................................
COR8            ..........................................................................
CORBETTI1       ..........................................................................
CORBETTI2       ..........................................................................

ALTAICA4        AACCACCTTCCTATGGATCCGAGCATCTTATCCACGATTCCGATATGACCAATTAATGCACCTCCTATGAAAAAACTTCC
ALTAICA         ............................C.............................................
ALT             ..........................................................................
TIGRIS1         ............................C.............................................
TIGRIS2         ............................C.............................................
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Ptt_Rajput_2007 ..........................................................................
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COR7            ..........................................................................
COR8            ..........................................................................
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CORBETTI1       ...........................................................................
CORBETTI2       ...........................................................................

ALTAICA4        TACCCCTTACTCTAGCCCTATGCATATGACACGTCTCCCTACCCATCATTACAGCAAGCATTCCACCCCAAACATAAG
ALTAICA         ...........................................................................
ALT             ...........................................................-----------------
TIGRIS1         ...........................................................................
TIGRIS2         ...........................................................................
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CORBETTI1       ...........................................................................
CORBETTI2       ...........................................................................
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ND2

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ALTAICA4  -TCAAACCCCCTATCCTCACCATCATTATACTAACCGTTATCTCAGGAACTATAATCGTAATAACAACTTCTCACTGACT
ALTAICA   A...........................................................................
ALT       ---------------------------------------------------------------------------
TIGRIS1   A...........................................................................
TIGRIS2   A...........................................................................
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SUMATRA1  A...........................................................................
SUMATRA2  A...........................................................................
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COR8       ----------------------------------------------------------------------------------
CORBETTI1  A.................................................................................
CORBETTI2  A.................................................................................
Ptc        ----------------------------------------------------------------------------------

ALTAICA4   TATAGTCTGAATTGGCTTCGAAATAAACCTATTAGCTATTATTCCCATCCTCATGAAAAAATATAACCCACGAGCCATAG
ALTAICA    .................................................................................
ALT        ----------------------------------------------------------------------.............
TIGRIS1    .................................................................................
TIGRIS2    .................................................................................A
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COR7       ----------------------------------------------------------------------.............
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COR8      ------------------------------------------------------------------------.............
CORBETTI1 ........................................................................................
CORBETTI2 ........................................................................................
Ptc       ------------------------------------------------------------------------------------

ALTAICA4  AAGCAGCCACAAAATACTTCCTGACACAAGCAACCGCTTCAATACTCCTAATAATAGGAATTATCATCAACCTGCTGCAC
ALTAICA   ........................................................................................
ALT       ........................................................................................
TIGRIS1   ........................................................................................
TIGRIS2   ........................................................................................
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COR8     ........................................................................................
CORBETTI1 .......................................................................................
CORBETTI2 .......................................................................................
Ptc       ------------------------------------------------------------------------------------

ALTAICA4  TCAGGACAATGAACCGTATCAAAAGACCTCAACCCCATGGCATCCATTATAATAACAACCGCCTTAGCAGTAAAACTAGG
ALTAICA   ........................................................................................
ALT       ........................................................................................
TIGRIS1   ............................T.......................................................
TIGRIS2   ............................T.......................................................
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TIG*7     ------------------------------------------------------------------------------------
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TIG*8     ----------------------------------------------------------------------------------------
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COR7      ........................................................................................
COR8      ........................................................................................
CORBETTI1 .......................................................................................
CORBETTI2 .......................................................................................
Ptc       ----------------------------------------------------------------------------------------

ALTAICA4  ACTAGCCCCATTCCACTTCTGAGTGCCCGAAGTTACACAAGGAATCTCCTTGTCTTCAGGCCTGATCCTACTCACATGAC
ALTAICA   ........................................................................................
ALT       ........................................................................................
TIGRIS1   ..........................................................C.............................
TIGRIS2   ..........................................................C.............................
TIG1      ..........................................................C.............................
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COR7       ..................................................C.....................
COR8       ..................................................C.....................
CORBETTI1  ..................................................C.....................
CORBETTI2  ..................................................C.....................
Ptc        ----------------------------------------------------------------------------------

ALTAICA4   AAAAAATCGCACCACTATCAATTCTTTACCAAATTTCACCCACCATTAACCCCAACCTACTCCTAGCAATAGCCATTATA
ALTAICA    ..................................................C.....................
ALT        ..................................................C.....................
TIGRIS1    ..................................................C.....................
TIGRIS2    ..................................................C.....................
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CORBETTI1  ...........................................................................
CORBETTI2  ...........................................................................
Ptc        ---------------------------------------------------------------------------

ALTAICA4   TCAGTTATAATCGGAGGCTGAGGGGGACTTAACCAAACCCAGCTACGAAAAATCATAGCATACTCCTCAATCGCCCATAT
ALTAICA    ...........................................................................
ALT        ...........................................................----------------
TIGRIS1    ...............................................................................T........
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CORBETTI1  ...............................................................................T........
CORBETTI2  ...........................................................................
Ptc        ------------------------------------------.............................T........

ALTAICA4   AGGTTGAATAACAGCCATCATAATATATAGCCCCACAATAATAATTTTAAACCTAACTATCTATATCATTATAACACTAA
ALTAICA    ...........................................................................
ALT        ---------------------------------------------------------------------------
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CORBETTI1 ..........................................................................
CORBETTI2 ..........................................................................
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ALTAICA4  CCACTTTCATGTTACTCATATACAACTCCACCACAACAACATTATCCTTATCACAAACATGAAACAAAACGCCCCTGATC
ALTAICA   ..........................................................................
ALT       --------------------------------------------------------------------------
TIGRIS1   ..........................................................................
TIGRIS2   ..........................................................................
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CORBETTI1 ................................................................................
CORBETTI2 ................................................................................
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ALTAICA4  ACCTCACTTATCCTACTGCTAATAATATCTCTGGGCGGCCTCCCCCCACTCTCTGGCTTCATCCCAAAATGAATAATCAT
ALTAICA   ................................................................................
ALT       --------------------------------------------------------------------------------
TIGRIS1   ..............................A.................................................
TIGRIS2   ..............................A.................................................
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CORBETTI1 ..........................................................................
CORBETTI2 ..........................................................................
Ptc       ..........................................................................

ALTAICA4  TCAAGAACTAACCAAAAATGAAATAATCATAATACCCACACTACTAGCCATAACAGCACTACTTAACCTATACTTCTACA
ALTAICA   ..........................................................................
ALT       --------------------------------------------------------------------------
TIGRIS1   ..........................................................................
TIGRIS2   ..........................................................................
TIG1      --------------------------------------------------------------------------
TIG2      --------------------------------------------------------------------------
TIG3      --------------------------------------------------------------------------
TIG4      --------------------------------------------------------------------------
TIG5      --------------------------------------------------------------------------
TIG6      --------------------------------------------------------------------------
TIG*7     --------------------------------------------------------------------------
TIG*8     --------------------------------------------------------------------------
TIG*9     --------------------------------------------------------------------------
TIG*10    --------------------------------------------------------------------------
TIG11     --------------------------------------------------------------------------
TIG12     --------------------------------------------------------------------------
TIG13     --------------------------------------------------------------------------
TIG14     --------------------------------------------------------------------------
TIG15     --------------------------------------------------------------------------
TIG16     --------------------------------------------------------------------------
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TIG21     --------------------------------------------------------------------------
TIG22     --------------------------------------------------------------------------
TIG23     --------------------------------------------------------------------------
TIG24     --------------------------------------------------------------------------
TIG25     --------------------------------------------------------------------------
TIG26     --------------------------------------------------------------------------
TIG27     --------------------------------------------------------------------------
TIG28     --------------------------------------------------------------------------
TIG29     --------------------------------------------------------------------------
TIG30     --------------------------------------------------------------------------
TIG31     --------------------------------------------------------------------------
SUMATRA1  ........................T.................................................
SUMATRA2  ........................T.................................................
SUM1      --------------------------------------------------------------------------
SUM2      --------------------------------------------------------------------------
SUM3      --------------------------------------------------------------------------
SUM4      --------------------------------------------------------------------------
SUM5      --------------------------------------------------------------------------
SUM6      --------------------------------------------------------------------------
SUM7      --------------------------------------------------------------------------
SUM8      --------------------------------------------------------------------------
AMO1      --------------------------------------------------------------------------
AMO2      --------------------------------------------------------------------------
AMO3/COR1 --------------------------------------------------------------------------
COR2      --------------------------------------------------------------------------
COR3      --------------------------------------------------------------------------
COR4      --------------------------------------------------------------------------
COR5      --------------------------------------------------------------------------
COR6      --------------------------------------------------------------------------
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COR7      ----------------------------------------------------------------------------------
COR8      ----------------------------------------------------------------------------------
CORBETTI1 ..................................................................................
CORBETTI2 ..................................................................................
Ptc       ..................................................................................

ALTAICA4  TACGACTAACATATACCACTGCACTAACTATATTCCCCTCAAACAACTGTATAAAAATAAAATGACGGTTCAAATGCACA
ALTAICA   ..................................................................................
ALT       ----------------------------------------------------------------------------------
TIGRIS1   ..................................................................................
TIGRIS2   ..................................................................................
TIG1      ----------------------------------------------------------------------------------
TIG2      ----------------------------------------------------------------------------------
TIG3      ----------------------------------------------------------------------------------
TIG4      ----------------------------------------------------------------------------------
TIG5      ----------------------------------------------------------------------------------
TIG6      ----------------------------------------------------------------------------------
TIG*7     ----------------------------------------------------------------------------------
TIG*8     ----------------------------------------------------------------------------------
TIG*9     ----------------------------------------------------------------------------------
TIG*10    ----------------------------------------------------------------------------------
TIG11     ----------------------------------------------------------------------------------
TIG12     ----------------------------------------------------------------------------------
TIG13     ----------------------------------------------------------------------------------
TIG14     ----------------------------------------------------------------------------------
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TIG16     ----------------------------------------------------------------------------------
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TIG20     ----------------------------------------------------------------------------------
TIG21     ----------------------------------------------------------------------------------
TIG22     ----------------------------------------------------------------------------------
TIG23     ----------------------------------------------------------------------------------
TIG24     ----------------------------------------------------------------------------------
TIG25     ----------------------------------------------------------------------------------
TIG26     ----------------------------------------------------------------------------------
TIG27     ----------------------------------------------------------------------------------
TIG28     ----------------------------------------------------------------------------------
TIG29     ----------------------------------------------------------------------------------
TIG30     ----------------------------------------------------------------------------------
TIG31     ----------------------------------------------------------------------------------
SUMATRA1  ..................................................................................
SUMATRA2  ..................................................................................
SUM1      ----------------------------------------------------------------------------------
SUM2      ----------------------------------------------------------------------------------
SUM3      ----------------------------------------------------------------------------------
SUM4      ----------------------------------------------------------------------------------
SUM5      ----------------------------------------------------------------------------------
SUM6      ----------------------------------------------------------------------------------
SUM7      ----------------------------------------------------------------------------------
SUM8      ----------------------------------------------------------------------------------
AMO1      ----------------------------------------------------------------------------------
AMO2      ----------------------------------------------------------------------------------
AMO3/COR1 ----------------------------------------------------------------------------------
COR2      ----------------------------------------------------------------------------------
COR3      ----------------------------------------------------------------------------------
COR4      ----------------------------------------------------------------------------------
COR5      ----------------------------------------------------------------------------------
COR6      ----------------------------------------------------------------------------------
COR7      ----------------------------------------------------------------------------------
COR8      ----------------------------------------------------------------------------------
CORBETTI1 ..................................................................................
CORBETTI2 ..................................................................................
Ptc       ..................................................................................

ALTAICA4  AAAAAAATAATCTTTTTACCCCCCTTAATCGTAATGTCCACCATACTACTCCCACTCACACCAATACTATCCGTCCTTGA
ALTAICA   ..................................................................................
ALT       ----------------------------------------------------------------------------------
TIGRIS1   ..................................................................................
TIGRIS2   ..................................................................................
TIG1      ----------------------------------------------------------------------------------
TIG2      ----------------------------------------------------------------------------------
TIG3      ----------------------------------------------------------------------------------
TIG4      ----------------------------------------------------------------------------------
TIG5      ----------------------------------------------------------------------------------
TIG6      ----------------------------------------------------------------------------------
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TIG*7     ------------------------------------------------------------------------------
TIG*8     ------------------------------------------------------------------------------
TIG*9     ------------------------------------------------------------------------------
TIG*10    ------------------------------------------------------------------------------
TIG11     ------------------------------------------------------------------------------
TIG12     ------------------------------------------------------------------------------
TIG13     ------------------------------------------------------------------------------
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TIG27     ------------------------------------------------------------------------------
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TIG30     ------------------------------------------------------------------------------
TIG31     ------------------------------------------------------------------------------
SUMATRA1  ..............................................................................
SUMATRA2  ..............................................................................
SUM1      ------------------------------------------------------------------------------
SUM2      ------------------------------------------------------------------------------
SUM3      ------------------------------------------------------------------------------
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SUM5      ------------------------------------------------------------------------------
SUM6      ------------------------------------------------------------------------------
SUM7      ------------------------------------------------------------------------------
SUM8      ------------------------------------------------------------------------------
AMO1      ------------------------------------------------------------------------------
AMO2      ------------------------------------------------------------------------------
AMO3/COR1 ------------------------------------------------------------------------------
COR2      ------------------------------------------------------------------------------
COR3      ------------------------------------------------------------------------------
COR4      ------------------------------------------------------------------------------
COR5      ------------------------------------------------------------------------------
COR6      ------------------------------------------------------------------------------
COR7      ------------------------------------------------------------------------------
COR8      ------------------------------------------------------------------------------
CORBETTI1 ..............................................................................
CORBETTI2 ..............................................................................
Ptc       ..........................................................-----------------------

ALTAICA4  TTA
ALTAICA   ...
ALT       ---
TIGRIS1   ...
TIGRIS2   ...
TIG1      ---
TIG2      ---
TIG3      ---
TIG4      ---
TIG5      ---
TIG6      ---
TIG*7     ---
TIG*8     ---
TIG*9     ---
TIG*10    ---
TIG11     ---
TIG12     ---
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TIG15     ---
TIG16     ---
TIG17     ---
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TIG21     ---
TIG22     ---
TIG23     ---
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TIG24     ---
TIG25     ---
TIG26     ---
TIG27     ---
TIG28     ---
TIG29     ---
TIG30     ---
TIG31     ---
SUMATRA1  ...
SUMATRA2  ...
SUM1      ---
SUM2      ---
SUM3      ---
SUM4      ---
SUM5      ---
SUM6      ---
SUM7      ---
SUM8      ---
AMO1      ---
AMO2      ---
AMO3/COR1 ---
COR2      ---
COR3      ---
COR4      ---
COR5      ---
COR6      ---
COR7      ---
COR8      ---
CORBETTI1 ...
CORBETTI2 ...
Ptc       ---
```

COI

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ALTAICA4  ----------------------------------------------------------ATGTTCATAAACCGCTGACTATTTT
ALTAICA   ----------------------------------------------------------..........................
ALT       ----------------------------------------------------------------------------------
Pta02     GCTCGAACCTCTGTCTTTAGATTTACAGTCTAATGCTTACTCAGCCATTTTACCT..........................
Pta04     GCTCGAACCTCTGTCTTTAGATTTACAGTCTAATGCTTACTCAGCCATTTTACCT..........................
TIGRIS1   ----------------------------------------------------------..........................
TIGRIS2   ----------------------------------------------------------..........................
TIG1      ----------------------------------------------------------------------------------
TIG2      ----------------------------------------------------------------------------------
TIG3      ----------------------------------------------------------------------------------
TIG4      ----------------------------------------------------------------------------------
TIG5      ----------------------------------------------------------------------------------
TIG6      ----------------------------------------------------------------------------------
Ptt01     GCTCGAACCTCTGTCTTTAGATTTACAGTCTAATGCTTACTCAGCCATTTTACCT..........................
Ptt02     GCTCGAACCTCTGTCTTTAGATTTACAGTCTAATGCTTACTCAGCCATTTTACCT..........................
Ptt03     ----------------------------------------------------------..........................
Ptt04     ----------------------------------------------------------..........................
Ptt_COX1  ---------------------------------------------------ATTTTACCT..........................
SUMATRA1  ----------------------------------------------------------..........................
SUMATRA2  ----------------------------------------------------------..........................
SUM1      ----------------------------------------------------------------------------------
SUM2      ----------------------------------------------------------------------------------
SUM3      ----------------------------------------------------------------------------------
SUM4      ----------------------------------------------------------------------------------
SUM5      ----------------------------------------------------------------------------------
SUM6      ----------------------------------------------------------------------------------
SUM7      ----------------------------------------------------------------------------------
AMO1      ----------------------------------------------------------------------------------
Pts01     ----------------------------------------------------------..........................
AMO2      ----------------------------------------------------------------------------------
AMO3/COR1 ----------------------------------------------------------------------------------
SUM8      ----------------------------------------------------------------------------------
COR2      ----------------------------------------------------------------------------------
COR3      ----------------------------------------------------------------------------------
COR4      ----------------------------------------------------------------------------------
COR5      ----------------------------------------------------------------------------------
COR6      ----------------------------------------------------------------------------------
COR7      ----------------------------------------------------------------------------------
COR8      ----------------------------------------------------------------------------------
CORBETTI1 ----------------------------------------------------------..........................
CORBETTI2 ----------------------------------------------------------..........................

ALTAICA4  CAACCAATCACAAGGATATTGGAACTCTTTACCTTTTATTTGGCGCCTGGGCTGGTATAGTGGGGACTGCCCTCAGTCTC
ALTAICA   ..........................................................G.......................
ALT       ----------------------------------------------------------------------------------
Pta02     ..................................................................................
Pta04     ..........................................................G.......................
TIGRIS1   ..........................................................G.......................
TIGRIS2   ..........................................................G.......................
TIG1      ----------------------------------------------------------------------------------
TIG2      ----------------------------------------------------------------------------------
TIG3      ----------------------------------------------------------------------------------
TIG4      ----------------------------------------------------------------------------------
TIG5      ----------------------------------------------------------------------------------
TIG6      ----------------------------------------------------------------------------------
Ptt01     ..........................................................G.......................
Ptt02     ..........................................................G.......................
Ptt03     ..........................................................G.......................
Ptt04     ..........................................................G.......................
Ptt_COX1  ..........................................................G.......................
SUMATRA1  ..........................................................G.......................
SUMATRA2  ..........................................................G.......................
SUM1      ----------------------------------------------------------------------------------
SUM2      ----------------------------------------------------------------------------------
SUM3      ----------------------------------------------------------------------------------
SUM4      ----------------------------------------------------------------------------------
SUM5      ----------------------------------------------------------------------------------
SUM6      ----------------------------------------------------------------------------------
SUM7      ----------------------------------------------------------------------------------
AMO1      ----------------------------------------------------------------------------------
Pts01     ..........................................................G.......................
AMO2      ----------------------------------------------------------------------------------
AMO3/COR1 ----------------------------------------------------------------------------------
SUM8      ----------------------------------------------------------------------------------
```

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COR2       ----------------------------------------------------------------------------------------
COR3       ----------------------------------------------------------------------------------------
COR4       ----------------------------------------------------------------------------------------
COR5       ----------------------------------------------------------------------------------------
COR6       ----------------------------------------------------------------------------------------
COR7       ----------------------------------------------------------------------------------------
COR8       ----------------------------------------------------------------------------------------
CORBETTI1  ..........................................T.............G.....................
CORBETTI2  ..........................................T.............G.....................

ALTAICA4   CTAATTCGAGCCGAACTGGGTCAACCTGGCACACTACTAGGAGATGACCAAATTTATAATGTAGTAGTTACTGCCCATGC
ALTAICA    ..........................................T.............G.....................
ALT        ----------------------------------------------------------------------------------------
Pta02      ..........................................T.............G.....................
Pta04      ..........................................T.............G.....................
TIGRIS1    ..........................................T.............G.....................
TIGRIS2    ..........................................T.............G.....................
TIG1       ----------------------------------------------------------------------------------------
TIG2       ----------------------------------------------------------------------------------------
TIG3       ----------------------------------------------------------------------------------------
TIG4       ----------------------------------------------------------------------------------------
TIG5       ----------------------------------------------------------------------------------------
TIG6       ----------------------------------------------------------------------------------------
Ptt01      ..........................................T.............G.....................
Ptt02      ..........................................T.............G.....................
Ptt03      ..........................................T.............G.....................
Ptt04      ..........................................T.............G.....................
Ptt_COX1   ..........................................T.............G.....................
SUMATRA1   ..........................................T.............G.....................
SUMATRA2   ..........................................T.............G.....................
SUM1       ----------------------------------------------------------------------------------------
SUM2       ----------------------------------------------------------------------------------------
SUM3       ----------------------------------------------------------------------------------------
SUM4       ----------------------------------------------------------------------------------------
SUM5       ----------------------------------------------------------------------------------------
SUM6       ----------------------------------------------------------------------------------------
SUM7       ----------------------------------------------------------------------------------------
AMO1       ----------------------------------------------------------------------------------------
Pts01      ..........................G.............................G.....................
AMO2       ----------------------------------------------------------------------------------------
AMO3/COR1  ----------------------------------------------------------------------------------------
SUM8       ----------------------------------------------------------------------------------------
COR2       ----------------------------------------------------------------------------------------
COR3       ----------------------------------------------------------------------------------------
COR4       ----------------------------------------------------------------------------------------
COR5       ----------------------------------------------------------------------------------------
COR6       ----------------------------------------------------------------------------------------
COR7       ----------------------------------------------------------------------------------------
COR8       ----------------------------------------------------------------------------------------
CORBETTI1  ...........T..........T.............G.....................T.....................
CORBETTI2  ..........................................T.............G.....................

ALTAICA4   CTTTGTGATAATCTTTTTTATAGTAATGCCTATTATAATTGGAGGATTCGGAAACTGGCTAGTTCCGTTAATAATCGGAG
ALTAICA    ..........................................T.............G.....................
ALT        ----------------------------------------------------------------------------------------
Pta02      ..........................................T.....C.......G.....................
Pta04      ..........................................T.....C.......G.....................
TIGRIS1    ..........................................T.............G.....................
TIGRIS2    ..........................................T.............G.....................
TIG1       ----------------------------------------------------------------------------------------
TIG2       ----------------------------------------------------------------------------------------
TIG3       ----------------------------------------------------------------------------------------
TIG4       ----------------------------------------------------------------------------------------
TIG5       ----------------------------------------------------------------------------------------
TIG6       ----------------------------------------------------------------------------------------
Ptt01      ..........................................T.............G.....................
Ptt02      ..........................................T.............G.....................
Ptt03      ..........................................T.............G.....................
Ptt04      ..........................................T.............G.....................
Ptt_COX1   ..........................................T.............G.....................
SUMATRA1   ..........................................T.............G.....................
SUMATRA2   ..........................................T.............G.....................
SUM1       ----------------------------------------------------------------------------------------
SUM2       ----------------------------------------------------------------------------------------
SUM3       ----------------------------------------------------------------------------------------
SUM4       ----------------------------------------------------------------------------------------
SUM5       ----------------------------------------------------------------------------------------
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SUM6       ----------------------------------------------------------------------------------
SUM7       ----------------------------------------------------------------------------------
AMO1       ----------------------------------------------------------------------------------
Pts01      ..........................................G...............................G.
AMO2       ----------------------------------------------------------------------------------
AMO3/COR1  ----------------------------------------------------------------------------------
SUM8       ----------------------------------------------------------------------------------
COR2       ----------------------------------------------------------------------------------
COR3       ----------------------------------------------------------------------------------
COR4       ----------------------------------------------------------------------------------
COR5       ----------------------------------------------------------------------------------
COR6       ----------------------------------------------------------------------------------
COR7       ----------------------------------------------------------------------------------
COR8       ----------------------------------------------------------------------------------
CORBETTI1  ..................................................................................
CORBETTI2  ..................................................................................

ALTAICA4   CCCCCGATATGGCATTCCCTCGAATGAATAACATAAGCTTCTGACTCCTTCCCCCATCCTTCCTACTTCTGCTCGCATCG
ALTAICA    ..................................................................................
ALT        ----------------------------------------------------------------------------------
Pta02      ..................................................................................
Pta04      ..................................................................................
TIGRIS1    ..................................................................................
TIGRIS2    ..................................................................................
TIG1       ----------------------------------------------------------------------------------
TIG2       ----------------------------------------------------------------------------------
TIG3       ----------------------------------------------------------------------------------
TIG4       ----------------------------------------------------------------------------------
TIG5       ----------------------------------------------------------------------------------
TIG6       ----------------------------------------------------------------------------------
Ptt01      ..................................................................................
Ptt02      ..................................................................................
Ptt03      ..................................................................................
Ptt04      ..................................................................................
Ptt_COX1   ..................................................................................
SUMATRA1   ..................................................................................
SUMATRA2   ..................................................................................
SUM1       ----------------------------------------------------------------------------------
SUM2       ----------------------------------------------------------------------------------
SUM3       ----------------------------------------------------------------------------------
SUM4       ----------------------------------------------------------------------------------
SUM5       ----------------------------------------------------------------------------------
SUM6       ----------------------------------------------------------------------------------
SUM7       ----------------------------------------------------------------------------------
AMO1       ----------------------------------------------------------------------------------
Pts01      ..................................................................................
AMO2       ----------------------------------------------------------------------------------
AMO3/COR1  ----------------------------------------------------------------------------------
SUM8       ----------------------------------------------------------------------------------
COR2       ----------------------------------------------------------------------------------
COR3       ----------------------------------------------------------------------------------
COR4       ----------------------------------------------------------------------------------
COR5       ----------------------------------------------------------------------------------
COR6       ----------------------------------------------------------------------------------
COR7       ----------------------------------------------------------------------------------
COR8       ----------------------------------------------------------------------------------
CORBETTI1  ..................................................................................
CORBETTI2  ..................................................................................

ALTAICA4   TCTATGGTAGAAGCTGGGGCAGGAACTGGGTGGACAGTATACCCACCCCTAGCTGGCAACCTAGCCCATGCAGGAGCATC
ALTAICA    ..................................................................................
ALT        ----------------------------------------------------------------------------------
Pta02      ..........G.........................................................................
Pta04      ..........G.........................................................................
TIGRIS1    ..................................................................................
TIGRIS2    ..................................................................................
TIG1       ----------------------------------------------------------------------------------
TIG2       ----------------------------------------------------------------------------------
TIG3       ----------------------------------------------------------------------------------
TIG4       ----------------------------------------------------------------------------------
TIG5       ----------------------------------------------------------------------------------
TIG6       ----------------------------------------------------------------------------------
Ptt01      ..................................................................................
Ptt02      ..................................................................................
Ptt03      ..................................................................................
Ptt04      ..................................................................................
Ptt_COX1   ..................................................................................
```

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SUMATRA1  ....................G.....................................................
SUMATRA2  ....................G.....................................................
SUM1      ----------------------------------------------------------------------------
SUM2      ----------------------------------------------------------------------------
SUM3      ----------------------------------------------------------------------------
SUM4      ----------------------------------------------------------------------------
SUM5      ----------------------------------------------------------------------------
SUM6      ----------------------------------------------------------------------------
SUM7      ----------------------------------------------------------------------------
AMO1      ----------------------------------------------------------------------------
Pts01     ............................................................................
AMO2      ----------------------------------------------------------------------------
AMO3/COR1 ----------------------------------------------------------------------------
SUM8      ----------------------------------------------------------------------------
COR2      ----------------------------------------------------------------------------
COR3      ----------------------------------------------------------------------------
COR4      ----------------------------------------------------------------------------
COR5      ----------------------------------------------------------------------------
COR6      ----------------------------------------------------------------------------
COR7      ----------------------------------------------------------------------------
COR8      ----------------------------------------------------------------------------
CORBETTI1 ............................................................................
CORBETTI2 ............................................................................

ALTAICA4  CGTGGATCTAACTATTTTTTCACTACACCTAGCAGGCGTCTCCTCAATCTTAGGTGCTATTAATTTTATTACTACTATTA
ALTAICA   ............................................................................
ALT       ----------------------------------------------------------------------------
Pta02     ............................................................................
Pta04     ............................................................................
TIGRIS1   ............................................................................
TIGRIS2   ............................................................................
TIG1      ----------------------------------------------------------------------------
TIG2      ----------------------------------------------------------------------------
TIG3      ----------------------------------------------------------------------------
TIG4      ----------------------------------------------------------------------------
TIG5      ----------------------------------------------------------------------------
TIG6      ----------------------------------------------------------------------------
Ptt01     ............................................................................
Ptt02     ............................................................................
Ptt03     ............................................................................
Ptt04     ............................................................................
Ptt_COX1  ............................................................................
SUMATRA1  ............................................................................
SUMATRA2  ............................................................................
SUM1      ----------------------------------------------------------------------------
SUM2      ----------------------------------------------------------------------------
SUM3      ----------------------------------------------------------------------------
SUM4      ----------------------------------------------------------------------------
SUM5      ----------------------------------------------------------------------------
SUM6      ----------------------------------------------------------------------------
SUM7      ----------------------------------------------------------------------------
AMO1      ----------------------------------------------------------------------------
Pts01     ............................................................................
AMO2      ----------------------------------------------------------------------------
AMO3/COR1 ----------------------------------------------------------------------------
SUM8      ----------------------------------------------------------------------------
COR2      ----------------------------------------------------------------------------
COR3      ----------------------------------------------------------------------------
COR4      ----------------------------------------------------------------------------
COR5      ----------------------------------------------------------------------------
COR6      ----------------------------------------------------------------------------
COR7      ----------------------------------------------------------------------------
COR8      ----------------------------------------------------------------------------
CORBETTI1 ............................................................................
CORBETTI2 ............................................................................

ALTAICA4  TTAATATAAAACCGCCCGCTATGTCCCAATACCAAACACCCCTGTTTGTTTGATCGGTTCTAATTACTGCTGTGTTGCTA
ALTAICA   ............................................................................
ALT       ----------------------------------------------------------------------------
Pta02     ..............................................................G.............
Pta04     ..............................................................G.............
TIGRIS1   ..................................G.........................................
TIGRIS2   ..................................G.........................................
TIG1      ----------------------------------------------------------------------------
TIG2      ----------------------------------------------------------------------------
TIG3      ----------------------------------------------------------------------------
TIG4      ----------------------------------------------------------------------------
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TIG5      ----------------------------------------------------------------------------------
TIG6      ----------------------------------------------------------------------------------
Ptt01     ..................................................................................
Ptt02     ..................................................................................
Ptt03     ..................................................................................
Ptt04     ...........................................................C......................
Ptt_COX1  ..................................................................................
SUMATRA1  ..................................................................................
SUMATRA2  ..................................................................................
SUM1      ----------------------------------------------------------------------------------
SUM2      ----------------------------------------------------------------------------------
SUM3      ----------------------------------------------------------------------------------
SUM4      ----------------------------------------------------------------------------------
SUM5      ----------------------------------------------------------------------------------
SUM6      ----------------------------------------------------------------------------------
SUM7      ----------------------------------------------------------------------------------
AMO1      ----------------------------------------------------------------------------------
Pts01     ........................................A.........................................
AMO2      ----------------------------------------------------------------------------------
AMO3/COR1 ----------------------------------------------------------------------------------
SUM8      ----------------------------------------------------------------------------------
COR2      ----------------------------------------------------------------------------------
COR3      ----------------------------------------------------------------------------------
COR4      ----------------------------------------------------------------------------------
COR5      ----------------------------------------------------------------------------------
COR6      ----------------------------------------------------------------------------------
COR7      ----------------------------------------------------------------------------------
COR8      ----------------------------------------------------------------------------------
CORBETTI1 ..................................................................................
CORBETTI2 ..................................................................................

ALTAICA4  CTTCTATCACTGCCAGTTTTAGCAGCAGGCATCACCATGCTACTGACAGATCGAAATCTAAATACCACATTTTTTGATCC
ALTAICA   ..................................................................................
ALT       ----------------------------------------------------------------------------------
Pta02     ...........................................................G......................
Pta04     ...........................................................G......................
TIGRIS1   ..................................................................................
TIGRIS2   ..................................................................................
TIG1      ----------------------------------------------------------------------------------
TIG2      ----------------------------------------------------------------------------------
TIG3      ----------------------------------------------------------------------------------
TIG4      ----------------------------------------------------------------------------------
TIG5      ----------------------------------------------------------------------------------
TIG6      ----------------------------------------------------------------------------------
Ptt01     ..................................................................................
Ptt02     ..................................................................................
Ptt03     ..................................................................................
Ptt04     ..................................................................................
Ptt_COX1  ..................................................................................
SUMATRA1  ..................................................................................
SUMATRA2  ..................................................................................
SUM1      ----------------------------------------------------------------------------------
SUM2      ----------------------------------------------------------------------------------
SUM3      ----------------------------------------------------------------------------------
SUM4      ----------------------------------------------------------------------------------
SUM5      ----------------------------------------------------------------------------------
SUM6      ----------------------------------------------------------------------------------
SUM7      ----------------------------------------------------------------------------------
AMO1      ----------------------------------------------------------------------------------
Pts01     ..................................................................................
AMO2      ----------------------------------------------------------------------------------
AMO3/COR1 ----------------------------------------------------------------------------------
SUM8      ----------------------------------------------------------------------------------
COR2      ----------------------------------------------------------------------------------
COR3      ----------------------------------------------------------------------------------
COR4      ----------------------------------------------------------------------------------
COR5      ----------------------------------------------------------------------------------
COR6      ----------------------------------------------------------------------------------
COR7      ----------------------------------------------------------------------------------
COR8      ----------------------------------------------------------------------------------
CORBETTI1 ..................................................................................
CORBETTI2 ...........................................................R......................

ALTAICA4  TGCCGGGGGAGGAGACCCCATCTTATATCAACACCTATTCTGATTCTTCGGTCACCCAGAAGTCTATATCTTAATCCTGC
ALTAICA   ..................................................................................
ALT       ------------------------------------------------------------------------------....
Pta02     ..................................................................................A.
```

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Pta04     ..........................................................................A.
TIGRIS1   ..........................................................................
TIGRIS2   ..........................................................................
TIG1      ----------------------------------------------------------------------....
TIG2      ----------------------------------------------------------------------....
TIG3      ----------------------------------------------------------------------....
TIG4      ----------------------------------------------------------------------....
TIG5      ----------------------------------------------------------------------....
TIG6      ----------------------------------------------------------------------....
Ptt01     ..........................................................................A.
Ptt02     ..........................................................................A.
Ptt03     ..........................................................................A.
Ptt04     ..........................................................................A.
Ptt_COX1  ..........................................................................
SUMATRA1  ..........................................................................
SUMATRA2  ..........................................................................
SUM1      ----------------------------------------------------------------------....
SUM2      ----------------------------------------------------------------------....
SUM3      ----------------------------------------------------------------------....
SUM4      ----------------------------------------------------------------------....
SUM5      ----------------------------------------------------------------------....
SUM6      ----------------------------------------------------------------------....
SUM7      ----------------------------------------------------------------------....
AMO1      ----------------------------------------------------------------------....
Pts01     ...T......................................................................A.
AMO2      ----------------------------------------------------------------------....
AMO3/COR1 ----------------------------------------------------------------------....
SUM8      ----------------------------------------------------------------------....
COR2      ----------------------------------------------------------------------....
COR3      ----------------------------------------------------------------------....
COR4      ----------------------------------------------------------------------....
COR5      ----------------------------------------------------------------------....
COR6      ----------------------------------------------------------------------....
COR7      ----------------------------------------------------------------------....
COR8      ----------------------------------------------------------------------....
CORBETTI1 ..........................................................................
CORBETTI2 ..........................................................................

ALTAICA4  CCGGGTTTGGAATAATTTCACATATTGTCACCTACTACTCAGGCAAAAAAGAACCTTTTGGCTACATGGGGATAGTCTGA
ALTAICA   ..........................................................................
ALT       ..........................................................................
Pta02     ....T.....-------------------------------------------------------------------
Pta04     ....T.....-------------------------------------------------------------------
TIGRIS1   ..........................................................................
TIGRIS2   ..........................................................................
TIG1      ..........................................................................
TIG2      ..........................................................................
TIG3      ..........................................................................
TIG4      ..........................................................................
TIG5      ..........................................................................
TIG6      ..........................................................................
Ptt01     ....T.....-------------------------------------------------------------------
Ptt02     ....T.....-------------------------------------------------------------------
Ptt03     ....T.....-------------------------------------------------------------------
Ptt04     ....T.....-------------------------------------------------------------------
Ptt_COX1  ..........................................................................
SUMATRA1  ..........................................................................
SUMATRA2  ..........................................................................
SUM1      ..........................................................................
SUM2      ..........................................................................
SUM3      ..........................................................................
SUM4      ..........................................................................
SUM5      ..........................................................................
SUM6      ..........................................................................
SUM7      ..........................................................................
AMO1      ..........................................................................
Pts01     ....T.....-------------------------------------------------------------------
AMO2      ..........................................................................
AMO3/COR1 ..........................................................................
SUM8      ..........................................................................
COR2      ..........................................................................
COR3      ..........................................................................
COR4      ..........................................................................
COR5      ..........................................................................
COR6      ..........................................................................
COR7      ..........................................................................
COR8      ..........................................................................
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CORBETTI1 ..........................................................................
CORBETTI2 ..........................................................................

ALTAICA4  GCCATAATGTCAATTGGCTTTCTGGGCTTTATCGTATGGGCCCATCACATGTTTACTGTAGGGATAGATGTGGATACACG
ALTAICA   ..........................................................................
ALT       ..........................................................................
Pta02     --------------------------------------------------------------------------
Pta04     --------------------------------------------------------------------------
TIGRIS1   ..........................................................................
TIGRIS2   ..........................................................................
TIG1      ..........................................................................
TIG2      ..........................................................................
TIG3      ..........................................................................
TIG4      ..........................................................................
TIG5      ..........................................................................
TIG6      ..........................................................................
Ptt01     --------------------------------------------------------------------------
Ptt02     --------------------------------------------------------------------------
Ptt03     --------------------------------------------------------------------------
Ptt04     --------------------------------------------------------------------------
Ptt_COX1  ..........................................................................-----
SUMATRA1  ..........................................................................
SUMATRA2  ..........................................................................
SUM1      ..........................................................................
SUM2      ..........................................................................
SUM3      ..........................................................................
SUM4      ..........................................................................
SUM5      ..........................................................................
SUM6      ..........................................................................
SUM7      ..........................................................................
AMO1      ..........................................................................
Pts01     --------------------------------------------------------------------------
AMO2      ..........................................................................
AMO3/COR1 ..........................................................................
SUM8      ..........................................................................
COR2      ..........................................................................
COR3      ..........................................................................
COR4      ..........................................................................
COR5      ..........................................................................
COR6      ..........................................................................
COR7      ..........................................................................
COR8      ..........................................................................
CORBETTI1 ..........................................................................
CORBETTI2 ..........................................................................

ALTAICA4  AGCATACTTTACGTCAGCTACTATAATTATCGCTATTCCTACTGGGGTAAAAGTATTTAGCTGATTGGCCACTCTTCACG
ALTAICA   ..........................................................................
ALT       ..........................................................................
Pta02     --------------------------------------------------------------------------
Pta04     --------------------------------------------------------------------------
TIGRIS1   ..........................................................................
TIGRIS2   ..........................................................A.............
TIG1      ..........................................................................
TIG2      ..........................................................................
TIG3      ..........................................................................
TIG4      ..........................................................................
TIG5      ..........................................................................
TIG6      ..........................................................................
Ptt01     --------------------------------------------------------------------------
Ptt02     --------------------------------------------------------------------------
Ptt03     --------------------------------------------------------------------------
Ptt04     --------------------------------------------------------------------------
Ptt_COX1  --------------------------------------------------------------------------
SUMATRA1  ..........................................................................
SUMATRA2  ..........................................................................
SUM1      ..........................................................................
SUM2      ..........................................................................
SUM3      ..........................................................................
SUM4      ..........................................................................
SUM5      ..........................................................................
SUM6      ..........................................................................
SUM7      ..........................................................................
AMO1      ..........................................................................
Pts01     --------------------------------------------------------------------------
AMO2      ..........................................................................
AMO3/COR1 ..........................................................................
SUM8      ..........................................................................
```

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COR2       ..........................................................................
COR3       ..........................................................................
COR4       ..........................................................................
COR5       ..........................................................................
COR6       ..........................................................................
COR7       ..........................................................................
COR8       ..........................................................................
CORBETTI1  ..........................................................................
CORBETTI2  ..........................................................................

ALTAICA4   GGGGTAATATTAAATGGTCTCCCGCTATACTATGGGCTTTGGGATTCATTTTCCTATTCACCGTAGGGGGCTTAACAGGA
ALTAICA    ..........................................................................
ALT        ..........................................................................
Pta02      --------------------------------------------------------------------------
Pta04      --------------------------------------------------------------------------
TIGRIS1    ..........................................................................
TIGRIS2    ..........................................................................
TIG1       ..........................................................................
TIG2       ..........................................................................
TIG3       ..........................................................................
TIG4       ..........................................................................
TIG5       ..........................................................................
TIG6       ..........................................................................
Ptt01      --------------------------------------------------------------------------
Ptt02      --------------------------------------------------------------------------
Ptt03      --------------------------------------------------------------------------
Ptt04      --------------------------------------------------------------------------
Ptt_COX1   --------------------------------------------------------------------------
SUMATRA1   ..........................................................................
SUMATRA2   ..........................................................................
SUM1       ..........................................................................
SUM2       ..........................................................................
SUM3       ..........................................................................
SUM4       ..........................................................................
SUM5       ..........................................................................
SUM6       ..........................................................................
SUM7       ..........................................................................
AMO1       ..........................................................................
Pts01      --------------------------------------------------------------------------
AMO2       ..........................................................................
AMO3/COR1  ..........................................................................
SUM8       ..........................................................................
COR2       ..........................................................................
COR3       ..........................................................................
COR4       ..........................................................................
COR5       ..........................................................................
COR6       ..........................................................................
COR7       ..........................................................................
COR8       ..........................................................................
CORBETTI1  ..........................................................................
CORBETTI2  ..........................................................................

ALTAICA4   ATTGTACTAGCAAACTCCTCATTGGATATTGTCCTTCACGACACATACTACGTAGTAGCCCACTTCCACTACGTCTTGTC
ALTAICA    ......T...................................................................
ALT        .........................................................................----
Pta02      --------------------------------------------------------------------------
Pta04      --------------------------------------------------------------------------
TIGRIS1    ......T...................................................................
TIGRIS2    ......T...................................................................
TIG1       ......T.....................................................................----
TIG2       ......T.....................................................................----
TIG3       ......T.....................................................................----
TIG4       ......T.....................................................................----
TIG5       ......T.....................................................................----
TIG6       ......T.....................................................................----
Ptt01      --------------------------------------------------------------------------
Ptt02      --------------------------------------------------------------------------
Ptt03      --------------------------------------------------------------------------
Ptt04      --------------------------------------------------------------------------
Ptt_COX1   --------------------------------------------------------------------------
SUMATRA1   ......T...................................................................
SUMATRA2   ......T...................................................................
SUM1       ......T.....................................................................----
SUM2       ......T.....................................................................----
SUM3       ......T.....................................................................----
SUM4       ......T.....................................................................----
SUM5       ......T.....................................................................----
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SUM6       ......T.............A.....................................................----
SUM7       ......T.............A.....................................................----
AMO1       ......T...........................................................------------
Pts01      ------------------------------------------------------------------------------
AMO2       ......T...........................................................------------
AMO3/COR1  ......T...........................................................------------
SUM8       ......T.............A.....................................................----
COR2       ......T...........................................................------------
COR3       ......T...........................................................------------
COR4       ......T...........................................................------------
COR5       ......T...........................................................------------
COR6       ......T...........................................................------------
COR7       ......T...........................................................------------
COR8       ......T...........................................................------------
CORBETTI1  ......T...........................................................
CORBETTI2  ..................................................................

ALTAICA4   AATAGGAGCAGTATTTGCTATTATAGGGGGCTTCGTTCACTGATTCCCCTTATTCTCAGGGTATACTCTTGATAATACTT
ALTAICA    ..................C.............................................................G
ALT        ------------------------------------------------------------------------------
Pta02      ------------------------------------------------------------------------------
Pta04      ------------------------------------------------------------------------------
TIGRIS1    ..................C...........................................................
TIGRIS2    ..................C...........................................................
TIG1       ------------------------------------------------------------------------------
TIG2       ------------------------------------------------------------------------------
TIG3       ------------------------------------------------------------------------------
TIG4       ------------------------------------------------------------------------------
TIG5       ------------------------------------------------------------------------------
TIG6       ------------------------------------------------------------------------------
Ptt01      ------------------------------------------------------------------------------
Ptt02      ------------------------------------------------------------------------------
Ptt03      ------------------------------------------------------------------------------
Ptt04      ------------------------------------------------------------------------------
Ptt_COX1   ------------------------------------------------------------------------------
SUMATRA1   ..................C...........................................................
SUMATRA2   ..................C...........................................................
SUM1       ------------------------------------------------------------------------------
SUM2       ------------------------------------------------------------------------------
SUM3       ------------------------------------------------------------------------------
SUM4       ------------------------------------------------------------------------------
SUM5       ------------------------------------------------------------------------------
SUM6       ------------------------------------------------------------------------------
SUM7       ------------------------------------------------------------------------------
AMO1       ------------------------------------------------------------------------------
Pts01      ------------------------------------------------------------------------------
AMO2       ------------------------------------------------------------------------------
AMO3/COR1  ------------------------------------------------------------------------------
SUM8       ------------------------------------------------------------------------------
COR2       ------------------------------------------------------------------------------
COR3       ------------------------------------------------------------------------------
COR4       ------------------------------------------------------------------------------
COR5       ------------------------------------------------------------------------------
COR6       ------------------------------------------------------------------------------
COR7       ------------------------------------------------------------------------------
COR8       ------------------------------------------------------------------------------
CORBETTI1  ..................C...........................................................
CORBETTI2  ..................................................................

ALTAICA4   GGGCAAAAGTTCATTTTACGATCATGTTCGTAGGTGTCAATATAACGTTTTTCCCTCAGCATTTCCTAGGCCTGTCTGGG
ALTAICA    ..............................................................................
ALT        ------------------------------------------------------------------------------
Pta02      ------------------------------------------------------------------------------
Pta04      ------------------------------------------------------------------------------
TIGRIS1    ..............................................................................
TIGRIS2    ..............................................................................
TIG1       ------------------------------------------------------------------------------
TIG2       ------------------------------------------------------------------------------
TIG3       ------------------------------------------------------------------------------
TIG4       ------------------------------------------------------------------------------
TIG5       ------------------------------------------------------------------------------
TIG6       ------------------------------------------------------------------------------
Ptt01      ------------------------------------------------------------------------------
Ptt02      ------------------------------------------------------------------------------
Ptt03      ------------------------------------------------------------------------------
Ptt04      ------------------------------------------------------------------------------
Ptt_COX1   ------------------------------------------------------------------------------
```

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SUMATRA1  ..........................................................................
SUMATRA2  ..........................................................................
SUM1      ----------------------------------------------------------------------------
SUM2      ----------------------------------------------------------------------------
SUM3      ----------------------------------------------------------------------------
SUM4      ----------------------------------------------------------------------------
SUM5      ----------------------------------------------------------------------------
SUM6      ----------------------------------------------------------------------------
SUM7      ----------------------------------------------------------------------------
AMO1      ----------------------------------------------------------------------------
Pts01     ----------------------------------------------------------------------------
AMO2      ----------------------------------------------------------------------------
AMO3/COR1 ----------------------------------------------------------------------------
SUM8      ----------------------------------------------------------------------------
COR2      ----------------------------------------------------------------------------
COR3      ----------------------------------------------------------------------------
COR4      ----------------------------------------------------------------------------
COR5      ----------------------------------------------------------------------------
COR6      ----------------------------------------------------------------------------
COR7      ----------------------------------------------------------------------------
COR8      ----------------------------------------------------------------------------
CORBETTI1 ..........................................................................
CORBETTI2 ..........................................................T...............

ALTAICA4  ATGCCTCGACGTTATTCTGACTATCCAGACGCGTATACAACTTGAAACACAATCTCCTCAATAGGCTCTTTTATTTCACT
ALTAICA   ..........................................................................
ALT       ----------------------------------------------------------------------------
Pta02     ----------------------------------------------------------------------------
Pta04     ----------------------------------------------------------------------------
TIGRIS1   ..........................................................................
TIGRIS2   ..........................................................................
TIG1      ----------------------------------------------------------------------------
TIG2      ----------------------------------------------------------------------------
TIG3      ----------------------------------------------------------------------------
TIG4      ----------------------------------------------------------------------------
TIG5      ----------------------------------------------------------------------------
TIG6      ----------------------------------------------------------------------------
Ptt01     ----------------------------------------------------------------------------
Ptt02     ----------------------------------------------------------------------------
Ptt03     ----------------------------------------------------------------------------
Ptt04     ----------------------------------------------------------------------------
Ptt_COX1  ----------------------------------------------------------------------------
SUMATRA1  ..........................................................................
SUMATRA2  ..........................................................................
SUM1      ----------------------------------------------------------------------------
SUM2      ----------------------------------------------------------------------------
SUM3      ----------------------------------------------------------------------------
SUM4      ----------------------------------------------------------------------------
SUM5      ----------------------------------------------------------------------------
SUM6      ----------------------------------------------------------------------------
SUM7      ----------------------------------------------------------------------------
AMO1      ----------------------------------------------------------------------------
Pts01     ----------------------------------------------------------------------------
AMO2      ----------------------------------------------------------------------------
AMO3/COR1 ----------------------------------------------------------------------------
SUM8      ----------------------------------------------------------------------------
COR2      ----------------------------------------------------------------------------
COR3      ----------------------------------------------------------------------------
COR4      ----------------------------------------------------------------------------
COR5      ----------------------------------------------------------------------------
COR6      ----------------------------------------------------------------------------
COR7      ----------------------------------------------------------------------------
COR8      ----------------------------------------------------------------------------
CORBETTI1 ..........................................................................
CORBETTI2 ..........................................................................

ALTAICA4  AACAGCAGTAATATTAATAGTCTTTATAATGTGAGAAGCTTTCGCATCAAAGCGAGAAGTAGCCACAGTGGAACTAACCA
ALTAICA   ..........................G.................................................
ALT       ----------------------------------------------------------------------------
Pta02     ----------------------------------------------------------------------------
Pta04     ----------------------------------------------------------------------------
TIGRIS1   ..........................G.................................................
TIGRIS2   ..........................G.................................................
TIG1      ----------------------------------------------------------------------------
TIG2      ----------------------------------------------------------------------------
TIG3      ----------------------------------------------------------------------------
TIG4      ----------------------------------------------------------------------------
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TIG5       ----------------------------------------------------------------------------------------
TIG6       ----------------------------------------------------------------------------------------
Ptt01      ----------------------------------------------------------------------------------------
Ptt02      ----------------------------------------------------------------------------------------
Ptt03      ----------------------------------------------------------------------------------------
Ptt04      ----------------------------------------------------------------------------------------
Ptt_COX1   ----------------------------------------------------------------------------------------
SUMATRA1   ........................G.....................................................
SUMATRA2   ........................G.....................................................
SUM1       ----------------------------------------------------------------------------------------
SUM2       ----------------------------------------------------------------------------------------
SUM3       ----------------------------------------------------------------------------------------
SUM4       ----------------------------------------------------------------------------------------
SUM5       ----------------------------------------------------------------------------------------
SUM6       ----------------------------------------------------------------------------------------
SUM7       ----------------------------------------------------------------------------------------
AMO1       ----------------------------------------------------------------------------------------
Pts01      ----------------------------------------------------------------------------------------
AMO2       ----------------------------------------------------------------------------------------
AMO3/COR1  ----------------------------------------------------------------------------------------
SUM8       ----------------------------------------------------------------------------------------
COR2       ----------------------------------------------------------------------------------------
COR3       ----------------------------------------------------------------------------------------
COR4       ----------------------------------------------------------------------------------------
COR5       ----------------------------------------------------------------------------------------
COR6       ----------------------------------------------------------------------------------------
COR7       ----------------------------------------------------------------------------------------
COR8       ----------------------------------------------------------------------------------------
CORBETTI1  ........................G.....................................................
CORBETTI2  ............................................................................................

ALTAICA4   CAACTAATCTCGAATGACTTCACGGATGTCCTCCTCCGTATCACACATTTGAAGAGCCAGCCTACGTGCTGTTAAAAT
ALTAICA    ............................................................................
ALT        ----------------------------------------------------------------------------
Pta02      ----------------------------------------------------------------------------
Pta04      ----------------------------------------------------------------------------
TIGRIS1    ............................................................................
TIGRIS2    ............................................................................
TIG1       ----------------------------------------------------------------------------
TIG2       ----------------------------------------------------------------------------
TIG3       ----------------------------------------------------------------------------
TIG4       ----------------------------------------------------------------------------
TIG5       ----------------------------------------------------------------------------
TIG6       ----------------------------------------------------------------------------
Ptt01      ----------------------------------------------------------------------------
Ptt02      ----------------------------------------------------------------------------
Ptt03      ----------------------------------------------------------------------------
Ptt04      ----------------------------------------------------------------------------
Ptt_COX1   ----------------------------------------------------------------------------
SUMATRA1   ............................................................................
SUMATRA2   ............................................................................
SUM1       ----------------------------------------------------------------------------
SUM2       ----------------------------------------------------------------------------
SUM3       ----------------------------------------------------------------------------
SUM4       ----------------------------------------------------------------------------
SUM5       ----------------------------------------------------------------------------
SUM6       ----------------------------------------------------------------------------
SUM7       ----------------------------------------------------------------------------
AMO1       ----------------------------------------------------------------------------
Pts01      ----------------------------------------------------------------------------
AMO2       ----------------------------------------------------------------------------
AMO3/COR1  ----------------------------------------------------------------------------
SUM8       ----------------------------------------------------------------------------
COR2       ----------------------------------------------------------------------------
COR3       ----------------------------------------------------------------------------
COR4       ----------------------------------------------------------------------------
COR5       ----------------------------------------------------------------------------
COR6       ----------------------------------------------------------------------------
COR7       ----------------------------------------------------------------------------
COR8       ----------------------------------------------------------------------------
CORBETTI1  ............................................................................
CORBETTI2  ............................................................G.....
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COII

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Tigris1   ATGGCATACCCCTTCCAGCTAGGTTTTCAAGATGCTACATCCCCCATTATAGAAGAGCTTTTACACTTCCATGATCATAC
Tigris2   ...............................................................................
Sumatrae1 ..................A............................................................
Sumatrae2 ..................A............................................................
Corbetti1 ..................A............................................................
Corbetti2 ..................A............................................................
Altaica4  ..................A............................................................
Altaica   ..................A............................................................

Tigris1   ATTAATAATTGTATTCCTAATTAGCTCCCTAGTCCTCTACATTATCTCATTAATACTGACAACTAAACTTACGCATACAA
Tigris2   ...............................................................................
Sumatrae1 ...............................................................................
Sumatrae2 ...............................................................................
Corbetti1 ...............................................................................
Corbetti2 ...............................................................................
Altaica4  ...............................................................................
Altaica   ...............................................................................

Tigris1   GCACAATAGACGCCCAAGAAGTAGAAACTATCTGAACCATTTTACCAGCCATCATCTTAATTCTCATTGCCCTGCCTTCC
Tigris2   ...............................................................................
Sumatrae1 ..........T....................................................................
Sumatrae2 ..........T....................................................................
Corbetti1 ..........T.............G.....................................................
Corbetti2 ..........T....................................................................
Altaica4  ..........T....................................................................
Altaica   ..........T............................C.....................................

Tigris1   TTACGAATTCTCTATATAATAGATGAGATTAATAATCCCTCCCTCACTGTAAAGACTATAGGACATCAGTGATACTGAAG
Tigris2   ...............................................................................
Sumatrae1 ...............................................................................
Sumatrae2 ...............................................................................
Corbetti1 ...............................................................................
Corbetti2 ...............................................................................
Altaica4  ...............................................................................
Altaica   ...............................................................................

Tigris1   TTATGAGTACACCGACTATGAGGACCTAAGCTTCGACTCCTACATAATCCCCACTCAAGAGTTAAAGCCCGGAGAGCTCC
Tigris2   ...............................................................................
Sumatrae1 ..............................................G................................
Sumatrae2 ..............................................G................................
Corbetti1 ...............................................................................
Corbetti2 ...............................................................................
Altaica4  ...............................................................................
Altaica   ......A.......................................................A..............

Tigris1   GACTACTAGAAGTTGATAACCGAGTAGTGTTGCCAATAGAAGTGACTATTCGCATGTTAGTCTCATCAGAGGACGTACTG
Tigris2   ...............................................................................
Sumatrae1 ...............................................................................
Sumatrae2 ...............................................................................
Corbetti1 ...............................................................................
Corbetti2 ...............................................................A...............
Altaica4  ...............................................................................
Altaica   ...............................................................................

Tigris1   CACTCGTGAGCCATCCCGTCCCTGGGCCTAAAAACTGACGCTATCCCAGGCCGACTAAACCAAACAACCCTAATAGGCAC
Tigris2   ...............................................................................
Sumatrae1 ..................A............................................................
Sumatrae2 ..................A............................................................
Corbetti1 ..................A............................................................
Corbetti2 ..................A............................................................
Altaica4  ..................A............................................................
Altaica   ..................A............................................................

Tigris1   ACGGCCTGGGCTATATTATGGTCAGTGCTCAGAAATCTGCGGCTCAAATCACAGTTTTATGCCCATTGTCCTTGAACTAG
Tigris2   ...............................................................................
Sumatrae1 ...............................................................................
Sumatrae2 ...............................................................................
Corbetti1 ...............................................................................
Corbetti2 ...............................................................................
Altaica4  ...............................................................................
Altaica   ...............................................................................

Tigris1   TCCCGCTGTCATATTTCGAAAAATGATCTGCATCTATACTGTAA-----
Tigris2   ........................................TTT--
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Sumatrae1 ........................................TTT--
Sumatrae2 ........................................TT---
Corbetti1 ........................................TTTC-
Corbetti2 ....RY.R........Y.............R.....R......T----
Altaica4  .................................G......TTTCA
Altaica   ........................................TT---
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ATP8-ATP6

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ALTAICA4  ATGCCACAGTTAGACACATCAACCTGGTTTATTACTATTATTTCAATAATCATGACACTGTTCGTTATATTTCAACTAAA
ALTAICA   ................................................................................
TIGRIS1   ................................................................................
TIGRIS2   ................................................................................
SUMATRA1  ................................................................................
SUMATRA2  ................................................................................
CORBETTI1 ................................................................................
CORBETTI2 ..............Y...........R..Y..Y.................Y...........TR..............

ALTAICA4  AATCTCAAAACATCTGTACCCATCAAGCCCAGAACCCAAATCTACAGCTGCATTAAAACAGCCGAGTCCCTGAGAAAAAA
ALTAICA   ................................................................................
TIGRIS1   ................................................................................
TIGRIS2   ................................................................................
SUMATRA1  ................................................................................
SUMATRA2  ................................................................................
CORBETTI1 ................................................................................
CORBETTI2 ............................R.................................K.RY..Y..........

ALTAICA4  AATGAACGAAAATCTATTCACCTCTTTTACTACCCCAACAATAATAGGACTGCCTGTTGTTGTGTTAATCGTTATGTTCC
ALTAICA   ................................................................................
TIGRIS1   ................................................................................
TIGRIS2   ................................................................................
SUMATRA1  ................................................................................
SUMATRA2  ................................................................................
CORBETTI1 ................................................................................
CORBETTI2 ..................................................Y.................YR.........

ALTAICA4  CCAGCATTCTATTTCCCTCGCCTAACCGACTAATTAATAACCGCCTAGTCTCACTCCAACAATGATTAGTACAACTTACA
ALTAICA   ........................................................................G.......
TIGRIS1   ..................A.............................................................
TIGRIS2   ..................A.............................................................
SUMATRA1  ..................A.............................................................
SUMATRA2  ..................A.............................................................
CORBETTI1 ....................................................................C...........
CORBETTI2 ............Y.....A.......................Y.....................................

ALTAICA4  TTAAAGCAAATACTGATTACCCACAATTACAAAGGACAAACCTGGGCCCTAATACTTATGTCTCTCATTTTATTTATTGG
ALTAICA   ................................................................................
TIGRIS1   ................................................................................
TIGRIS2   ................................................................................
SUMATRA1  ................................................................................
SUMATRA2  ................................................................................
CORBETTI1 ................................................................................
CORBETTI2 ..............CC.TT..........................................................

ALTAICA4  GTCAACAAATCTGCTAGGTCTACTACCTCACTCATTTACTCCAACTACCCAATTATCAATAAACCTAGGCATAGCCATCC
ALTAICA   ..................C.............................................................
TIGRIS1   ................................................................................
TIGRIS2   ................................................................................
SUMATRA1  ................................................................................
SUMATRA2  ................................................................................
CORBETTI1 ................................................................................
CORBETTI2 ............Y.....................................................Y...............

ALTAICA4  CCTTGTGAGCCGGCACCGTAATCACTGGATTCCGTCACAAAACTAAAGCATCCTTGGCCCACTTTCTACCACAAGGAACA
ALTAICA   ....................................................C...........................
TIGRIS1   ....................................................C...........................
TIGRIS2   ....................................................C...........................
SUMATRA1  ....................................................C...........................
SUMATRA2  ....................................................C...........................
CORBETTI1 ....................................................C...........................
CORBETTI2 ................................................................................

ALTAICA4  CCAGTCCCCTTAATCCCTATGCTCGTAATTATCGAAACTATCAGCCTTTTTATCCAGCCCGTAGCCCTAGCCGTACGACT
ALTAICA   ................................................................................
TIGRIS1   ................................................................................
TIGRIS2   ................................................................................
SUMATRA1  ................................................................................
SUMATRA2  ................................................................................
CORBETTI1 ................................................................................
CORBETTI2 ................................................................................

ALTAICA4  CACAGCTAATATTACTGCAGGCCATTTATTAATACACCTAATCGGAGGAGCTGCTTTAGCCCTAACAAATATTAGTGCCC
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ALTAICA   ..........................................................................
TIGRIS1   ..........................................T.......................................
TIGRIS2   ..........................................T.......................................
SUMATRA1  ..........................................T.......................................
SUMATRA2  ..........................................T.......................................
CORBETTI1 ..........................................................................
CORBETTI2 ..........................................Y.......................................

ALTAICA4  CTACTGCTTTAATTACCTTTATCATCCTCATCCTACTGACAATTCTTGAATTCGCTGTAGCTCTAATCCAAGCCTATGTT
ALTAICA   ..........................................................................
TIGRIS1   ....................................A.....................................
TIGRIS2   ....................................A.....................................
SUMATRA1  ................................................T...........................
SUMATRA2  ................................................T...........................
CORBETTI1 ..........................................................................
CORBETTI2 ..........................................................................

ALTAICA4  TTTACCCTACTTGTGAGCCTGTATTTACATGATAATACTTAA
ALTAICA   ...................................
TIGRIS1   ................A..................
TIGRIS2   ................A..................
SUMATRA1  ...................................
SUMATRA2  ...................................
CORBETTI1 ...................................
CORBETTI2 ...................................
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COIII-tRNA^{-Gly}

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ALTAICA4  CAAGCCTATGTTTTTACCCTACTTGTGAGCCTGTATTTACATGATAATACTTAATGACCCACCAAACCCACGCATATCAC
ALTAICA   ................................................................................
Pta01     --------------------------------------------------------........................
Pta02     --------------------------------------------------------........................
Pta04     --------------------------------------------------------........................
TIGRIS1   ..............................A.................................................
TIGRIS2   ..............................A.................................................
Ptt01     -----.............G.............................................................
Ptt02     -----.....G.........G.........................................................
Ptt03     -----.............G.............................................................
Ptt04     -----.............G.............................................................
SUMATRA1  ................................................................................
SUMATRA2  ................................................................................
Pts01     --------------------------------------------------------........................
CORBETTI1 ................................................................................
CORBETTI2 ..............................................................Y.................

ALTAICA4  ATGGTTAATCCCAGCCCATGGCCACTTACAGGGGCCCTTTCGGCCCTACTAATAACCTCAGGCCTGGCTATATGATTTCA
ALTAICA   ................................................................................
Pta01     ................................................................................
Pta02     ................................................................................
Pta04     ................................................................................
TIGRIS1   ................................................................................
TIGRIS2   ................................................................................
Ptt01     ................................................................................
Ptt02     ................................................................................
Ptt03     ................................................................................
Ptt04     ................................................................................
SUMATRA1  ................................................................................
SUMATRA2  ................................................................................
Pts01     ................................................................................
CORBETTI1 ................................................................................
CORBETTI2 ..............................R.................................................

ALTAICA4  CTATAACTCAATACTACTATTAACTCTAGGAATAACCACTAACCTATTGACTATATACCAATGGTGACGAGACATCATTC
ALTAICA   ................................................................................
Pta01     ................................................................................
Pta02     ................................................................................
Pta04     ................................................................................
TIGRIS1   ................................................................................
TIGRIS2   ................................................................................
Ptt01     ................................................................................
Ptt02     ................................................................................
Ptt03     ................................................................................
Ptt04     ................................................................................
SUMATRA1  ................................................................................
SUMATRA2  ................................................................................
Pts01     ................................................................................
CORBETTI1 ................................................................................
CORBETTI2 ............................................................Y...................

ALTAICA4  GGGAGAGCACATTCCAAGGCCACCACACACCCGTTGTTCAAAAAGGCCTCCGATACGGAATAATCCTTTTCATCATCTCA
ALTAICA   ..............................A.................................................
Pta01     ................................................................................
Pta02     ................................................................................
Pta04     ................................................................................
TIGRIS1   .A............................A.................................................
TIGRIS2   .A............................A.................................................
Ptt01     ..............................A.................................................
Ptt02     ..............................A.................................................
Ptt03     ..............................A.................................................
Ptt04     ..............................A.................................................
SUMATRA1  ..............................A.................................................
SUMATRA2  ..............................A.................................................
Pts01     ..............................A.................................................
CORBETTI1 ..............................A.................................................
CORBETTI2 ..............................A.................................................

ALTAICA4  GAAGTATTCTTCTTCGCAGGTTTTTTCTGGGCCTTCTATCACTCAAGCCTGGCCCCGACCCCCGAATTGGGAGGATGCTG
ALTAICA   ................................................................................
Pta01     ................................................................................
Pta02     ................................................................................
Pta04     ................................................................................
TIGRIS1   ....................A...........................................................
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TIGRIS2   ..................A.....................................................................
Ptt01     ..................A.....................................................................
Ptt02     ..................A.....................................................................
Ptt03     ..................A.....................................................................
Ptt04     ..................A.....................................................................
SUMATRA1  ..................A.....................................................................
SUMATRA2  ..................A.....................................................................
Pts01     ..................A.....................................................................
CORBETTI1 ..................A.....................................................................
CORBETTI2 ..................A.....................................................................

ALTAICA4  GCCACCAACAGGTATTATTCCCCTAAACCCCCTAGAAGTCCCACTACTCAATACTTCTGTGCTCTTAGCTTCCGGAGTGT
ALTAICA   ..................A.....................................................................
Pta01     ..................A.....................................................................
Pta02     ..................A.....................................................................
Pta04     ..................A.....................................................................
TIGRIS1   ..................A.....................................................................
TIGRIS2   ..................A.....................................................................
Ptt01     ..................A.....................................................................
Ptt02     ..................A.....................................................................
Ptt03     ..................A.....................................................................
Ptt04     ..................A.....................................................................
SUMATRA1  ..................A.....................................................C...............
SUMATRA2  ..................A.....................................................C...............
Pts01     ..................A.....................................G...............................
CORBETTI1 ..................A.....................................................................
CORBETTI2 ..................A.....................................................................

ALTAICA4  CAATCACCTGAGCCCATCATAGCCTAATAGAAGGAAATCGAAAACACATGCTCCAAGCACTATTTATTACAATCTCCCTA
ALTAICA   ..................A.....................................................................
Pta01     ..................A.....................................................................
Pta02     ..................A.....................................................................
Pta04     ..................A.....................................................................
TIGRIS1   ..................A.....................................................................
TIGRIS2   ..................A.....................................................................
Ptt01     ..................A.....................................................................
Ptt02     ..................A.....................................................................
Ptt03     ..................A.....................................................................
Ptt04     ..................A.....................................................................
SUMATRA1  ..................A.....................................................................
SUMATRA2  ..................A.....................................................................
Pts01     ..................A.....................................................................
CORBETTI1 ..................A.....................................................................
CORBETTI2 ..................A.....................................................................

ALTAICA4  GGAGTCTATTTTACCCTCCTCCAAGCCTCTGAGTACTATGAAACATCATTTACAATCTCGGACGGAGTTTATGGGTCCAC
ALTAICA   ..................A.....................................................................
Pta01     ..................A.....................................................................
Pta02     ..................A.....................................................................
Pta04     ..................A.....................................................................
TIGRIS1   ..................A.....................................................................
TIGRIS2   ..................A.....................................................................
Ptt01     ..................A.....................................................................
Ptt02     ..................A.....................................................................
Ptt03     ..................A.....................................................................
Ptt04     ..................A.....................................................................
SUMATRA1  ..................A.....................................T...............................
SUMATRA2  ..................A.....................................T...............................
Pts01     ..................A.....................................................................
CORBETTI1 ..................A.....................................................................
CORBETTI2 ..................A.....................................................................

ALTAICA4  CTTTTTCATAGCCACAGGGTTCCACGGACTACACGTAATTATTGGCTCTACCTTCCTAATCGTATGTTTCTTGCGCCAAC
ALTAICA   ..................A.....................................................................
Pta01     ..................A.....................................................................
Pta02     ..................A.....................................................................
Pta04     ..................A.....................................................................
TIGRIS1   ..................A.....................................................................
TIGRIS2   ..................A.....................................................................
Ptt01     ..................A.....................................................................
Ptt02     ..................A.....................................................................
Ptt03     ..................A.....................................................................
Ptt04     ..................A.....................................................................
SUMATRA1  ..................A.....................................................C...............
SUMATRA2  ..................A.....................................................C...............
Pts01     ..................A.....................................................................
CORBETTI1 ..................A.....................................................................
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CORBETTI2 ................A.............................................................

ALTAICA4  TAAAATACCACTTCACATCGAGCCACCATTTTGGATTCGAAGCCGCTGCTTGATATTGACATTTCGTAGACGTGG
ALTAICA   ................................................................................
Pta01     ......................T.....................................C...........A.
Pta02     ......................T.....................................C...........A.
Pta04     ......................T.....................................C...........A.
TIGRIS1   ................................................................................
TIGRIS2   ................................................................................
Ptt01     ...........................................................C...........A.
Ptt02     ...........................................................C...........A.
Ptt03     ...........................................................C...........A.
Ptt04     ...........................................................C...........A.
SUMATRA1  ................................................................................
SUMATRA2  ................................................................................
Pts01     ...................................T.......................C........-----
CORBETTI1 ................................................................................
CORBETTI2 ................................................................................
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ND4-ND4L

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ALTAICA4  ATAAACATAATACTCGCTCTACTCACCAACACACTTCTATCCACACTACTTGTACTCATCGCGTTCTGACTACCCCAACT
ALTAICA   ................................................................................
TIGRIS1   ................................................................................
TIGRIS2   ................................................................................
SUMATRA1  ................................................................................
SUMATRA2  ................................................................................
CORBETTI1 ................................................................................
CORBETTI2 ................................................................................

ALTAICA4  AAACACCTATGCAGAAAAAGCAAGTCCTTATGAATGTGGATTTGACCCCATAGGATCCGCTCGCCTGCCCTTCTCCATAA
ALTAICA   ................................................................................
TIGRIS1   ................................................................................
TIGRIS2   ................................................................................
SUMATRA1  ..............G.................................................................
SUMATRA2  ..............G.................................................................
CORBETTI1 ................................................................................
CORBETTI2 ............................................................T.................

ALTAICA4  AATTCTTCCTAGTAGCTATCACATTCTTGCTATTCGACCTAGAAATTGCACTACTGCTCCCTCTTCCCTGAGCCTCACAA
ALTAICA   ................................................................................
TIGRIS1   ................................................................................
TIGRIS2   ................................................................................
SUMATRA1  ................................................................................
SUMATRA2  ................................................................................
CORBETTI1 ................................................................................
CORBETTI2 ................................................................................

ALTAICA4  ACAAACAAACTGTCAACCATGCTTATCACAGCCCTTCTACTAATCTCCCTATTAGCCGCAAGCCTAGCCTACGAGTGAAC
ALTAICA   ................................................................................
TIGRIS1   ................................................................................
TIGRIS2   ................................................................................
SUMATRA1  ................................................................................
SUMATRA2  ................................................................................
CORBETTI1 ................................................................................
CORBETTI2 ................................................................................

ALTAICA4  CCAAAAAGGATTAGAATGAACTGAATATGATAATTAGTTTAAACTAAAACAAATGATTTCGACTCATTAGATTGTAGCTT
ALTAICA   ................................................................................
TIGRIS1   ................................................................................
TIGRIS2   ................................................................................
SUMATRA1  ................................................................................
SUMATRA2  ................................................................................
CORBETTI1 ................................................................................
CORBETTI2 ................................................................................

ALTAICA4  ACCCTATAATTATCAAATGTCCATAGTCTATGTTAACATCTTCCTGGCTTTCATCGTATCACTCATAGGACTATTAATGT
ALTAICA   ................................................................................
TIGRIS1   ................................................................................
TIGRIS2   ................................................................................
SUMATRA1  ................................................................................
SUMATRA2  ................................................................................
CORBETTI1 ................................................................................
CORBETTI2 ................................................................................

ALTAICA4  ACCGATCCCACTTAATATCCTCCCTTCTATGCCTAGAAGGCATAATACTATCCCTATTTATTATGATAACCATGGCAGTT
ALTAICA   ................................................................................
TIGRIS1   ...............................T................................................
TIGRIS2   ...............................T................................................
SUMATRA1  ................................................................................
SUMATRA2  ................................................................................
CORBETTI1 ................................................................................
CORBETTI2 ................................................................................

ALTAICA4  CTAAACAATCACTTTACACTAGCTAGCATGACCCCCATTATCCTGCTAGTATTTGCAGCCTGCGAGGCAGCACTGGGCTT
ALTAICA   ................................................................................
TIGRIS1   ................................................................................
TIGRIS2   ................................................................................
SUMATRA1  ................................................................................
SUMATRA2  ................................................................................
CORBETTI1 ................................................................................
CORBETTI2 ................................................................................

ALTAICA4  GTCCCTACTAGTAATGGTATCAAATACATATGGTACCGACTATGTACAAAACCTAAACCTCTTGCAATGCTAA
ALTAICA   ...........................................................................
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TIGRIS1   ..........................................................................
TIGRIS2   ..........................................................................
SUMATRA1  ..........................................................................
SUMATRA2  ..........................................................................
CORBETTI1 ..........................................................................
CORBETTI2 ..........................................................................
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ND5

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ALTAICA4      --------------------ATAAACCTACTTACCTCCTCTATACTCACTGCGATATTTATCCTACTCCTACCTATCATT
ALTAICA       --------------------.............................................................
TIGRIS1       --------------------.............................A...........................
TIGRIS2       --------------------.............................A...........................
TIG11         -------------------------------------------------------------------------------
TIG12         -------------------------------------------------------------------------------
TIG13         -------------------------------------------------------------------------------
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TIG31         -------------------------------------------------------------------------------
Ptt.R187      -------------------------------------------------------------------------------
Ptt.R18       -------------------------------------------------------------------------------
Ptt.R132      -------------------------------------------------------------------------------
Ptt.R1089     -------------------------------------------------------------------------------
Ptt.R1083     -------------------------------------------------------------------------------
Ptt.R17       -------------------------------------------------------------------------------
Ptt.R956      -------------------------------------------------------------------------------
Ptt.R311      -------------------------------------------------------------------------------
Ptt.R308      -------------------------------------------------------------------------------
Ptt.R310      -------------------------------------------------------------------------------
Ptt.R309      -------------------------------------------------------------------------------
Ptt.R1081     -------------------------------------------------------------------------------
Ptt.R265      -------------------------------------------------------------------------------
Ptt.R1188     -------------------------------------------------------------------------------
Ptt.R47       -------------------------------------------------------------------------------
Ptt.R209      -------------------------------------------------------------------------------
Ptt.Menghu12  TGCAACTCCAAATAAAAGTA.............................................................
Ptt.Menghu1   --------------------.............................................................
SUMATRA1      --------------------.............................................................
SUMATRA2      --------------------.............................................................
Pta-172C      TGCAACTCCAAATAAAAGTA.............................................................
Pta-172T      TGCAACTCCAAATAAAAGTA.............................................................
CORBETTI2     --------------------.............................................................

ALTAICA4      ACATCCAACACTCAATTATATAAAAGTAACCTATACCCTCACTATGTAAAAACCACAATCTCTTACGCCTTTACCATTAG
ALTAICA       ................................................................................
TIGRIS1       ................................................................................
TIGRIS2       ................................................................................
TIG11         -------------------------------------------------------------------------------
TIG12         -------------------------------------------------------------------------------
TIG13         -------------------------------------------------------------------------------
TIG14         -------------------------------------------------------------------------------
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TIG30         -------------------------------------------------------------------------------
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TIG31        ------------------------------------------------------------------------------
Ptt.R187     ------------------------------------------------------------------------------
Ptt.R18      ------------------------------------------------------------------------------
Ptt.R132     ------------------------------------------------------------------------------
Ptt.R1089    ------------------------------------------------------------------------------
Ptt.R1083    ------------------------------------------------------------------------------
Ptt.R17      ------------------------------------------------------------------------------
Ptt.R956     ------------------------------------------------------------------------------
Ptt.R311     ------------------------------------------------------------------------------
Ptt.R308     ------------------------------------------------------------------------------
Ptt.R310     ------------------------------------------------------------------------------
Ptt.R309     ------------------------------------------------------------------------------
Ptt.R1081    ------------------------------------------------------------------------------
Ptt.R265     ------------------------------------------------------------------------------
Ptt.R1188    ------------------------------------------------------------------------------
Ptt.R47      ------------------------------------------------------------------------------
Ptt.R209     ------------------------------------------------------------------------------
Ptt.Menghu12 ..............................................................................
Ptt.Menghu1  ..............................................................................
SUMATRA1     ..............................................................................
SUMATRA2     ..............................................................................
Pta-172C     ..............................................................................
Pta-172T     ..............................................................................
CORBETTI2    ..............................................................................

ALTAICA4     TATAATCCCAGTCATAATATTCATTTCCTCCGGACAAGAGATAACCATCTCAAACTGATGTTGACTATCAATTCAAACCC
ALTAICA      ..............................................................................
TIGRIS1      ..............................................................................
TIGRIS2      ..............................................................................
TIG11        ------------------------------------------------------------------------------
TIG12        ------------------------------------------------------------------------------
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Ptt.R187     ------------------------------------------------------------------------------
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Ptt.R309     ------------------------------------------------------------------------------
Ptt.R1081    ------------------------------------------------------------------------------
Ptt.R265     ------------------------------------------------------------------------------
Ptt.R1188    ------------------------------------------------------------------------------
Ptt.R47      ------------------------------------------------------------------------------
Ptt.R209     ------------------------------------------------------------------------------
Ptt.Menghu12 ..............................................................................
Ptt.Menghu1  ..............................................................................
SUMATRA1     ..............................................................................
SUMATRA2     ...........C..................................................................
Pta-172C     ...........C..................................................................
Pta-172T     ..............................................................................
CORBETTI2    ...........-..................................................................

ALTAICA4     TTAAATTATCACTAAGCTTCAAACTAGATTATTTCTCGATCATCTTCATCCCAGTAGCACTTTTCGTTACATGGTCGATC
ALTAICA      ..............................................................................
TIGRIS1      ..............................................................................
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TIGRIS2      ..........................................................................
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TIG12        --------------------------------------------------------------------------
TIG13        --------------------------------------------------------------------------
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Ptt.R309     --------------------------------------------------------------------------
Ptt.R1081    --------------------------------------------------------------------------
Ptt.R265     --------------------------------------------------------------------------
Ptt.R1188    --------------------------------------------------------------------------
Ptt.R47      --------------------------------------------------------------------------
Ptt.R209     --------------------------------------------------------------------------
Ptt.Menghu12 ..........................................................................
Ptt.Menghu1  ..........................................................................
SUMATRA1     ..........................................................................
SUMATRA2     ..........................................................................
Pta-172C     ..........................................................................
Pta-172T     ..........................................................................
CORBETTI2    ..........................................................................

ALTAICA4     ATAGAATTCTCAATGTGATACATACACACAGATCCCTATATTAACCAGTTCTTTAAGTACCTCCTTATATTCCTAATCAC
ALTAICA      ..........................................................................
TIGRIS1      ..........................................................................
TIGRIS2      ..........................................................................
TIG11        --------------------------------------------------------------------------
TIG12        --------------------------------------------------------------------------
TIG13        --------------------------------------------------------------------------
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TIG30        --------------------------------------------------------------------------
TIG31        --------------------------------------------------------------------------
Ptt.R187     ----------------------------------------------------------------..........
Ptt.R18      --------------------------------------------------------------------.....
Ptt.R132     ----------------------------------------------------------..............
Ptt.R1089    ----------------------------------------------------------..............
Ptt.R1083    --------------------------------------------------------------------.....
Ptt.R17      --------------------------------------------------------------------....
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Ptt.R956      ------------------------------------------------------------------------.............
Ptt.R311      ---------------------------------------------------------------------------------.....
Ptt.R308      ------------------------------------------------------------------------...........
Ptt.R310      ---------------------------------------------------------------------------------.....
Ptt.R309      ---------------------------------------------------------------------------------..
Ptt.R1081     ------------------------------------------------------------------...............
Ptt.R265      ---------------------------------------------------------------------------.........
Ptt.R1188     ------------------------------------------------------------------...................
Ptt.R47       ------------------------------------------------------------------.................
Ptt.R209      ------------------------------------------------------------------.................
Ptt.Menghu12 ................G.....G.-----------------------------------------------------------
Ptt.Menghu1   ..................................................................................
SUMATRA1      ..................................................................................
SUMATRA2      ..................................................................................
Pta-172C      ................G.....G.-----------------------------------------------------------
Pta-172T      ................G.....G.-----------------------------------------------------------
CORBETTI2     ..................................................................................

ALTAICA4      TATAATGATCTTAGTAACCGCCAATAATCTATTTCAGCTGTTTATTGGATGGGAGGGAGTAGGAATTATATCTTTCCTAC
ALTAICA       ...............G..................................................................
TIGRIS1       ...............G..................................................................
TIGRIS2       ...............G..................................................................
TIG11         -------........G..................................................................
TIG12         -------........G..................................................................
TIG13         -------........G..................................................................
TIG14         -------........G..................................................................
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TIG28         -------........G..................................................................
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TIG30         -------........G..................................................................
TIG31         -------........G..................................................................
Ptt.R187      ...............G..................................................................
Ptt.R18       ...............G..................................................................
Ptt.R132      ...............G..................................................................
Ptt.R1089     ...............G..................................................................
Ptt.R1083     ...............G..................................................................
Ptt.R17       ...............G..................................................................
Ptt.R956      ...............G..................................................................
Ptt.R311      ...............G..................................................................
Ptt.R308      ...............G..................................................................
Ptt.R310      ...............G..................................................................
Ptt.R309      ...............G..................................................................
Ptt.R1081     ...............G..................................................................
Ptt.R265      ...............G..................................................................
Ptt.R1188     ...............G..................................................................
Ptt.R47       ...............G..................................................................
Ptt.R209      ...............G..................................................................
Ptt.Menghu12 -----------------------------------------------------------------------------------
Ptt.Menghu1   ...............G..................................................................
SUMATRA1      ..................................................................................
SUMATRA2      ...............G..................................................................
Pta-172C      -----------------------------------------------------------------------------------
Pta-172T      -----------------------------------------------------------------------------------
CORBETTI2     ...............G..................................................................

ALTAICA4      TTATCGGATGATGATATGGTCGAGCAGACGCAAACACTGCCGCCCTGCAAGCAATTCTCTACAACCGTATTGGAGATGTG
ALTAICA       ..................................................................................
TIGRIS1       ..............................................A...................................
TIGRIS2       ..............................................A...................................
TIG11         ..................................................................................
TIG12         ..................................................................................
TIG13         ..................................................................................
TIG14         ..............................................A...................................
TIG15         ..............................................A...................................
TIG16         ..................................................................................
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TIG30        ..........................................................................
TIG31        ..........................................................................
Ptt.R187     ..........................................................................
Ptt.R18      ..............................................A...........................
Ptt.R132     ..........................................................................
Ptt.R1089    ..........................................................................
Ptt.R1083    ..........................................................................
Ptt.R17      ..........................................................................
Ptt.R956     ..........................................................................
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Ptt.R1081    ..........................................................................
Ptt.R265     ..........................................................................
Ptt.R1188    ..........................................................................
Ptt.R47      ..........................................................................
Ptt.R209     ..........................................................................
Ptt.Menghu12 --------------------------------------------------------------------------
Ptt.Menghu1  ..........................................T.................................A
SUMATRA1     ..........................................................................
SUMATRA2     ..........................................................................
Pta-172C     --------------------------------------------------------------------------
Pta-172T     --------------------------------------------------------------------------
CORBETTI2    ..........................................................................A

ALTAICA4     GGATTTATCATGGCCATAGCATGATTCCTTACCAACCTAAATGCATGAAACCTCCAACAAATCTTTATCACTCAACATGA
ALTAICA      ..........................................................................
TIGRIS1      ..........................................................................
TIGRIS2      ..........................................................................
TIG11        ..........................................................................
TIG12        ..........................................................................
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TIG31        ..........................................................................
Ptt.R187     ..........................................................................
Ptt.R18      ..........................................................................
Ptt.R132     ..........................................................................
Ptt.R1089    ..........................................................................
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Ptt.R308     ..........................................................................
Ptt.R310     ..........................................................................
Ptt.R309     ..........................................................................
Ptt.R1081    ..........................................................................
Ptt.R265     ..........................................................................
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Ptt.R1188     ..........................................................................
Ptt.R47       ..........................................................................
Ptt.R209      ..........................................................................
Ptt.Menghu12 --------------------------------------------------------------------------
Ptt.Menghu1   ..........................................................................
SUMATRA1      ..........................................................................
SUMATRA2      ..........................................................................
Pta-172C      --------------------------------------------------------------------------
Pta-172T      --------------------------------------------------------------------------
CORBETTI2     ..........................................................................

ALTAICA4      AAGCCTGAATATGCCATTACTAGGACTCCTCCTAGCCGCCACAGGCAAGTCCGCCCAATTTGGCCTACACCCATGATTGC
ALTAICA       ..........................................................................
TIGRIS1       ..........................................................................
TIGRIS2       ..........................................................................
TIG11         ..........................................................................
TIG12         ..........................................................................
TIG13         ..........................................................................
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TIG19         ..........................................................................
TIG20         ..........................................................................A.
TIG21         ..........................................................................
TIG22         ..........................................................................
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TIG26         ..........................................................................
TIG27         ..........................................................................
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TIG31         ..........................................................................
Ptt.R187      ..........................................................................
Ptt.R18       ..........................................................................
Ptt.R132      ..........................................................................
Ptt.R1089     ..........................................................................
Ptt.R1083     ..........................................................................
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Ptt.R956      ..........................................................................
Ptt.R311      ..........................................................................
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Ptt.R309      ..........................................................................
Ptt.R1081     ..........................................................................
Ptt.R265      ..........................................................................
Ptt.R1188     ..........................................................................
Ptt.R47       ..........................................................................
Ptt.R209      ..........................................................................
Ptt.Menghu12 --------------------------------------------------------------------------
Ptt.Menghu1   ..........................................................................
SUMATRA1      ..........................................................................
SUMATRA2      ..........................................................................
Pta-172C      --------------------------------------------------------------------------
Pta-172T      --------------------------------------------------------------------------
CORBETTI2     ..........................................................................

ALTAICA4      CATCAGCCATAGAAGGTCCAACTCCCGTCTCCGCCCTACTCCACTCAAGCACAATAGTTGTAGCCGGAGTCTTCTTATTA
ALTAICA       ..........................................................................
TIGRIS1       ..........................................................................
TIGRIS2       ..........................................................................
TIG11         ..........................................................................
TIG12         ..........................................................................
TIG13         ..........................................................................
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TIG23         ..........................................................................
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TIG25        ..........................................................................
TIG26        ..........................................T.......................................
TIG27        ..........................................................................
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TIG29        ..........................................................................
TIG30        ..........................................................................
TIG31        .....................................T....................................
Ptt.R187     ..........................................................................
Ptt.R18      ..........................................................................
Ptt.R132     ..........................................................................
Ptt.R1089    ..........................................................................
Ptt.R1083    ..........................................................................
Ptt.R17      ..........................................T.......................................
Ptt.R956     ..........................................................................
Ptt.R311     ..........................................................................
Ptt.R308     ..........................................................................
Ptt.R310     ..........................................................................
Ptt.R309     ..........................................................................
Ptt.R1081    ..........................................................................
Ptt.R265     ..........................................................................
Ptt.R1188    ..........................................................................
Ptt.R47      ..........................................................................
Ptt.R209     ..........................................................................
Ptt.Menghu12 --------------------------------------------------------------------------
Ptt.Menghu1  ..........................................................................
SUMATRA1     ..........................................................................
SUMATRA2     ..........................................................................
Pta-172C     --------------------------------------------------------------------------
Pta-172T     --------------------------------------------------------------------------
CORBETTI2    ..........................................................................

ALTAICA4     ATCCGCTTCCACCCACTCATAGAACAAAATAAAGCCATACAAACCCTCACTCTATGCCTGGGGGCCATCACAACCCTATT
ALTAICA      ..........................................................................
TIGRIS1      ..........................................................................
TIGRIS2      ..........................................................................
TIG11        ..........................................................................
TIG12        ..........................................................................
TIG13        ..........................................................................
TIG14        ..........................................................................
TIG15        ..........................................................................
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TIG19        ..........................................A.................................
TIG20        ..........................................................................
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TIG24        ..........................................A.................................
TIG25        ................................A.........................................
TIG26        ................................A.........................................
TIG27        ..........................................................................
TIG28        ...A......................................................................
TIG29        ..........................................................................
TIG30        ..........................................................................
TIG31        ..........................................................................
Ptt.R187     ..........................................................................
Ptt.R18      ..........................................................................
Ptt.R132     ................................A.........................................
Ptt.R1089    ..........................................................................
Ptt.R1083    ..........................................................................
Ptt.R17      ................................A.........................................
Ptt.R956     ..........................................................................
Ptt.R311     ................................A.........................................
Ptt.R308     ................................A.........................................
Ptt.R310     ................................A.........................................
Ptt.R309     ................................A.........................................
Ptt.R1081    ..........................................................................
Ptt.R265     ..........................................................................
Ptt.R1188    ..........................................................................
Ptt.R47      ..........................................................................
Ptt.R209     ..........................................................................
Ptt.Menghu12 --------------------------------------------------------------------------
Ptt.Menghu1  ..........................................................................
SUMATRA1     ..........................................................................
SUMATRA2     ..........................................................................
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Pta-172C        ------------------------------------------------------------------------------
Pta-172T        ------------------------------------------------------------------------------
CORBETTI2       ..............................................................................

ALTAICA4        CACAGCCATCTGTGCCCTCACACAAAATGATATTAAAAAAATTGTTGCTTTCTCAACTTCAAGCCAATTAGGCCTGATAA
ALTAICA         ..............................................................................
TIGRIS1         ..............................................................................
TIGRIS2         ..............................................................................
TIG11           .........------------------------------------------------------------------------
TIG12           .........------------------------------------------------------------------------
TIG13           .........------------------------------------------------------------------------
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TIG28           .........------------------------------------------------------------------------
TIG29           .........------------------------------------------------------------------------
TIG30           .........------------------------------------------------------------------------
TIG31           .........------------------------------------------------------------------------
Ptt.R187        ..............................A....------------------------------------------
Ptt.R18         ..............................A....------------------------------------------
Ptt.R132        ..............................-------------------------------------------------
Ptt.R1089       .............................--------------------------------------------------
Ptt.R1083       ...................................-------------------------------------------
Ptt.R17         ..............................-------------------------------------------------
Ptt.R956        ..............................-------------------------------------------------
Ptt.R311        ..............................-------------------------------------------------
Ptt.R308        ..............................A...-----------------------------------------
Ptt.R310        ..............................-------------------------------------------------
Ptt.R309        ..............................-------------------------------------------------
Ptt.R1081       ..............................-------------------------------------------------
Ptt.R265        ..............................A.....---------------------------------------
Ptt.R1188       ..............................A.----------------------------------------------
Ptt.R47         ..............................-------------------------------------------------
Ptt.R209        ........................-----------------------------------------------------
Ptt.Menghu12    ------------------------------------------------------------------------------
Ptt.Menghu1     ........................................A.....................................
SUMATRA1        ..............................................................................
SUMATRA2        ..............................................................................
Pta-172C        ------------------------------------------------------------------------------
Pta-172T        ------------------------------------------------------------------------------
CORBETTI2       ..............................................................................

ALTAICA4        TCGTTACTATCGGAATTAACCAACCCTACCTTGCATTTCTGCATATCTGCACACACGCATTTTTTAAAGCCATATTATTC
ALTAICA         ..................................C...........................................
TIGRIS1         ..................................C...........................................
TIGRIS2         ..................................C...........................................
TIG11           ------------------------------------------------------------------------------
TIG12           ------------------------------------------------------------------------------
TIG13           ------------------------------------------------------------------------------
TIG14           ------------------------------------------------------------------------------
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TIG30           ------------------------------------------------------------------------------
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TIG31        ----------------------------------------------------------------------------------
Ptt.R187     ----------------------------------------------------------------------------------
Ptt.R18      ----------------------------------------------------------------------------------
Ptt.R132     ----------------------------------------------------------------------------------
Ptt.R1089    ----------------------------------------------------------------------------------
Ptt.R1083    ----------------------------------------------------------------------------------
Ptt.R17      ----------------------------------------------------------------------------------
Ptt.R956     ----------------------------------------------------------------------------------
Ptt.R311     ----------------------------------------------------------------------------------
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Ptt.R1081    ----------------------------------------------------------------------------------
Ptt.R265     ----------------------------------------------------------------------------------
Ptt.R1188    ----------------------------------------------------------------------------------
Ptt.R47      ----------------------------------------------------------------------------------
Ptt.R209     ----------------------------------------------------------------------------------
Ptt.Menghu12 ----------------------------------------------------------------------------------
Ptt.Menghu1  ..................................C...................................................
SUMATRA1     ..................................C...................................................
SUMATRA2     ..................................C...................................................
Pta-172C     ----------------------------------------------------------------------------------
Pta-172T     ----------------------------------------------------------------------------------
CORBETTI2    ..................................C...................................................

ALTAICA4     ATGTGCTCCGGATCAATTATCCACAGTCTAAACGACGAGCAAGATATTCGAAAAATAGGCGGACTATACAAACCAATACC
ALTAICA      ..........................................................................
TIGRIS1      ..........................................................................
TIGRIS2      ..........................................................................
TIG11        ----------------------------------------------------------------------------------
TIG12        ----------------------------------------------------------------------------------
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Ptt.R187     ----------------------------------------------------------------------------------
Ptt.R18      ----------------------------------------------------------------------------------
Ptt.R132     ----------------------------------------------------------------------------------
Ptt.R1089    ----------------------------------------------------------------------------------
Ptt.R1083    ----------------------------------------------------------------------------------
Ptt.R17      ----------------------------------------------------------------------------------
Ptt.R956     ----------------------------------------------------------------------------------
Ptt.R311     ----------------------------------------------------------------------------------
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Ptt.R1081    ----------------------------------------------------------------------------------
Ptt.R265     ----------------------------------------------------------------------------------
Ptt.R1188    ----------------------------------------------------------------------------------
Ptt.R47      ----------------------------------------------------------------------------------
Ptt.R209     ----------------------------------------------------------------------------------
Ptt.Menghu12 ----------------------------------------------------------------------------------
Ptt.Menghu1  ..........................................................................
SUMATRA1     ..........................................................................
SUMATRA2     ..............................................................T...........
Pta-172C     ----------------------------------------------------------------------------------
Pta-172T     ----------------------------------------------------------------------------------
CORBETTI2    ..............................................................T...........

ALTAICA4     CTTTACTACCACCTCCCTTATTATCGGAAGCCTCGCATTAACAGGCATGCCATTCCTAACAGGCTTTTACTCCAAAGACC
ALTAICA      ..........................................................................
TIGRIS1      ..........................................................................
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TIGRIS2      ..........................................................................
TIG11        --------------------------------------------------------------------------
TIG12        --------------------------------------------------------------------------
TIG13        --------------------------------------------------------------------------
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TIG31        --------------------------------------------------------------------------
Ptt.R187     --------------------------------------------------------------------------
Ptt.R18      --------------------------------------------------------------------------
Ptt.R132     --------------------------------------------------------------------------
Ptt.R1089    --------------------------------------------------------------------------
Ptt.R1083    --------------------------------------------------------------------------
Ptt.R17      --------------------------------------------------------------------------
Ptt.R956     --------------------------------------------------------------------------
Ptt.R311     --------------------------------------------------------------------------
Ptt.R308     --------------------------------------------------------------------------
Ptt.R310     --------------------------------------------------------------------------
Ptt.R309     --------------------------------------------------------------------------
Ptt.R1081    --------------------------------------------------------------------------
Ptt.R265     --------------------------------------------------------------------------
Ptt.R1188    --------------------------------------------------------------------------
Ptt.R47      --------------------------------------------------------------------------
Ptt.R209     --------------------------------------------------------------------------
Ptt.Menghu12 --------------------------------------------------------------------------
Ptt.Menghu1  ..........................................................................
SUMATRA1     ..........................................................................
SUMATRA2     ..........................................................................
Pta-172C     --------------------------------------------------------------------------
Pta-172T     --------------------------------------------------------------------------
CORBETTI2    ..........................................................................

ALTAICA4     TAATCATCGAGACAGCCAATACGTCGTATACCAACGCCTGAGCCCTATTGGTCACTCTCATTGCTACATCCCTCACAGCC
ALTAICA      ..........................................................................
TIGRIS1      ..........................................................................
TIGRIS2      ..........................................................................
TIG11        --------------------------------------------------------------------------
TIG12        --------------------------------------------------------------------------
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TIG28        --------------------------------------------------------------------------
TIG29        --------------------------------------------------------------------------
TIG30        --------------------------------------------------------------------------
TIG31        --------------------------------------------------------------------------
Ptt.R187     --------------------------------------------------------------------------
Ptt.R18      --------------------------------------------------------------------------
Ptt.R132     --------------------------------------------------------------------------
Ptt.R1089    --------------------------------------------------------------------------
Ptt.R1083    --------------------------------------------------------------------------
Ptt.R17      --------------------------------------------------------------------------
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Ptt.R956      ----------------------------------------------------------------------------
Ptt.R311      ----------------------------------------------------------------------------
Ptt.R308      ----------------------------------------------------------------------------
Ptt.R310      ----------------------------------------------------------------------------
Ptt.R309      ----------------------------------------------------------------------------
Ptt.R1081     ----------------------------------------------------------------------------
Ptt.R265      ----------------------------------------------------------------------------
Ptt.R1188     ----------------------------------------------------------------------------
Ptt.R47       ----------------------------------------------------------------------------
Ptt.R209      ----------------------------------------------------------------------------
Ptt.Menghu12  ----------------------------------------------------------------------------
Ptt.Menghu1   ............................................................................
SUMATRA1      ............................................................................
SUMATRA2      ............................................................................
Pta-172C      ----------------------------------------------------------------------------
Pta-172T      ----------------------------------------------------------------------------
CORBETTI2     ............................................................................

ALTAICA4      GCCTATAGTACTCGAATCATATTCTTTGCACTCCTGGGGCAACCCCGATTCAACTCCCTAAGCCCAATCAATGAAAACAA
ALTAICA       ..............T.............................................................
TIGRIS1       ............................................................................
TIGRIS2       ............................................................................
TIG11         ----------------------------------------------------------------------------
TIG12         ----------------------------------------------------------------------------
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TIG31         ----------------------------------------------------------------------------
Ptt.R187      ----------------------------------------------------------------------------
Ptt.R18       ----------------------------------------------------------------------------
Ptt.R132      ----------------------------------------------------------------------------
Ptt.R1089     ----------------------------------------------------------------------------
Ptt.R1083     ----------------------------------------------------------------------------
Ptt.R17       ----------------------------------------------------------------------------
Ptt.R956      ----------------------------------------------------------------------------
Ptt.R311      ----------------------------------------------------------------------------
Ptt.R308      ----------------------------------------------------------------------------
Ptt.R310      ----------------------------------------------------------------------------
Ptt.R309      ----------------------------------------------------------------------------
Ptt.R1081     ----------------------------------------------------------------------------
Ptt.R265      ----------------------------------------------------------------------------
Ptt.R1188     ----------------------------------------------------------------------------
Ptt.R47       ----------------------------------------------------------------------------
Ptt.R209      ----------------------------------------------------------------------------
Ptt.Menghu12  ----------------------------------------------------------------------------
Ptt.Menghu1   ............................................................................
SUMATRA1      ............................................................................
SUMATRA2      ............................................................................
Pta-172C      ----------------------------------------------------------------------------
Pta-172T      ----------------------------------------------------------------------------
CORBETTI2     ............................................................................

ALTAICA4      CCCCCACCTCATCAACTCCATTAAACGTCTCTTAATTGGAAGCATTTTTGCAGGATACTTGATCTCCCATAACATCCCCC
ALTAICA       ............................................................................
TIGRIS1       ............................................................................
TIGRIS2       ............................................................................
TIG11         ----------------------------------------------------------------------------
TIG12         ----------------------------------------------------------------------------
TIG13         ----------------------------------------------------------------------------
TIG14         ----------------------------------------------------------------------------
TIG15         ----------------------------------------------------------------------------
TIG16         ----------------------------------------------------------------------------
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TIG17        ----------------------------------------------------------------------------------
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TIG30        ----------------------------------------------------------------------------------
TIG31        ----------------------------------------------------------------------------------
Ptt.R187     ----------------------------------------------------------------------------------
Ptt.R18      ----------------------------------------------------------------------------------
Ptt.R132     ----------------------------------------------------------------------------------
Ptt.R1089    ----------------------------------------------------------------------------------
Ptt.R1083    ----------------------------------------------------------------------------------
Ptt.R17      ----------------------------------------------------------------------------------
Ptt.R956     ----------------------------------------------------------------------------------
Ptt.R311     ----------------------------------------------------------------------------------
Ptt.R308     ----------------------------------------------------------------------------------
Ptt.R310     ----------------------------------------------------------------------------------
Ptt.R309     ----------------------------------------------------------------------------------
Ptt.R1081    ----------------------------------------------------------------------------------
Ptt.R265     ----------------------------------------------------------------------------------
Ptt.R1188    ----------------------------------------------------------------------------------
Ptt.R47      ----------------------------------------------------------------------------------
Ptt.R209     ----------------------------------------------------------------------------------
Ptt.Menghu12 ----------------------------------------------------------------------------------
Ptt.Menghu1  ..................................................................................
SUMATRA1     ..................................................................................
SUMATRA2     ..................................................................................
Pta-172C     ----------------------------------------------------------------------------------
Pta-172T     ----------------------------------------------------------------------------------
CORBETTI2    ..................................................................................

ALTAICA4     CAACGACCATCCCACAAATGACCATACCCTGCCACCTAAAACTAACTGCTCTCGCCATGACCATTATAGGCTTTATCCTG
ALTAICA      ............................................................C.................
TIGRIS1      ............................................................C.................
TIGRIS2      ............................................................C.................
TIG11        ----------------------------------------------------------------------------------
TIG12        ----------------------------------------------------------------------------------
TIG13        ----------------------------------------------------------------------------------
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TIG31        ----------------------------------------------------------------------------------
Ptt.R187     ----------------------------------------------------------------------------------
Ptt.R18      ----------------------------------------------------------------------------------
Ptt.R132     ----------------------------------------------------------------------------------
Ptt.R1089    ----------------------------------------------------------------------------------
Ptt.R1083    ----------------------------------------------------------------------------------
Ptt.R17      ----------------------------------------------------------------------------------
Ptt.R956     ----------------------------------------------------------------------------------
Ptt.R311     ----------------------------------------------------------------------------------
Ptt.R308     ----------------------------------------------------------------------------------
Ptt.R310     ----------------------------------------------------------------------------------
Ptt.R309     ----------------------------------------------------------------------------------
Ptt.R1081    ----------------------------------------------------------------------------------
Ptt.R265     ----------------------------------------------------------------------------------
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Ptt.R1188     ----------------------------------------------------------------------------------
Ptt.R47       ----------------------------------------------------------------------------------
Ptt.R209      ----------------------------------------------------------------------------------
Ptt.Menghu12  ----------------------------------------------------------------------------------
Ptt.Menghu1   ..............................................................C.....................
SUMATRA1      ..................................................................................
SUMATRA2      ..............................................................C.....................
Pta-172C      ----------------------------------------------------------------------------------
Pta-172T      ----------------------------------------------------------------------------------
CORBETTI2     ..............................................................C.....................

ALTAICA4      GCATTAGAGCTTAACCTCGTGGCTAAAAACTTAAAATTTAAATACCCCTCAAATCTTTTTAAGTTTTCTAACCTCCTCGG
ALTAICA       ..................................................................................
TIGRIS1       ..................................................................................
TIGRIS2       ..................................................................................
TIG11         ----------------------------------------------------------------------------------
TIG12         ----------------------------------------------------------------------------------
TIG13         ----------------------------------------------------------------------------------
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TIG30         ----------------------------------------------------------------------------------
TIG31         ----------------------------------------------------------------------------------
Ptt.R187      ----------------------------------------------------------------------------------
Ptt.R18       ----------------------------------------------------------------------------------
Ptt.R132      ----------------------------------------------------------------------------------
Ptt.R1089     ----------------------------------------------------------------------------------
Ptt.R1083     ----------------------------------------------------------------------------------
Ptt.R17       ----------------------------------------------------------------------------------
Ptt.R956      ----------------------------------------------------------------------------------
Ptt.R311      ----------------------------------------------------------------------------------
Ptt.R308      ----------------------------------------------------------------------------------
Ptt.R310      ----------------------------------------------------------------------------------
Ptt.R309      ----------------------------------------------------------------------------------
Ptt.R1081     ----------------------------------------------------------------------------------
Ptt.R265      ----------------------------------------------------------------------------------
Ptt.R1188     ----------------------------------------------------------------------------------
Ptt.R47       ----------------------------------------------------------------------------------
Ptt.R209      ----------------------------------------------------------------------------------
Ptt.Menghu12  ----------------------------------------------------------------------------------
Ptt.Menghu1   ..................................................................................
SUMATRA1      ..................................................................................
SUMATRA2      ..................................................................................
Pta-172C      ----------------------------------------------------------------------------------
Pta-172T      ----------------------------------------------------------------------------------
CORBETTI2     ..................................................................................G..

ALTAICA4      GTACTTTCCAATCGTAATTCACCGCCTCCCATCGATAATAAGCCTAACCATAAGCCAAAAATCCGCATCGATACTATTAG
ALTAICA       ..................................................................................
TIGRIS1       ..................................................................................
TIGRIS2       ..................................................................................
TIG11         ----------------------------------------------------------------------------------
TIG12         ----------------------------------------------------------------------------------
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TIG23         ----------------------------------------------------------------------------------
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TIG24         ----------------------------------------------------------------------------
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TIG31         ----------------------------------------------------------------------------
Ptt.R187      ----------------------------------------------------------------------------
Ptt.R18       ----------------------------------------------------------------------------
Ptt.R132      ----------------------------------------------------------------------------
Ptt.R1089     ----------------------------------------------------------------------------
Ptt.R1083     ----------------------------------------------------------------------------
Ptt.R17       ----------------------------------------------------------------------------
Ptt.R956      ----------------------------------------------------------------------------
Ptt.R311      ----------------------------------------------------------------------------
Ptt.R308      ----------------------------------------------------------------------------
Ptt.R310      ----------------------------------------------------------------------------
Ptt.R309      ----------------------------------------------------------------------------
Ptt.R1081     ----------------------------------------------------------------------------
Ptt.R265      ----------------------------------------------------------------------------
Ptt.R1188     ----------------------------------------------------------------------------
Ptt.R47       ----------------------------------------------------------------------------
Ptt.R209      ----------------------------------------------------------------------------
Ptt.Menghu12  ----------------------------------------------------------------------------
Ptt.Menghu1   ............................................................................
SUMATRA1      ............................................................................
SUMATRA2      ............................................................................
Pta-172C      ----------------------------------------------------------------------------
Pta-172T      ----------------------------------------------------------------------------
CORBETTI2     ............................................................................

ALTAICA4      ATATAATCTGGCTAGAAAATGTATTACCAAAATCCATCTCCCACTTCCAAATAAAAATATCAACCGCCGTATCTAATCAG
ALTAICA       ............................................................................
TIGRIS1       ............................................................................
TIGRIS2       ............................................................................
TIG11         ----------------------------------------------------------------------------
TIG12         ----------------------------------------------------------------------------
TIG13         ----------------------------------------------------------------------------
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TIG31         ----------------------------------------------------------------------------
Ptt.R187      ----------------------------------------------------------------------------
Ptt.R18       ----------------------------------------------------------------------------
Ptt.R132      ----------------------------------------------------------------------------
Ptt.R1089     ----------------------------------------------------------------------------
Ptt.R1083     ----------------------------------------------------------------------------
Ptt.R17       ----------------------------------------------------------------------------
Ptt.R956      ----------------------------------------------------------------------------
Ptt.R311      ----------------------------------------------------------------------------
Ptt.R308      ----------------------------------------------------------------------------
Ptt.R310      ----------------------------------------------------------------------------
Ptt.R309      ----------------------------------------------------------------------------
Ptt.R1081     ----------------------------------------------------------------------------
Ptt.R265      ----------------------------------------------------------------------------
Ptt.R1188     ----------------------------------------------------------------------------
Ptt.R47       ----------------------------------------------------------------------------
Ptt.R209      ----------------------------------------------------------------------------
Ptt.Menghu12  ----------------------------------------------------------------------------
Ptt.Menghu1   .C..........................................................................
SUMATRA1      ............................................................................
SUMATRA2      ............................................................................
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Pta-172C     ----------------------------------------------------------------------------------
Pta-172T     ----------------------------------------------------------------------------------
CORBETTI2    ..................................................................................

ALTAICA4     AAGGGACTAGTTAAGCTCTACTTCCTATCCTTCATAATCACCCTGACCCTTAGCCTACTCTTACT
ALTAICA      ............................................................
TIGRIS1      ............................................................
TIGRIS2      ............................................................
TIG11        ------------------------------------------------------------
TIG12        ------------------------------------------------------------
TIG13        ------------------------------------------------------------
TIG14        ------------------------------------------------------------
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TIG31        ------------------------------------------------------------
Ptt.R187     ------------------------------------------------------------
Ptt.R18      ------------------------------------------------------------
Ptt.R132     ------------------------------------------------------------
Ptt.R1089    ------------------------------------------------------------
Ptt.R1083    ------------------------------------------------------------
Ptt.R17      ------------------------------------------------------------
Ptt.R956     ------------------------------------------------------------
Ptt.R311     ------------------------------------------------------------
Ptt.R308     ------------------------------------------------------------
Ptt.R310     ------------------------------------------------------------
Ptt.R309     ------------------------------------------------------------
Ptt.R1081    ------------------------------------------------------------
Ptt.R265     ------------------------------------------------------------
Ptt.R1188    ------------------------------------------------------------
Ptt.R47      ------------------------------------------------------------
Ptt.R209     ------------------------------------------------------------
Ptt.Menghu12 ------------------------------------------------------------
Ptt.Menghu1  ............................................................
SUMATRA1     ............................T...............................
SUMATRA2     ............................T...............................
Pta-172C     ------------------------------------------------------------
Pta-172T     ------------------------------------------------------------
CORBETTI2    ............................................................
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ND6

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ALTAICA4  TTAGTTTCCACGAGTAACCTCTATAATCACCAATACACCAATAAGCAAAGACCAACCAGTGACAACCACTAGCCAGGT
ALTAICA   ...............................................................................
ALT       --.............................................................................
TIGRIS1   ...............................................................................
TIGRIS2   ...............................................................................
TIG1      --.............................................................................
TIG2      --.............................................................................
TIG3      --.............................................................................
TIG4      --.............................................................................
TIG5      --.............................................................................
TIG6      --.............................................................................
SUMATRA1  ...............................................................................
SUMATRA2  ...............................................................................
SUM1      --.............................................................................
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SUM3      --.............................................................................
SUM4      --.............................................................................
SUM5      --.............................................................................
AMO1      --.............................................................................
SUM6      --.............................................................................
SUM7      --.............................................................................
SUM8      --.............................................................................
AMO2      --.............................................................................
AMO3/COR1 --.............................................................................
COR2      --.............................................................................
COR3      --.............................................................................
COR4      --.............................................................................
COR5      --.............................................................................
COR6      --.............................................................................
COR7      --.............................................................................
COR8      --.............................................................................
CORBETTI1 ...............................................................................
CORBETTI2 ...............................................................................

ALTAICA4  TCCATAACTATACAGTGCTGCAATTCCTATGGCCTCCTCACTAAAAAACCCCGAGTCACCCGTATCATAGATCACTCA
ALTAICA   ...............................................................................
ALT       ...............................................................................
TIGRIS1   ...............................................................................
TIGRIS2   ...............................................................................
TIG1      ...............................................................................
TIG2      ...............................................................................
TIG3      ...............................................................................
TIG4      ...............................................................................
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TIG6      ...............................................................................
SUMATRA1  ...............................................................................
SUMATRA2  ...............................................................................
SUM1      ...............................................................................
SUM2      ...............................................................................
SUM3      ...............................................................................
SUM4      ...............................................................................
SUM5      ...............................................................................
AMO1      .............................................................................C..
SUM6      ...............................................................................
SUM7      ...............................................................................
SUM8      ...............................................................................
AMO2      ...............................................................................
AMO3/COR1 ...............................................................................
COR2      ...............................................................................
COR3      ...............................................................................
COR4      ...............................................................................
COR5      ...............................................................................
COR6      ...............................................................................
COR7      ...............................................................................
COR8      ...............................................................................
CORBETTI1 ...............................................................................
CORBETTI2 ...............................................................................

ALTAICA4  ATCACCCGCACCATTAAACTTAAACACAACCTCAACCTCATCTTCCTTTAAAATATAGCAAGCAGTCAACAACTCCGC
ALTAICA   ...............................................................................
ALT       ...............................................................................
TIGRIS1   ........................T......................................................
TIGRIS2   .......................T.......................................................
TIG1      .......................T.......................................................
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TIG2       .......................T.....................................................
TIG3       .......................T.....................................................
TIG4       .......................T.....................................................
TIG5       .......................T.....................................................
TIG6       .......................T.....................................................
SUMATRA1   .....................................................................................
SUMATRA2   .....................................................................................
SUM1       .....................................................................................
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AMO1       .....................................................................................
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SUM7       .....................................................................................
SUM8       .....................................................................................
AMO2       .....................................................................................
AMO3/COR1 .....................................................................................
COR2       .....................................................................................
COR3       .....................................................................................
COR4       .....................................................................................
COR5       .....................................................................................
COR6       .....................................................................................
COR7       .....................................................................................
COR8       .....................................................................................
CORBETTI1 .....................................................................................
CORBETTI2 .....................................................................................

ALTAICA4  TAATACCCCCGTAATAAACGCACCTAATACGGCTTTATTAGATGTCCACGCCTCGGGGTAGGGCTCAGTAGCCATAGC
ALTAICA    ....................................G.....................................
ALT        .....................................................................................
TIGRIS1    ....................................G.....................................
TIGRIS2    ....................................G.....................................
TIG1       ....................................G.....................................
TIG2       ....................................G.....................................
TIG3       ....................................G.....................................
TIG4       ....................................G.....................................
TIG5       ....................................G.....................................
TIG6       ....................................G.....................................
SUMATRA1   ....................................G.....................................
SUMATRA2   ....................................G.....................................
SUM1       ....................................G.....................................
SUM2       ....................................G.....................................
SUM3       ....................................G.....................................
SUM4       ....................................G.....................................
SUM5       ....................................G.....................................
AMO1       ....................................G.....................................
SUM6       ....................................G.....................................
SUM7       ....................................G.....................................
SUM8       ....................................G.....................................
AMO2       ....................................G.....................................
AMO3/COR1  ....................................G.....................................
COR2       ....................................G.....................................
COR3       ....................................G.....................................
COR4       ....................................G.....................................
COR5       ....................................G.....................................
COR6       ....................................G.....................................
COR7       ....................................G.....................................
COR8       ....................................G.....................................
CORBETTI1  ....................................G.....................................
CORBETTI2  .....................................................................................

ALTAICA4  TGTAGTGTACCCAAACACCACAAGCATGCCCCCCAAATAAATTAAAAAAACTATTAAACCTAAAAATGACCCCCCAAA
ALTAICA    ............................T............................................
ALT        ...........................................................----------
TIGRIS1    .....................................................................................
TIGRIS2    .....................................................................................
TIG1       ..........................................................----------
TIG2       .........................................................----------
TIG3       ........................................................----------
TIG4       .......................................................----------
TIG5       ......................................................----------
TIG6       .....................................................----------
SUMATRA1   .....................................................................................
SUMATRA2   .....................................................................................
SUM1       ......................................................----------
SUM2       .....................................................----------
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SUM3       ..........................................................----------
SUM4       ..........................................................----------
SUM5       ..........................................................----------
AMO1       ..........................................................----------
SUM6       ..........................................................----------
SUM7       ..........................................................----------
SUM8       ..........................................................----------
AMO2       ..........................................................----------
AMO3/COR1  ..........................................................----------
COR2       ..........................................................----------
COR3       ..........................................................----------
COR4       ..........................................................----------
COR5       ..........................................................----------
COR6       ..........................................................----------
COR7       ............................T.............................----------
COR8       ............................T.............................----------
CORBETTI1  ..........................................................
CORBETTI2  ..........................................................

ALTAICA4   ATTCAATACAATACCGCAACCAACACCACCAGCCACAATCAATCCAAGCCCACCATAAATAGGAGAAGGCTTTGAAGA
ALTAICA    ..........................................................................
ALT        --------------------------------------------------------------------------
TIGRIS1    ..........................................................................
TIGRIS2    ..........................................................................
TIG1       --------------------------------------------------------------------------
TIG2       --------------------------------------------------------------------------
TIG3       --------------------------------------------------------------------------
TIG4       --------------------------------------------------------------------------
TIG5       --------------------------------------------------------------------------
TIG6       --------------------------------------------------------------------------
SUMATRA1   ..........................................................................
SUMATRA2   ..........................................................................
SUM1       --------------------------------------------------------------------------
SUM2       --------------------------------------------------------------------------
SUM3       --------------------------------------------------------------------------
SUM4       --------------------------------------------------------------------------
SUM5       --------------------------------------------------------------------------
AMO1       --------------------------------------------------------------------------
SUM6       --------------------------------------------------------------------------
SUM7       --------------------------------------------------------------------------
SUM8       --------------------------------------------------------------------------
AMO2       --------------------------------------------------------------------------
AMO3/COR1  --------------------------------------------------------------------------
COR2       --------------------------------------------------------------------------
COR3       --------------------------------------------------------------------------
COR4       --------------------------------------------------------------------------
COR5       --------------------------------------------------------------------------
COR6       --------------------------------------------------------------------------
COR7       --------------------------------------------------------------------------
COR8       --------------------------------------------------------------------------
CORBETTI1  ..........................................................................
CORBETTI2  ..........................................................................

ALTAICA4   AAAACTCACAAAGCTCACCACGAAAATTGTACTTAAAATAAATACAATGTATGTTATCATA
ALTAICA    ............................................................
ALT        ------------------------------------------------------------
TIGRIS1    ............................................................
TIGRIS2    ............................................................
TIG1       ------------------------------------------------------------
TIG2       ------------------------------------------------------------
TIG3       ------------------------------------------------------------
TIG4       ------------------------------------------------------------
TIG5       ------------------------------------------------------------
TIG6       ------------------------------------------------------------
SUMATRA1   ............................................................
SUMATRA2   ............................................................
SUM1       ------------------------------------------------------------
SUM2       ------------------------------------------------------------
SUM3       ------------------------------------------------------------
SUM4       ------------------------------------------------------------
SUM5       ------------------------------------------------------------
AMO1       ------------------------------------------------------------
SUM6       ------------------------------------------------------------
SUM7       ------------------------------------------------------------
SUM8       ------------------------------------------------------------
AMO2       ------------------------------------------------------------
AMO3/COR1  ------------------------------------------------------------
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COR2      ------------------------------------------------------------
COR3      ------------------------------------------------------------
COR4      ------------------------------------------------------------
COR5      ------------------------------------------------------------
COR6      ------------------------------------------------------------
COR7      ------------------------------------------------------------
COR8      ------------------------------------------------------------
CORBETTI1 ............................................................
CORBETTI2 ............................................................
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Cytochrome *b*

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ALTAICA4       ATGACCAACATTCGAAAATCACACCCCCTTATCAAAATTATTAATCACTCATTTATTGACCTACCCGCCCCATCCAATAT
ALTAICA        ................................................................................
ALT            --------------------------------------------------------------------------------
Pta.S1         ................................................................................
Pta.S2         ................................................................................
Pta.S3         ................................................................................
Pta.S4         ................................................................................
Pta.S5         ................................................................................
Pta.S6         ................................................................................
Pta.S7         ................................................................................
Pta.S8         ................................................................................
Pta.S10        ................................................................................
Pta.S11        ................................................................................
Pta.S12        ................................................................................
Pta.S13        ................................................................................
Pta.S14        ................................................................................
Pta.S15        ................................................................................
Pta.OR602      ...............................................................................A................
Pta.bl4867     ...............................................................................A................
Pta.bl4034     ................................................................................
Pta.bl2981     ................................................................................
Pta.FJ895266   --------------------------------------------------------------------------------
TIGRIS1        ................................................................................
TIGRIS2        ................................................................................
TIG1           --------------------------------------------------------------------------------
TIG2           --------------------------------------------------------------------------------
TIG3           --------------------------------------------------------------------------------
TIG4           --------------------------------------------------------------------------------
TIG5           --------------------------------------------------------------------------------
TIG6           --------------------------------------------------------------------------------
TIG*10         --------------------------------------------------------------------------------
TIG*9          --------------------------------------------------------------------------------
TIG*8          --------------------------------------------------------------------------------
TIG*7          --------------------------------------------------------------------------------
TIG31          --------------------------------------------------------------------------------
TIG30          --------------------------------------------------------------------------------
TIG29          --------------------------------------------------------------------------------
TIG28          --------------------------------------------------------------------------------
TIG27          --------------------------------------------------------------------------------
TIG26          --------------------------------------------------------------------------------
TIG25          --------------------------------------------------------------------------------
TIG24          --------------------------------------------------------------------------------
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TIG20          --------------------------------------------------------------------------------
TIG19          --------------------------------------------------------------------------------
TIG18          --------------------------------------------------------------------------------
TIG17          --------------------------------------------------------------------------------
TIG16          --------------------------------------------------------------------------------
TIG15          --------------------------------------------------------------------------------
TIG14          --------------------------------------------------------------------------------
TIG13          --------------------------------------------------------------------------------
TIG12          --------------------------------------------------------------------------------
TIG11          --------------------------------------------------------------------------------
Ptt.B2         ..........................................C.....................A................
Ptt.B3         ................................................................................
Ptt.B4         ................................................................................
Ptt.B5         ................................................................................
Ptt.B6         ................................................................................
Ptt.B7         ................................................................................
Ptt.B8         ................................................................................
Ptt.B9         ................................................................................
SUMATRA1       ................................................................................
SUMATRA2       ................................................................................
SUM1           --------------------------------------------------------------------------------
SUM2           --------------------------------------------------------------------------------
SUM3           --------------------------------------------------------------------------------
SUM4           --------------------------------------------------------------------------------
SUM5           --------------------------------------------------------------------------------
SUM6           --------------------------------------------------------------------------------
SUM7           --------------------------------------------------------------------------------
SUM8           --------------------------------------------------------------------------------
Su1            ................................................................................
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Su2_cytb        ..........................................................................
Su3             ..........................................................................
Su2             ..........................................................................
Su5             ..........................................................................
Su6             ..........................................................................
Su7             ..........................................................................
Su9             ..........................................................................
Su10            ..........................................................................
AMO1            --------------------------------------------------------------------------
AMO2            --------------------------------------------------------------------------
AMO3/COR1       --------------------------------------------------------------------------
COR2            --------------------------------------------------------------------------
COR3            --------------------------------------------------------------------------
COR4            --------------------------------------------------------------------------
COR5            --------------------------------------------------------------------------
COR6            --------------------------------------------------------------------------
COR7            --------------------------------------------------------------------------
COR8            --------------------------------------------------------------------------
CORBETTI1       ..........................................................A...............
CORBETTI2       ..........................................................................
C3              ..........................................................................
C2              ..........................................................................
jacksoni_TIG32  ----------------------------------------------------------T........C..
jacksoni_TIG31  ----------------------------------------------------------T........C..
jacksoni_TIG30  ----------------------------------------------------------T........C..
jacksoni_TIG29  ----------------------------------------------------------T........C..
jacksoni_TIG28  ----------------------------------------------------------T........C..
jacksoni_TIG27  ----------------------------------------------------------T........C..
jacksoni_TIG26  ----------------------------------------------------------T........C..
jacksoni_TIG25  ----------------------------------------------------------T........C..
jacksoni_TIG24  ----------------------------------------------------------T........C..
jacksoni_TIG23  ----------------------------------------------------------T........C..
jacksoni_TIG22  ----------------------------------------------------------T........C..
jacksoni_TIG21  ----------------------------------------------------------T........C..
jacksoni_TCA2   ----------------------------------------------------------T........C..
jacksoni_TCA1   ----------------------------------------------------------T........C..
jacksoni_MZ9    ----------------------------------------------------------T........C..
jacksoni_MZ8    ----------------------------------------------------------T........C..
jacksoni_MZ7    ----------------------------------------------------------T........C..
jacksoni_MZ6    ----------------------------------------------------------T........C..
jacksoni_MZ5    ----------------------------------------------------------T........C..
jacksoni_MZ4    ----------------------------------------------------------T........C..
jacksoni_MZ3    ----------------------------------------------------------T........C..
jacksoni_MZ1    ----------------------------------------------------------T........C..
jacksoni_TZ9    ----------------------------------------------------------T........C..
jacksoni_TZ8    ----------------------------------------------------------T........C..
jacksoni_TZ7    ----------------------------------------------------------T........C..
jacksoni_TZ6    ----------------------------------------------------------T........C..
jacksoni_TZ5    ----------------------------------------------------------T........C..
jacksoni_TZ4    ----------------------------------------------------------T........C..
jacksoni_TZ2    ----------------------------------------------------------T........C..
jacksoni_TZ1    ----------------------------------------------------------T........C..
corbetti.HZ     --------------------------------------------------------------------------
sondaica        --------------------------------------------------------------------------
sondaica2       --------------------------------------------------------------------------

ALTAICA4        TTCAGCATGATGAAACTTTGGCTCCTTACTAGGGGTGTGCTTAATCTTACAAATCCTCACTGGCCTCTTTCTAGCCATAC
ALTAICA         ...........................................................C..............
ALT             --------------------------------------------------------------------------
Pta.S1          ..........................................................................
Pta.S2          ..........................................................................
Pta.S3          ..........................................................................
Pta.S4          ..........................................................................
Pta.S5          ..........................................................................
Pta.S6          ..........................................................................
Pta.S7          ..........................................................................
Pta.S8          ..........................................................................
Pta.S10         ..........................................................................
Pta.S11         ..........................................................................
Pta.S12         ..........................................................................
Pta.S13         ..........................................................................
Pta.S14         ..........................................................................
Pta.S15         ..........................................................................
Pta.OR602       ...........................................................C..............
Pta.bl4867      ...........................................................C..............
Pta.bl4034      ..........................................................................
Pta.bl2981      ..........................................................................
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Pta.FJ895266    ----------------------------------------------------------------------------
TIGRIS1         ............................................................................
TIGRIS2         ............................................................................
TIG1            ----------------------------------------------------------------------------
TIG2            ----------------------------------------------------------------------------
TIG3            ----------------------------------------------------------------------------
TIG4            ----------------------------------------------------------------------------
TIG5            ----------------------------------------------------------------------------
TIG6            ----------------------------------------------------------------------------
TIG*10          ----------------------------------------------------------------------------
TIG*9           ----------------------------------------------------------------------------
TIG*8           ----------------------------------------------------------------------------
TIG*7           ----------------------------------------------------------------------------
TIG31           ----------------------------------------------------------------------------
TIG30           ----------------------------------------------------------------------------
TIG29           ----------------------------------------------------------------------------
TIG28           ----------------------------------------------------------------------------
TIG27           ----------------------------------------------------------------------------
TIG26           ----------------------------------------------------------------------------
TIG25           ----------------------------------------------------------------------------
TIG24           ----------------------------------------------------------------------------
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TIG20           ----------------------------------------------------------------------------
TIG19           ----------------------------------------------------------------------------
TIG18           ----------------------------------------------------------------------------
TIG17           ----------------------------------------------------------------------------
TIG16           ----------------------------------------------------------------------------
TIG15           ----------------------------------------------------------------------------
TIG14           ----------------------------------------------------------------------------
TIG13           ----------------------------------------------------------------------------
TIG12           ----------------------------------------------------------------------------
TIG11           ----------------------------------------------------------------------------
Ptt.B2          ............................................................................
Ptt.B3          ............................................................................
Ptt.B4          ............................................................................
Ptt.B5          ............................................................................
Ptt.B6          ............................................................................
Ptt.B7          ............................................................................
Ptt.B8          ............................................................................
Ptt.B9          ............................................................................
SUMATRA1        ............................................................................
SUMATRA2        ............................................................................
SUM1            ----------------------------------------------------------------------------
SUM2            ----------------------------------------------------------------------------
SUM3            ----------------------------------------------------------------------------
SUM4            ----------------------------------------------------------------------------
SUM5            ----------------------------------------------------------------------------
SUM6            ----------------------------------------------------------------------------
SUM7            ----------------------------------------------------------------------------
SUM8            ----------------------------------------------------------------------------
Su1             ............................................................................
Su2_cytb        ............................................................................
Su3             ............................................................................
Su2             ............................................................................
Su5             ............................................................................
Su6             ............................................................................
Su7             ............................................................................
Su9             ............................................................................
Su10            ............................................................................
AMO1            ----------------------------------------------------------------------------
AMO2            ----------------------------------------------------------------------------
AMO3/COR1       ----------------------------------------------------------------------------
COR2            ----------------------------------------------------------------------------
COR3            ----------------------------------------------------------------------------
COR4            ----------------------------------------------------------------------------
COR5            ----------------------------------------------------------------------------
COR6            ----------------------------------------------------------------------------
COR7            ----------------------------------------------------------------------------
COR8            ----------------------------------------------------------------------------
CORBETTI1       ............................................................................
CORBETTI2       ............................................................................
C3              ............................................................................
C2              ............................................................................
jacksoni_TIG32 C............................................................................
jacksoni_TIG31 C............................................................................
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jacksoni_TIG30 C.....................................................................
jacksoni_TIG29 C.....................................................C...............
jacksoni_TIG28 C.....................................................................
jacksoni_TIG27 C.....................................................................
jacksoni_TIG26 C.....................................................................
jacksoni_TIG25 C.....................................................C...............
jacksoni_TIG24 C.....................................................................
jacksoni_TIG23 C.....................................................C...............
jacksoni_TIG22 C.....................................................................
jacksoni_TIG21 C.....................................................................
jacksoni_TCA2  C.....................................................................
jacksoni_TCA1  C.....................................................................
jacksoni_MZ9   C.....................................................C...............
jacksoni_MZ8   C.....................................................C...............
jacksoni_MZ7   C.....................................................C...............
jacksoni_MZ6   C.....................................................................
jacksoni_MZ5   C.....................................................................
jacksoni_MZ4   C.....................................................................
jacksoni_MZ3   C.....................................................C...............
jacksoni_MZ1   C.....................................................................
jacksoni_TZ9   C.....................................................C...............
jacksoni_TZ8   C.....................................................................
jacksoni_TZ7   C.....................................................................
jacksoni_TZ6   C.....................................................................
jacksoni_TZ5   C.....................................................................
jacksoni_TZ4   C.....................................................C...............
jacksoni_TZ2   C.....................................................C...............
jacksoni_TZ1   C.....................................................C...............
corbetti.HZ    ---------------------------------------------------------------.......
sondaica       ---------------------------------------------------------------------
sondaica2      ---------------------------------------------------------------------

ALTAICA4       ACTACACATCAGACACAATAACCGCTTTCTCATCAGTTACCCACATTTGCCGCGACGTAAACTACGGCTGGATTATCCGA
ALTAICA        .....................................................................
ALT            ---------------------------------------------------------------------
Pta.S1         .....................................................................
Pta.S2         .....................................................................
Pta.S3         .....................................................................
Pta.S4         .....................................................................
Pta.S5         .....................................................................
Pta.S6         .....................................................................
Pta.S7         .....................................................................
Pta.S8         .....................................................................
Pta.S10        .....................................................................
Pta.S11        .....................................................................
Pta.S12        .....................................................................
Pta.S13        .....................................................................
Pta.S14        .....................................................................
Pta.S15        .....................................................................
Pta.OR602      .....................................................................
Pta.bl4867     .....................................................................
Pta.bl4034     .....................................................................
Pta.bl2981     .....................................................................
Pta.FJ895266   ---------------------------------------------------------------.....
TIGRIS1        .....................................................................
TIGRIS2        .....................................................................
TIG1           ---------------------------------------------------------------------
TIG2           ---------------------------------------------------------------------
TIG3           ---------------------------------------------------------------------
TIG4           ---------------------------------------------------------------------
TIG5           ---------------------------------------------------------------------
TIG6           ---------------------------------------------------------------------
TIG*10         ---------------------------------------------------------------------
TIG*9          ---------------------------------------------------------------------
TIG*8          ---------------------------------------------------------------------
TIG*7          ---------------------------------------------------------------------
TIG31          ---------------------------------------------------------------------
TIG30          ---------------------------------------------------------------------
TIG29          ---------------------------------------------------------------------
TIG28          ---------------------------------------------------------------------
TIG27          ---------------------------------------------------------------------
TIG26          ---------------------------------------------------------------------
TIG25          ---------------------------------------------------------------------
TIG24          ---------------------------------------------------------------------
TIG23          ---------------------------------------------------------------------
TIG22          ---------------------------------------------------------------------
TIG21          ---------------------------------------------------------------------
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TIG20          --------------------------------------------------------------------------------
TIG19          --------------------------------------------------------------------------------
TIG18          --------------------------------------------------------------------------------
TIG17          --------------------------------------------------------------------------------
TIG16          --------------------------------------------------------------------------------
TIG15          --------------------------------------------------------------------------------
TIG14          --------------------------------------------------------------------------------
TIG13          --------------------------------------------------------------------------------
TIG12          --------------------------------------------------------------------------------
TIG11          --------------------------------------------------------------------------------
Ptt.B2         ................................................................................
Ptt.B3         ................................................................................
Ptt.B4         ................................................................................
Ptt.B5         ................................................................................
Ptt.B6         ................................................................................
Ptt.B7         ................................................................................
Ptt.B8         ................................................................................
Ptt.B9         ................................................................................
SUMATRA1       ........................A.......................................................
SUMATRA2       ........................A.......................................................
SUM1           --------------------------------------------------------------------------------
SUM2           --------------------------------------------------------------------------------
SUM3           --------------------------------------------------------------------------------
SUM4           --------------------------------------------------------------------------------
SUM5           --------------------------------------------------------------------------------
SUM6           --------------------------------------------------------------------------------
SUM7           --------------------------------------------------------------------------------
SUM8           --------------------------------------------------------------------------------
Su1            ........................A.......................................................
Su2_cytb       ........................A.......................................................
Su3            ........................A.......................................................
Su2            ........................A.......................................................
Su5            ........................A.......................................................
Su6            ........................A.......................................................
Su7            ........................A.......................................................
Su9            ........................A.......................................................
Su10           ........................A.......................................................
AMO1           --------------------------------------------------------------------------------
AMO2           --------------------------------------------------------------------------------
AMO3/COR1      --------------------------------------------------------------------------------
COR2           --------------------------------------------------------------------------------
COR3           --------------------------------------------------------------------------------
COR4           --------------------------------------------------------------------------------
COR5           --------------------------------------------------------------------------------
COR6           --------------------------------------------------------------------------------
COR7           --------------------------------------------------------------------------------
COR8           --------------------------------------------------------------------------------
CORBETTI1      ................................................................................
CORBETTI2      ................................................................................
C3             ...............................................................T................
C2             ...............................................................T................
jacksoni_TIG32 ...............................................................T................
jacksoni_TIG31 ...............................................................T................
jacksoni_TIG30 ...............................................................T................
jacksoni_TIG29 ................................................................................
jacksoni_TIG28 ...............................................................T................
jacksoni_TIG27 ...............................................................T................
jacksoni_TIG26 ...............................................................T................
jacksoni_TIG25 ................................................................................
jacksoni_TIG24 ...............................................................T................
jacksoni_TIG23 ................................................................................
jacksoni_TIG22 ...............................................................T................
jacksoni_TIG21 ...............................................................T................
jacksoni_TCA2  ..........A.......................................................................
jacksoni_TCA1  ................................................................................
jacksoni_MZ9   ................................................................................
jacksoni_MZ8   ..........A.......................................................................
jacksoni_MZ7   ..........A.......................................................................
jacksoni_MZ6   ..........A.......................................................T................
jacksoni_MZ5   ..........A.......................................................T................
jacksoni_MZ4   ..........A.......................................................T................
jacksoni_MZ3   ................................................................................
jacksoni_MZ1   ..........A.A.....................................................T................
jacksoni_TZ9   ..........A.......................................................................
jacksoni_TZ8   ..........A.......................................................T................
jacksoni_TZ7   ...............................................................T................
jacksoni_TZ6   ...............................................................T................
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jacksoni_TZ5    ..........A.....................................................T.....
jacksoni_TZ4    ................................................................................
jacksoni_TZ2    ................................................................................
jacksoni_TZ1    ................................................................................
corbetti.HZ     ................................................................................
sondaica        --------------------------------------------------------------------------------
sondaica2       --------------------------------------------------------------------------------

ALTAICA4        TATCTACATGCCAACGGAGCCTCCATATTCTTTATCTGTCTATACATGCACGTAGGACGAGGAATATACTACGGCTCCTA
ALTAICA         ................................................................................
ALT             ------------------------------------------------------------.....------------
Pta.S1          ................................................................................
Pta.S2          ................................................................................
Pta.S3          ................................................................................
Pta.S4          ................................................................................
Pta.S5          ................................................................................
Pta.S6          ................................................................................
Pta.S7          ................................................................................
Pta.S8          ................................................................................
Pta.S10         ................................................................................
Pta.S11         ................................................................................
Pta.S12         ................................................................................
Pta.S13         ................................................................................
Pta.S14         ................................................................................
Pta.S15         ................................................................................
Pta.OR602       ..C.............................................................................
Pta.bl4867      ..C.............................................................................
Pta.bl4034      ................................................................................
Pta.bl2981      ................................................................................
Pta.FJ895266    ................................................................................
TIGRIS1         ................................................................................
TIGRIS2         ................................................................................
TIG1            ------------------------------------------------------------.....------------
TIG2            ------------------------------------------------------------.....------------
TIG3            ------------------------------------------------------------.....------------
TIG4            ------------------------------------------------------------.....------------
TIG5            ------------------------------------------------------------.....------------
TIG6            ------------------------------------------------------------.....------------
TIG*10          ------------------------------------------------------------.....------------
TIG*9           ------------------------------------------------------------.....------------
TIG*8           ------------------------------------------------------------.....------------
TIG*7           ------------------------------------------------------------.....------------
TIG31           ------------------------------------------------------------.....------------
TIG30           ------------------------------------------------------------.....------------
TIG29           ------------------------------------------------------------.....------------
TIG28           ------------------------------------------------------------.....------------
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TIG17           ------------------------------------------------------------.....------------
TIG16           ------------------------------------------------------------.....------------
TIG15           ------------------------------------------------------------.....------------
TIG14           ------------------------------------------------------------.....------------
TIG13           ------------------------------------------------------------.....------------
TIG12           ------------------------------------------------------------.....------------
TIG11           ------------------------------------------------------------.....------------
Ptt.B2          ................................................................................
Ptt.B3          ................................................................................
Ptt.B4          ................................................................................
Ptt.B5          ................................................................................
Ptt.B6          ................................................................................
Ptt.B7          ................................................................................
Ptt.B8          ................................................................................
Ptt.B9          ................................................................................
SUMATRA1        ................................................................................
SUMATRA2        ................................................................................
SUM1            ------------------------------------------------------------.....------------
SUM2            ------------------------------------------------------------.....------------
SUM3            ------------------------------------------------------------.....------------
SUM4            ------------------------------------------------------------.....------------
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SUM5            ------------------------------------------------------------.................
SUM6            ------------------------------------------------------------.................C.
SUM7            ------------------------------------------------------------.................C.
SUM8            ------------------------------------------------------------.................C.
Su1             ...........................................................................
Su2_cytb        ...........................................................................
Su3             ...........................................................................
Su2             ...........................................................................
Su5             ...........................................................................
Su6             ...........................................................................C.
Su7             ...........................................................................
Su9             ...........................................................................
Su10            ...........................................................................
AMO1            ------------------------------------------------------------.................
AMO2            ------------------------------------------------------------.................
AMO3/COR1       ------------------------------------------------------------.................
COR2            ------------------------------------------------------------.................
COR3            ------------------------------------------------------------.................
COR4            ------------------------------------------------------------.................
COR5            ------------------------------------------------------------.................
COR6            ------------------------------------------------------------.................
COR7            ------------------------------------------------------------.................
COR8            ------------------------------------------------------------.................
CORBETTI1       ...........................................................................
CORBETTI2       ...........................................................................
C3              ...........................................................................
C2              ...........................................................................
jacksoni_TIG32  ...........................................................................
jacksoni_TIG31  ...........................................................................
jacksoni_TIG30  ...........................................................................
jacksoni_TIG29  ...........................................................................
jacksoni_TIG28  ...........................................................................
jacksoni_TIG27  ...........................................................................
jacksoni_TIG26  ...........................................................................
jacksoni_TIG25  ...........................................................................
jacksoni_TIG24  ...........................................................................
jacksoni_TIG23  ...........................................................................
jacksoni_TIG22  ...........................................................................
jacksoni_TIG21  ...........................................................................
jacksoni_TCA2   ...........................................................................
jacksoni_TCA1   ...........................................................................
jacksoni_MZ9    ...........................................................................
jacksoni_MZ8    ...........................................................................
jacksoni_MZ7    ...........................................................................
jacksoni_MZ6    ...........................................................................
jacksoni_MZ5    ...........................................................................
jacksoni_MZ4    ...........................................................................
jacksoni_MZ3    ...........................................................................
jacksoni_MZ1    ...........................................................................
jacksoni_TZ9    ...........................................................................
jacksoni_TZ8    ...........................................................................
jacksoni_TZ7    ...........................................................................
jacksoni_TZ6    ...........................................................................
jacksoni_TZ5    ...........................................................................
jacksoni_TZ4    ...........................................................................
jacksoni_TZ2    ...........................................................................
jacksoni_TZ1    ...........................................................................
corbetti.HZ     ...........................................................................
sondaica        ---------------------------------------------------------------------------
sondaica2       ---------------------------------------------------------------------------

ALTAICA4        CACCTTCTCAGAAACATGAAATATCGGGATTGTGCTATTGTTTACGGTCATGGCTACAGCCTTCATAGGATATGTCTTAC
ALTAICA         ..............................C............................................
ALT             ...........................................................................
Pta.S1          ...........................................................................
Pta.S2          ...........................................................................
Pta.S3          ...........................................................................
Pta.S4          ...........................................................................
Pta.S5          ...........................................................................
Pta.S6          ...........................................................................
Pta.S7          ...........................................................................
Pta.S8          ...........................................................................
Pta.S10         ...........................................................................
Pta.S11         ...........................................................................
Pta.S12         ...........................................................................
Pta.S13         ...........................................................................
Pta.S14         ...........................................................................
```

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Pta.S15         ..........................................................................
Pta.OR602       ..........................................................................
Pta.bl4867      ..........................................................................
Pta.bl4034      ..........................................................................
Pta.bl2981      ..........................................................................
Pta.FJ895266    ..........................................................................
TIGRIS1         ..................C.......................................................
TIGRIS2         ..................C.......................................................
TIG1            ..................C.......................................................
TIG2            ..................C.......................................................
TIG3            ..........................................................................
TIG4            ..................C.......................................................
TIG5            ..................C.......................................................
TIG6            ..................C.......................................................
TIG*10          ..............................................A...........................
TIG*9           ..................C.......................................................
TIG*8           ..................C.......................T...............................
TIG*7           ..................C.......................T...............................
TIG31           ..................C.......................................................
TIG30           ..................C.......................................................
TIG29           ..................C.......................................................
TIG28           ..................C.......................................................
TIG27           ..................C.......................................................
TIG26           ..................C.......................................................
TIG25           ..................C.......................................................
TIG24           ..................C.......................................................
TIG23           ..................C.......................................................
TIG22           ..................C.......................................................
TIG21           ..................C...............A.......................................
TIG20           ..................C.......................................................
TIG19           ..................C.......................................................
TIG18           ..................C.......................................................
TIG17           ..................C.......................................................
TIG16           ..................C.......................................................
TIG15           ..................C...............A.......................................
TIG14           ..................C.......................................................
TIG13           ..................C.......................................................
TIG12           ..................C.......................T...............................
TIG11           ..................C.......................................................
Ptt.B2          ..............................................A...........................
Ptt.B3          ..........................................................................
Ptt.B4          ..........................................................................
Ptt.B5          ..................C.......................................................
Ptt.B6          ..................C.......................................................
Ptt.B7          ..................C.......................................................
Ptt.B8          ..................C.......................................................
Ptt.B9          ..................C.......................................................
SUMATRA1        ..........................................................................
SUMATRA2        ..........................................................................
SUM1            ..........................................................................
SUM2            ..........................................................................
SUM3            ..........................................................................
SUM4            ..........................................................................
SUM5            ..................C.......................................................
SUM6            ..........................................................................
SUM7            ..........................................................................
SUM8            ..........................................................................
Su1             ..........................................................................
Su2_cytb        ..........................................................................
Su3             ..........................................................................
Su2             ..........................................................................
Su5             ..........................................................................
Su6             ..........................................................................
Su7             ..........................................................................
Su9             ..........................................................................
Su10            ..........................................................................
AMO1            ..........................................................................
AMO2            ..............................................A...........................
AMO3/COR1       ..............................................A...........................
COR2            ..............................................A...........................
COR3            ..............................................A...........................
COR4            ..........................................................................
COR5            ..........................................................................
COR6            ..........................................................................
COR7            ..........................................................................
COR8            ............................C.............................................
CORBETTI1       ..............................................A...........................
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CORBETTI2      ................................................................................
C3             ................................................................................
C2             ................................................................................
jacksoni_TIG32 ................................................................................
jacksoni_TIG31 ................................................................................
jacksoni_TIG30 ................................................................................
jacksoni_TIG29 ................................................................................
jacksoni_TIG28 ................................................................................
jacksoni_TIG27 ................................................................................
jacksoni_TIG26 ................................................................................
jacksoni_TIG25 ..............................C.................................................
jacksoni_TIG24 ................................................................................
jacksoni_TIG23 ..............................C.................................................
jacksoni_TIG22 ................................................................................
jacksoni_TIG21 ................................................................................
jacksoni_TCA2  ................................................................................
jacksoni_TCA1  ................................................................................
jacksoni_MZ9   ................................................................................
jacksoni_MZ8   ................................................................................
jacksoni_MZ7   ................................................................................
jacksoni_MZ6   ................................................................................
jacksoni_MZ5   ................................................................................
jacksoni_MZ4   ................................................................................
jacksoni_MZ3   ..............................C.................................................
jacksoni_MZ1   ................................................................................
jacksoni_TZ9   ................................................................................
jacksoni_TZ8   ................................................................................
jacksoni_TZ7   ................................................................................
jacksoni_TZ6   ................................................................................
jacksoni_TZ5   ................................................................................
jacksoni_TZ4   ..............................C.................................................
jacksoni_TZ2   ................................................................................
jacksoni_TZ1   ................................................................................
corbetti.HZ    ..........................................A.....................................
sondaica       --------------------------------------------------------------------------------
sondaica2      --------------------------------------------------------------------------------

ALTAICA4       CATGAGGCCAAATGTCTTTTTGAGGGGCAACCGTAATCACCAACCTCCTGTCAGCAATCCCATATATTGGGACCGACCTA
ALTAICA        ................................................................................
ALT            ................................................................................
Pta.S1         ................................................................................
Pta.S2         ................................................................................
Pta.S3         ................................................................................
Pta.S4         ................................................................................
Pta.S5         ................................................................................
Pta.S6         ................................................................................
Pta.S7         ................................................................................
Pta.S8         ................................................................................
Pta.S10        ................................................................................
Pta.S11        ................................................................................
Pta.S12        ................................................................................
Pta.S13        ................................................................................
Pta.S14        ................................................................................
Pta.S15        ................................................................................
Pta.OR602      ..------------------------------------------------------------------------------
Pta.bl4867     ..------------------------------------------------------------------------------
Pta.bl4034     ..------------------------------------------------------------------------------
Pta.bl2981     ..------------------------------------------------------------------------------
Pta.FJ895266   ................................................................................
TIGRIS1        ................................................................................
TIGRIS2        ................................................................................
TIG1           ................................................................................
TIG2           ................................................................................
TIG3           ................................................................................
TIG4           ................................................................................
TIG5           ................................................................................
TIG6           ................................................................................
TIG*10         ..........................----------------------------------------------------
TIG*9          ..........................----------------------------------------------------
TIG*8          ..........................----------------------------------------------------
TIG*7          ..........................----------------------------------------------------
TIG31          ................................................................................
TIG30          ................................................................................
TIG29          ................................................................................
TIG28          ................................................................................
TIG27          ..............................................................C.................
TIG26          ................................................................................
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TIG25          ..........................................................................
TIG24          ..........................................................................
TIG23          ..........................................................................
TIG22          ..........................................................................
TIG21          ..........................................................................
TIG20          ..........................................................................
TIG19          ..........................................................................
TIG18          ..........................................................................
TIG17          ..........................................................................
TIG16          ..........................................................................C.....
TIG15          ..........................................................................
TIG14          ..........................................................................
TIG13          ..........................................................................
TIG12          ..........................................................................
TIG11          ..........................................................................
Ptt.B2         ..........................................................................
Ptt.B3         ..........................................................................
Ptt.B4         ..........................................................................
Ptt.B5         ..........................................................................
Ptt.B6         ..........................................................................
Ptt.B7         ..........................................................................
Ptt.B8         ..........................................................................
Ptt.B9         ..........................................................................
SUMATRA1       ..........................................................................
SUMATRA2       ..........................................................................
SUM1           ..........................................................................
SUM2           ..........................................................................
SUM3           ..........................................................................
SUM4           ..........................................................................
SUM5           ..........................................................................
SUM6           ..........................................................................
SUM7           ..........................................................................
SUM8           ..........................................................................
Su1            ..........................................................................
Su2_cytb       ..........................................................................
Su3            ..........................................................................
Su2            ..........................................................................
Su5            ..........................................................................
Su6            ..........................................................................
Su7            ..........................................................................
Su9            ..........................................................................
Su10           ..........................................................................
AMO1           ..........................................................................
AMO2           ..........................................................................
AMO3/COR1     ..........................................................................
COR2           ..........................................................................
COR3           ..........................................................................
COR4           ..........................................................................
COR5           ..........................................................................
COR6           ..........................................................................
COR7           ..........................................................................
COR8           ..........................................................................
CORBETTI1      ..........................................................................
CORBETTI2      ..........................................................................
C3             ..........................................................................
C2             ..........................................................................
jacksoni_TIG32 .......A.....A..A..C.........----------------------------------------------------
jacksoni_TIG31 .......A.....A..A..C.........----------------------------------------------------
jacksoni_TIG30 .......A.....A..A..C.........----------------------------------------------------
jacksoni_TIG29 .......A.....A..A..C.........----------------------------------------------------
jacksoni_TIG28 .......A.....A..A..C.........----------------------------------------------------
jacksoni_TIG27 .......A.....A..A..C.........----------------------------------------------------
jacksoni_TIG26 .......A.....A..A..C.........----------------------------------------------------
jacksoni_TIG25 .......A.....A..A..C.........----------------------------------------------------
jacksoni_TIG24 .......A.....A..A..C.........----------------------------------------------------
jacksoni_TIG23 .......A.....A..A..C.........----------------------------------------------------
jacksoni_TIG22 .......A.....A..A..C.........----------------------------------------------------
jacksoni_TIG21 .......A.....A..A..C.........----------------------------------------------------
jacksoni_TCA2  .......A.....A..A..C.........----------------------------------------------------
jacksoni_TCA1  .......A.....A..A..C.........----------------------------------------------------
jacksoni_MZ9   .......A.....A..A..C.........----------------------------------------------------
jacksoni_MZ8   .......A.....A..A..C.........----------------------------------------------------
jacksoni_MZ7   .......A.....A..A..C.........----------------------------------------------------
jacksoni_MZ6   .......A.....A..A..C.........----------------------------------------------------
jacksoni_MZ5   .......A.....A..A..C.........----------------------------------------------------
jacksoni_MZ4   .......A.....A..A..C.........----------------------------------------------------
jacksoni_MZ3   .......A.....A..A..C.........----------------------------------------------------
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jacksoni_MZ1   .......A.....A..A..C.........----------------------------------------------------
jacksoni_TZ9   .......A.....A..A..C.........----------------------------------------------------
jacksoni_TZ8   .......A.....A..A..C.........----------------------------------------------------
jacksoni_TZ7   .......A.....A..A..C.........----------------------------------------------------
jacksoni_TZ6   .......A.....A..A..C.........----------------------------------------------------
jacksoni_TZ5   .......A.....A..A..C.........----------------------------------------------------
jacksoni_TZ4   .......A.....A..A..C.........----------------------------------------------------
jacksoni_TZ2   .......A.....A..A..C.........----------------------------------------------------
jacksoni_TZ1   .......A.....A..A..C.........----------------------------------------------------
corbetti.HZ    ...................................................................................
sondaica       ----------------------------------------------------------------------------------
sondaica2      ----------------------------------------------------------------------------------

ALTAICA4       GTAGAGTGAATCTGAGGGGGTTTCTCAGTAGACAAAGCTACCCTGACACGATTCTTTGCCTTCCACTTCATCCTTCCGTT
ALTAICA        ...................................................................................
ALT            ...................................................................................
Pta.S1         ...................................................................................
Pta.S2         ...................................................................................
Pta.S3         ...................................................................................
Pta.S4         ...................................................................................
Pta.S5         ...................................................................................
Pta.S6         ...................................................................................
Pta.S7         ...................................................................................
Pta.S8         ...................................................................................
Pta.S10        ...................................................................................
Pta.S11        ...................................................................................
Pta.S12        ...................................................................................
Pta.S13        ...................................................................................
Pta.S14        ...................................................................................
Pta.S15        ...................................................................................
Pta.OR602      ----------------------------------------------------------------------------------
Pta.bl4867     ----------------------------------------------------------------------------------
Pta.bl4034     ----------------------------------------------------------------------------------
Pta.bl2981     ----------------------------------------------------------------------------------
Pta.FJ895266   ...................................................................................
TIGRIS1        ...................................................................................
TIGRIS2        ...................................................................................
TIG1           ...................................................................................
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TIG3           ...................................................................................
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TIG5           ...................................................................................
TIG6           ...................................................................................
TIG*10         ----------------------------------------------------------------------------------
TIG*9          ----------------------------------------------------------------------------------
TIG*8          ----------------------------------------------------------------------------------
TIG*7          ----------------------------------------------------------------------------------
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TIG23          ...................................................................................
TIG22          ...................................................................................
TIG21          ...................................................................................
TIG20          ...................................................................................
TIG19          ...................................................................................
TIG18          ...................................................................................
TIG17          ...................................................................................
TIG16          .....A.............................................................................
TIG15          ...................................................................................
TIG14          ...................................................................................
TIG13          ...................................................................................
TIG12          ...................................................................................
TIG11          ...................................................................................
Ptt.B2         ..................................................................................A..
Ptt.B3         ...................................................................................
Ptt.B4         ...................................................................................
Ptt.B5         ...................................................................................
Ptt.B6         ...................................................................................
Ptt.B7         ...................................................................................
Ptt.B8         ...................................................................................
Ptt.B9         ...................................................................................
SUMATRA1      ...................................................................................
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SUMATRA2        ...............................................................................
SUM1            ...............................................................................
SUM2            ...............................................................................
SUM3            ..............................................................................C.....
SUM4            ...............................................................................
SUM5            ...............................................................................
SUM6            ...............................................................................
SUM7            ...............................................................................
SUM8            ...............................................................................
Su1             ...............................................................................
Su2_cytb        ...............................................................................
Su3             ...............................................................................
Su2             ..............................................................................C.....
Su5             ...............................................................................
Su6             ...............................................................................
Su7             ...............................................................................
Su9             ...............................................................................
Su10            ...............................................................................
AMO1            ...............................................................................
AMO2            ...............................................................................A..
AMO3/COR1       ...............................................................................A..
COR2            ...............................................................................A..
COR3            ...............................................................................A..
COR4            ...............................................................................
COR5            ...............................................................................
COR6            ...............................................................................
COR7            ...............................................................................
COR8            ...............................................................................
CORBETTI1       ...............................................................................A..
CORBETTI2       ...............................................................................A..
C3              ...............................................................................
C2              ...............................................................................
jacksoni_TIG32  -------------------------------------------------------------------------------
jacksoni_TIG31  -------------------------------------------------------------------------------
jacksoni_TIG30  -------------------------------------------------------------------------------
jacksoni_TIG29  -------------------------------------------------------------------------------
jacksoni_TIG28  -------------------------------------------------------------------------------
jacksoni_TIG27  -------------------------------------------------------------------------------
jacksoni_TIG26  -------------------------------------------------------------------------------
jacksoni_TIG25  -------------------------------------------------------------------------------
jacksoni_TIG24  -------------------------------------------------------------------------------
jacksoni_TIG23  -------------------------------------------------------------------------------
jacksoni_TIG22  -------------------------------------------------------------------------------
jacksoni_TIG21  -------------------------------------------------------------------------------
jacksoni_TCA2   -------------------------------------------------------------------------------
jacksoni_TCA1   -------------------------------------------------------------------------------
jacksoni_MZ9    -------------------------------------------------------------------------------
jacksoni_MZ8    -------------------------------------------------------------------------------
jacksoni_MZ7    -------------------------------------------------------------------------------
jacksoni_MZ6    -------------------------------------------------------------------------------
jacksoni_MZ5    -------------------------------------------------------------------------------
jacksoni_MZ4    -------------------------------------------------------------------------------
jacksoni_MZ3    -------------------------------------------------------------------------------
jacksoni_MZ1    -------------------------------------------------------------------------------
jacksoni_TZ9    -------------------------------------------------------------------------------
jacksoni_TZ8    -------------------------------------------------------------------------------
jacksoni_TZ7    -------------------------------------------------------------------------------
jacksoni_TZ6    -------------------------------------------------------------------------------
jacksoni_TZ5    -------------------------------------------------------------------------------
jacksoni_TZ4    -------------------------------------------------------------------------------
jacksoni_TZ2    -------------------------------------------------------------------------------
jacksoni_TZ1    -------------------------------------------------------------------------------
corbetti.HZ     ...............................................................................A..
sondaica        ------------...................................................................
sondaica2       ------------...................................................................

ALTAICA4        TATCGTCTCAGCCCTAGCAGCAGTCCACCTCCTATTCCTTCACGAAACAGGATCCAATAACCCCTCAGGAATGGTGTCCG
ALTAICA         ...............................................................................
ALT             ...............................................................................
Pta.S1          ...............................................................................
Pta.S2          ...............................................................................
Pta.S3          ...............................................................................
Pta.S4          ...............................................................................
Pta.S5          ...............................................................................
Pta.S6          ...............................................................................
Pta.S7          ...............................................................................
Pta.S8          ...............................................................................
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Pta.S10        ..........................................................................
Pta.S11        ..........................................................................
Pta.S12        ..........................................................................
Pta.S13        ..........................................................................
Pta.S14        ..........................................................................
Pta.S15        ..........................................................................
Pta.OR602      --------------------------------------------------------------------------
Pta.bl4867     --------------------------------------------------------------------------
Pta.bl4034     --------------------------------------------------------------------------
Pta.bl2981     --------------------------------------------------------------------------
Pta.FJ895266   ..........................................................................
TIGRIS1        ..........................................................................
TIGRIS2        ..........................................................................
TIG1           ..........................................................................
TIG2           ..........................................................................
TIG3           ..........................................................................
TIG4           ..........................................................................
TIG5           ..........................................................................
TIG6           ..........................................................................
TIG*10         --------------------------------------------------------------------------
TIG*9          --------------------------------------------------------------------------
TIG*8          --------------------------------------------------------------------------
TIG*7          --------------------------------------------------------------------------
TIG31          ..........................................................................
TIG30          ..........................................T.......................................
TIG29          ........................................C..T.....................................
TIG28          ..........................................................................
TIG27          ........................................C..T.....................................
TIG26          ..........................................................................
TIG25          ..........................................................................
TIG24          ..........................................................................
TIG23          ..........................................................................A....
TIG22          ..........................................................................A....
TIG21          ..........................................................................A....
TIG20          ..........................................................................A....
TIG19          ..........................................................................
TIG18          ..........................................................................
TIG17          ..........................................................................
TIG16          ............T.............................................................
TIG15          ..........................................................................
TIG14          ..........................................................................
TIG13          ..........................................................................
TIG12          ..........................................................................
TIG11          ..........................................................................
Ptt.B2         ..........................................................................
Ptt.B3         ..........................................................................
Ptt.B4         ..........................................................................
Ptt.B5         ..........................................................................
Ptt.B6         ..........................................................................
Ptt.B7         ..........................................................................
Ptt.B8         ..........................................................................
Ptt.B9         ..........................................................................
SUMATRA1       ..........................................................................
SUMATRA2       ..........................................................................
SUM1           ..........................................................................
SUM2           ..........................................................................
SUM3           ..........................................................................
SUM4           ..........................................................................
SUM5           ..........................................................................
SUM6           ..........................................................................
SUM7           ..........................................................................
SUM8           ..........................................................................
Su1            ..........................................................................
Su2_cytb       ..........................................................................
Su3            ..........................................................................
Su2            ..........................................................................
Su5            ..........................................................................
Su6            ..........................................................................
Su7            ..........................................................................
Su9            ..........................................................................
Su10           ..........................................................................
AMO1           ..........................................................................
AMO2           ..........................................................................
AMO3/COR1      ..........................................................................
COR2           ..........................................................................
COR3           ..........................................................................
COR4           ....A.....................................................................
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COR5            ..........................................................................
COR6            ..........................................................................
COR7            ..........................................................................
COR8            ..........................................................................
CORBETTI1       ..........................................................................
CORBETTI2       ..........................................Y..R..........Y.................R..Y.
C3              ..........................................................................
C2              ....A.....................................................................
jacksoni_TIG32  --------------------------------------------------------------------------
jacksoni_TIG31  --------------------------------------------------------------------------
jacksoni_TIG30  --------------------------------------------------------------------------
jacksoni_TIG29  --------------------------------------------------------------------------
jacksoni_TIG28  --------------------------------------------------------------------------
jacksoni_TIG27  --------------------------------------------------------------------------
jacksoni_TIG26  --------------------------------------------------------------------------
jacksoni_TIG25  --------------------------------------------------------------------------
jacksoni_TIG24  --------------------------------------------------------------------------
jacksoni_TIG23  --------------------------------------------------------------------------
jacksoni_TIG22  --------------------------------------------------------------------------
jacksoni_TIG21  --------------------------------------------------------------------------
jacksoni_TCA2   --------------------------------------------------------------------------
jacksoni_TCA1   --------------------------------------------------------------------------
jacksoni_MZ9    --------------------------------------------------------------------------
jacksoni_MZ8    --------------------------------------------------------------------------
jacksoni_MZ7    --------------------------------------------------------------------------
jacksoni_MZ6    --------------------------------------------------------------------------
jacksoni_MZ5    --------------------------------------------------------------------------
jacksoni_MZ4    --------------------------------------------------------------------------
jacksoni_MZ3    --------------------------------------------------------------------------
jacksoni_MZ1    --------------------------------------------------------------------------
jacksoni_TZ9    --------------------------------------------------------------------------
jacksoni_TZ8    --------------------------------------------------------------------------
jacksoni_TZ7    --------------------------------------------------------------------------
jacksoni_TZ6    --------------------------------------------------------------------------
jacksoni_TZ5    --------------------------------------------------------------------------
jacksoni_TZ4    --------------------------------------------------------------------------
jacksoni_TZ2    --------------------------------------------------------------------------
jacksoni_TZ1    --------------------------------------------------------------------------
corbetti.HZ     ..........................................................................
sondaica        ..........................................................................
sondaica2       ..........................................................................

ALTAICA4        ACTCAGACAAAATCCCATTCCACCCATACTACACAATTAAAGATATCTTAGGCCTCTTAGTACTAATCCTAACCCTCACA
ALTAICA         .........................................................................T.
ALT             ..........................................................................
Pta.S1          ..........................................................................
Pta.S2          ..........................................................................
Pta.S3          ..........................................................................
Pta.S4          ..........................................................................
Pta.S5          ..........................................................................
Pta.S6          ..........................................................................
Pta.S7          ..........................................................................
Pta.S8          ..........................................................................
Pta.S10         ..........................................................................
Pta.S11         ..........................................................................
Pta.S12         ..........................................................................
Pta.S13         ..........................................................................
Pta.S14         ..........................................................................
Pta.S15         ..........................................................................
Pta.OR602       --------------------------------------------------------------------------
Pta.bl4867      --------------------------------------------------------------------------
Pta.bl4034      --------------------------------------------------------------------------
Pta.bl2981      --------------------------------------------------------------------------
Pta.FJ895266    ..........................................................................
TIGRIS1         .........................................................................T.
TIGRIS2         .........................................................................T.
TIG1            .........................................................................T.
TIG2            .........................................................................T.
TIG3            .........................................................................T.
TIG4            .........................................................................T.
TIG5            .........................................................................T.
TIG6            .........................................................................T.
TIG*10          --------------------------------------------------------------------------
TIG*9           --------------------------------------------------------------------------
TIG*8           --------------------------------------------------------------------------
TIG*7           --------------------------------------------------------------------------
TIG31           .........................................................................T.
```

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TIG30          ..........................................................................T.
TIG29          ..........................................................................T.
TIG28          ..........................................................................T.
TIG27          ..........................................................................T.
TIG26          ..........................................................................T.
TIG25          ..........................................................................T.
TIG24          ..........................................................................T.
TIG23          ..........................................................................T.
TIG22          ..........................................................................T.
TIG21          ..........................................................................T.
TIG20          ..........................................................................T.
TIG19          ..........................................................................T.
TIG18          ..........................................................................T.
TIG17          ..........................................................................T.
TIG16          ..........................................................................T.
TIG15          ..........................................................................T.
TIG14          ..........................................................................T.
TIG13          ..........................................................................T.
TIG12          ..........................................................................T.
TIG11          ..........................................................................T.
Ptt.B2         ..........................................................................
Ptt.B3         ..........................................................................
Ptt.B4         ..........................................................................
Ptt.B5         ..........................................................................T.
Ptt.B6         ..........................................................................T.
Ptt.B7         ..........................................................................T.
Ptt.B8         ..........................................................................T.
Ptt.B9         ..........................................................................T.
SUMATRA1       ..................................................................G.....T.
SUMATRA2       ..................................................................G.....T.
SUM1           ..................................................................G.....T.
SUM2           ..................................................................G.....T.
SUM3           ..................................................................G.....T.
SUM4           ..................................................................G.....T.
SUM5           ..................................................................G.....T.
SUM6           ..................................................................G.....T.
SUM7           ..................................................................G.....T.
SUM8           ..................................................................G.....T.
Su1            ..................................................................G.....T.
Su2_cytb       ..................................................................G.....T.
Su3            ..................................................................G.....T.
Su2            ..................................................................G.....T.
Su5            ..................................................................G.....T.
Su6            ..................................................................G.....T.
Su7            ..................................................................G.....T.
Su9            ..................................................................G.....T.
Su10           ..................................................................G.....T.
AMO1           ..........................................................................T.
AMO2           ..........................................................................
AMO3/COR1      ..........................................................................
COR2           ..........................................................................
COR3           ..........................................................................
COR4           ............T.............................................................T.
COR5           ............T.............................................................T.
COR6           ..........................................................................T.
COR7           ..........................................................................T.
COR8           ..........................................................................T.
CORBETTI1      ..........................................................................
CORBETTI2      ..............R.................Y.....Y.....R.....Y.....................Y.
C3             ..........................................................................
C2             ............T.............................................................T.
jacksoni_TIG32 --------------------------------------------------------------------------
jacksoni_TIG31 --------------------------------------------------------------------------
jacksoni_TIG30 --------------------------------------------------------------------------
jacksoni_TIG29 --------------------------------------------------------------------------
jacksoni_TIG28 --------------------------------------------------------------------------
jacksoni_TIG27 --------------------------------------------------------------------------
jacksoni_TIG26 --------------------------------------------------------------------------
jacksoni_TIG25 --------------------------------------------------------------------------
jacksoni_TIG24 --------------------------------------------------------------------------
jacksoni_TIG23 --------------------------------------------------------------------------
jacksoni_TIG22 --------------------------------------------------------------------------
jacksoni_TIG21 --------------------------------------------------------------------------
jacksoni_TCA2  --------------------------------------------------------------------------
jacksoni_TCA1  --------------------------------------------------------------------------
jacksoni_MZ9   --------------------------------------------------------------------------
jacksoni_MZ8   --------------------------------------------------------------------------
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jacksoni_MZ7   ------------------------------------------------------------------------------
jacksoni_MZ6   ------------------------------------------------------------------------------
jacksoni_MZ5   ------------------------------------------------------------------------------
jacksoni_MZ4   ------------------------------------------------------------------------------
jacksoni_MZ3   ------------------------------------------------------------------------------
jacksoni_MZ1   ------------------------------------------------------------------------------
jacksoni_TZ9   ------------------------------------------------------------------------------
jacksoni_TZ8   ------------------------------------------------------------------------------
jacksoni_TZ7   ------------------------------------------------------------------------------
jacksoni_TZ6   ------------------------------------------------------------------------------
jacksoni_TZ5   ------------------------------------------------------------------------------
jacksoni_TZ4   ------------------------------------------------------------------------------
jacksoni_TZ2   ------------------------------------------------------------------------------
jacksoni_TZ1   ------------------------------------------------------------------------------
corbetti.HZ    ..............................................................................
sondaica       ..............................................................G.............T.
sondaica2      ..............................................................G.............T.

ALTAICA4       CTACTCGTCCTATTCT-CACCAGACCTATTAGGAGACCCTGATAACTACATCCCCGCCAACCCCCTAAATACCCCTCCCC
ALTAICA        ...............-..............................................................
ALT            ...............-.....--------------------------------------------------------
Pta.S1         ...............-..............................................................
Pta.S2         ...............-..............................................................
Pta.S3         ...............-..............................................................
Pta.S4         ...............-..............................................................
Pta.S5         ...............-..............................................................
Pta.S6         ...............-..............................................................
Pta.S7         ...............-..............................................................
Pta.S8         ...............-..............................................................
Pta.S10        ...............-..............................................................
Pta.S11        ...............-..............................................................
Pta.S12        ...............-..............................................................
Pta.S13        ...............-..............................................................
Pta.S14        ...............-..............................................................
Pta.S15        ...............-..............................................................
Pta.OR602      ------------------------------------------------------------------------------
Pta.bl4867     ------------------------------------------------------------------------------
Pta.bl4034     ------------------------------------------------------------------------------
Pta.bl2981     ------------------------------------------------------------------------------
Pta.FJ895266   ...............-................--------------------------------------------
TIGRIS1        ...............-..............................................................
TIGRIS2        ...............-..............................................................
TIG1           ...............-.....--------------------------------------------------------
TIG2           ...............-.....--------------------------------------------------------
TIG3           ...............-.....--------------------------------------------------------
TIG4           ...............-.....--------------------------------------------------------
TIG5           ...............-.....--------------------------------------------------------
TIG6           ...............-.....--------------------------------------------------------
TIG*10         ------------------------------------------------------------------------------
TIG*9          ------------------------------------------------------------------------------
TIG*8          ------------------------------------------------------------------------------
TIG*7          ------------------------------------------------------------------------------
TIG31          ...............-.............--------------------------------------------------
TIG30          ...............-.............--------------------------------------------------
TIG29          ...............-.............--------------------------------------------------
TIG28          ...............-.............--------------------------------------------------
TIG27          ...............-.............--------------------------------------------------
TIG26          ...............-.............--------------------------------------------------
TIG25          ...............-.............--------------------------------------------------
TIG24          ...............-.............--------------------------------------------------
TIG23          ...............-.............--------------------------------------------------
TIG22          ...............-.............--------------------------------------------------
TIG21          ...............-.............--------------------------------------------------
TIG20          ...............-.............--------------------------------------------------
TIG19          ...............-.............--------------------------------------------------
TIG18          ...............-.............--------------------------------------------------
TIG17          ...............-.............--------------------------------------------------
TIG16          ...............-.............--------------------------------------------------
TIG15          ...............-.............--------------------------------------------------
TIG14          ...............-.............--------------------------------------------------
TIG13          ...............-.............--------------------------------------------------
TIG12          ...............-.............--------------------------------------------------
TIG11          ...............-.............--------------------------------------------------
Ptt.B2         ...............-..............................................................
Ptt.B3         ...............-..............................................................
Ptt.B4         ...............-..............................................................
Ptt.B5         ...............-..............................................................
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Ptt.B6          ................-.....................................................................
Ptt.B7          ................-.....................................................................
Ptt.B8          ................-.....................................................................
Ptt.B9          ................-.....................................................................
SUMATRA1        ................-.....................................................................
SUMATRA2        ................-.....................................................................
SUM1            ................-.....----------------------------------------------------------------
SUM2            ................-.....----------------------------------------------------------------
SUM3            ................-.....----------------------------------------------------------------
SUM4            ................-.....----------------------------------------------------------------
SUM5            ................-.....----------------------------------------------------------------
SUM6            ................-.....----------------------------------------------------------------
SUM7            ................-.....----------------------------------------------------------------
SUM8            ................-.....----------------------------------------------------------------
Su1             ................-.....................................................................
Su2_cytb        ................-.....................................................................
Su3             ................-.....................................................................
Su2             ................-.....................................................................
Su5             ................-.....................................................................
Su6             ................-.....................................................................
Su7             ................-.....................................................................
Su9             ................-.....................................................................
Su10            ................-.....................................................................
AMO1            ................-.....----------------------------------------------------------------
AMO2            ................-.....----------------------------------------------------------------
AMO3/COR1       ................-.....----------------------------------------------------------------
COR2            ................-.....----------------------------------------------------------------
COR3            ................-.....----------------------------------------------------------------
COR4            ................-.....----------------------------------------------------------------
COR5            ................-.....----------------------------------------------------------------
COR6            ................-.....----------------------------------------------------------------
COR7            ................-.....----------------------------------------------------------------
COR8            ................-.....----------------------------------------------------------------
CORBETTI1       ................-.....................................................................
CORBETTI2       ................-.................R....Y.....................Y.....Y..........
C3              ................-.....................................................................
C2              ................-.....................................................................
jacksoni_TIG32  ------------------------------------------------------------------------------------
jacksoni_TIG31  ------------------------------------------------------------------------------------
jacksoni_TIG30  ------------------------------------------------------------------------------------
jacksoni_TIG29  ------------------------------------------------------------------------------------
jacksoni_TIG28  ------------------------------------------------------------------------------------
jacksoni_TIG27  ------------------------------------------------------------------------------------
jacksoni_TIG26  ------------------------------------------------------------------------------------
jacksoni_TIG25  ------------------------------------------------------------------------------------
jacksoni_TIG24  ------------------------------------------------------------------------------------
jacksoni_TIG23  ------------------------------------------------------------------------------------
jacksoni_TIG22  ------------------------------------------------------------------------------------
jacksoni_TIG21  ------------------------------------------------------------------------------------
jacksoni_TCA2   ------------------------------------------------------------------------------------
jacksoni_TCA1   ------------------------------------------------------------------------------------
jacksoni_MZ9    ------------------------------------------------------------------------------------
jacksoni_MZ8    ------------------------------------------------------------------------------------
jacksoni_MZ7    ------------------------------------------------------------------------------------
jacksoni_MZ6    ------------------------------------------------------------------------------------
jacksoni_MZ5    ------------------------------------------------------------------------------------
jacksoni_MZ4    ------------------------------------------------------------------------------------
jacksoni_MZ3    ------------------------------------------------------------------------------------
jacksoni_MZ1    ------------------------------------------------------------------------------------
jacksoni_TZ9    ------------------------------------------------------------------------------------
jacksoni_TZ8    ------------------------------------------------------------------------------------
jacksoni_TZ7    ------------------------------------------------------------------------------------
jacksoni_TZ6    ------------------------------------------------------------------------------------
jacksoni_TZ5    ------------------------------------------------------------------------------------
jacksoni_TZ4    ------------------------------------------------------------------------------------
jacksoni_TZ2    ------------------------------------------------------------------------------------
jacksoni_TZ1    ------------------------------------------------------------------------------------
corbetti.HZ     ................-....................----------------------------------------
sondaica        ................-....................----------------------------------------
sondaica2       ................-....................----------------------------------------

ALTAICA4        ATATTAAGCCCGAATGGTATTTCCTATTCGCATACGCAATCCTCCGATCTATTCCCAATAAACTAGGAGGAGTTCTAGCC
ALTAICA         ................................................................................
ALT             --------------------------------------------------------------------------------
Pta.S1          ................................................................................
Pta.S2          ................................................................................
Pta.S3          ................................................................................
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Pta.S4          ................................................................................
Pta.S5          ................................................................................
Pta.S6          ................................................................................
Pta.S7          ................................................................................
Pta.S8          ................................................................................
Pta.S10         ................................................................................
Pta.S11         ................................................................................
Pta.S12         ................................................................................
Pta.S13         ................................................................................
Pta.S14         ................................................................................
Pta.S15         ................................................................................
Pta.OR602       --------------------------------------------------------------------------------
Pta.bl4867      --------------------------------------------------------------------------------
Pta.bl4034      --------------------------------------------------------------------------------
Pta.bl2981      --------------------------------------------------------------------------------
Pta.FJ895266    --------------------------------------------------------------------------------
TIGRIS1         ................................................................................
TIGRIS2         ................................................................................
TIG1            --------------------------------------------------------------------------------
TIG2            --------------------------------------------------------------------------------
TIG3            --------------------------------------------------------------------------------
TIG4            --------------------------------------------------------------------------------
TIG5            --------------------------------------------------------------------------------
TIG6            --------------------------------------------------------------------------------
TIG*10          --------------------------------------------------------------------------------
TIG*9           --------------------------------------------------------------------------------
TIG*8           --------------------------------------------------------------------------------
TIG*7           --------------------------------------------------------------------------------
TIG31           --------------------------------------------------------------------------------
TIG30           --------------------------------------------------------------------------------
TIG29           --------------------------------------------------------------------------------
TIG28           --------------------------------------------------------------------------------
TIG27           --------------------------------------------------------------------------------
TIG26           --------------------------------------------------------------------------------
TIG25           --------------------------------------------------------------------------------
TIG24           --------------------------------------------------------------------------------
TIG23           --------------------------------------------------------------------------------
TIG22           --------------------------------------------------------------------------------
TIG21           --------------------------------------------------------------------------------
TIG20           --------------------------------------------------------------------------------
TIG19           --------------------------------------------------------------------------------
TIG18           --------------------------------------------------------------------------------
TIG17           --------------------------------------------------------------------------------
TIG16           --------------------------------------------------------------------------------
TIG15           --------------------------------------------------------------------------------
TIG14           --------------------------------------------------------------------------------
TIG13           --------------------------------------------------------------------------------
TIG12           --------------------------------------------------------------------------------
TIG11           --------------------------------------------------------------------------------
Ptt.B2          ................................................................................
Ptt.B3          ................................................................................
Ptt.B4          ................................................................................
Ptt.B5          ................................................................................
Ptt.B6          ................................................................................
Ptt.B7          ................................................................................
Ptt.B8          ................................................................................
Ptt.B9          ................................................................................
SUMATRA1        ................................................................................
SUMATRA2        ................................................................................
SUM1            --------------------------------------------------------------------------------
SUM2            --------------------------------------------------------------------------------
SUM3            --------------------------------------------------------------------------------
SUM4            --------------------------------------------------------------------------------
SUM5            --------------------------------------------------------------------------------
SUM6            --------------------------------------------------------------------------------
SUM7            --------------------------------------------------------------------------------
SUM8            --------------------------------------------------------------------------------
Su1             ................................................................................
Su2_cytb        ................................................................................
Su3             ................................................................................
Su2             ................................................................................
Su5             ................................................................................
Su6             ................................................................................
Su7             ................................................................................
Su9             ................................................................................
Su10            ................................................................................
AMO1            --------------------------------------------------------------------------------
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AMO2            ----------------------------------------------------------------------------------
AMO3/COR1       ----------------------------------------------------------------------------------
COR2            ----------------------------------------------------------------------------------
COR3            ----------------------------------------------------------------------------------
COR4            ----------------------------------------------------------------------------------
COR5            ----------------------------------------------------------------------------------
COR6            ----------------------------------------------------------------------------------
COR7            ----------------------------------------------------------------------------------
COR8            ----------------------------------------------------------------------------------
CORBETTI1       ..................................................................................
CORBETTI2       ....Y....S.................Y.....................................R......Y.....
C3              ..................................................................................
C2              ..................................................................................
jacksoni_TIG32  ----------------------------------------------------------------------------------
jacksoni_TIG31  ----------------------------------------------------------------------------------
jacksoni_TIG30  ----------------------------------------------------------------------------------
jacksoni_TIG29  ----------------------------------------------------------------------------------
jacksoni_TIG28  ----------------------------------------------------------------------------------
jacksoni_TIG27  ----------------------------------------------------------------------------------
jacksoni_TIG26  ----------------------------------------------------------------------------------
jacksoni_TIG25  ----------------------------------------------------------------------------------
jacksoni_TIG24  ----------------------------------------------------------------------------------
jacksoni_TIG23  ----------------------------------------------------------------------------------
jacksoni_TIG22  ----------------------------------------------------------------------------------
jacksoni_TIG21  ----------------------------------------------------------------------------------
jacksoni_TCA2   ----------------------------------------------------------------------------------
jacksoni_TCA1   ----------------------------------------------------------------------------------
jacksoni_MZ9    ----------------------------------------------------------------------------------
jacksoni_MZ8    ----------------------------------------------------------------------------------
jacksoni_MZ7    ----------------------------------------------------------------------------------
jacksoni_MZ6    ----------------------------------------------------------------------------------
jacksoni_MZ5    ----------------------------------------------------------------------------------
jacksoni_MZ4    ----------------------------------------------------------------------------------
jacksoni_MZ3    ----------------------------------------------------------------------------------
jacksoni_MZ1    ----------------------------------------------------------------------------------
jacksoni_TZ9    ----------------------------------------------------------------------------------
jacksoni_TZ8    ----------------------------------------------------------------------------------
jacksoni_TZ7    ----------------------------------------------------------------------------------
jacksoni_TZ6    ----------------------------------------------------------------------------------
jacksoni_TZ5    ----------------------------------------------------------------------------------
jacksoni_TZ4    ----------------------------------------------------------------------------------
jacksoni_TZ2    ----------------------------------------------------------------------------------
jacksoni_TZ1    ----------------------------------------------------------------------------------
corbetti.HZ     ----------------------------------------------------------------------------------
sondaica        ----------------------------------------------------------------------------------
sondaica2       ----------------------------------------------------------------------------------

ALTAICA4        CTAGTCTTATCCATCTTAATCTTAGCCACTATCCCTGCCCTCCACACATCCAAACAACGAGGAATAATGTTTCGACCGCT
ALTAICA         ............................T.....................................................
ALT             ----------------------------------------------------------------------------------
Pta.S1          ..................................................................................
Pta.S2          ..................................................................................
Pta.S3          ..................................................................................
Pta.S4          ..................................................................................
Pta.S5          ..................................................................................
Pta.S6          ..................................................................................
Pta.S7          ..................................................................................
Pta.S8          ..................................................................................
Pta.S10         ..................................................................................
Pta.S11         ..................................................................................
Pta.S12         ..................................................................................
Pta.S13         ..................................................................................
Pta.S14         ..................................................................................
Pta.S15         ..................................................................................
Pta.OR602       ----------------------------------------------------------------------------------
Pta.bl14867     ----------------------------------------------------------------------------------
Pta.bl14034     ----------------------------------------------------------------------------------
Pta.bl12981     ----------------------------------------------------------------------------------
Pta.FJ895266    ----------------------------------------------------------------------------------
TIGRIS1         ............................T.....................................................
TIGRIS2         ............................T.....................................................
TIG1            ----------------------------------------------------------------------------------
TIG2            ----------------------------------------------------------------------------------
TIG3            ----------------------------------------------------------------------------------
TIG4            ----------------------------------------------------------------------------------
TIG5            ----------------------------------------------------------------------------------
TIG6            ----------------------------------------------------------------------------------
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TIG*10          ----------------------------------------------------------------------------------------
TIG*9           ----------------------------------------------------------------------------------------
TIG*8           ----------------------------------------------------------------------------------------
TIG*7           ----------------------------------------------------------------------------------------
TIG31           ----------------------------------------------------------------------------------------
TIG30           ----------------------------------------------------------------------------------------
TIG29           ----------------------------------------------------------------------------------------
TIG28           ----------------------------------------------------------------------------------------
TIG27           ----------------------------------------------------------------------------------------
TIG26           ----------------------------------------------------------------------------------------
TIG25           ----------------------------------------------------------------------------------------
TIG24           ----------------------------------------------------------------------------------------
TIG23           ----------------------------------------------------------------------------------------
TIG22           ----------------------------------------------------------------------------------------
TIG21           ----------------------------------------------------------------------------------------
TIG20           ----------------------------------------------------------------------------------------
TIG19           ----------------------------------------------------------------------------------------
TIG18           ----------------------------------------------------------------------------------------
TIG17           ----------------------------------------------------------------------------------------
TIG16           ----------------------------------------------------------------------------------------
TIG15           ----------------------------------------------------------------------------------------
TIG14           ----------------------------------------------------------------------------------------
TIG13           ----------------------------------------------------------------------------------------
TIG12           ----------------------------------------------------------------------------------------
TIG11           ----------------------------------------------------------------------------------------
Ptt.B2          ............................T...................................................
Ptt.B3          ............................T...................................................
Ptt.B4          ............................T...................................................
Ptt.B5          ............................T...................................................
Ptt.B6          ............................T...................................................
Ptt.B7          ............................T...................................................
Ptt.B8          ............................T...................................................
Ptt.B9          ............................T...................................................
SUMATRA1        ............................T..................................................A..
SUMATRA2        ............................T..................................................A..
SUM1            ----------------------------------------------------------------------------------------
SUM2            ----------------------------------------------------------------------------------------
SUM3            ----------------------------------------------------------------------------------------
SUM4            ----------------------------------------------------------------------------------------
SUM5            ----------------------------------------------------------------------------------------
SUM6            ----------------------------------------------------------------------------------------
SUM7            ----------------------------------------------------------------------------------------
SUM8            ----------------------------------------------------------------------------------------
Su1             ............................T..................................................A..
Su2_cytb        ............................T..................................................A..
Su3             ............................T..................................................A..
Su2             ............................T..................................................A..
Su5             ............................T..................................................A..
Su6             ............................T..................................................A..
Su7             ............................T..................................................A..
Su9             ............................T..................................................A..
Su10            ............................T..................................................A..
AMO1            ----------------------------------------------------------------------------------------
AMO2            ----------------------------------------------------------------------------------------
AMO3/COR1       ----------------------------------------------------------------------------------------
COR2            ----------------------------------------------------------------------------------------
COR3            ----------------------------------------------------------------------------------------
COR4            ----------------------------------------------------------------------------------------
COR5            ----------------------------------------------------------------------------------------
COR6            ----------------------------------------------------------------------------------------
COR7            ----------------------------------------------------------------------------------------
COR8            ----------------------------------------------------------------------------------------
CORBETTI1       ............................T..................................................A..
CORBETTI2       .Y....Y.....................T......Y.....................................R.....
C3              ........................................................................................
C2              ............................T...........................................................
jacksoni_TIG32  ----------------------------------------------------------------------------------------
jacksoni_TIG31  ----------------------------------------------------------------------------------------
jacksoni_TIG30  ----------------------------------------------------------------------------------------
jacksoni_TIG29  ----------------------------------------------------------------------------------------
jacksoni_TIG28  ----------------------------------------------------------------------------------------
jacksoni_TIG27  ----------------------------------------------------------------------------------------
jacksoni_TIG26  ----------------------------------------------------------------------------------------
jacksoni_TIG25  ----------------------------------------------------------------------------------------
jacksoni_TIG24  ----------------------------------------------------------------------------------------
jacksoni_TIG23  ----------------------------------------------------------------------------------------
jacksoni_TIG22  ----------------------------------------------------------------------------------------
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jacksoni_TIG21 ----------------------------------------------------------------------------------
jacksoni_TCA2  ----------------------------------------------------------------------------------
jacksoni_TCA1  ----------------------------------------------------------------------------------
jacksoni_MZ9   ----------------------------------------------------------------------------------
jacksoni_MZ8   ----------------------------------------------------------------------------------
jacksoni_MZ7   ----------------------------------------------------------------------------------
jacksoni_MZ6   ----------------------------------------------------------------------------------
jacksoni_MZ5   ----------------------------------------------------------------------------------
jacksoni_MZ4   ----------------------------------------------------------------------------------
jacksoni_MZ3   ----------------------------------------------------------------------------------
jacksoni_MZ1   ----------------------------------------------------------------------------------
jacksoni_TZ9   ----------------------------------------------------------------------------------
jacksoni_TZ8   ----------------------------------------------------------------------------------
jacksoni_TZ7   ----------------------------------------------------------------------------------
jacksoni_TZ6   ----------------------------------------------------------------------------------
jacksoni_TZ5   ----------------------------------------------------------------------------------
jacksoni_TZ4   ----------------------------------------------------------------------------------
jacksoni_TZ2   ----------------------------------------------------------------------------------
jacksoni_TZ1   ----------------------------------------------------------------------------------
corbetti.HZ    ----------------------------------------------------------------------------------
sondaica       ----------------------------------------------------------------------------------
sondaica2      ----------------------------------------------------------------------------------

ALTAICA4       AAGCCAATGCTTATTCTGACTCTTAGTGGCAGACCTTCTAACCCTAACATGAATTGGTGGCCAACCTGTAGAACACCCCT
ALTAICA        ....................................G.....................................
ALT            ----------------------------------------------------------------------------------
Pta.S1         ................................................................................
Pta.S2         ................................................................................
Pta.S3         ................................................................................
Pta.S4         ................................................................................
Pta.S5         ....................................G.....................................
Pta.S6         ....................................G.....................................
Pta.S7         ................................................................................
Pta.S8         ....................................G.....................................
Pta.S10        ................................................................................
Pta.S11        ................................................................................
Pta.S12        ................................................................................
Pta.S13        ....................................G.....................................
Pta.S14        ................................................................................
Pta.S15        ................................................................................
Pta.OR602      ----------------------------------------------------------------------------------
Pta.bl4867     ----------------------------------------------------------------------------------
Pta.bl4034     ----------------------------------------------------------------------------------
Pta.bl2981     ----------------------------------------------------------------------------------
Pta.FJ895266   ----------------------------------------------------------------------------------
TIGRIS1        ....................................G.....................................
TIGRIS2        ....................................G.....................................
TIG1           ----------------------------------------------------------------------------------
TIG2           ----------------------------------------------------------------------------------
TIG3           ----------------------------------------------------------------------------------
TIG4           ----------------------------------------------------------------------------------
TIG5           ----------------------------------------------------------------------------------
TIG6           ----------------------------------------------------------------------------------
TIG*10         ----------------------------------------------------------------------------------
TIG*9          ----------------------------------------------------------------------------------
TIG*8          ----------------------------------------------------------------------------------
TIG*7          ----------------------------------------------------------------------------------
TIG31          ----------------------------------------------------------------------------------
TIG30          ----------------------------------------------------------------------------------
TIG29          ----------------------------------------------------------------------------------
TIG28          ----------------------------------------------------------------------------------
TIG27          ----------------------------------------------------------------------------------
TIG26          ----------------------------------------------------------------------------------
TIG25          ----------------------------------------------------------------------------------
TIG24          ----------------------------------------------------------------------------------
TIG23          ----------------------------------------------------------------------------------
TIG22          ----------------------------------------------------------------------------------
TIG21          ----------------------------------------------------------------------------------
TIG20          ----------------------------------------------------------------------------------
TIG19          ----------------------------------------------------------------------------------
TIG18          ----------------------------------------------------------------------------------
TIG17          ----------------------------------------------------------------------------------
TIG16          ----------------------------------------------------------------------------------
TIG15          ----------------------------------------------------------------------------------
TIG14          ----------------------------------------------------------------------------------
TIG13          ----------------------------------------------------------------------------------
TIG12          ----------------------------------------------------------------------------------
```

```
TIG11          ----------------------------------------------------------------------------------------
Ptt.B2         .....................................G..................................................
Ptt.B3         ....................................................................................
Ptt.B4         ....................................................................................
Ptt.B5         .....................................G..................................................
Ptt.B6         .....................................G..................................................
Ptt.B7         .....................................G..................................................
Ptt.B8         .....................................G..................................................
Ptt.B9         .....................................G..................................................
SUMATRA1       .....................................G..................................................
SUMATRA2       .....................................G..................................................
SUM1           ----------------------------------------------------------------------------------------
SUM2           ----------------------------------------------------------------------------------------
SUM3           ----------------------------------------------------------------------------------------
SUM4           ----------------------------------------------------------------------------------------
SUM5           ----------------------------------------------------------------------------------------
SUM6           ----------------------------------------------------------------------------------------
SUM7           ----------------------------------------------------------------------------------------
SUM8           ----------------------------------------------------------------------------------------
Su1            .....................................G..................................................
Su2_cytb       .....................................G..................................................
Su3            .....................................G..................................................
Su2            .....................................G..................................................
Su5            .....................................G..................................................
Su6            .....................................G..................................................
Su7            .....................................G..................................................
Su9            .....................................G..................................................
Su10           .....................................G..................................................
AMO1           ----------------------------------------------------------------------------------------
AMO2           ----------------------------------------------------------------------------------------
AMO3/COR1      ----------------------------------------------------------------------------------------
COR2           ----------------------------------------------------------------------------------------
COR3           ----------------------------------------------------------------------------------------
COR4           ----------------------------------------------------------------------------------------
COR5           ----------------------------------------------------------------------------------------
COR6           ----------------------------------------------------------------------------------------
COR7           ----------------------------------------------------------------------------------------
COR8           ----------------------------------------------------------------------------------------
CORBETTI1      ....................................................................................
CORBETTI2      ......R....Y.......Y.........R........G.....R...........Y.................Y....
C3             ....................................................................................
C2             .....................................G..................................................
jacksoni_TIG32 ----------------------------------------------------------------------------------------
jacksoni_TIG31 ----------------------------------------------------------------------------------------
jacksoni_TIG30 ----------------------------------------------------------------------------------------
jacksoni_TIG29 ----------------------------------------------------------------------------------------
jacksoni_TIG28 ----------------------------------------------------------------------------------------
jacksoni_TIG27 ----------------------------------------------------------------------------------------
jacksoni_TIG26 ----------------------------------------------------------------------------------------
jacksoni_TIG25 ----------------------------------------------------------------------------------------
jacksoni_TIG24 ----------------------------------------------------------------------------------------
jacksoni_TIG23 ----------------------------------------------------------------------------------------
jacksoni_TIG22 ----------------------------------------------------------------------------------------
jacksoni_TIG21 ----------------------------------------------------------------------------------------
jacksoni_TCA2  ----------------------------------------------------------------------------------------
jacksoni_TCA1  ----------------------------------------------------------------------------------------
jacksoni_MZ9   ----------------------------------------------------------------------------------------
jacksoni_MZ8   ----------------------------------------------------------------------------------------
jacksoni_MZ7   ----------------------------------------------------------------------------------------
jacksoni_MZ6   ----------------------------------------------------------------------------------------
jacksoni_MZ5   ----------------------------------------------------------------------------------------
jacksoni_MZ4   ----------------------------------------------------------------------------------------
jacksoni_MZ3   ----------------------------------------------------------------------------------------
jacksoni_MZ1   ----------------------------------------------------------------------------------------
jacksoni_TZ9   ----------------------------------------------------------------------------------------
jacksoni_TZ8   ----------------------------------------------------------------------------------------
jacksoni_TZ7   ----------------------------------------------------------------------------------------
jacksoni_TZ6   ----------------------------------------------------------------------------------------
jacksoni_TZ5   ----------------------------------------------------------------------------------------
jacksoni_TZ4   ----------------------------------------------------------------------------------------
jacksoni_TZ2   ----------------------------------------------------------------------------------------
jacksoni_TZ1   ----------------------------------------------------------------------------------------
corbetti.HZ    ----------------------------------------------------------------------------------------
sondaica       ----------------------------------------------------------------------------------------
sondaica2      ----------------------------------------------------------------------------------------

ALTAICA4       TTATTGCCATCGGCCAACTAGCCTCTATCCTATACTTCTTCATCCTCCTGGTCCTAATACCCATCTCAGGCATTATTGAA
```

```
ALTAICA       ..............................................A.............................
ALT           --------------------------------------------------------------------------------
Pta.S1        ..............................................A.............................
Pta.S2        ..............................................A.............................
Pta.S3        ..............................................A.............................
Pta.S4        ..............................................A.............................
Pta.S5        --------------------------------------------------------------------------------
Pta.S6        ..............................................A.............................
Pta.S7        ..............................................A.............................
Pta.S8        ..............................................A.............................
Pta.S10       --------------------------------------------------------------------------------
Pta.S11       --------------------------------------------------------------------------------
Pta.S12       ..............................................A.............................
Pta.S13       --------------------------------------------------------------------------------
Pta.S14       --------------------------------------------------------------------------------
Pta.S15       ..............................................A.............................
Pta.OR602     --------------------------------------------------------------------------------
Pta.bl14867   --------------------------------------------------------------------------------
Pta.bl14034   --------------------------------------------------------------------------------
Pta.bl12981   --------------------------------------------------------------------------------
Pta.FJ895266  --------------------------------------------------------------------------------
TIGRIS1       ..............................................A.............................
TIGRIS2       ..............................................A.............................
TIG1          --------------------------------------------------------------------------------
TIG2          --------------------------------------------------------------------------------
TIG3          --------------------------------------------------------------------------------
TIG4          --------------------------------------------------------------------------------
TIG5          --------------------------------------------------------------------------------
TIG6          --------------------------------------------------------------------------------
TIG*10        --------------------------------------------------------------------------------
TIG*9         --------------------------------------------------------------------------------
TIG*8         --------------------------------------------------------------------------------
TIG*7         --------------------------------------------------------------------------------
TIG31         --------------------------------------------------------------------------------
TIG30         --------------------------------------------------------------------------------
TIG29         --------------------------------------------------------------------------------
TIG28         --------------------------------------------------------------------------------
TIG27         --------------------------------------------------------------------------------
TIG26         --------------------------------------------------------------------------------
TIG25         --------------------------------------------------------------------------------
TIG24         --------------------------------------------------------------------------------
TIG23         --------------------------------------------------------------------------------
TIG22         --------------------------------------------------------------------------------
TIG21         --------------------------------------------------------------------------------
TIG20         --------------------------------------------------------------------------------
TIG19         --------------------------------------------------------------------------------
TIG18         --------------------------------------------------------------------------------
TIG17         --------------------------------------------------------------------------------
TIG16         --------------------------------------------------------------------------------
TIG15         --------------------------------------------------------------------------------
TIG14         --------------------------------------------------------------------------------
TIG13         --------------------------------------------------------------------------------
TIG12         --------------------------------------------------------------------------------
TIG11         --------------------------------------------------------------------------------
Ptt.B2        ..............................................A.............................
Ptt.B3        ..............................................A.............................
Ptt.B4        ..............................................A.............................
Ptt.B5        ..............................................A.............................
Ptt.B6        ..............................................A.............................
Ptt.B7        ..............................................A.............................
Ptt.B8        ..............................................A.............................
Ptt.B9        ..............................................A.............................
SUMATRA1      ..............................................A.............................
SUMATRA2      ..............................................A.............................
SUM1          --------------------------------------------------------------------------------
SUM2          --------------------------------------------------------------------------------
SUM3          --------------------------------------------------------------------------------
SUM4          --------------------------------------------------------------------------------
SUM5          --------------------------------------------------------------------------------
SUM6          --------------------------------------------------------------------------------
SUM7          --------------------------------------------------------------------------------
SUM8          --------------------------------------------------------------------------------
Su1           ..............................................A.............................
Su2_cytb      ..............................................A.............................
Su3           ..............................................A.............................
Su2           ..............................................A.............................
Su5           ..............................................A.............................
```

```
Su6             ..............................................A.............................
Su7             ..............................................A.............................
Su9             ..............................................A.............................
Su10            ..............................................A.............................
AMO1            ----------------------------------------------------------------------------
AMO2            ----------------------------------------------------------------------------
AMO3/COR1       ----------------------------------------------------------------------------
COR2            ----------------------------------------------------------------------------
COR3            ----------------------------------------------------------------------------
COR4            ----------------------------------------------------------------------------
COR5            ----------------------------------------------------------------------------
COR6            ----------------------------------------------------------------------------
COR7            ----------------------------------------------------------------------------
COR8            ----------------------------------------------------------------------------
CORBETTI1       ..............................................A.............................
CORBETTI2       .Y...R..................Y.....................YY.AR.........................
C3              ..............................................A.............................
C2              ..............................................A.............................
jacksoni_TIG32  ----------------------------------------------------------------------------
jacksoni_TIG31  ----------------------------------------------------------------------------
jacksoni_TIG30  ----------------------------------------------------------------------------
jacksoni_TIG29  ----------------------------------------------------------------------------
jacksoni_TIG28  ----------------------------------------------------------------------------
jacksoni_TIG27  ----------------------------------------------------------------------------
jacksoni_TIG26  ----------------------------------------------------------------------------
jacksoni_TIG25  ----------------------------------------------------------------------------
jacksoni_TIG24  ----------------------------------------------------------------------------
jacksoni_TIG23  ----------------------------------------------------------------------------
jacksoni_TIG22  ----------------------------------------------------------------------------
jacksoni_TIG21  ----------------------------------------------------------------------------
jacksoni_TCA2   ----------------------------------------------------------------------------
jacksoni_TCA1   ----------------------------------------------------------------------------
jacksoni_MZ9    ----------------------------------------------------------------------------
jacksoni_MZ8    ----------------------------------------------------------------------------
jacksoni_MZ7    ----------------------------------------------------------------------------
jacksoni_MZ6    ----------------------------------------------------------------------------
jacksoni_MZ5    ----------------------------------------------------------------------------
jacksoni_MZ4    ----------------------------------------------------------------------------
jacksoni_MZ3    ----------------------------------------------------------------------------
jacksoni_MZ1    ----------------------------------------------------------------------------
jacksoni_TZ9    ----------------------------------------------------------------------------
jacksoni_TZ8    ----------------------------------------------------------------------------
jacksoni_TZ7    ----------------------------------------------------------------------------
jacksoni_TZ6    ----------------------------------------------------------------------------
jacksoni_TZ5    ----------------------------------------------------------------------------
jacksoni_TZ4    ----------------------------------------------------------------------------
jacksoni_TZ2    ----------------------------------------------------------------------------
jacksoni_TZ1    ----------------------------------------------------------------------------
corbetti.HZ     ----------------------------------------------------------------------------
sondaica        ----------------------------------------------------------------------------
sondaica2       ----------------------------------------------------------------------------

ALTAICA4        AACCGCCTCCTTAAATGA---
ALTAICA         ..................A--
ALT             ----------------------
Pta.S1          ..................AGA
Pta.S2          ..................AGA
Pta.S3          ..................AGA
Pta.S4          ..................AGA
Pta.S5          ..................AGA
Pta.S6          ..................AGA
Pta.S7          ..................AGA
Pta.S8          ..................AGA
Pta.S10         ..................AGA
Pta.S11         ..................AGA
Pta.S12         ..................AGA
Pta.S13         ..................AGA
Pta.S14         ..................AGA
Pta.S15         ..................AGA
Pta.OR602       ----------------------
Pta.bl4867      ----------------------
Pta.bl4034      ----------------------
Pta.bl2981      ----------------------
Pta.FJ895266    ----------------------
TIGRIS1         ..................---
TIGRIS2         ..................A--
TIG1            ----------------------
```

```
TIG2            --------------------
TIG3            --------------------
TIG4            --------------------
TIG5            --------------------
TIG6            --------------------
TIG*10          --------------------
TIG*9           --------------------
TIG*8           --------------------
TIG*7           --------------------
TIG31           --------------------
TIG30           --------------------
TIG29           --------------------
TIG28           --------------------
TIG27           --------------------
TIG26           --------------------
TIG25           --------------------
TIG24           --------------------
TIG23           --------------------
TIG22           --------------------
TIG21           --------------------
TIG20           --------------------
TIG19           --------------------
TIG18           --------------------
TIG17           --------------------
TIG16           --------------------
TIG15           --------------------
TIG14           --------------------
TIG13           --------------------
TIG12           --------------------
TIG11           --------------------
Ptt.B2          ..................AGA
Ptt.B3          ..................AGA
Ptt.B4          ..................AGA
Ptt.B5          ..................AGA
Ptt.B6          ..................AGA
Ptt.B7          ..................AGA
Ptt.B8          ..................AGA
Ptt.B9          ..................AGA
SUMATRA1        ..................---
SUMATRA2        ..................---
SUM1            --------------------
SUM2            --------------------
SUM3            --------------------
SUM4            --------------------
SUM5            --------------------
SUM6            --------------------
SUM7            --------------------
SUM8            --------------------
Su1             ..................AGA
Su2_cytb        ..................AGA
Su3             ..................AGA
Su2             ..................AGA
Su5             ..................AGA
Su6             ..................AGA
Su7             ..................AGA
Su9             ..................AGA
Su10            ..................AGA
AMO1            --------------------
AMO2            --------------------
AMO3/COR1       --------------------
COR2            --------------------
COR3            --------------------
COR4            --------------------
COR5            --------------------
COR6            --------------------
COR7            --------------------
COR8            --------------------
CORBETTI1       ............--------
CORBETTI2       ..................---
C3              ..................AGA
C2              ..................AGA
jacksoni_TIG32  --------------------
jacksoni_TIG31  --------------------
jacksoni_TIG30  --------------------
jacksoni_TIG29  --------------------
jacksoni_TIG28  --------------------
jacksoni_TIG27  --------------------
```

```
jacksoni_TIG26 ----------------------
jacksoni_TIG25 ----------------------
jacksoni_TIG24 ----------------------
jacksoni_TIG23 ----------------------
jacksoni_TIG22 ----------------------
jacksoni_TIG21 ----------------------
jacksoni_TCA2  ----------------------
jacksoni_TCA1  ----------------------
jacksoni_MZ9   ----------------------
jacksoni_MZ8   ----------------------
jacksoni_MZ7   ----------------------
jacksoni_MZ6   ----------------------
jacksoni_MZ5   ----------------------
jacksoni_MZ4   ----------------------
jacksoni_MZ3   ----------------------
jacksoni_MZ1   ----------------------
jacksoni_TZ9   ----------------------
jacksoni_TZ8   ----------------------
jacksoni_TZ7   ----------------------
jacksoni_TZ6   ----------------------
jacksoni_TZ5   ----------------------
jacksoni_TZ4   ----------------------
jacksoni_TZ2   ----------------------
jacksoni_TZ1   ----------------------
corbetti.HZ    ----------------------
sondaica       ----------------------
sondaica2      ----------------------
```

Control region

```
ALTAICA4    TCCCTAAGACTTCAAGGAAGAAGCAATAGCCCCACCATCAGCACCCAAAGCTGAAATTCTTTCTTAAACTATTCCTTGCC
ALTAICA     ...............................................................................
ALT         ...............................................................................
Pta04       -------------------------.C........T.....................................------
Pta.S12     -------------------------------------------------------------------------------..
AMO1        ...............................................................................
AMO2        ...............................................................................T.
Pts         -------------------------.C........T.....................................------
AMO3/COR1   ...............................................................................T.
CORBETTI1   ...............................................................................T.
COR2        ...............................................................................T.
COR3        ...............................................................................T.
COR4        ...............................................................................
COR5        ...............................................................................
COR6        ...............................................................................
COR7        ...............................................................................
COR8        ...............................................................................
SUMATRA1    ...............................................................................
SUMATRA2    ...............................................................................
SUM1        ...............................................................................
SUM2        ...............................................................................
SUM3        ...............................................................................
SUM4        ...............................................................................
SUM5        ...............................................................................
SUM6        ...............................................................................
SUM7        ...............................................................................
SUM8        ...............................................................................
TIGRIS1     ...............................................................................
TIGRIS2     ...............................................................................
TIG1        ...............................................................................
TIG2        ...............................................................................
TIG3        ...............................................................................
TIG4        ...............................................................................
TIG5        ...............................................................................
TIG6        ...............................................................................
TIG31       ...............................................................................
TIG30       ...............................................................................
TIG29       ...............................................................................
TIG28       ...............................................................................
TIG27       ...............................................................................
TIG26       ...............................................................................
TIG25       ...............................................................................
TIG24       ...............................................................................
TIG23       ...............................................................................
TIG22       ...............................................................................
TIG21       ...............................................................................
TIG20       ...............................................................................
TIG19       ...............................................................................
TIG18       ...............................................................................
TIG17       ...............................................................................
TIG16       ...............................................................................
TIG15       ...............................................................................
TIG14       ...............................................................................
TIG13       ...............................................................................
TIG12       ...............................................................................
TIG11       ...............................................................................
Ptt03       -------------------------.C........T.....................................------
Ptt01       -------------------------.C........T.....................................------
sondaica    ...............................................................................
sondaica(2) ...............................................................................

ALTAICA4    AATACCAAAAAACAACCCCATGACTTTCATAATTCATATATTGCATATACCCGTACTGTGCTTGCCCAGTATGTCCTCAT
ALTAICA     ..C............................................................................
ALT         ...............................................................................
Pta04       ...............................................................................
Pta.S12     ...............................................................................
AMO1        ...............................................................................
AMO2        ...............................................................................
Pts         ...............................................................................
AMO3/COR1   ...............................................................................
CORBETTI1   ...............................................................................
COR2        ...............................................................................
COR3        ...............................................................................
COR4        ...............................................................................
```

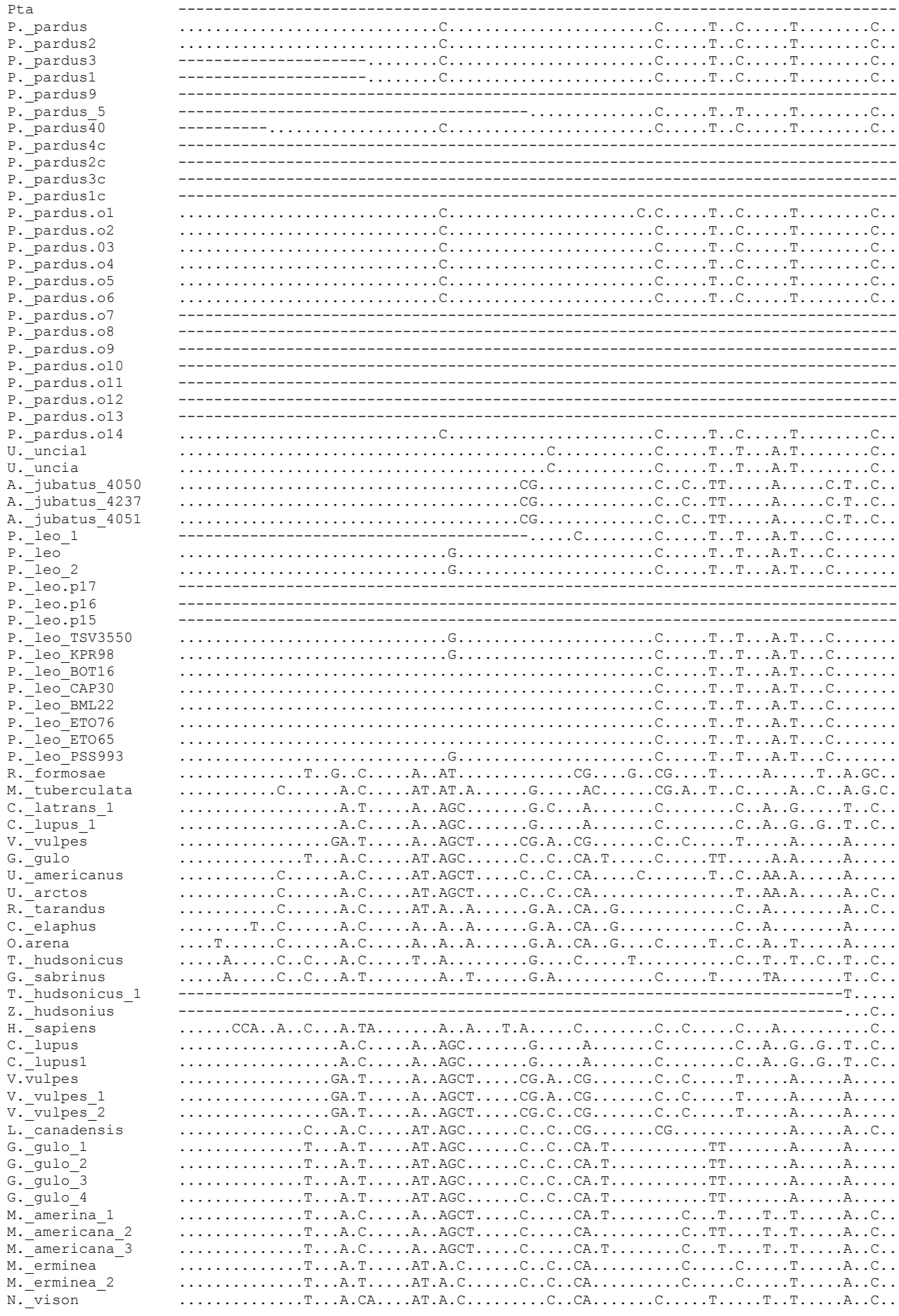
```
COR5        ..........................................................................
COR6        ..C.......................................................................
COR7        ..C.......................................................................
COR8        ..C.......................................................................
SUMATRA1    ..........................................................................
SUMATRA2    ..........................................................................
SUM1        ..........................................................................
SUM2        ..........................................................................
SUM3        ..........................................................................
SUM4        ..........................................................................
SUM5        ..........................................................................
SUM6        ..........................................................................
SUM7        ..........................................................................
SUM8        ..........................................................................
TIGRIS1     ..........................................................................
TIGRIS2     ..........................................................................
TIG1        ..........................................................................
TIG2        ..........................................................................
TIG3        ..........................................................................
TIG4        ..........................................................................
TIG5        ..........................................................................
TIG6        ..........................................................................
TIG31       ..........................................................................
TIG30       ..........................................................................
TIG29       ..........................................................................
TIG28       ..........................................................................
TIG27       ..........................................................................
TIG26       ..........................................................................
TIG25       ..........................................................................
TIG24       ..........................................................................
TIG23       ..........................................................................
TIG22       ..........................................................................
TIG21       ..........................................................................
TIG20       ..........................................................................
TIG19       ..............................................................................A.....
TIG18       ........................................A.................................A.....
TIG17       ..........................................................................
TIG16       ..........................................................................
TIG15       ..........................................................................
TIG14       ..........................................................................
TIG13       ..........................................................................
TIG12       ..........................................................................
TIG11       ..........................................................................
Ptt03       ..C.......................................................................
Ptt01       ..........................................................................
sondaica    ..........................................................................
sondaica(2) ..........................................................................

ALTAICA4    CCCCACAAAAAATAAGTGAAAAAATCCTCAATCCCCGTT-
ALTAICA     ....................................-
ALT         ....................................-
Pta04       ....................C...............-
Pta.S12     ....................................G
AMO1        ....................................-
AMO2        ....................................-
Pts         ....................................-
AMO3/COR1   ....................................-
CORBETTI1   ....................................-
COR2        ....................................-
COR3        ....................................-
COR4        .T..................................-
COR5        .T..................................-
COR6        ....................................-
COR7        ....................................-
COR8        ....................................-
SUMATRA1    ....................................-
SUMATRA2    ....................................-
SUM1        ....................................-
SUM2        ....................................-
SUM3        ....................................-
SUM4        ....................................-
SUM5        ....................................-
SUM6        ....................................-
SUM7        ....................................-
SUM8        ....................................-
TIGRIS1     ...........-........................-
TIGRIS2     ...........-........................-
```

```
TIG1        ....................................-
TIG2        ....................................-
TIG3        ....................................-
TIG4        ....................................-
TIG5        ....................................-
TIG6        ....................................-
TIG31       ....................................-
TIG30       ....................................-
TIG29       ....................................-
TIG28       ....................................-
TIG27       ....................................-
TIG26       ....................................-
TIG25       ............................C.......-
TIG24       ............................C.......-
TIG23       ....................................-
TIG22       ...........-........................-
TIG21       ...........-........................-
TIG20       ...........-........................-
TIG19       ...........-........................-
TIG18       ...........-........................-
TIG17       ...........-........................-
TIG16       ...........-........................-
TIG15       ...........-........................-
TIG14       ...........-........................-
TIG13       ...........-........................-
TIG12       ...........-........................-
TIG11       ...........-........................-
Ptt03       ....................................-
Ptt01       ....................................-
sondaica    ...........-........................-
sondaica(2) ...........-........................-
```

6.5 Appendix 5: The cyt *b* sequence alignment of 349 mammalian sequences, 71 tiger sequences available on GenBank, and our tiger cyt *b* sequences.

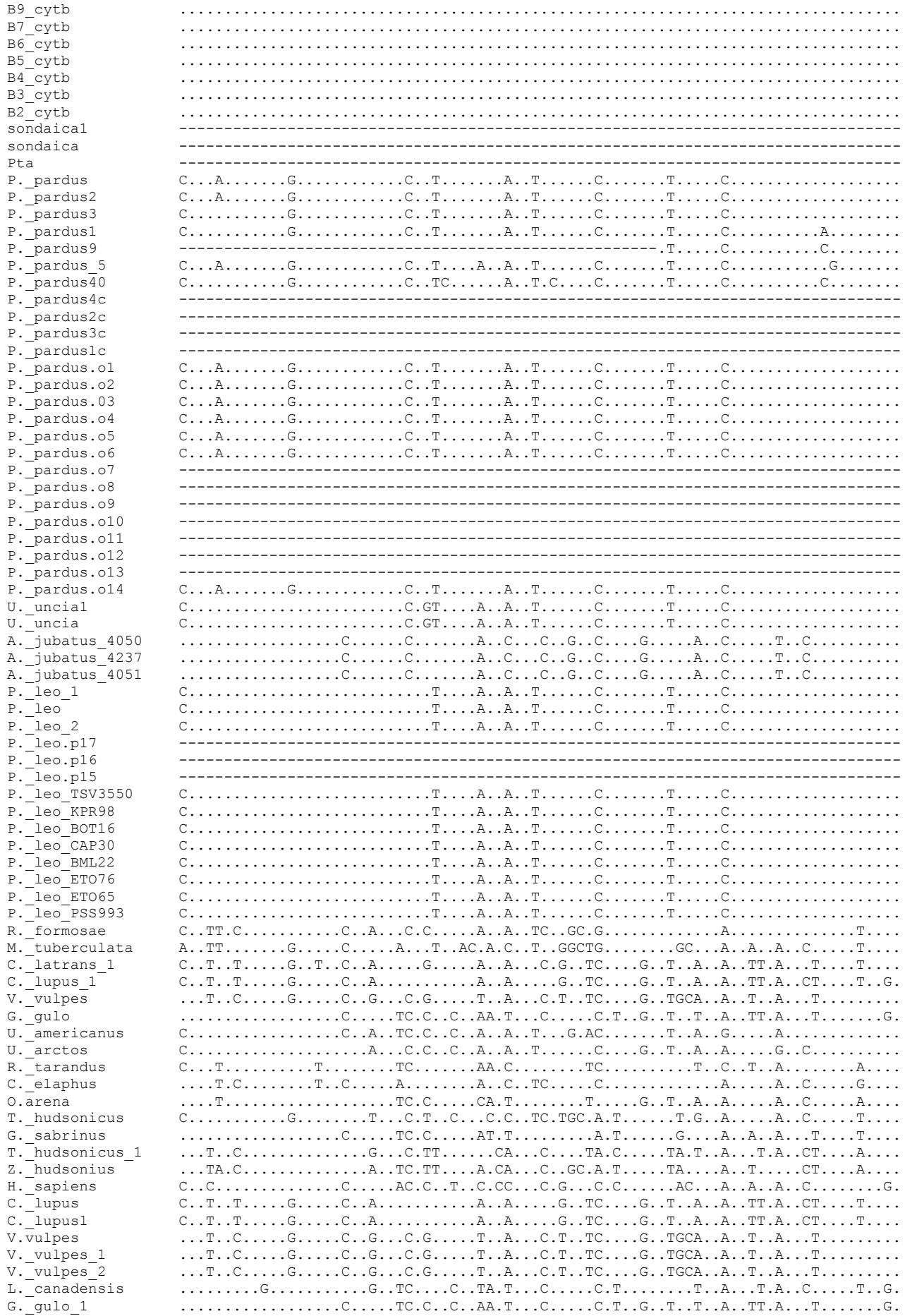
```
ALTAICA4          ATGACCAACATTCGAAAATCACACCCCCTTATCAAAATTATTAATCACTCATTTATTGACCTACCCGCCCCATCCAATAT
ALT               ------------------------------------------------------------------------------
AMO1              ------------------------------------------------------------------------------
AMO2              ------------------------------------------------------------------------------
AMO3/COR1         ------------------------------------------------------------------------------
COR2              ------------------------------------------------------------------------------
COR3              ------------------------------------------------------------------------------
COR4              ------------------------------------------------------------------------------
COR5              ------------------------------------------------------------------------------
COR6              ------------------------------------------------------------------------------
COR7              ------------------------------------------------------------------------------
COR8              ------------------------------------------------------------------------------
SUM1              ------------------------------------------------------------------------------
SUM2              ------------------------------------------------------------------------------
SUM3              ------------------------------------------------------------------------------
SUM4              ------------------------------------------------------------------------------
SUM5              ------------------------------------------------------------------------------
SUM6              ------------------------------------------------------------------------------
SUM7              ------------------------------------------------------------------------------
SUM8              ------------------------------------------------------------------------------
TIG1              ------------------------------------------------------------------------------
TIG2              ------------------------------------------------------------------------------
TIG3              ------------------------------------------------------------------------------
TIG4              ------------------------------------------------------------------------------
TIG5              ------------------------------------------------------------------------------
TIG6              ------------------------------------------------------------------------------
TIGRIS1           ..............................................................................
TIGRIS2           ..............................................................................
SUMATRA1          ..............................................................................
SUMATRA2          ..............................................................................
CORBETTI1         ..............................................................................A.............
CORBETTI2         ..............................................................................
ALTAICA           ..............................................................................
S5_cytb           ..............................................................................
S3_cytb           ..............................................................................
B8_cytb           ..............................................................................
C3_cytb           ..............................................................................
C2_cytb           ..............................................................................
C1_cytb           ..............................................................................
Su10_cytb         ..............................................................................
Su9_cytb          ..............................................................................
Su7_cytb          ..............................................................................
Su6_cytb          ..............................................................................
Su5_cytb          ..............................................................................
Su4_cytb          ..............................................................................
Su3_cytb          ..............................................................................
Su2_cytb          ..............................................................................
Su1_cytb          ..............................................................................
S15_cytb          ..............................................................................
S13_cytb          ..............................................................................
S12_cytb          ..............................................................................
S11_cytb          ..............................................................................
S10_cytb          ..............................................................................
S8_cytb           ..............................................................................
S7_cytb           ..............................................................................
S6_cytb           ..............................................................................
S4_cytb           ..............................................................................
S2_cytb           ..............................................................................
S1_cytb           ..............................................................................
B9_cytb           ..............................................................................
B7_cytb           ..............................................................................
B6_cytb           ..............................................................................
B5_cytb           ..............................................................................
B4_cytb           ..............................................................................
B3_cytb           ..............................................................................
B2_cytb           ..............................................C.....................A.............
sondaica1         ------------------------------------------------------------------------------
sondaica          ------------------------------------------------------------------------------
```


Pta
P._pardus
P._pardus2
P._pardus3
P._pardus1
P._pardus9
P._pardus_5
P._pardus40
P._pardus4c
P._pardus2c
P._pardus3c
P._pardus1c
P._pardus.o1
P._pardus.o2
P._pardus.03
P._pardus.o4
P._pardus.o5
P._pardus.o6
P._pardus.o7
P._pardus.o8
P._pardus.o9
P._pardus.o10
P._pardus.o11
P._pardus.o12
P._pardus.o13
P._pardus.o14
U._uncia1
U._uncia
A._jubatus_4050
A._jubatus_4237
A._jubatus_4051
P._leo_1
P._leo
P._leo_2
P._leo.p17
P._leo.p16
P._leo.p15
P._leo_TSV3550
P._leo_KPR98
P._leo_BOT16
P._leo_CAP30
P._leo_BML22
P._leo_ETO76
P._leo_ETO65
P._leo_PSS993
R._formosae
M._tuberculata
C._latrans_1
C._lupus_1
V._vulpes
G._gulo
U._americanus
U._arctos
R._tarandus
C._elaphus
O.arena
T._hudsonicus
G._sabrinus
T._hudsonicus_1
Z._hudsonius
H._sapiens
C._lupus
C._lupus1
V.vulpes
V._vulpes_1
V._vulpes_2
L._canadensis
G._gulo_1
G._gulo_2
G._gulo_3
G._gulo_4
M._amerina_1
M._americana_2
M._americana_3
M._erminea
M._erminea_2
N._vison

```
U._americanus_1    ...........C......A.C.....AT.AGCT.....C..C..CA.....C.......T..C..AA.A.....A.....
U._americanus_2    ...........C......A.C.....AT.AGCT.....C..C..CA.....C.C.....T..C..A..A.....A.....
U._americanus_3    ...........C......A.C.....AT.AGCT.....C..C..CA.....C.......T..C..AA.A.....A.....
U._arctos_1        ...........C......A.T.....AT.AGCT.....CG.C..CA................T..AA.A.....A..C..
U._arctos_2        .....T.....C......A.T.....AT.AGCT.....C..C..CA................T..AA.A.....A..C..
U._arctos_3        ...........C......A.T.....AT.AGCT.....C..C..CA................T..AA.A.....A..C..
R._tarandus_27     ------------......A.C.....AT.A..A......G.A...A..G.............C..AA.......A..C..
R._tarandus_22     ------------......A.C.....AT.A..A......G.A..CA..G.............C..A........A.....
R._tarandus_09     ------------------A.C.....AT.A..A......G.A..CA..G.............C..A........A..C..
O._moschatus_1     ??????????????????????????????????...A.G.A...A..G.G...........C..AA.......A..C..
O._moschatus_2     ??????????????????????????????????????????A...A..G.G...........C..AA.......A..C..
O._moschatus_3     ??????????????????????????????????????????A...A..G.G...........C..AA.......A..C..
O._moschatus_4     ????????????????????????????????????......G.A...A..G.G...........C..AA.......A..C..
O._moschatus_17    ........T..C......A.T.....A..A..A......G.A...A..G.G...........C..AA.......A..C..
O._moschatus_5     ----------------------------------------------------------------------------------
O._moschatus_6     ----------------------------------------------------------------------------------
O._moschatus_7     ----------------------------------------------------------------------------------
O._moschatus_8     ----------------------------------------------------------------------------------
O._moschatus_9     ----------------------------------------------------------------------------------
O._moschatus_10    ----------------------------------------------------------------------------------
O._moschatus_11    ----------------------------------------------------------------------------------
O._moschatus_12    ----------------------------------------------------------------------------------
O._moschatus_13    ----------------------------------------------------------------------------------
O._moschatus_14    ----------------------------------------------------------------------------------
O._moschatus_15    ----------------------------------------------------------------------------------
O._moschatus_16    ----------------------------------------------------------------------------------
O._moschatus_2.    ........T..C......A.T.....A..A..A......G.A...A..G.G...........C..AA.......A..C..
O._moschatus_39    ........T..C......A.T.....A..A..A......G.A...A..G.G...........C..AA.......A..C..
O._dalli_OD2       ...........C......A.C.....A..A..A......G.A..CA..G..........T..C..A........A.....
O._dalli_Od1       ...........C......A.C.....A..A..A......G.A..CA..G..........T..C..A........A.....
O._dalli           ....T......C......A.C.....A..A..A......G.A..CA..G..........T..C..A........A.....
O._dalli_2         ...........C......A.C.....A..A..A......G.A..CA..G..........T..C..A........A.....
M._caligata        .....A....C...T...A.C..T..TT.A..T..................C..C.....TT....T..G..C..T.....
M._caligata_2      .....A....C...T...A.C..T..TT.A..T..................C..C.....TT....T..G..C..T.....
M._caligata_3      .....A........T...A.C..T..TT.A..T..................C..C.....TT....T..G..C..T.....
M._broweri         .....A....CC..C...A.C..T.....A..T........C........C........TT....T..A..C..T.....
M._broweri_2       .....A....CC..C...A.C..T.....A..T........C........C........TT....T..A..C..T.....
M._broweri_3       .....A....CC..C...ATC..T.....A..T........C........C........TT....T..A..C..T.....
M._broweri_4       .....A....CC..C...ATC..T.....A..T........C........C........TT....T..A..C..T.....
S._parryii_S83     .....A.....C..C...A.T.....TT.A..T.....CG.C..C.....C.....C...T....T..A..C.....C..
S._parryii_S79     .....A.....C..C...A.T.....TT.A..T.....CG.C..C.....C.....C...T....T..A..T.....C..
S._parryii         .....A.....C..C...A.T.....TT.A..T.....CG.C..C.....C.....C...T....T..A..T.....C..
S._parryii_2       .....A.....C..C...A.T.....TT.A..T.....CG.C..C.....C.....C...T....T..A..T.....C..
S._parryii_3       .....A.....C..C...A.T.....TT.A..T.....CG.C..C.....C.....C...T....T..A..T.....C..
T._hudsonicus_6    .....A.....C..C...A.C.....T..A.........G....C.....T..........C..T..T..C..T..C..
T._hudsonicus_2    .....A.....C..C...A.C.....T..A.........G....C.....T..........C..T..T..C..T..C..
T._hudsonicus_3    .....A.....C..C...A.C.....T..A..T......G....C.....T..........C..T..T..C..T..C..
T._hudsonicus_4    .....A.....C..C...A.C.....T..A..T......G....C..A..T..........C..T..T..C..T..C..
T._hudsonicus_5    .....A.....C..C...A.C.....T..A..T......G....C.....T........T..C..T..T..C..T..C..
C._fiber           .....A.....C......A.......A..A.CA........C..C........C..C.....C..AA.A...........
C._fiber_2         .....A.....C......A.......A..A.CA........C..C........C..C.....C..AA.A...........
C._fiber_3         .....A.....C......A.......A..A.CA........C..C........C..C.....C..AA.A...........
Z._hudsonius_49    ----------------------------------------------------------------------------.....
Z._hudsonius_47    ----------------------------------------------------------------------------.....
Z._hudsonius_42    ----------------------------------------------------------------------------.....
Z._hudsonius_36    ----------------------------------------------------------------------------.....
M._glareolus_159   ------------------------------.....C..C..C................C...........A..C..
M._glareolus_152   ------------------------..T..A........C..C..C................C...........A..C..
M._glareolus       ----------------------------------------------------------------------------------
D._groenlandicus_3 ----------------------------------------------------------------------------------
D._groenlandicus_2 ----------------------------------------------------------------------------------
D._groenlandicus_4 ----------------------------------------------------------------------------------
L._trimucronatus   ----------------------------------------------------------------------------------
L._trimucronatus_2 ----------------------------------------------------------------------------------
L._trimucronatus_3 ----------------------------------------------------------------------------------
M._arvalis_139     ---------------------------------------------.....G..C..C.....T..T........A..C..
M._arvalis_204     ----------------------------------------------------------------------------------
M._longicaudus     .....A.T...C......AA......A..A........A.....C................T..AA.......A..C..
M._subterraneus    ----------------------------------------------------------------------------------
M._oeconomus       .....A.TT..C..G...AA......A..A........A..C..C........C........C..A........A.....
M._oeconomus_2     .....A.TT..C..G...AA......A..A........A..C..C........C........C..A........A.....
M._oeconomus_3     .....A.TT..C..G...AA...T..A..A........A..C..C........C........C..A........A.....
M._maximowiczii    .....?.T...C......AAG.....A..A........A....GC.G......C..C.....C..A........A..C..
M._mongolicus      .....AGC...C......A.C.....A..GG.......A.....C........C..C.....C..A........A..C..
M._californicus_I  .....A.TT..C......AA......A..A..........C..C........C.....T..C..AA.......A..C..
M._californicus_J  .....A.TT..C......AA......A..A..........C..C........C.....T..C..AA.......A..C..
E._dorsatum        ...........C..C.....T.....T...........C..C..C........C........C..AA....C..T..C..
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O._collaris       ..........A......AAC........A..A........C..C.....T..C........C..AA....C..A..C..
O._collaris_2     ..........A......AAC........A..A......G.C..C.....T..C........C..AA....C..A..C..
O._collaris_3     ..........A......AAC........A..A......G.C..C.....T..C..C.....C..AA....C..A..C..
O._collaris_4     ..........A......AAC........A..A......G.C..C.....T..C..C.....C..AA....C..A..C..
L._othus          ............T...A.T........AC.A......G....C.....CC.A........T........C..A..C..
L._timidus        ------------------------------------------------------------------------------..
L._granatensis    ------------------------------------------------------------------------------.C..
L._europaeus      ------------------------------------------------------------------------------.
P._largha         ..........C......A.C..T..A..A..A........C..CA.......C..C.........A.A.....A.....
P._largha_Pl21    ..........C......A.C..T..A..A..A........C..CA.......C..C.........A.A.....A.....
P._largha_Pl16    ..........C......A.C..T..A..A..A........C..CA.......C..C.........A.A.....A.....
P._largha_Pl10    ..........C......A.C..T..A..A..A........C..CA.......C..C.........A.A.....A.....
E._barbatus       ..........C......A.T.....A..A........C..C..CAG......C..C.........A.A..G..A..C..
E._barbatus_2     ..........C......A.T.....A..A........C..C..CAG......C..C.........A.A..G..A..C..
E._barbatus_3     ..........C......A.T.....A..A........C..C..CAG......C..C.........A.A..G..A..C..


ALTAICA4          TTCAGCATGATGAAACTTTGGCTCCTTACTAGGGGTGTGCTTAATCTTACAAATCCTCACTGGCCTCTTTCTAGCCATAC
ALT               ------------------------------------------------------------------------------
AMO1              ------------------------------------------------------------------------------
AMO2              ------------------------------------------------------------------------------
AMO3/COR1         ------------------------------------------------------------------------------
COR2              ------------------------------------------------------------------------------
COR3              ------------------------------------------------------------------------------
COR4              ------------------------------------------------------------------------------
COR5              ------------------------------------------------------------------------------
COR6              ------------------------------------------------------------------------------
COR7              ------------------------------------------------------------------------------
COR8              ------------------------------------------------------------------------------
SUM1              ------------------------------------------------------------------------------
SUM2              ------------------------------------------------------------------------------
SUM3              ------------------------------------------------------------------------------
SUM4              ------------------------------------------------------------------------------
SUM5              ------------------------------------------------------------------------------
SUM6              ------------------------------------------------------------------------------
SUM7              ------------------------------------------------------------------------------
SUM8              ------------------------------------------------------------------------------
TIG1              ------------------------------------------------------------------------------
TIG2              ------------------------------------------------------------------------------
TIG3              ------------------------------------------------------------------------------
TIG4              ------------------------------------------------------------------------------
TIG5              ------------------------------------------------------------------------------
TIG6              ------------------------------------------------------------------------------
TIGRIS1           ..............................................................................
TIGRIS2           ..............................................................................
SUMATRA1          ..............................................................................
SUMATRA2          ..............................................................................
CORBETTI1         ..............................................................................
CORBETTI2         ..............................................................................
ALTAICA           ..............................................................C...............
S5_cytb           ..............................................................................
S3_cytb           ..............................................................................
B8_cytb           ..............................................................................
C3_cytb           ..............................................................................
C2_cytb           ..............................................................................
C1_cytb           ..............................................................................
Su10_cytb         ..............................................................................
Su9_cytb          ..............................................................................
Su7_cytb          ..............................................................................
Su6_cytb          ..............................................................................
Su5_cytb          ..............................................................................
Su4_cytb          ..............................................................................
Su3_cytb          ..............................................................................
Su2_cytb          ..............................................................................
Su1_cytb          ..............................................................................
S15_cytb          ..............................................................................
S13_cytb          ..............................................................................
S12_cytb          ..............................................................................
S11_cytb          ..............................................................................
S10_cytb          ..............................................................................
S8_cytb           ..............................................................................
S7_cytb           ..............................................................................
S6_cytb           ..............................................................................
S4_cytb           ..............................................................................
S2_cytb           ..............................................................................
S1_cytb           ..............................................................................
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B9_cytb
B7_cytb
B6_cytb
B5_cytb
B4_cytb
B3_cytb
B2_cytb
sondaica1
sondaica
Pta
P._pardus
P._pardus2
P._pardus3
P._pardus1
P._pardus9
P._pardus_5
P._pardus40
P._pardus4c
P._pardus2c
P._pardus3c
P._pardus1c
P._pardus.o1
P._pardus.o2
P._pardus.03
P._pardus.o4
P._pardus.o5
P._pardus.o6
P._pardus.o7
P._pardus.o8
P._pardus.o9
P._pardus.o10
P._pardus.o11
P._pardus.o12
P._pardus.o13
P._pardus.o14
U._uncia1
U._uncia
A._jubatus_4050
A._jubatus_4237
A._jubatus_4051
P._leo_1
P._leo
P._leo_2
P._leo.p17
P._leo.p16
P._leo.p15
P._leo_TSV3550
P._leo_KPR98
P._leo_BOT16
P._leo_CAP30
P._leo_BML22
P._leo_ETO76
P._leo_ETO65
P._leo_PSS993
R._formosae
M._tuberculata
C._latrans_1
C._lupus_1
V._vulpes
G._gulo
U._americanus
U._arctos
R._tarandus
C._elaphus
O.arena
T._hudsonicus
G._sabrinus
T._hudsonicus_1
Z._hudsonius
H._sapiens
C._lupus
C._lupus1
V.vulpes
V._vulpes_1
V._vulpes_2
L._canadensis
G._gulo_1

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G._gulo_2          .................C.....TC.C..C..AA.T...C.....C.T..G..T..T..A..TT.A...T.......G.
G._gulo_3          .................C.....TC.C..C..AA.T...C.....C.T..G..T..T..A..TT.A...T.......G.
G._gulo_4          .................C.....TC.C..C..AA.T...C.....C.T..G..T..T..A..TT.A...T.......G.
M._amerina_1       ...C.............C......C.C..T..AA.C...C.....C....G..T..T..A..TT.A.............
M._americana_2     ...C.............C......C.C..T..AA.C...C.....C....G..T..T..A..TT.A.............
M._americana_3     ...C.............C......C.C..T..AA.C...C.....C....G..T..T..A..TT.A.............
M._erminea         C.................C......C.C..C..AA.C...C.....A.T..G..T..T..A..TT.A...T.......G.
M._erminea_2       C.................C......C.C..C..AA.C...C.....A.T..G..T..T..A..TT.A...T.......G.
N._vison           C.................C..G...C....C..AA.C...C....TC.T.....T..T..A...T.A..CT........
U._americanus_1    C.................C..A...C.C..C..A..A..T...G.AC.......T..A..G.....A.............
U._americanus_2    C.................C..G...C.C..C..A..A..T...G.AC.......T..A..G.....A..C.....T....
U._americanus_3    C.................C..A...C.C..C..A..A..T...G.AC.......T..A..G.....A.............
U._arctos_1        C.....................A...C.C..T..A.....T.....TC....G..T..A..A.....A.....G.......
U._arctos_2        C.....................A...C.C..T..A.....T.....TC....G..T..A..A.....A.....G.......
U._arctos_3        C.....................A...C.C..T..A.....T.....TC....G..T..A..A.....A.............
R._tarandus_27     C...T..........T........TC.G.....AA.C........TC..........T..C..T..A........A....
R._tarandus_22     C...T..........T........TC.......AA.C........TC..........T.....T..A........A....
R._tarandus_09     C...T..........T........TC.......AA.C........TC..........T..C..T..A........A....
O._moschatus_1     C...T.............C......C.C.....TA.C...C....TC........T.A..A.....A........A....
O._moschatus_2     C.................C......C.C.....TA.C...C....TC........T.A..A.....A........A....
O._moschatus_3     C.................C......C.C.....TA.C...C....TC........T.A..A.....A........A....
O._moschatus_4     C...T.............C......C.C.....TA.C...C....TC..........A..A.....A........A....
O._moschatus_17    C...T.............C......C.C.....TA.C...C....TC........T.A..A.....A........A....
O._moschatus_5     ----------------------------------------------------------------------------------
O._moschatus_6     ----------------------------------------------------------------------------------
O._moschatus_7     ----------------------------------------------------------------------------------
O._moschatus_8     ----------------------------------------------------------------------------------
O._moschatus_9     ----------------------------------------------------------------------------------
O._moschatus_10    ----------------------------------------------------------------------------------
O._moschatus_11    ----------------------------------------------------------------------------------
O._moschatus_12    ----------------------------------------------------------------------------------
O._moschatus_13    ----------------------------------------------------------------------------------
O._moschatus_14    ----------------------------------------------------------------------------------
O._moschatus_15    ----------------------------------------------------------------------------------
O._moschatus_16    ----------------------------------------------------------------------------------
O._moschatus_2.    C...T.............C......C.C.....TA.C...C....TC........T.A..A.....A........A....
O._moschatus_39    C...T.............C......C.C.....TA.C...C....TC........T.A..A.....A........A....
O._dalli_OD2       C...T.....................TC.C.....CA.T........T..........A..A.....A........A....
O._dalli_Od1       C...T.....................TC.C.....CA.T........T..........A..A.....A........A....
O._dalli           C...T................A..TC.C.....CA.T........T.....G..T..A..A.....A........A....
O._dalli_2         C...T.....................TC.C.....CA.T........T..........A..A.....A........A....
M._caligata        ....A..........T........TC..T....AC.A......G..A.C......T.T..C..AT.A........A....
M._caligata_2      ....A..........T........TC..T....AC.A......G..A.C......T.T..C..AT.A........A....
M._caligata_3      ....A..........T........TC..T....AC.A......G..A.C......T.T..C..AT.A........A....
M._broweri         ....A................A...C.........C.T..T...GCTA.C......T.T..C..A..A........A....
M._broweri_2       ....A................A..TC.........C.T..T...GCTA.C......T.T..C..A..A........A....
M._broweri_3       ....A................A..TC........C.T..T...GCTA.C......T.T..C..A..A........A....
M._broweri_4       ....A................A..TC........C.T..T...GCTA.C......T.T..C..A..A........A....
S._parryii_S83     C..T..........T.....G..TC.T.....CC.C...C..GCAA.C.....T........AT.A........A....
S._parryii_S79     ...T.................G..TC.T.....CC.C...C..GCAA.C.....T........AT.A........A....
S._parryii         ...T.................G..TC.T.....CC.C...C..GCAA.C.....T........AT.A........A....
S._parryii_2       C..T.................G..TC.T.....CC.C...C..GCAA.C.....T........AT.A........A....
S._parryii_3       ...T.................G..TC.T.....CC.C...C..GCAA.C.....T........AT.A........A....
T._hudsonicus_6    C...........G........T...C.T..T...C.C...C.TGC.A.T......T.G..A.....A..C.....T....
T._hudsonicus_2    C...........G........T...C.T..T...C.C..TC.TGC.A.T......T.G..A.....A..C.....T....
T._hudsonicus_3    C...........G........T..TC.T..C..AC.C..TC.CGC.A.T......T.G..A.....A..C.....T....
T._hudsonicus_4    C.....................T..TC.T..C..AC.C..TC.CGCTA.T......T.G..A.....A..C.....T....
T._hudsonicus_5    C.....................T..TC.T..C..AC.C..TC.CGCTA.T......T.G..A.....A..C.....T....
C._fiber           C.....G...........C..A...C.......AA.C.........C.......TGCA..A..A..A..C.....A....
C._fiber_2         C.....G...........C..A...C.......AA.C.........C.......TGCA..A..A..A..C.....A....
C._fiber_3         C.....G...........C..A...C.......AA.C.........C.......TGCA..A..A..A..C.....A....
Z._hudsonius_49    ...TA.C..............G..TC.TT......CA...C..GCTA.C..G..TA.T..A..T.....CT....A....
Z._hudsonius_47    ...TA.C..............G..TC.TT......CA...C..GCTA....G..TA.T..A..T.....CT....A....
Z._hudsonius_42    ...TA.C..............G..TC.TT......CA...C..GCTA.C..G..TA.T..A..T.....CT....A....
Z._hudsonius_36    ...TA.C..............G..TC.TT......CA...C..GCTA.C..G..TA.T..A..T.....CT....A....
M._glareolus_159   C...T.........................T..CC.T...C.....A.T...........A..A.....C.....A....
M._glareolus_152   C...T.........................T..CC.T...C.....A.T...........A..A.....C.....A....
M._glareolus       ------------.....C..T...C....T..CC.T...C....TA.C...........A..A..T..C..........
D._groenlandicus_3 -----------....T..C......C....C..CC.A...C.....A.T.....T..T..A..G..A..C..........
D._groenlandicus_2 ---------------------....C....C..CC.A...C.....A.T.....T..T..A..A..A..C..........
D._groenlandicus_4 ----------------------------------C.A...C.....A.T.....T..T..A..A..A..C.....T....
L._trimucronatus   -------...........C..A...C.T.....AC.T...C....TA.C........T..A..AT.A..C..........
L._trimucronatus_2 -------...........C..A...C.T.....AC.T...C....TA.C........T..A..AT.A..C..........
L._trimucronatus_3 -------.............A...C.T..G..AC.T...C.....A.T........T..A..GT.A..C..........
M._arvalis_139     C...T.............C.....TC.C.....TC.T..TC.G..TG.C.....T.....A..AT.A..C.....T....
M._arvalis_204     ----------------------..C.C.....TC.T..TC.G..TG.C.....T.....A..AT.A..C.....T....
M._longicaudus     C...T..............A..TC.......AC.C........AA.T.....T.....A..A..A..CT....T....
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M._subterraneus    -----...................AC.G.....CC.C...C....TG.......T.....A..A..A..C..T..T....
M._oeconomus       C...T.............C......C.G..C..CC.C...C....AA.C......A....A..GT.A..C..........
M._oeconomus_2     C...T.............C......C.G..C..CC.C...C....AA.C......A....A..GT.A..C..........
M._oeconomus_3     C...T.............C......C.G..C..CC.C...C....AA.C......A....A..A..A..C..T.......
M._maximowiczii    C...T.T...........C......C.......CC.C...C.....A.C.....T.....G..AT.A..C..........
M._mongolicus      C...T...T.........C......C.......CC.T...C....TA.C.....T.....A..AT.A..C..........
M._californicus_I  C...T....G........C......C.......CC.C...C.....A.T.....T.....A..A..A..C..G.......
M._californicus_J  C...T....G........C......C.......CC.C...C.....A.T.....T.....A..A..A..C..G.......
E._dorsatum        C...T....G.....T.....A......T....T..T..TC..C.A.........G.T..A.....A........T....
O._collaris        C..C..............C..A...C.T.....CC.A...C..GG.A.T......A.T......T.A..C..........
O._collaris_2      C..C..............C..A...C.T.....CC.A...C..GG.A.T..G...A.T......T.A..C..........
O._collaris_3      C..C..............C..A...C.T.....CC.A...C..GG.A.T......A.T......T.A..C..........
O._collaris_4      C..C..............C..A...C.T.....CC.A...C..GG.A.T......A.T......T.A..C..........
L._othus           C.....C.....G.............C..T....AC.A...C....AA.C........A........A..C.....T....
L._timidus         C.....C..................C..T....AC.A...C....AA.C........A........A..C.....T....
L._granatensis     ......C..................TC..T....AT.A...C.T..AA.C........A......T.G..C.....T....
L._europaeus       C..T..C...........C.....TC..T.G..AT.A...C....AA.C..G.....A......T.A..............
P._largha          C.....................A..TC.T..C..AA.C...C.....C.G..G...T.A..A...T.G..C..........
P._largha_Pl21     C.....................A..TC.T..C..AA.C...C.....C.G..G...T.A..A...T.A..C..........
P._largha_Pl16     C.....................A..TC.T..C..AA.C...C.....C.G..G...T.A..A...T.A..C..........
P._largha_Pl10     C.................C..A..TC.T..C..AA.C...C.....C.G..G...T.A..A...T.G..C..........
E._barbatus        C.................C..A...C.C..C...A.C...C.T..T..........A..A.....A..C..........
E._barbatus_2      C.................C..A...C.C..C...A.C...C.T..T..........A..A.....A..C..........
E._barbatus_3      C.................C..A...C.C..C...A.C...C.T..T..........A..A.....A..C..........
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ALTAICA4           ACTACACATCAGACACAATAACCGCTTTCTCATCAGTTACCCACATTTGCCGCGACGTAAACTACGGCTGGATTATCCGA
ALT                ----------------------------------------------------------------------------------------
AMO1               ----------------------------------------------------------------------------------------
AMO2               ----------------------------------------------------------------------------------------
AMO3/COR1          ----------------------------------------------------------------------------------------
COR2               ----------------------------------------------------------------------------------------
COR3               ----------------------------------------------------------------------------------------
COR4               ----------------------------------------------------------------------------------------
COR5               ----------------------------------------------------------------------------------------
COR6               ----------------------------------------------------------------------------------------
COR7               ----------------------------------------------------------------------------------------
COR8               ----------------------------------------------------------------------------------------
SUM1               ----------------------------------------------------------------------------------------
SUM2               ----------------------------------------------------------------------------------------
SUM3               ----------------------------------------------------------------------------------------
SUM4               ----------------------------------------------------------------------------------------
SUM5               ----------------------------------------------------------------------------------------
SUM6               ----------------------------------------------------------------------------------------
SUM7               ----------------------------------------------------------------------------------------
SUM8               ----------------------------------------------------------------------------------------
TIG1               ----------------------------------------------------------------------------------------
TIG2               ----------------------------------------------------------------------------------------
TIG3               ----------------------------------------------------------------------------------------
TIG4               ----------------------------------------------------------------------------------------
TIG5               ----------------------------------------------------------------------------------------
TIG6               ----------------------------------------------------------------------------------------
TIGRIS1            ........................................................................................
TIGRIS2            ........................................................................................
SUMATRA1           ......................A.................................................................
SUMATRA2           ......................A.................................................................
CORBETTI1          ........................................................................................
CORBETTI2          ........................................................................................
ALTAICA            ........................................................................................
S5_cytb            ........................................................................................
S3_cytb            ........................................................................................
B8_cytb            ........................................................................................
C3_cytb            ...................................................................................T....
C2_cytb            ...................................................................................T....
C1_cytb            ...................................................................................T....
Su10_cytb          ......................A.................................................................
Su9_cytb           ......................A.................................................................
Su7_cytb           ......................A.................................................................
Su6_cytb           ......................A.................................................................
Su5_cytb           ......................A.................................................................
Su4_cytb           ......................A.................................................................
Su3_cytb           ......................A.................................................................
Su2_cytb           ......................A.................................................................
Su1_cytb           ......................A.................................................................
S15_cytb           ........................................................................................
S13_cytb           ........................................................................................
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S12_cytb          ..........................................................................
S11_cytb          ..........................................................................
S10_cytb          ..........................................................................
S8_cytb           ..........................................................................
S7_cytb           ..........................................................................
S6_cytb           ..........................................................................
S4_cytb           ..........................................................................
S2_cytb           ..........................................................................
S1_cytb           ..........................................................................
B9_cytb           ..........................................................................
B7_cytb           ..........................................................................
B6_cytb           ..........................................................................
B5_cytb           ..........................................................................
B4_cytb           ..........................................................................
B3_cytb           ..........................................................................
B2_cytb           ..........................................................................
sondaica1         --------------------------------------------------------------------------
sondaica          --------------------------------------------------------------------------
Pta               ------------------------------------------------------------...........
P._pardus         .T..T.............C.......................T..C........T.....T..T.....A........G
P._pardus2        .T..T.............C.......................T..C........T.....T..T.....A........G
P._pardus3        .T..T.............C.......................T..C........T.....T..T.....A........G
P._pardus1        .T..T.............C.......................T..C........T.C...T..T.....A........G
P._pardus9        .T..T.............C.......................T..C........T.C...T..T.....A........G
P._pardus_5       .T................C...................G....T..C.............T........A........G
P._pardus40       .T..T.............C.......................T..C........T.C...T..T.....A........G
P._pardus4c       --------------------------------------------------------------------------
P._pardus2c       --------------------------------------------------------------------------
P._pardus3c       --------------------------------------------------------------------------
P._pardus1c       --------------------------------------------------------------------------
P._pardus.o1      .T..T.............C.......................T..C........T.....T..T.....A........G
P._pardus.o2      .T..T.............C.......................T..C........T.....T..T.....A........G
P._pardus.03      .T..T.............C.......................T..C........T.....T..T.....A........G
P._pardus.o4      .T..T.............C.......................T..C........T.....T..T.....A........G
P._pardus.o5      .T..T.............C.......................T..C........T.....T..T.....A........G
P._pardus.o6      .T..T.............C.......................T..C........T.....T..T.....A........G
P._pardus.o7      --------------------------------------------------------------------------
P._pardus.o8      --------------------------------------------------------------------------
P._pardus.o9      --------------------------------------------------------------------------
P._pardus.o10     --------------------------------------------------------------------------
P._pardus.o11     --------------------------------------------------------------------------
P._pardus.o12     --------------------------------------------------------------------------
P._pardus.o13     --------------------------------------------------------------------------
P._pardus.o14     .T..T.............C.......................T..C........T.....T..T.....A........G
U._uncia1         ....T.............................G.....C........C.............T..T.....A.........
U._uncia          ....T.............................G.....C........C.............T..T.....A.........
A._jubatus_4050   ........................C..T...........T.....C...........C...........A.....T...
A._jubatus_4237   ........................C..T...........T.....C...........C...........A.....T...
A._jubatus_4051   ........................C..T...........T.....C...........C...........A.....T...
P._leo_1          .T......C...............................C..................T........T.....A........G
P._leo            .T......C...............................C..................T........T.....A........G
P._leo_2          .T......C...............................C..................T........T.....A........G
P._leo.p17        --------------------------------------------------------------------------
P._leo.p16        --------------------------------------------------------------------------
P._leo.p15        --------------------------------------------------------------------------
P._leo_TSV3550    .T......C...............................C..................T........T.....A........G
P._leo_KPR98      .T......C...............................C..................T........T.....A........G
P._leo_BOT16      .T......C...............................C..................T........T.....A........G
P._leo_CAP30      .T......C...............................C..................T........T.....A........G
P._leo_BML22      .T......C...............................C..................T........T.....A........G
P._leo_ETO76      .T......C...............................C..................T........T.....A........G
P._leo_ETO65      .T......C...............................C..................T........T.....A........G
P._leo_PSS993     .T......C...............................C..................T........T.....A........G
R._formosae       ................C.CC..A.......AC..C..A..A.....C.....A.....C.........A..AG.CC.A..C
M._tuberculata    .T.....TG....T.TTGA...A..C...AGC.....GT....T..C..T..A...........T..A...C.CC.G..C
C._latrans_1      ....T.....G......GCC..A.....T........C........C..T..A.....T...........A........C
C._lupus_1        ....T.....G......GCC..A.....T........C........C.....A.....T...........A........C
V._vulpes         ....T.....T......GCT..T...........T..C..T.....C.....A.....T.....T.....A........C
G._gulo           .......G.....T...GCT..A.............C.....T..C.....A.....C.....T.....AG.C......
U._americanus     .............T....CT..A..C..T......A.C.....T........A..T..TC.......A..A.........
U._arctos         ....T.............CC..A.....T........C..............A.....TC.......A..AG........
R._tarandus       .T..T.....C..T........A..A.....C..T.....T.....C..T..A.....C..T..T.....A..C......
C._elaphus        ....T.....T..T........A..A.....C..T..C.....T..C..T..A..T..C..T..T.....A.....T...
O.arena           ....T...C.T.......C...A..A.....C..T..A.............A...........T.....A.........
T._hudsonicus     .......C..T...........A..A.....C.....C.....T........A...........T..T..AC.A..T..C
G._sabrinus       .T........C.....................C..T..C.....T..C..T..T...........T.....AC.A......
T._hudsonicus_1   ....T.....T.....TTCCT.A..C..T..C.....G.....T........A........T.....T..AC.A..T..C
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Z._hudsonius       ....T.....T....TCTCC..A..C.....T..........T........A........T..T.....AT.C.....C
H._sapiens         .....T..C.....G.CTC......C..T......A.CG.......CACT..A........T..T.....A..C.....C
C._lupus           ....T.....G......GCC..A.....T........C........C.....A.....T..........A........C
C._lupus1          ....T.....G......GCC..A.....T........C........C.....A.....T..........A........C
V.vulpes           ....T.....T......GCT..T..........T..C..T.....C.....A.....T.....T.....A........C
V._vulpes_1        ....T.....T......GCT..T..........T..C..T.....C.....A.....T.....T.....A........C
V._vulpes_2        ....T.....T......GCT..T..........T..C..T.....C.....A.....T.....T.....A........C
L._canadensis      .T..............GCC..A..C..T..G..G..C.....T..C.....A.....C..T.....T..AG.......G
G._gulo_1          .......G.....T...GCT..A.............C.....T..C.....A.....C.....T.....AG.C......
G._gulo_2          .......G.....T...GCT..A.............C.....T..C.....A.....C.....T.....AG.C......
G._gulo_3          .......G.....T...GCT..A.............C.....T..C.....A.....C.....T.....AG.C......
G._gulo_4          .......G.....T...GCT..A.............C.....T..C.....A.....C.....T.....AG.C......
M._amerina_1       ............T...GCC..A..C..........................A..T..C..........A.........
M._americana_2     ............T...GCC..A..C..........................A..T..C..........A.........
M._americana_3     ............T...GCC..A..C..........................A..T..C..........A.........
M._erminea         .T..............GCC..A..C..........C........C.....A.....C..........A..C......
M._erminea_2       .T..............GCC..A..C..........C........C.....A.....C..........A..C......
N._vison           ...............GCT..A..C..T........C..T..T........A.....T..T..T..T..A..C..T...
U._americanus_1    ............T....CT..A..C..T......A.C.....T........A..T..TC.......A..A.........
U._americanus_2    ....T............CT..A..C..T......A.C.....T........A..T..TC.......A..A.........
U._americanus_3    ............T....CT..A..C..T......A.C.....T........A..T..TC.......A..A.........
U._arctos_1        ....T............CC..A.....T........C.............A.....TC.......A..AG........
U._arctos_2        ....T............CC..A.....T........C.............A.....TC.......A..AG........
U._arctos_3        ....T............CC..A.....T........C.............A.....TC.......A..AG........
R._tarandus_27     .T..T.....C..T........A..A.....C..T.....T.....C..T..A.....C..T..T.....A..C......
R._tarandus_22     .T..T.....C..T........A..A.....C..T.....T.....C..T..A.....C.....T.....A..C......
R._tarandus_09     .T..T.....C..T........A..A.....C..T.....T.....C..T..A.....C..T..T.....A..C......
O._moschatus_1     ..........C.......C...A..A.....T..T..A..A...........G..T.............A..C..T...
O._moschatus_2     ..........C.......C...A..A.....T..T..A..A...........G..T.............A..C..T...
O._moschatus_3     ..........C.......C...A..A.....T..T..A..A...........G..T.............A..C..T...
O._moschatus_4     ..........C..T....C...A..A.....T..T..A..A...........G..T.............A..C..T...
O._moschatus_17    ..........C.......C...A..A.....T..T..A..A...........G..T.............A..C..T...
O._moschatus_5     ----------------------------------------------------------------------------------
O._moschatus_6     ----------------------------------------------------------------------------------
O._moschatus_7     ----------------------------------------------------------------------------------
O._moschatus_8     ----------------------------------------------------------------------------------
O._moschatus_9     ----------------------------------------------------------------------------------
O._moschatus_10    ----------------------------------------------------------------------------------
O._moschatus_11    ----------------------------------------------------------------------------------
O._moschatus_12    ----------------------------------------------------------------------------------
O._moschatus_13    ----------------------------------------------------------------------------------
O._moschatus_14    ----------------------------------------------------------------------------------
O._moschatus_15    ----------------------------------------------------------------------------------
O._moschatus_16    ----------------------------------------------------------------------------------
O._moschatus_2.    ..........C.......C...A..A.....T..T..A..A...........G..T.............A..C..T...
O._moschatus_39    ..........C.......C...A..A.....T..T..A..A...........A..T.............A..C..T...
O._dalli_OD2       ........C.T.......C...A..A.....C..C..A.............A...........T.....A........
O._dalli_Od1       ........C.T.......C...A..A.....C..C..A.............A...........T.....A........
O._dalli           ..........C..T....C...A..C.....C..C..A.............A...........T.....A..C.....
O._dalli_2         ........C.T.......C...A..A.....C..C..A.............A...........T.....A........
M._caligata        ..........C..T..CT....A.............C........C..T..A...............AC.......C
M._caligata_2      ..........C..T..CT....A.............C........C..T..A...............AC....T..C
M._caligata_3      ..........C..T..CT....A.............C........C..T..A...............AC.......C
M._broweri         ....T.....T..T..T.....A.............G........C..T..A........T..T.....AC.......C
M._broweri_2       ....T.....T..T..T.....A.............G........C..T..A........T..T.....AC.......C
M._broweri_3       ....T.....T..T..T.....A.............G........C..T..A........T..T.....AC.......C
M._broweri_4       ....T.....T..T..T.....A.............G........C..T..A........T..T.....AC.......C
S._parryii_S83     .T..T.....T..T..T.....A..C..T...........T...........A..T.....T..T..T..AC.A.....C
S._parryii_S79     .T..T.....T..T..T.....A..C..T...........T...........A..T.....T..T.....AC.A.....C
S._parryii         .T..T.....T..T..T.....A..C..T...........T...........A..T.....T..T.....AC.A.....C
S._parryii_2       .T..T.....C..T..T.....A..C..T...........T...........A..T.....T..T.....AC.A.....C
S._parryii_3       .T..T.....T..T..T.....A..C..T...........T...........A..T.....T..T.....AC.A.....C
T._hudsonicus_6    .......C..T...........A..A.....C.....C.....T........A...........T..T..AC.A..T..C
T._hudsonicus_2    .......C..T...........A..A.....C.....C.....T........A...........T..T..AC.A..T..C
T._hudsonicus_3    .......C..T...........A..A.....C.....C.....T........A...........T..T..AC.A..T..C
T._hudsonicus_4    .......C..T...........A..A.....C.....C.....T........A...........T..T..AC.A..T..C
T._hudsonicus_5    .......C..T...........A..A.....C.....C.....T........A...........T..T..AC.A..T..C
C._fiber           ................C.C...A..A..T..T.....CG.A.....C.....A..................A..C.....G
C._fiber_2         ................C.C...A..A..T..T.....CG.A.....C.....A..................A..C.....G
C._fiber_3         ................C.C...A..A..T..T.....CG.A.....C.....A.....G............A..C.....G
Z._hudsonius_49    ....T.....T..T.TCTCC..A........T.....C.....T........A..T.....T........AC.A.....C
Z._hudsonius_47    ....T.....T..T.TCTCC..A........T.....C.....T........A..T.....T........AC.A.....C
Z._hudsonius_42    ....T.....T..T.TCTCC..A........T.....C.....T........A..T.....T........AC.A.....C
Z._hudsonius_36    ....T.....T..T.TCTCC..A........T.....C.....T........A..T.....T........AC.A.....C
M._glareolus_159   ................TC...A..A..T..................C..T..A..................AC.......C
M._glareolus_152   ...........T.....TC...A..A..T..................C..T..A..................AC.......C
M._glareolus       .T...........T...TC...A..A...........C..T.....C..T..A..................AC.C.....C
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D._groenlandicus_3 ..........C......GC...A..A...........AG.A........?..A..T..G..T.....G..AC.A..T..C
D._groenlandicus_2 ..........C......GC...A..A...........AG.A...........A..T..G..T.....A..AC.A..T..C
D._groenlandicus_4 ..........C......GC...A..A...........AG.T...........A..T..G..T.....G..AC.A..T..C
L._trimucronatus   ..........T..T...GC...A..A...........AG.......C.....A..T..G........T..AC.G......
L._trimucronatus_2 ..........T..T...GC...A..A...........AG.......C.....A.....G........T..AT.G......
L._trimucronatus_3 ..........C......GC...A..A...........GG.T.....C.....A..T...........T..AT.A......
M._arvalis_139     ................GC...A..A...........AG....T..C..T..A...........T..T..AC........
M._arvalis_204     ................GC...A..A...........AG....T..C..T..A...........T..T..AC........
M._longicaudus     .......G..........C...A..A..T.........AG.T..T..C.....A...........T.....AT.A......
M._subterraneus    ...............TGC...G..A...........AG.......A.....A...............AC.C......
M._oeconomus       ....T.............C...A..A...........AG....T..C.....A.....C...........AC.A......
M._oeconomus_2     ....T.............C...A..A...........AG....T..C.....A.....C...........AC.A......
M._oeconomus_3     ....T.............C...A..A...........AG....T..C..T..A.....G...........AC.C......
M._maximowiczii    ................TC...A..A...........AG....T..C.....A.....G.....T.....AC.C.....T
M._mongolicus      ............T...GC...G..A...........AG....T.....T..A...........T.....AC.C.....T
M._californicus_I  ....T.........T...GC...A..A...........AG.......C.....A.........T.........AC.C......
M._californicus_J  ....T.........T...GC...A..A...........AG.......C.....A.........T.........AC.C......
E._dorsatum        .T.....CG.G..T....GC..A..A.........A.C.....T.....T..A..T.....T.....A..AT.A..T...
O._collaris        ................C....A..A...........C........C.....A.....G..T........A........C
O._collaris_2      ................C....A..A...........C........C.....A........T........A........C
O._collaris_3      ................C....A..A...........C........C.....A........T........A........C
O._collaris_4      ................C....A..A...........C........C.....A.....G..T........A..C.....C
L._othus           ................GC...A..A..T..T.....C..A..T........A...........T.....AC....T..T
L._timidus         ................GC...A..A..T..T.....C..A..T.....T..A...........T.....AC....T..T
L._granatensis     ....T............GC...A..A.....C.....C..T..T........A...............AC.C..T..C
L._europaeus       ................GCT..A..A.....C........A..T........A..T.............AC.C..T..T
P._largha          .......C..........CC..A..C............A........C.....A...............A..C.....T
P._largha_Pl21     .......C..........CC..A..C............A........C.....A...............A..C.....T
P._largha_Pl16     .......C..........CC..A..C............A........C.....A...............A..C.....T
P._largha_Pl10     .......C..........CC..A..C............A........C.....A...............A..C.....T
E._barbatus        .T.....C.....T....CC..A..............A.....T..C..T..A........T..T.....A.........
E._barbatus_2      .T.....C.....T....CC..A..............A.....T..C..T..A........T..T.....A.........
E._barbatus_3      .T.....C.....T....CC..A..............A.....T..C..T..A........T..T.....A.........
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ALTAICA4           TATCTACATGCCAACGGAGCCTCCATATTCTTTATCTGTCTATACATGCACGTAGGACGAGGAATATACTACGGCTCCTA
ALT                ------------------------------------------------------------..................
AMO1               ------------------------------------------------------------..................
AMO2               ------------------------------------------------------------..................
AMO3/COR1          ------------------------------------------------------------..................
COR2               ------------------------------------------------------------..................
COR3               ------------------------------------------------------------..................
COR4               ------------------------------------------------------------..................
COR5               ------------------------------------------------------------..................
COR6               ------------------------------------------------------------..................
COR7               ------------------------------------------------------------..................
COR8               ------------------------------------------------------------..................
SUM1               ------------------------------------------------------------..................
SUM2               ------------------------------------------------------------..................
SUM3               ------------------------------------------------------------..................
SUM4               ------------------------------------------------------------..................
SUM5               ------------------------------------------------------------..................
SUM6               ------------------------------------------------------------.................C.
SUM7               ------------------------------------------------------------.................C.
SUM8               ------------------------------------------------------------.................C.
TIG1               ------------------------------------------------------------..................
TIG2               ------------------------------------------------------------..................
TIG3               ------------------------------------------------------------..................
TIG4               ------------------------------------------------------------..................
TIG5               ------------------------------------------------------------..................
TIG6               ------------------------------------------------------------..................
TIGRIS1            ............................................................................
TIGRIS2            ............................................................................
SUMATRA1           ............................................................................
SUMATRA2           ............................................................................
CORBETTI1          ............................................................................
CORBETTI2          ............................................................................
ALTAICA            ............................................................................
S5_cytb            ............................................................................
S3_cytb            ............................................................................
B8_cytb            ............................................................................
C3_cytb            ............................................................................
C2_cytb            ............................................................................
C1_cytb            ............................................................................
Su10_cytb          ............................................................................
Su9_cytb           ............................................................................
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Su7_cytb          ...............................................................................
Su6_cytb          ..............................................................................C.
Su5_cytb          ...............................................................................
Su4_cytb          ...............................................................................
Su3_cytb          ...............................................................................
Su2_cytb          ...............................................................................
Su1_cytb          ...............................................................................
S15_cytb          ...............................................................................
S13_cytb          ...............................................................................
S12_cytb          ...............................................................................
S11_cytb          ...............................................................................
S10_cytb          ...............................................................................
S8_cytb           ...............................................................................
S7_cytb           ...............................................................................
S6_cytb           ...............................................................................
S4_cytb           ...............................................................................
S2_cytb           ...............................................................................
S1_cytb           ...............................................................................
B9_cytb           ...............................................................................
B7_cytb           ...............................................................................
B6_cytb           ...............................................................................
B5_cytb           ...............................................................................
B4_cytb           ...............................................................................
B3_cytb           ...............................................................................
B2_cytb           ...............................................................................
sondaica1         -------------------------------------------------------------------------------
sondaica          -------------------------------------------------------------------------------
Pta               ...............................................................................
P._pardus         ........C.....T.....................C........A..T...........GG.......T........
P._pardus2        ........C.....T.....................C........A..T...........GG.......T........
P._pardus3        ........C.....T.....................C...........T..............C....T........
P._pardus1        ........C.....T.....................C...........T.C...................T........
P._pardus9        ........C.....T.....................C...........T.G...................T........
P._pardus_5       ...T.............-------------------------------------------------------------
P._pardus40       ........C.....T.....................C...........T.G...................T........
P._pardus4c       -------------------------------------------------------------------------------
P._pardus2c       -------------------------------------------------------------------------------
P._pardus3c       -------------------------------------------------------------------------------
P._pardus1c       -------------------------------------------------------------------------------
P._pardus.o1      ........C.....T.....................C........A..T...........G........T........
P._pardus.o2      ........C.....T.....................C........A..T...........G........T........
P._pardus.03      ........C.....T.....................C........A..T...........G........T........
P._pardus.o4      ........C.....T.....................C........A..T...........G........T........
P._pardus.o5      ........C.....T.....................C........A..T...........G........T........
P._pardus.o6      ........C.....T.....................C........A..T...........G........T........
P._pardus.o7      -------------------------------------------------------------------------------
P._pardus.o8      -------------------------------------------------------------------------------
P._pardus.o9      -------------------------------------------------------------------------------
P._pardus.o10     -------------------------------------------------------------------------------
P._pardus.o11     -------------------------------------------------------------------------------
P._pardus.o12     -------------------------------------------------------------------------------
P._pardus.o13     -------------------------------------------------------------------------------
P._pardus.o14     ........C.....T.....................C........A..T...........G........T........
U._uncia1         ..C.....C.............................C........A.................G..............
U._uncia          ..C.....C.............................C........A.................G..............
A._jubatus_4050   ..CA.G..C..............T.............C...........T..............................
A._jubatus_4237   ..CA.G..C..............T.............C...........T..............................
A._jubatus_4051   ..CA.G..C..............T.............C...........T..............................
P._leo_1          ..C.....C.........-------------------------------------------------------------
P._leo            ..C.....C.............................C...........T.....................T........
P._leo_2          ..C.....C.............................C...........T.....................T........
P._leo.p17        -------------------------------------------------------------------------------
P._leo.p16        -------------------------------------------------------------------------------
P._leo.p15        -------------------------------------------------------------------------------
P._leo_TSV3550    ..C.....C.............................C...........T.....................T........
P._leo_KPR98      ..C.....C.............................C...........T.....................T........
P._leo_BOT16      ..C.....C.............................C...........T.....................T........
P._leo_CAP30      ..C.....C.............................C...........T.....................T........
P._leo_BML22      ..C.....C.............................C...........T.....................T........
P._leo_ETO76      ..C.....C.............................C...........T.....................T........
P._leo_ETO65      ..C.....C.............................C...........T.....................T........
P._leo_PSS993     ..C.....C.............................C...........T.....................T........
R._formosae       ..C..T..C.....T.....T........T..C.....CT.G.T.T.A.................C........T.....
M._tuberculata    ........C..T........A..A........C..T..C..G..TC.C..T.....C..T..CT.G..T..T........
C._latrans_1      ..CA.......A..T..C..T..............T.....G.T...A..T..G........CC...........A.....
C._lupus_1        ...A.G..C..A..T..C..T.................C....T.C.A..T...........CC....T.....A.....
V._vulpes         ..CA.......A........A..T.....T........C..C.T.........G........CT....T..T..A..T..
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G._gulo           ...A.............G.....................C....TTC.......C.....G..CC.......T..G..T..
U._americanus     ..CA.......T........T.....G...........C..G.T..............G..TC.G.....T.....A..
U._arctos         ...G.......A..T...........C...........C....TT..............G..CC.G.....T.....A..
R._tarandus       ..CA................A..A.....T..C.....CT...TT..A..T...........CC..........A..A..
C._elaphus        ...A....C..A.....G..A..A.....T..C..........T...A..T.....G.....CC.G........A..A..
O.arena           ...A....C..A.....G..A..A.....T........C....TT.....T...........CC.......T..A..A..
T._hudsonicus     ..CA.......T..T.....A..T.....T.....T..C....T.C.C........T.....CC.T..............
G._sabrinus       ...A....C..A..T..T..T..........C..T..C..T.T.C.T..T.....C......C.C..T..T........
T._hudsonicus_1   ..C..C..C..T..T.....T.....G..........CT...TTT.A..T.....C.....TC.T.....T.....T..
Z._hudsonius      .....C..C..T..T.....T...C..........T..CT...TTC.A........C.....CC..........A..T..
H._sapiens        ..C..T..C.....T..C.....A.............C..C.T.C.A...A.C..G.....CC....T.....A..A.T
C._lupus          ...A.G..C..A..T..C..T................C....T.C.A..T...........CC....T.....A.....
C._lupus1         ...A.G..C..A..T..C..T................C....T.C.A..T...........CC....T.....A.....
V.vulpes          ..CA.......A........A..T.....T........C..C.T.........G........CT....T..T..A..T..
V._vulpes_1       ..CA.......A........A..T.....T........C..C.T.........G........CT....T..T..A..T..
V._vulpes_2       ..CA.......A........A..T.....T........C..C.T.....................CT....T..T..A..T..
L._canadensis     ...A.......A.....................C.....C....T.C....T...........CC..........A..T..
G._gulo_1         ...A.............G.....................C..G.TTC.......C.....G..CC.......T..G..T..
G._gulo_2         ...A.............G.....................C..G.TTC.......C.....G..CC.......T..G..T..
G._gulo_3         ...A.............G.....................C..G.TTC.......C.....G..CC.......T..G..T..
G._gulo_4         ...A.............G.....................C..G.TTC.......C.....G..CC.......T..G..T..
M._amerina_1      ..CA..........T..G..T...........C.....C..G.T.C.......T.....G..CC.......T..A..T..
M._americana_2    ..CA..........T..G..T...........C.....C..G.T.C.......T.....G..CC.......T..A..T..
M._americana_3    ..CA..........T..G..T...........C.....C..G.T.C.......T.....G..CC.......T..A..T..
M._erminea        ..CA....C..A........T...............C....T.C.A..............CT....T..T..T..T..
M._erminea_2      ..CA....C..A........T...............C....T.C.A..............CT....T..T..T..T..
N._vison          ...A....C..A..T.....T............G.T..CT.G.T.C.A..T...........CT....T..T..A..T..
U._americanus_1   ..CA.......T........T.....G...........C..G.T..............G..TC.G.....T.....A..
U._americanus_2   ..CA.......T........T...............C..G.T..............G..TC.G.....T.....A..
U._americanus_3   ..CA.......T........T.....G.............G.T..............G..TC.G.....T.....A..
U._arctos_1       ...G.......A..T...........G.....C.....C....T..............G..CC.G.....T.....A..
U._arctos_2       ...G.......A..T...........G.....C.....C....T..............G..CC.G.....T.....A..
U._arctos_3       ...G.......A..............G...........C....T..............G..CC.G.....T.....A..
R._tarandus_27    ..CA................A..A.....T..C.....CT...TT..A..T...........CC..........A..A..
R._tarandus_22    ..CA................A..A.....T..C.....CT...TT..A..T...........CC..........A..A..
R._tarandus_09    ..CA................A..A.....T..C.....CT...TT..A..T...........CC.......T..A..A..
O._moschatus_1    ...A....C..A........A..A........C.....C....T..................CC..........A..A..
O._moschatus_2    ...A.G..C..A........A..A........C.....C....T..................CC..........A..A..
O._moschatus_3    ...A....C..A........A..A........C.....C....T..................CC..........A..A..
O._moschatus_4    ...A....C..A........A..A........C.....C....T..................CC..........A..A..
O._moschatus_17   ...A....C..A........A..A........C.....C....T..................CC..........A..A..
O._moschatus_5    ----------------------------------------------------------------------------------
O._moschatus_6    ----------------------------------------------------------------------------------
O._moschatus_7    ----------------------------------------------------------------------------------
O._moschatus_8    ----------------------------------------------------------------------------------
O._moschatus_9    ----------------------------------------------------------------------------------
O._moschatus_10   ----------------------------------------------------------------------------------
O._moschatus_11   ----------------------------------------------------------------------------------
O._moschatus_12   ----------------------------------------------------------------------------------
O._moschatus_13   ----------------------------------------------------------------------------------
O._moschatus_14   ----------------------------------------------------------------------------------
O._moschatus_15   ----------------------------------------------------------------------------------
O._moschatus_16   ----------------------------------------------------------------------------------
O._moschatus_2.   ...A....C..A........A..A........C.....C....T..................CC..........A..A..
O._moschatus_39   ...A....C..A........A..A........C.....C....T..................CC..........A..A..
O._dalli_OD2      ...A....C..A........A..A.....T.....T..C....T......T........G..CC....T..T..A..A..
O._dalli_Od1      ...A....C..A........A..A.....T.....T..C....T......T........G..CC....T..T..A..A..
O._dalli          ...A....C..A........A..A.....T.....T..C....T......T........G..CC....T..T..A..A..
O._dalli_2        ...A....C..A........A..A.....T.....T..C....T......T........G..CC....T..T..A..A..
M._caligata       ...A.......T.....T..A..AG....T..C.....C..C.TTC.T..T.....T..............T.....A..
M._caligata_2     ...A.......T.....T..A..AG....T..C.....C..C.TTC.T..T.....T..............T.....A..
M._caligata_3     ...A.......T.....T..A..AG....T..C.....C..C.TTC.T..T.....T..............T.....A..
M._broweri        ...A.......T.....C..A..A.....T.....A..C..C.TTC.T..T.....C..................A..
M._broweri_2      ...A.......T.....C..A..A.....T.....A..C..C.TTC.T..T.....C..................A..
M._broweri_3      ...A.......T.....C..A..A.....T........C..C.TTC.T..T.....C..................A..
M._broweri_4      ...A.......T.....C..A..A.....T........C..C.TTC.T..T.....C..................A..
S._parryii_S83    ...A.......T.....C..A..T.....T........C..C.TTC.T..T.....C......C.G.....T.....A..
S._parryii_S79    ...A.......T.....C..A..T..G..T........C..C.TTC.T..T.....C......C.......T.....A..
S._parryii        ...A.......T.....C..A..T..G..T........C..C.TTC.T..T.....C......C.......T.....A..
S._parryii_2      ...A.......T.....C..A..T..G..T........C..C.TTC.T..T.....C......C.......T.....A..
S._parryii_3      ...A.......T.....C..A..T..G..T........CA.C.TTC.T..T.....C......C.......T.....A..
T._hudsonicus_6   ..CA.......T..T.....A..T.....T.....T..C....T.C.C........T.....CC.T..............
T._hudsonicus_2   ..CA.......T..T.....A..T.....T.....T..C....T.C.C........T.....CC.T..............
T._hudsonicus_3   ..CA.......T..T.....A..T.....T.....T..C....T.C.C........T.....CC.T..T...........
T._hudsonicus_4   ..CA.......T..T.....A..T.....T.....T..C....T.C.C........T.....CC.T..............
T._hudsonicus_5   ..CA.......T..T.....A..T.....T.....T..C....T.C.C........T.....CC.T..............
C._fiber          ..C..T..C..........A...........C.....C..G.T.C.A....C............C........A.....
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C._fiber_2          ..C..T..C..........A..........C.....C..G.T.C.A....C...........C........A.....
C._fiber_3          ..C..T..C..........A..........C.....C..G.T.C.A....C...........C........A.....
Z._hudsonius_49     .....C..C..T..T.....T...C..........T..CT...TTC.A..T.....C.....CC....T..T..G..T..
Z._hudsonius_47     .....C..C..T..T.....T...C..........T..CT...TTC.A..T.....C.....CC....T..T..G..T..
Z._hudsonius_42     .....C..C..T..T.....T...C..........T..CT...TTC.A..T.....C.....CC....T..T..G..T..
Z._hudsonius_36     .....C..C..T..T.....T...C..........T..CT...TTC.A..T.....C.....CC....T..T..G..T..
M._glareolus_159    ...A.G.....A.....................C..T..C..T.TTC.T.............C........T........
M._glareolus_152    ...A.G.....A.....................C..T..C..T.TTC.T.............C........T........
M._glareolus        ...A.......A..T..................C........T.T.C.C.............C.....T..T........
D._groenlandicus_3  ..CA.......A.....................C.....CT.G.TTT.A........C.....C..C..T..........
D._groenlandicus_2  ..CA.......A.....................C.....CT.G.TTT.A........C.....C..C..T..........
D._groenlandicus_4  ...A.......A.....................C.....CT.G.TTT.A........C.....C..C..T..........
L._trimucronatus    ...A....C..A..T.....................T..C....T.C.C..T..G........TG.C..T........T..
L._trimucronatus_2  ...A....C..A..T.....................T..C....T.C.C..T............TG.C..T........T..
L._trimucronatus_3  ...A.......A.....................T..C....T.C.C..T........G..TG.T..T........T..
M._arvalis_139      ..CA..............T...........C.....C..G.T.C.A..............G.C............A..
M._arvalis_204      ..CA..............T...........C.....C..G.T.C.A..............G.C............A..
M._longicaudus      ..CA..............T..A.............C....T.C.A..T..G..G..T...G.C..............
M._subterraneus     ..CA....C..T...........A........C..T..C....TTC.............C...G.T..............
M._oeconomus        ..CA.............G..T...........C.....C....T.C.A........G......G.C..............
M._oeconomus_2      ..CA.............G..T...........C.....C....T.C.A........G......G.C...........T..
M._oeconomus_3      ..CA..............T...........C.....C....T.C.A..............G.C...........T..
M._maximowiczii     ...A.......T.....G..T...........C..T..C....T.C..........G........C..............
M._mongolicus       ..CA....C..........T...........C..T..C..G.T.C.......G..G..G...G.C.....T........
M._californicus_I   ...A.......T.....................C..........T...A..T..............C..T..........
M._californicus_J   ...A.......T.....................C..........T...A..T..............C..T..........
E._dorsatum         ..C..C.....T..T.....A........T......CTCT....TC...................T.....T........
O._collaris         ..C..G..C..T.....C..A...........C.....C....T.C.A........C.....T..C...........T..
O._collaris_2       ..C..G..C..T.....C..A........T..C.....CT...T.C.A........C.....T..C...........T..
O._collaris_3       ..C..G..C..T.....C..A........T..C.....C....T.C.A........C.....T..C...........T..
O._collaris_4       ..C..G..C..T.....C..A........T..C.....C....T.C.A........C.....T..C...........T..
L._othus            ..C..G..C.....T.....A..A.....T........CT....T..A..T.....T..T.....C...........A..
L._timidus          ..C..G..C...........A..A.....T........CT....T..A..T.....T..T.....C...........A..
L._granatensis      ..C..G..C..T........T..A...........T..CT.......A..T.....C..T.....C...........A..
L._europaeus        ..CT....C..T..T.....A..A...........T..CT....T..A..T.....C..T.....C...........A..
P._largha           .....T..C..A..T.....T........T..C.....C...........T.............C.G..T..........
P._largha_Pl21      .....T..C..A..T.....T........T........C...........T.............C.G..T..........
P._largha_Pl16      .....T..C..A..T.....T........T..C.....C...........T.............C.G..T..........
P._largha_Pl10      .....T..C..A..T.....T........T..C.....C...........T.............C.G..T..........
E._barbatus         ...A....C..T........T..T........C.....C........A..T............C..............T..
E._barbatus_2       ...A....C..T........T..T........C.....C........A..T............C..............T..
E._barbatus_3       ...A....C..T........T..T........C.....C........A..T............C..............T..
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ALTAICA4            CACCTTCTCAGAAACATGAAATATCGGGATTGTGCTATTGTTTACGGTCATGGCTACAGCCTTCATAGGATATGTCTTAC
ALT                 ..................................................................................
AMO1                ..................................................................................
AMO2                ..........................................A.......................................
AMO3/COR1           ..........................................A.......................................
COR2                ..........................................A.......................................
COR3                ..........................................A.......................................
COR4                ..................................................................................
COR5                ..................................................................................
COR6                ..................................................................................
COR7                ..................................................................................
COR8                ..............................C...................................................
SUM1                ..................................................................................
SUM2                ..................................................................................
SUM3                ..................................................................................
SUM4                ..................................................................................
SUM5                ....................C.............................................................
SUM6                ..................................................................................
SUM7                ..................................................................................
SUM8                ..................................................................................
TIG1                ....................C.............................................................
TIG2                ....................C.............................................................
TIG3                ..................................................................................
TIG4                ....................C.............................................................
TIG5                ....................C.............................................................
TIG6                ....................C.............................................................
TIGRIS1             ....................C.............................................................
TIGRIS2             ....................C.............................................................
SUMATRA1            ..................................................................................
SUMATRA2            ..................................................................................
CORBETTI1           ..........................................A.......................................
CORBETTI2           ..................................................................................
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ALTAICA           ..............................C.............................................
S5_cytb           ..............................................................................
S3_cytb           ..............................................................................
B8_cytb           ..................C...........................................................
C3_cytb           ..............................................................................
C2_cytb           ..............................................................................
C1_cytb           ..............................................................................
Su10_cytb         ..............................................................................
Su9_cytb          ..............................................................................
Su7_cytb          ..............................................................................
Su6_cytb          ..............................................................................
Su5_cytb          ..............................................................................
Su4_cytb          ..............................................................................
Su3_cytb          ..............................................................................
Su2_cytb          ..............................................................................
Su1_cytb          ..............................................................................
S15_cytb          ..............................................................................
S13_cytb          ..............................................................................
S12_cytb          ..............................................................................
S11_cytb          ..............................................................................
S10_cytb          ..............................................................................
S8_cytb           ..............................................................................
S7_cytb           ..............................................................................
S6_cytb           ..............................................................................
S4_cytb           ..............................................................................
S2_cytb           ..............................................................................
S1_cytb           ..............................................................................
B9_cytb           ..................C...........................................................
B7_cytb           ..................C...........................................................
B6_cytb           ..................C...........................................................
B5_cytb           ..................C...........................................................
B4_cytb           ..............................................................................
B3_cytb           ..............................................................................
B2_cytb           ..........................................A...................................
sondaica1         ------------------------------------------------------------------------------
sondaica          ------------------------------------------------------------------------------
Pta               ..............................................................................
P._pardus         ...T........G.....G..C..T..AG.C..AT.....C.C.....T.....C.......................
P._pardus2        ...T........G.....G..C..T..AG.C..AT.....C.C.....T.....C.......................
P._pardus3        ...T........G.....G..C..T..AG.C..AT.......C.....T.....C.......................
P._pardus1        ...T.....T.CG.....G..C..T..AG.C..AT.......C.....T.....C.........C.............
P._pardus9        ...T.......CG.....G..C..T..AG.C..AT.......C.....T.....C.........CG............
P._pardus_5       ------------------------------------------------------------------------------
P._pardus40       ...T.......CG.....G..C..T..AG.C..AT.......C.....T.....C.........CG............
P._pardus4c       ------------------------------------------------------------------------------
P._pardus2c       ------------------------------------------------------------------------------
P._pardus3c       ------------------------------------------------------------------------------
P._pardus1c       ------------------------------------------------------------------------------
P._pardus.o1      ...T........G.....G..C..T..AG.C..AT.......C.....T.....C.......................
P._pardus.o2      ...T........G.....G..C..T..AG.C..AT.......C..A..T.....C.......................
P._pardus.03      ...T........G.....G..C..T..AG.C..AT.......C.....T.....C.......................
P._pardus.o4      ...T........G.....G..C..T..AG.C..AT.......C.....T.....C.......................
P._pardus.o5      ...T........G.....G..C..T..AG.C..AT.......C.....T.....C.......................
P._pardus.o6      ...T........G.....G..C..T..AG.C..AT.......C..A..T.....C.......................
P._pardus.o7      ------------------------------------------------------------------------------
P._pardus.o8      ------------------------------------------------------------------------------
P._pardus.o9      ------------------------------------------------------------------------------
P._pardus.o10     ------------------------------------------------------------------------------
P._pardus.o11     ------------------------------------------------------------------------------
P._pardus.o12     ------------------------------------------------------------------------------
P._pardus.o13     ------------------------------------------------------------------------------
P._pardus.o14     ...T........G.....G..C..T..AG.C..AT.......C.....T.....C.......................
U._uncia1         ..................C..T..AGCC..A......C.CG.A.....................G.............
U._uncia          ..................C..T..AGCC..A......C.CG.A.....................G.............
A._jubatus_4050   ....................T..A..CA.A...C.AC.C..A.....A..C.........................
A._jubatus_4237   ....................T..A..CA.A...C.AC.C..A.....A..C.........................
A._jubatus_4051   ....................T..A..CA.A...C.AC.C..A.....A..C.........................
P._leo_1          ------------------------------------------------------------------------------
P._leo            T..................C..T..A..C..AT.G.....C..A..T..A.........................
P._leo_2          T..T...............C..T..A.....AT.G.....C..A..T..A.........................
P._leo.p17        ------------------------------------------------------------------------------
P._leo.p16        ------------------------------------------------------------------------------
P._leo.p15        ------------------------------------------------------------------------------
P._leo_TSV3550    T..T...............C..T..A..CA.AT.G...C.C..A..T..A.........................
P._leo_KPR98      T..T...............C..T..A..CA.AT.G...C.C..A..T..A.........................
P._leo_BOT16      T..T.................T..A..CA.AT.G...C.C..A..T..A.........................
P._leo_CAP30      T..T.................T..A..CA.AT.G...C.C..A..T..A.........................
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P._leo_BML22      T..T.....................T..A..CA.AT.G...C.C..A..T..A.............................
P._leo_ETO76      T..T.....................T..A..CA.AT.G...C.C..A..T..A.............................
P._leo_ETO65      T..T.....................T..A..CA.AT.G...C.C..A..T..A.............................
P._leo_PSS993     T..T.................C..T..A..CA.AT.G...C.C..A..T..A.............................
R._formosae       ...A..T..............C.....A...A.C..CC.C..CG.C.....A........A........C.....AC.T.
M._tuberculata    T.TA...CT............CG.T..AG.C.CC...C.A...G.T..A..A..A..T..A...C....C..C...C...
C._latrans_1      TGTA...AT............C..T..A....CA...C.A..CG.AAC...A..C.....A........C.....AC.G.
C._lupus_1        TGTA...AT............C..T..A.....A.....A..CG.AAC...A..C.....A.....G..C.....AC...
V._vulpes         TGTA...AT..............T..A...A.CT.......CG.AAC......C.....A..T..G..C..C..T....
G._gulo           ...A.A...C...........C.....C..CA.CT.G..A..C..A.....A..A.....A........T..C..G....
U._americanus     .CTAC................C..T..C...A.C..CC.A.....A..T..A..C..C..A..............C.G.
U._arctos         .CTA.................C.....C..CA.T..CC.A.....A..T..A..C..C..A..T........C...C...
R._tarandus       T......CT..............T..AG.GA.C..C..A.....A..A..A........A..TG...........C...
C._elaphus        T..T..TCT...G..G.....C.....AG.A..T..TC.A.....A..T..A..C.....A...G...........C...
O.arena           T......CT............C.....AG.AA.C..CC.A...G..ACA..A..C.....A........C.....T....
T._hudsonicus     .....A..TC.....C.....C..T..TG.CA.C..TC.A...G.T..A..A.....T..A..T...........TC.C.
G._sabrinus       T....A..TC.....C.....C..T..AG.CA.T..C..A...G.A..T..A..C.....A..T.....C..C..TC...
T._hudsonicus_1   T..T..TATC........G........A...C.T..T..A....T..T..A...........T.....C.....GC.T.
Z._hudsonius      T.....TATC...........CG.T..T..CC.C..C..A..CG.TACT..A..A........T.....C..C..TC.T.
H._sapiens        TCT..A.........C.....C.....C...A.C..CC..C..G.AACT..A..A..............C......C.C.
C._lupus          TGTA...AT............C..T..A.....A.....A..CG.AAC...A..C.....A.....G..C.....AC...
C._lupus1         TGTA...AT............C..T..A.....A.....A..CG.AAC...A..C.....A.....G..C.....AC...
V.vulpes          TGTA...AT..............T..A...A.CT.......CG.AAC......C.....A..T..G..C..C..T....
V._vulpes_1       TGTA...AT..............T..A...A.CT.......CG.AAC......C.....A..T..G..C..C..T....
V._vulpes_2       TGTA...AT..............T..A...A.CT.......CG.AAC......C.....A..T..G..C..C..T....
L._canadensis     T.TA...C.C..G........C.....C.....T...C.A...G....T..A..A.....A........T..C.......
G._gulo_1         ...A.AT..C...........C.....C..CA.CT.G..A..C..AA....A..A.....A........T..C..G....
G._gulo_2         ...A.AT..C...........C.....C..CA.CT.G..A..C..AA....A..A.....A........T..C..G....
G._gulo_3         ...A.AT..C...........C.....C..CA.CT.G..A..C..AA....A..A.....A........T..C..G....
G._gulo_4         ...A.AT..C...........C.....C..CA.CT.G..A..C..AA....A..A.....A........T..C..G....
M._amerina_1      T.TA.A.C.T.........G.....T..C..CA.C.....A..CG.A..T..A..A.....A........T..C..TC.G.
M._americana_2    T.TA.A.C.T.........G.....T..C..CA.C.....A..CG.A..T..A..A.....A........T..C..TC.G.
M._americana_3    T.TA.A.C.T.........G.....T..C..CA.C.....A..CG.A..T..A..A.....A........T..C..TC.G.
M._erminea        T.TA...C.C...........C..T..C...A.CT....A..CG.A.....A..A..T..A........T..C..T....
M._erminea_2      T.TA...C.C...........C..T..C...A.CT....A..CG.A.....A..A..T..A........T..C..T....
N._vison          T.TA..TC.T.............T..T..CA.CT..C.A..C..A..A..A..A.....A........T..C..A....
U._americanus_1   .CTAC................C..T..C...A.C..CC.A.....A..T..A..C..C..A..............C.G.
U._americanus_2   .CTAC................C..T..C...A.C..CC.A.....A.....A..C..C..A..T...........C...
U._americanus_3   .CTAC................C..T..C...A.C..CC.A.....A..T..A..C..C..A..............C.G.
U._arctos_1       .CTA.................C..T..C...A.T..CC.A.....A..T..A..C..C..A..T...........C...
U._arctos_2       .CTA.................C..T..C...A.T..CC.A.....A..T..A..C..C..A..T...........C...
U._arctos_3       .CTA.................C..T..C...A.T..CC.A.....A..T..A..C..C..A..T...........C...
R._tarandus_27    .......CT..............T..AG.GA.C..C..A.....A..A..A........A..TG...........C...
R._tarandus_22    .......CT..............T..AG.GA.C..C..A.....A..A..A........A..TG...........C...
R._tarandus_09    .......CT..............T..AG.GA.C..C..A.....A..A..A........A..TG...........C...
O._moschatus_1    ...T....T............C..A...G.AA.T..TC.AC.C.TAACA..A........A........C......C...
O._moschatus_2    ...T....T............C..A...G.AA.T..TC.AC.C.TAACA..A........A........C......C...
O._moschatus_3    ...T....T............C..A...G.AA.T..TC.AC.C.TAACA..A........A........C......C...
O._moschatus_4    ...T....T............C..A...G.AA.T..TC.AC.C.TAACA..A........A........C......C...
O._moschatus_17   ...T....T............C..A...G.AA.T..TC.AC.C.TAACA..A........A........C......C...
O._moschatus_5    ----------------------------------------------------------------------------------
O._moschatus_6    ----------------------------------------------------------------------------------
O._moschatus_7    ----------------------------------------------------------------------------------
O._moschatus_8    ----------------------------------------------------------------------------------
O._moschatus_9    ----------------------------------------------------------------------------------
O._moschatus_10   ----------------------------------------------------------------------------------
O._moschatus_11   ----------------------------------------------------------------------------------
O._moschatus_12   ----------------------------------------------------------------------------------
O._moschatus_13   ----------------------------------------------------------------------------------
O._moschatus_14   ----------------------------------------------------------------------------------
O._moschatus_15   ----------------------------------------------------------------------------------
O._moschatus_16   ----------------------------------------------------------------------------------
O._moschatus_2.   ...T....T............C..A...G.AA.T..TC.AC.C.TAACA..A........A........C......C...
O._moschatus_39   ........T............C......G.AA.T..TC.AC.C..AACA..A........A........C......C...
O._dalli_OD2      T..T...CT..............T..AG.AA.C..C..A...G.AACA..A..C.....A........C.....T....
O._dalli_Od1      T..T...CT..............T..AG.AA.C..C..A...G.AACA..A..C.....A........C.....T....
O._dalli          T..T...CT..............T..AG.AA.C..C..A...G.AACA..A..C.....A........C......C...
O._dalli_2        T..T...CT..............T..AG.AA.C..CY.A...G.AACA..A..C.....A........C......C...
M._caligata       T....AT.TT............C..T......A.T..CC.A...G.A..A..A................C.....TC.C.
M._caligata_2     T....AT.TT............C..T......A.T..CC.A...G.A..A..A................C.....TC.C.
M._caligata_3     T....AT.TT............C..T......A.T..CC.A...G.A..A..A................C.....TC.C.
M._broweri        T....A...C.................AG..A.T..CC.A..CG.A..A..A..C.....T........C......C.C.
M._broweri_2      T....A...C.................AG..A.T..CC.A..CG.A..A..A..C.....T........C......C.C.
M._broweri_3      T....A...T.................AG..A.T..CC.A..CG.A..A..A..C.....T........C......C.C.
M._broweri_4      T....A...T.................AG..A.T..CC.A..CG.A..A..A..C.....T........C......C.C.
S._parryii_S83    ...T.A..TT............C..T..AG.CA.T..CC....CGTA..A..A..C.....T.....G..C.....TC.T.
S._parryii_S79    T.TT.A..TT............C..T..AG.CA.C..CC....CGTA..A..A..C.....T.....G..C.....TC.T.
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S._parryii          T.TT.A..TT..........C..T..AG.CA.C..CC....CGT...A..A..C.....T.....G..C.....TC.T.
S._parryii_2        T.TT.A..TT..........C..T..AG.CA.C..CC....CGTA..A..A..C.....T.....G..C.....TC.T.
S._parryii_3        T.TT.A..TT..........C..T..AG.CA.C..CC....CGT...A..A..C.....T.....G..C.....TC.T.
T._hudsonicus_6     .....A..TC.....C.....C..T..TG.CA.C..TC.A...G.T..A..A.....T..A..T..........TC.C.
T._hudsonicus_2     .....A..TC.....C.....C..T..TG.CA.C..TC.A...G.T..A..A.....T..A..T..........TC.C.
T._hudsonicus_3     .....A..TC.....C.....C..T..TG.CA.C..TC.A...G.T..A..A.....T..A..T..........TC.C.
T._hudsonicus_4     .....A..TC.....C.....C..T..TG.CA.C..TC.A...G.T..A..A.....T..A..T..........TC.C.
T._hudsonicus_5     .....A..TC.....C.....C..T..TG.CA.C..TC.A...G.T..A..A.....T..A..T..........TC.C.
C._fiber            ......TA.................T..T..CA.CT..C.AC....A..T..A..C..T..T.............AC.C.
C._fiber_2          ......TA.................T..T..CA.CT..C.AC.C..A..T..A..C..T..T.............AC.C.
C._fiber_3          ......TA.................T..T..CA.TT..C.AC...TA..T..A..C..T..T.............AC.C.
Z._hudsonius_49     T......ATC........G.....T..A...C.C..C..A..CG.TACT.....A.............C..C...C.T.
Z._hudsonius_47     T.T....ATC........G.....T..A...C.C..C..A..CG.TACT.....A.............C..C..TC.T.
Z._hudsonius_42     T......ATC........G.....T..A...C.C..C..A..CG.TACT.....A.............C..C...C.T.
Z._hudsonius_36     T......ATC........G.....T..A...C.C..C..A..CG.TACT.....A.............C..C...C.T.
M._glareolus_159    T.A.A.AATT.....C.....C..A..C...A.CT..C.A..CG.T..A..A..A.....A........T..C...C...
M._glareolus_152    T.A.A.AATT.....C.....C..A..C...A.CT..C.A..CG.T..A..A..A.....A........T..C...C...
M._glareolus        ..A.A.AATT.....C.....C..A..T..CA.CT.GC.A..CG.C..A..A..A.....A..T.....C......C...
D._groenlandicus_3  ..ATA.AATT.....T.....C..A..C...A.C..CC.A...G.T..A..A..A.....A........G.....GC.C.
D._groenlandicus_2  ..ATA.AATT.....T.....C..A..C..CA.C..CC.A...G.T..A..A..A.....A........G.....GC.C.
D._groenlandicus_4  ..ATA.AATT.....T.....C..A..C..CA.C..CC.A...G.T..A..A..A.....A........G.....GC.C.
L._trimucronatus    ..A.A.AATT.....C.....C..A..A...A.T...C.A..CG.T..T..A..A.....A........C.....TC.T.
L._trimucronatus_2  ..A.A.AATT..G..C.....C..A......A.C...C.A..CG.T..T..A..A.....A........C.....TC.T.
L._trimucronatus_3  T.A.A.AATT.....C.....C..A..A.....C...C.A..CG.T..T..A..A.....A..T.....C.....TC.T.
M._arvalis_139      T.A.A.AATC...........C..A........C...C.A..CG.C..A..A..A.....A........C..C...C.T.
M._arvalis_204      T.A.A.AATC...........C..A........C...C.A..CG.C..A..A..A.....A........C..C...C.T.
M._longicaudus      T.ATA.AATC...........C..A..A...A.T..CC.A...G.C..A..A..A.....A........T.....AC.T.
M._subterraneus     ..A.A.AATT.............A..T..CA.TT..C.A..CG.C..A..A..A.....A........T..C..TC.G.
M._oeconomus        T.A.A.AATC...........C..A..A.....A..TC.A..CG.C..A..A..C.....A........C..CT.TC.T.
M._oeconomus_2      T.A.A.AATC...........C..A..A.....A..TC.A..CG.C..A..A..C.....A........C..C..TC.T.
M._oeconomus_3      T.A.A.AATC...........C..A..A.....A..TC.A..CG.C..A..A..C.....A........C..C...C.T.
M._maximowiczii     ..A.A.AATC...........C..A......A.C..CC.A..CG.C.....A..C.....A.....G..C..C..AC.C.
M._mongolicus       ..A.A.AA.C...........C..A..C..CA.C...C.A..CG.C..A..A..C.....A........C.....GC.C.
M._californicus_I   ..A.A.AATC...........C..A..A..C..AT..C....CG.A.....A..A..T..A........C..C..AC...
M._californicus_J   ..A.A.AATC...........C..A..A..C..AT..C....CG.A.....A..A..T..A........T..C..AC...
E._dorsatum         T..A.A.A.......C........T..T..CC.C...C.A.....A..T..A..C..............C...C.T.
O._collaris         .....A............G..C.....A..CT.A.....A..CG.A.....A.....C...........C..C...C.C.
O._collaris_2       .....A............G..C.....A..CT.A.....A..CG.A.....A.....C...........C..C...C.C.
O._collaris_3       .....A............G..C..T..A..CT.A.....A..CG.A.....A.....C...........C..C...C.C.
O._collaris_4       .....A............G..C..T..A..CT.A.....A..CG.A.....A.....C...........C..C...C.C.
L._othus            T..T.A.CT......C..G.....T..C...A.T...C.A...G.A..A..A..C.....A..T.....C.....TC.C.
L._timidus          T..T.A.CT......C..G.....T..C...A.T...C.A...G.A..A..A..C.....A..T.....C.....TC.C.
L._granatensis      T....ATCT......C........T..C...A.C.....A...G.A..A..A..C.....A........C..C...C.T.
L._europaeus        T..T.A.CT......C.....C..T..C...A.T...C.A..CG.A..A...........A........C..C...C.C.
P._largha           ...A...A....G........C.....C...A.C..C..A..C..C.....A........A.....G..C..C...C...
P._largha_Pl21      ...A...A....G........C.....C...A.C..C..A..C..C.....A........A.....G..C..C...C...
P._largha_Pl16      ...A...A....G........C.....C...A.C..C..A..C..C.....A..C.....A.....G..C..C...C...
P._largha_Pl10      ...A...A....G........C.....C...A.C..C..A..C..C.....A........A.....G..C..C...C...
E._barbatus         T..A..TAT............C.....C...A.C...C.A..C..C.....A..C.....A........C..C...C...
E._barbatus_2       T..A..TAT............C.....C...A.C...C.A..C..C.....A..C.....A........C..C...C...
E._barbatus_3       T..A..TAT............C.....C...A.C...C.A..C..C.....A..C.....A........C..C...C...
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ALTAICA4            CATGAGGCCAAATGTCTTTTTGAGGGGCAACCGTAATCACCAACCTCCTGTCAGCAATCCCATATATTGGGACCGACCTA
ALT                 ..................................................................................
AMO1                ..................................................................................
AMO2                ..................................................................................
AMO3/COR1           ..................................................................................
COR2                ..................................................................................
COR3                ..................................................................................
COR4                ..................................................................................
COR5                ..................................................................................
COR6                ..................................................................................
COR7                ..................................................................................
COR8                ..................................................................................
SUM1                ..................................................................................
SUM2                ..................................................................................
SUM3                ..................................................................................
SUM4                ..................................................................................
SUM5                ..................................................................................
SUM6                ..................................................................................
SUM7                ..................................................................................
SUM8                ..................................................................................
TIG1                ..................................................................................
TIG2                ..................................................................................
TIG3                ..................................................................................
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TIG4              ..........................................................................
TIG5              ..........................................................................
TIG6              ..........................................................................
TIGRIS1           ..........................................................................
TIGRIS2           ..........................................................................
SUMATRA1          ..........................................................................
SUMATRA2          ..........................................................................
CORBETTI1         ..........................................................................
CORBETTI2         ..........................................................................
ALTAICA           ..........................................................................
S5_cytb           ..........................................................................
S3_cytb           ..........................................................................
B8_cytb           ..........................................................................
C3_cytb           ..........................................................................
C2_cytb           ..........................................................................
C1_cytb           ..........................................................................
Su10_cytb         ..........................................................................
Su9_cytb          ..........................................................................
Su7_cytb          ..........................................................................
Su6_cytb          ..........................................................................
Su5_cytb          ..........................................................................
Su4_cytb          ..........................................................................
Su3_cytb          ..........................................................................
Su2_cytb          ..........................................................................
Su1_cytb          ..........................................................................
S15_cytb          ..........................................................................
S13_cytb          ..........................................................................
S12_cytb          ..........................................................................
S11_cytb          ..........................................................................
S10_cytb          ..........................................................................
S8_cytb           ..........................................................................
S7_cytb           ..........................................................................
S6_cytb           ..........................................................................
S4_cytb           ..........................................................................
S2_cytb           ..........................................................................
S1_cytb           ..........................................................................
B9_cytb           ..........................................................................
B7_cytb           ..........................................................................
B6_cytb           ..........................................................................
B5_cytb           ..........................................................................
B4_cytb           ..........................................................................
B3_cytb           ..........................................................................
B2_cytb           ..........................................................................
sondaica1         --------------------------------------------------------------------------
sondaica          --------------------------------------------------------------------------
Pta               ..........................................................................
P._pardus         .G..G........A..C.....................T...........A..............C.......TT......
P._pardus2        .G..G........A..C.....................T...........A..............C.......TT......
P._pardus3        .G..G........A..C.....................T...........A..............C.......TT......
P._pardus1        .G..G........A..C.....................T...........A.....G........C.......TT......
P._pardus9        .G..G........A..C....----------------------------------------------------------
P._pardus_5       --------------------------------------------------------------------------
P._pardus40       .G..G........A..C................A...T...........A..............C.......TT....C.
P._pardus4c       ----------------------...A..T..T..C..............A....A......C.GC..C..A..TA.TT..
P._pardus2c       ----------------------...A..T..T..C..............A....A......C.GC..C..A..TA.TT..
P._pardus3c       ----------------------...A..T..T..C..............A....A......C.GC..C..A..TA.TT..
P._pardus1c       ----------------------...A..T..T..C..............A....A......C.GC..C..A..TA.TT..
P._pardus.o1      .G------------------------------------------------------------------------
P._pardus.o2      .G------------------------------------------------------------------------
P._pardus.03      .G------------------------------------------------------------------------
P._pardus.o4      .G------------------------------------------------------------------------
P._pardus.o5      .G------------------------------------------------------------------------
P._pardus.o6      .G------------------------------------------------------------------------
P._pardus.o7      --------------------------------------------------------------------------
P._pardus.o8      --------------------------------------------------------------------------
P._pardus.o9      --------------------------------------------------------------------------
P._pardus.o10     --------------------------------------------------------------------------
P._pardus.o11     --------------------------------------------------------------------------
P._pardus.o12     --------------------------------------------------------------------------
P._pardus.o13     --------------------------------------------------------------------------
P._pardus.o14     .G------------------------------------------------------------------------
U._uncia1         .C...........A..C..C.....A........G........T.....A...T..........C.......G.A.....
U._uncia          .C...........A..C..C.....A........G........T.....A...T..........C.......G.A.....
A._jubatus_4050   .......T.....A.....C.....A.....T.....T...........A........T..T..C..C..C..TA.T...
A._jubatus_4237   .......T.....A.....C.....A.....T.....T...........A........T..T..C..C..C..TA.T...
A._jubatus_4051   .......T.....A.....C.....A.....T.....T...........A........T..T..C..C..C..TA.T...
P._leo_1          --------------------------------------------------------------------------
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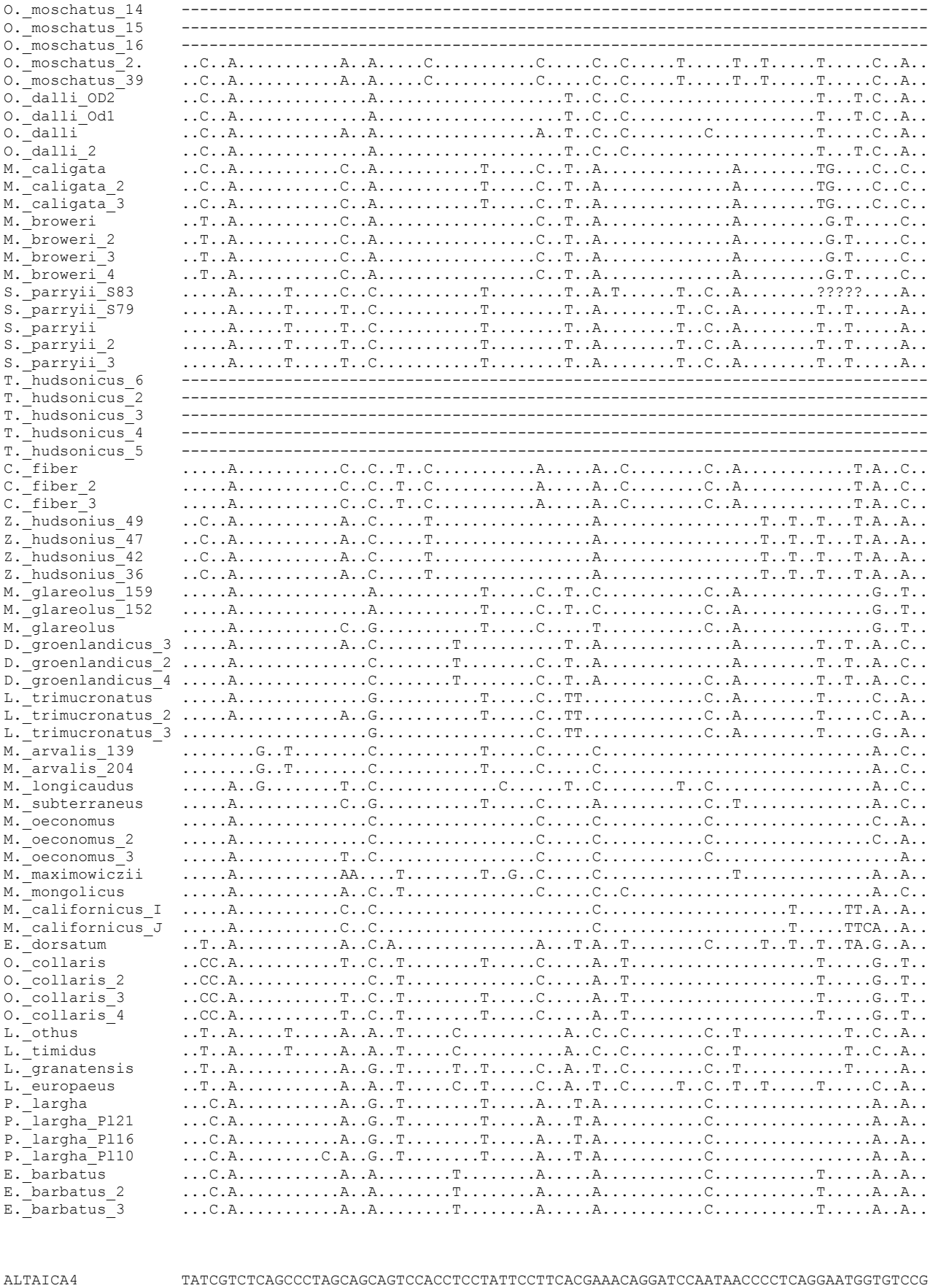
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P._leo            .G..G........A..C........T.....T........T..T.....A..............C..C...G........
P._leo_2          .G..G........A..C........T.....T........T..T.....A..............C..C...G........
P._leo.p17        ----------------------...A..T..T..C..............A....A......C.GCG.C..A..TA.TT..
P._leo.p16        ----------------------...A..T..T..C..............A....A......C.GCG.C..A..TA.TT..
P._leo.p15        ----------------------...A..T..T..C..............A....A......C.GCG.C..A..TA.TT..
P._leo_TSV3550    .G..G........A..C........T.....T........T..T.....A..............C..C...G........
P._leo_KPR98      .G..G........A..C........T.....T........T..T.....A..............C..C...G........
P._leo_BOT16      .G..G........A..C........T.....T........T..T.....A..............C..C..AG........
P._leo_CAP30      .G..G........A..C........T.....T........T..T.....A..............C..C..AG........
P._leo_BML22      .G..G........A..C........T.....T........T..T.....A..............C..C..AG........
P._leo_ETO76      .G..G........A..C........T.....T........T..T.....A..............C..C..AG........
P._leo_ETO65      .G..G........A..C........T.....T........T..T.....A..............C..C...G........
P._leo_PSS993     .G..G........A..C........T.....T........T..T.....A..............C..C...G........
R._formosae       .C............A..C..C.....A.....T..C.....A..T.....C.....T........CG.C.....AAC....
M._tuberculata    .............A.....C.....C.....A..C..T..A...T.A..A.....C.....C..CG....A..A..TA..
C._latrans_1      .......A.....A..A........A...........T..T..T..C..T..C.....C.....C..A...A..T...
C._lupus_1        .......A.....A..A..............T........T..T..T..C..T..C.....T.....C..A..T...T..
V._vulpes         .G.....A.....A..A..C..................T..A..T..T..A..T..T..T..C.....C..A.....T...
G._gulo           .......A.....A..C..C.....C.....T..G..T........A..A.....C........C..C.....TAG...T
U._americanus     .C............A..C..C.....A.....T..T..............A.....C.....C........A..A......
U._arctos         .C..............C..C.....A..G..T..C........T..A..A.....C..T..C..C..C..A..G.....G
R._tarandus       .......A.....A..A..C.....A.....A..T.....A..T.....C........T...........T..AA.T...
C._elaphus        .......A.....A..A..C.....A.....A..C............T..C........T...........T..AA.T...
O.arena           .......A.....A..A..C.....A.....A..T..T...........T........T...........C..AA.....
T._hudsonicus     .T............A..C..C........C..A..C.....A........C.....T...........C..C..TAG....
G._sabrinus       .C.....A.....A.....C.....A..C.....C...........T..C.....T..T..T.....C.....AACA..T
T._hudsonicus_1   .T.....A.....A..G........A..T..A.....T..A.....T..A.....C........C.....CT.AACT...
Z._hudsonius      .T.....A.....A..G........A..T..A..C.....A.....A..A.....C..T...........CT.AAC.T..
H._sapiens        .G...........A..A..C........C..A.....T..A...T.A..A..C..C........C........A......
C._lupus          .......A.....A..A..............T........T..T..T..C..T..C.....T.....C..A..T...T..
C._lupus1         .......A.....A..A..............T........T..T..T..C..T..C.....T.....C..A..T...T..
V.vulpes          .G.....A.....A..A..C..................T..A..T..T..A..T..T.....C.....C..A.....T...
V._vulpes_1       .G.....A.....A..A..C..................T..A..T..T..A..T..T.....C.....C..A.....T...
V._vulpes_2       .G.....A.....A..A..C..................T..A..T..T..A..T..T.....C.....C..A.....T...
L._canadensis     .......A.....A..C........T..T.....C..T..T...T.A..A.....T........CG.C..C...AGT..T
G._gulo_1         .......A.....A..C..C.....C.....T..G..T........A..A.....C........C..C.....TAG...T
G._gulo_2         .......A.....A..C..C.....C.....T..G..T........A..A.....C........C..C.....TAG...T
G._gulo_3         .......A.....A..C..C.....C.....T..G..T........A..A.....C........C..C.....TAG...T
G._gulo_4         .......A.....A..C..C.....C.....T..G..T........A..A.....C........C..C.....TAG...T
M._amerina_1      .......A.....A..C........T..G........T........A........C.....C..C..C..A...AGT..C
M._americana_2    .......A.....A..C........T..G........T........A........C.....C..C..C..A...AGT..C
M._americana_3    .......A.....A..C........T..G..................A........C.....C..C..C..A...AGT..C
M._erminea        .......A.....A..A........T............T..T..TT.A..A..C..C........C..C..A..TA....T
M._erminea_2      .......A.....A..A........T............T..T..TT.A..A..C..C........C..C..A..TA....T
N._vison          .......A.....A..A........T............T.....T..A..C.....T........C..C..A..TA.T..T
U._americanus_1   .C............A..C..C.....A.....T..T..............A.....C.....C........A..A......
U._americanus_2   .C............A..C..C.....A.....T..C..............A.....C.....C........AG.A...T..
U._americanus_3   .C............A..C..C.....A.....T..T..............A.....C.....C........A..A......
U._arctos_1       .C..............C..C.....A.....T..C........T..A..A..G..C..T..C.....C..A..G.....G
U._arctos_2       .C..............C..C.....A.....T..C........T..A..A..G..C..T..C.....C..A..G.....G
U._arctos_3       .C..............C..C.....A.....T..C........T..A..A..G..C..T..C.....C..A..G.....G
R._tarandus_27    .......A.....A..A..C.....A.....A..T.....A..T.....C........T...........T..AA.T...
R._tarandus_22    .......A.....A..A..C.....A.....A..T.....A..T.....C........T...........T..AA.T...
R._tarandus_09    .......A.....A..A..C.....A.....A..T.....A..T.....C........T...........T..AA.T...
O._moschatus_1    .......A.....A..A..C.....A..T..A..C.....T........C..............C..C..C..AA.....
O._moschatus_2    .......A.....A..A..C.....A..T..A..C.....T........C..............C..C..C..AA.....
O._moschatus_3    .......A.....A..A..C.....A..T..A..C.....T........C..............C..C..C..AA.....
O._moschatus_4    .......A.....A..A..C.....A..T..A..C.....T........C..............C..C..C..AA.....
O._moschatus_17   .......A.....A..A..C.....A..T..A..C.....T........C..............C..C..C..AA.....
O._moschatus_5    ----------------------------------------------------------------------------------
O._moschatus_6    ----------------------------------------------------------------------------------
O._moschatus_7    ----------------------------------------------------------------------------------
O._moschatus_8    ----------------------------------------------------------------------------------
O._moschatus_9    ----------------------------------------------------------------------------------
O._moschatus_10   ----------------------------------------------------------------------------------
O._moschatus_11   ----------------------------------------------------------------------------------
O._moschatus_12   ----------------------------------------------------------------------------------
O._moschatus_13   ----------------------------------------------------------------------------------
O._moschatus_14   ----------------------------------------------------------------------------------
O._moschatus_15   ----------------------------------------------------------------------------------
O._moschatus_16   ----------------------------------------------------------------------------------
O._moschatus_2.   .......A.....A..A..C.....A..T..A..C.....T........C..............C..C..C..AA.....
O._moschatus_39   .......A.....A..A..C.....A..T..A..T.....T........C..............C..C..C..AA.....
O._dalli_OD2      .......A.....A..A..C.....A.....A..C..T.....T..T..C............G..C.....T..AA.T...
O._dalli_Od1      .......A.....A..A..C.....A.....A..C..T.....T..T..C............G..C.....T..AA.T...
O._dalli          .......A.....A..A..C.....A.....A..T..T.....T..T..C..............C.....C..AA.T...
O._dalli_2        .......A.....A..A..C.....A.....A..Y..T.....T..T..C............G..C.....T..AA.T...
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M._caligata        .C.....T.....A..A..C.....A.....T.....T..T..T..TT.A..C..T..T.....C.....T..AAC.T..
M._caligata_2      .C.....T.....A..A..C.....A.....T.....T..T..T..TT.A..C..T..T.....C.....T..AAC.T..
M._caligata_3      .C.....T.....A..A..C.....A.....T.....T..T..T..TT.A..C..T..T.....C.....T..AAC.T..
M._broweri         .C..........A..A..C.........................AT.A..T..T.CT.....C.....C..AAC.T..
M._broweri_2       .C..........A..A..C.........................AT.A..T..T.CT.....C.....C..AAC.T..
M._broweri_3       .C.....T.....A..A..C.........................AT.A..T..T.CT.....C.....C..AAC.T..
M._broweri_4       .C.....T.....A..A..C.........................AT.A..T..T.CT.....C.....C..AAC.T..
S._parryii_S83     .C.....T........A..C.....A.....T.....T..T.....TT.A..C..T..T.....C.....A..AAC....
S._parryii_S79     .C..G..T........A..C.....A.....T.....T..T.....TT.A..C..T..T..G..C.....A..AAC....
S._parryii         .C..G..T........A..C.....A.....T.....T..T.....TT.A..C..T..T..G..C.....A..AAC....
S._parryii_2       .C..G..T.....A..A..C.....A.....T.....T..T.....TT.A..C..T..T..G..C.....A..AAC....
S._parryii_3       .C..G..T........A..C.....A.....T.....T..T.....TT.A..C..T..T..G..C.....A..AAC....
T._hudsonicus_6    .T-------------------------------------------------------------------------------
T._hudsonicus_2    .T-------------------------------------------------------------------------------
T._hudsonicus_3    .T-------------------------------------------------------------------------------
T._hudsonicus_4    .T-------------------------------------------------------------------------------
T._hudsonicus_5    .T-------------------------------------------------------------------------------
C._fiber           .......A.....A..C..C.....T..C..A........A.....A..C.................C..AT..A.....
C._fiber_2         .......A.....A..C..C.....T..C..A........A.....A..C.................C..AT..A.....
C._fiber_3         .......A.....A..C..C.....T..C..A........A.....A..C.................C..AT..A.....
Z._hudsonius_49    .C.....A.....A..A...........T..A..C..T..A.....TT.A.....C..T...........CT.AAC.T..
Z._hudsonius_47    .C.....A.....A..A...........T..A..C..T..A.....TT.A.....C..T...........CT.AAC.T..
Z._hudsonius_42    .C.....A.....A..A...........T..A..C..T..A.....TT.A.....C..T...........CT.AAC.T..
Z._hudsonius_36    .C.....A.....A..A...........T..A..C..T..A.....TT.A.....C..T...........CT.AAC.T..
M._glareolus_159   .......G.....A..C..C.....A..C..A.....T..A..T..A..A.....T.....T..C..C..C..AAC....
M._glareolus_152   .......G.....A..C..C.....A..C..A.....T..A..T..A..A.....T.....T..C..C..C..AAC....
M._glareolus       .......A.....A..C..C........T..A........A.....AT.A.....C.....C.....C..C..AAC....
D._groenlandicus_3 .......A.....A.....C.....A..C..A..................A.....T..T..C..C..C..A..AACT...
D._groenlandicus_2 ....G..A...........C........C..A...........T.....A.....T..T..C..C..?..A..AACT...
D._groenlandicus_4 ....G..A.....A.....C........C..A...........T.....A.....T..T..C..C..C..A..AACT...
L._trimucronatus   ............A..C...........C..A.....T..A..T.....C.....T.....C.........C..AAC....
L._trimucronatus_2 ............A..C...........C..A.....T..A........C.....T..T..C..C.....C..AAC....
L._trimucronatus_3 ............A..C...........C..A..T.....A..T.....C.....C..T..C..C.....C..AAC....
M._arvalis_139     ............A..A..C........C..A..C..T..A..T...T.A...........C..C..C..T..TACAT..
M._arvalis_204     ............A..A..C........C..A..C..T..A..T...T.A...........C..C..C..T..TACAT..
M._longicaudus     .......G..G..A..A..C........T..A........A.....T..A.....C..T.AC...G.C..C..AACA...
M._subterraneus    ....G..A.....A..A..C.....T..C..A..C..T..A..............C..T..T..C..C..A..TACAT.G
M._oeconomus       ............A..A..C........C..A........A..T...........C...........C..T..AAC....
M._oeconomus_2     ............A..A..C........C..A........A..T...........C...........C..T..AAC....
M._oeconomus_3     ............A..A..C........C..A........A.............T...........C..T..AAC....
M._maximowiczii    ............A..A..C........C..A........A........A.....T.....C.....C..T..AAC....
M._mongolicus      ............A..A..C........C..A........A........A.....T........C..A..C..AAC...G
M._californicus_I  .......A.....A..A..C.....A..C..A........A.....AT.A.....T.....C..C..C..C..AACA...
M._californicus_J  .......A.....A..A..C.....A..C..A........A.....AT.A.....T.....C..C..C..C..AACA...
E._dorsatum        .T..G..A.....A..A..C.....A.....T..T.............T.A..C........C.....C..T..AAC.T..
O._collaris        .......A.....A..C..C..................T...........A..T........G..C..C..C........T
O._collaris_2      .......A.....A..C..C..................T...........A..T........G..C..C..C........T
O._collaris_3      .......A.....A..C..C..................T...........A..T........G..C..C..C........T
O._collaris_4      .......A.....A..C..C..................T...........A..T........G..C..C..C........T
L._othus           .......A.....A..A..C.....C..T..T.....T.....T..TT.A.....T.....C..C.....A..AAC....
L._timidus         .......A.....A..A..C.....C..T..T.....T.....T..TT.A.....T.....C..C.....A..AAC....
L._granatensis     .......A.....A..A..C.....A..T.....G..T..T..T.....A.....C.....C.....C..A..AAC.T..
L._europaeus       .......A.....A..A..C........T........T..T..T..T..A.....C..T..T.....C..A..AAC....
P._largha          .......A.....A..A........A.....A..C..T.....T..A..A...........C.....C..A........T
P._largha_Pl21     .......A.....A..A........A.....A..C..T.....T..A..A...........C.....C..A........T
P._largha_Pl16     .......A.....A..A........A.....A..C..T.....T..A..A...........C.....C..A........T
P._largha_Pl10     .......A.....A..A........A.....A..C..T.....T..A..A...........C.....C..A........T
E._barbatus        .......G.....A..A........A........T...........A..A...........C..C..C.....T..T...
E._barbatus_2      .......G.....A..A........A........T...........A..A...........C..C..C.....T..T...
E._barbatus_3      .......G.....A..A........A........T...........A..A...........C..C..C.....T..T...
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ALTAICA4           GTAGAGTGAATCTGAGGGGGTTTCTCAGTAGACAAAGCTACCCTGACACGATTCTTTGCCTTCCACTTCATCCTTCCGTT
ALT                ............................................................................
AMO1               ............................................................................
AMO2               ...........................................................................A..
AMO3/COR1          ..........................................................................A..
COR2               .........................................................................A..
COR3               ........................................................................A..
COR4               ............................................................................
COR5               ............................................................................
COR6               ............................................................................
COR7               ............................................................................
COR8               ............................................................................
SUM1               ............................................................................
SUM2               ............................................................................
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SUM3            ..........................................................................C.........
SUM4            ..........................................................................C.........
SUM5            ..........................................................................C.........
SUM6            ..........................................................................C.........
SUM7            ..........................................................................C.........
SUM8            ..........................................................................C.........
TIG1            ..........................................................................C.........
TIG2            ..........................................................................C.........
TIG3            ..........................................................................C.........
TIG4            ..........................................................................C.........
TIG5            ..........................................................................C.........
TIG6            ..........................................................................C.........
TIGRIS1         ..........................................................................C.........
TIGRIS2         ..........................................................................C.........
SUMATRA1        ..........................................................................C.........
SUMATRA2        ..........................................................................C.........
CORBETTI1       ..........................................................................A..C.....
CORBETTI2       ..........................................................................A..C.....
ALTAICA         ..........................................................................C.........
S5_cytb         ..........................................................................C.........
S3_cytb         ..........................................................................C.........
B8_cytb         ..........................................................................C.........
C3_cytb         ..........................................................................C.........
C2_cytb         ..........................................................................C.........
C1_cytb         ..........................................................................C.........
Su10_cytb       ..........................................................................C.........
Su9_cytb        ..........................................................................C.........
Su7_cytb        ..........................................................................C.........
Su6_cytb        ..........................................................................C.........
Su5_cytb        ..........................................................................C.........
Su4_cytb        ..........................................................................C.........
Su3_cytb        ..........................................................................C.........
Su2_cytb        ..........................................................................C.........
Su1_cytb        ..........................................................................C.........
S15_cytb        ..........................................................................C.........
S13_cytb        ..........................................................................C.........
S12_cytb        ..........................................................................C.........
S11_cytb        ..........................................................................C.........
S10_cytb        ..........................................................................C.........
S8_cytb         ..........................................................................C.........
S7_cytb         ..........................................................................C.........
S6_cytb         ..........................................................................C.........
S4_cytb         ..........................................................................C.........
S2_cytb         ..........................................................................C.........
S1_cytb         ..........................................................................C.........
B9_cytb         ..........................................................................C.........
B7_cytb         ..........................................................................C.........
B6_cytb         ..........................................................................C.........
B5_cytb         ..........................................................................C.........
B4_cytb         ..........................................................................C.........
B3_cytb         ..........................................................................C.........
B2_cytb         ..........................................................................A..C.....
sondaica1       ----------..................................................................C.........
sondaica        ----------..................................................................C.........
Pta             ..........................................................................C.........
P._pardus       .....A.............C.....................T.................................A..C.....
P._pardus2      .....A.............C.....................T.................................A..C.....
P._pardus3      .....A.............C.....................T.................................A..C.....
P._pardus1      .....A.............C.....................T.................................A..C.....
P._pardus9      ----------------------------------------------------------------------------------
P._pardus_5     ----------------------------------------------------------------------------------
P._pardus40     .C...A.............C.......G............T.................................A..C.....
P._pardus4c     .....A.AC........A..A.................C.....................T.G...T..T..C..A..C.....
P._pardus2c     .....A.AC........A..A.................C.....................T.G...T..T..C..A..C.....
P._pardus3c     .....A.AC........A..A.................C.....................T.G...T..T..C..A..C.....
P._pardus1c     .....A.AC........A..A.................C.....................T.G...T..T..C..A..C.....
P._pardus.o1    ----------------------------------------------------------------------------------
P._pardus.o2    ----------------------------------------------------------------------------------
P._pardus.03    ----------------------------------------------------------------------------------
P._pardus.o4    ----------------------------------------------------------------------------------
P._pardus.o5    ----------------------------------------------------------------------------------
P._pardus.o6    ----------------------------------------------------------------------------------
P._pardus.o7    ----------------------------------------------------------------------------------
P._pardus.o8    ----------------------------------------------------------------------------------
P._pardus.o9    ----------------------------------------------------------------------------------
P._pardus.o10   ----------------------------------------------------------------------------------
P._pardus.o11   ----------------------------------------------------------------------------------
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P._pardus.o12     ----------------------------------------------------------------------------------------
P._pardus.o13     ----------------------------------------------------------------------------------------
P._pardus.o14     ----------------------------------------------------------------------------------------
U._uncia1         .....A..G..........C..........T.....CT..T.....................T........A..
U._uncia          .....A..G..........C..........T.....CT..T.....................T........A..
A._jubatus_4050   ..........T.....A........G.....................................T........A..
A._jubatus_4237   ..........T.....A........G.....................................T........A..
A._jubatus_4051   ..........T.....A........G.....................................T........A..
P._leo_1          ----------------------------------------------------------------------------------------
P._leo            ........G........A..C.................C.....................................A..
P._leo_2          ...C............A..C.................C.....................................A..
P._leo.p17        .....A.AC........A..A.................C..G.................T.G...T..T..C..A..
P._leo.p16        .....A.AC........A..A.................C..G.................T.G...T..T..C..A..
P._leo.p15        .....A.AC........A..A.................C..G.................T.G...T..T..C..A..
P._leo_TSV3550    ........G........A..C.................C.....................................A..
P._leo_KPR98      ........G........A..C.................C.....................................A..
P._leo_BOT16      ........G........A..C.................C.....................................A..
P._leo_CAP30      ........G........A..C.................C.....................................A..
P._leo_BML22      ........G........A..C.................C.....................................A..
P._leo_ETO76      ........G........A..C.................C.....................................A..
P._leo_ETO65      ........G........A..C.................C.....................................A..
P._leo_PSS993     ........G........A..C.................C.....................................A..
R._formosae       .....A...G.......C..A..T.....T..T.....C..A..C..C........C...C.A......C.G..A..C..
M._tuberculata    ..CC.A...G.A.....C..A.A.G.G.................A..C..G..................T..T..C..C..
C._latrans_1      .....A...........C..C........G........A.....A..............A........T.....C..A..
C._lupus_1        .....A...........C..C........G........A.....A..............A.....T........C..T..
V._vulpes         .....A.....T........C..................A.....A..............A........T........A..
G._gulo           .....A..............G..................C................T..............T...T.A..A..
U._americanus     .....A..G...........C..T..T..GA.T..G..A..T.........................T..T.....A..
U._arctos         .....A..............C..T..C.....T..G..G..T..A..............T........T..T..C.....
R._tarandus       ..C..A.....T.....A..A..T..T.....T.....A.....A..C.....T.....T........T..T.....A..
C._elaphus        ..C..A..G........A..C..T..............A.....A..C.....T..C..T........T..T..C..A..
O.arena           ..C..A........G..A..A.......................C..C.....T..C.....T.....T..TT.C..A..
T._hudsonicus     ..........T.....T..A........T........C..T..A..T........C..G.....T..T...T.A..T..
G._sabrinus       .....A...........A..C.....T..C..............A..C.....T.....A..T..T..TG....C..T..
T._hudsonicus_1   .....A..G........A..G.....T...........G.....A..T................T.....T..TT.A..A..
Z._hudsonius      ..T..A...........T..C.....T...........C.....A.....................T..T...T.G..A..
H._sapiens        ..TC.A...........A..C.A...........GTC.C.....C.............A....T.........T.G..C..
C._lupus          .....A..G........C..C........G........A.....A..............A.....T........C..T..
C._lupus1         .....A..G........C..C........G........A.....A..............A.....T........C..T..
V.vulpes          .....A.....T........C..................A.....A..............A........T........A..
V._vulpes_1       .....A.....T........C..................A.....A..............A........T........A..
V._vulpes_2       .....A.....T........C..................A.....A..............A........T........A..
L._canadensis     .....A...........A..G..T..............C.....A........T..C...........T..T..A.....
G._gulo_1         .....A..............G..................C................T..............T...T.A..A..
G._gulo_2         .....A..............G..................C................T..............T...T.A..A..
G._gulo_3         .....A..............G..................C................T..............T...T.A..A..
G._gulo_4         .....A..............G..................C................T..............T...T.A..A..
M._amerina_1      .....A...........A..A.....G........G........A...........C...........T.....G..A..
M._americana_2    .....A...........A..A.....G........G........A..G........C...........T.....G..A..
M._americana_3    .....A...........A..A.....G........G........A...........C...........T.....G..A..
M._erminea        .....A...........C..A..T..............C...T.A...........C.........T..T.....G..A..
M._erminea_2      .....A...........C..A..T..............C...T.A...........C.........T..T.....G..A..
N._vison          .....A..............A..T..............C...T.A...........C.....T...........G..A..
U._americanus_1   .....A..G...........C..T..T..GA.T..G..A..T.........................T..T.....A..
U._americanus_2   .....A..G...........C..T..T..GA.T.....A..T..A.....................T........A..
U._americanus_3   .....A..G...........C..T..T..GA.T..G..A..T.........................T..T.....A..
U._arctos_1       .....A..............C..T..C.....T..G..A..T..A..............T........T.....C..A..
U._arctos_2       .....A..............C..T..C.....T..G..A..T..A..............T........T..T..C..A..
U._arctos_3       .....A..............C..T..C.....T..G..A..T..A..............T........T..T..C.....
R._tarandus_27    ..C..A.....T.....A..A..T..T.....T.....A.....A..C.....T.....T........T..T.....A..
R._tarandus_22    ..C..A..G..T.....A..A..T..T.....T.....A.....A..C.....T.....T..T.....T..T.....A..
R._tarandus_09    ..C..A.....T.....A..A..T..T.....T.....A.....A..C.....T.....T..T.....T..T.....A..
O._moschatus_1    ..C..A...........A..A.....C...........C.....C..C.....T.....T..T.....T.....C..A..
O._moschatus_2    ..C..A...........A..A.....C...........C.....C..C.....T.....T..T.....T.....C..A..
O._moschatus_3    ..C..A...........A..A.....C...........C.....C..C.....T.....T..T.....T.....C..A..
O._moschatus_4    ..C..A...........A..A.....C...........C.....C..C.....T.....T..T.....T.....C..A..
O._moschatus_17   ..C..A...........A..A.....C...........C.....C..C.....T.....T..T.....T.....C..A..
O._moschatus_5    ----------------------------------------------------------------------------------------
O._moschatus_6    ----------------------------------------------------------------------------------------
O._moschatus_7    ----------------------------------------------------------------------------------------
O._moschatus_8    ----------------------------------------------------------------------------------------
O._moschatus_9    ----------------------------------------------------------------------------------------
O._moschatus_10   ----------------------------------------------------------------------------------------
O._moschatus_11   ----------------------------------------------------------------------------------------
O._moschatus_12   ----------------------------------------------------------------------------------------
O._moschatus_13   ----------------------------------------------------------------------------------------
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O._moschatus_14
O._moschatus_15
O._moschatus_16
O._moschatus_2.
O._moschatus_39
O._dalli_OD2
O._dalli_Od1
O._dalli
O._dalli_2
M._caligata
M._caligata_2
M._caligata_3
M._broweri
M._broweri_2
M._broweri_3
M._broweri_4
S._parryii_S83
S._parryii_S79
S._parryii
S._parryii_2
S._parryii_3
T._hudsonicus_6
T._hudsonicus_2
T._hudsonicus_3
T._hudsonicus_4
T._hudsonicus_5
C._fiber
C._fiber_2
C._fiber_3
Z._hudsonius_49
Z._hudsonius_47
Z._hudsonius_42
Z._hudsonius_36
M._glareolus_159
M._glareolus_152
M._glareolus
D._groenlandicus_3
D._groenlandicus_2
D._groenlandicus_4
L._trimucronatus
L._trimucronatus_2
L._trimucronatus_3
M._arvalis_139
M._arvalis_204
M._longicaudus
M._subterraneus
M._oeconomus
M._oeconomus_2
M._oeconomus_3
M._maximowiczii
M._mongolicus
M._californicus_I
M._californicus_J
E._dorsatum
O._collaris
O._collaris_2
O._collaris_3
O._collaris_4
L._othus
L._timidus
L._granatensis
L._europaeus
P._largha
P._largha_Pl21
P._largha_Pl16
P._largha_Pl10
E._barbatus
E._barbatus_2
E._barbatus_3
ALTAICA4 TATCGTCTCAGCCCTAGCAGCAGTCCACCTCCTATTCCTTCACGAAACAGGATCCAATAACCCCTCAGGAATGGTGTCCG
ALT
AMO1
AMO2
AMO3/COR1

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COR2            ..........................................................................
COR3            ..........................................................................
COR4            ....A.....................................................................
COR5            ..........................................................................
COR6            ..........................................................................
COR7            ..........................................................................
COR8            ..........................................................................
SUM1            ..........................................................................
SUM2            ..........................................................................
SUM3            ..........................................................................
SUM4            ..........................................................................
SUM5            ..........................................................................
SUM6            ..........................................................................
SUM7            ..........................................................................
SUM8            ..........................................................................
TIG1            ..........................................................................
TIG2            ..........................................................................
TIG3            ..........................................................................
TIG4            ..........................................................................
TIG5            ..........................................................................
TIG6            ..........................................................................
TIGRIS1         ..........................................................................
TIGRIS2         ..........................................................................
SUMATRA1        ..........................................................................
SUMATRA2        ..........................................................................
CORBETTI1       ..........................................................................
CORBETTI2       ..........................................Y..R..........Y..............R..Y.
ALTAICA         ..........................................................................
S5_cytb         ..........................................................................
S3_cytb         ..........................................................................
B8_cytb         ..........................................................................
C3_cytb         ..........................................................................
C2_cytb         ....A.....................................................................
C1_cytb         ....A.....................................................................
Su10_cytb       ..........................................................................
Su9_cytb        ..........................................................................
Su7_cytb        ..........................................................................
Su6_cytb        ..........................................................................
Su5_cytb        ..........................................................................
Su4_cytb        ..........................................................................
Su3_cytb        ..........................................................................
Su2_cytb        ..........................................................................
Su1_cytb        ..........................................................................
S15_cytb        ..........................................................................
S13_cytb        ..........................................................................
S12_cytb        ..........................................................................
S11_cytb        ..........................................................................
S10_cytb        ..........................................................................
S8_cytb         ..........................................................................
S7_cytb         ..........................................................................
S6_cytb         ..........................................................................
S4_cytb         ..........................................................................
S2_cytb         ..........................................................................
S1_cytb         ..........................................................................
B9_cytb         ..........................................................................
B7_cytb         ..........................................................................
B6_cytb         ..........................................................................
B5_cytb         ..........................................................................
B4_cytb         ..........................................................................
B3_cytb         ..........................................................................
B2_cytb         ..........................................................................
sondaica1       ..........................................................................
sondaica        ..........................................................................
Pta             ..........................................................................
P._pardus       ....A.......T.................................G........T..C..............A..A..T.
P._pardus2      ....A.......T.................................G........T..C..............A..A..T.
P._pardus3      ....A.......T.................................G........T..C..............A..A....
P._pardus1      ....A.......T.................................G........T..C..............A..A....
P._pardus9      --------------------------------------------------------------------------
P._pardus_5     --------------------------------------------------------------------------
P._pardus40     ....A.......T.C...............................CG........T..C..............AA..A....
P._pardus4c     ...TA.T.......................TTC......A...C........C.T..C..............A..A..T.
P._pardus2c     ...TA.T.......................TTC......A...C........C.T..C..............A..A..T.
P._pardus3c     ...TA.T.......................TTC......A...C........C.T..C..............A..A..T.
P._pardus1c     ...TA.T.......................TTC......A...C........C.T..C..............A..A..T.
P._pardus.o1    --------------------------------------------------------------------------
P._pardus.o2    --------------------------------------------------------------------------
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P._pardus.03      ----------------------------------------------------------------------------------------
P._pardus.o4      ----------------------------------------------------------------------------------------
P._pardus.o5      ----------------------------------------------------------------------------------------
P._pardus.o6      ----------------------------------------------------------------------------------------
P._pardus.o7      ----------------------------------------------------------------------------A..T.
P._pardus.o8      ----------------------------------------------------------------------------A.YT.
P._pardus.o9      ----------------------------------------------------------------------------A..T.
P._pardus.o10     ----------------------------------------------------------------------------A..T.
P._pardus.o11     ----------------------------------------------------------------------------A..T.
P._pardus.o12     ----------------------------------------------------------------------------A..T.
P._pardus.o13     ----------------------------------------------------------------------------A..T.
P._pardus.o14     ----------------------------------------------------------------------------
U._uncia1         C...A.............A.A.................T..........T..C.................A..T.
U._uncia          C...A.............A.A.................T..........T..C.................A..T.
A._jubatus_4050   C...A.................A......T....T..C.....G.........................CACA....
A._jubatus_4237   C...A.................A......T....T..C.....G.........................CACA....
A._jubatus_4051   C...A.................A......T....T..C.....G.........................CACA....
P._leo_1          ----------------------------------------------------------------------------------------
P._leo            ....A.........................G.....C..T..........T...................A..T.
P._leo_2          ....A.........................G.....C..T..........T...................A..T.
P._leo.p17        ...TA.T.....................TTC......A...C........C.T..C..G..........A..A..T.
P._leo.p16        ...TA.T.....................TTC......A...C........C.T..C..G..........A..A..T.
P._leo.p15        ...TA.T.....................TTC......A...C........C.T..C..G..........A..A..T.
P._leo_TSV3550    ....A.................................C..T..........T...................A..T.
P._leo_KPR98      ....A.................................C..T..........T...................A..T.
P._leo_BOT16      ....A.................................C..T..........T...................A..T.
P._leo_CAP30      ....A.................................C..T..........T...................A..T.
P._leo_BML22      ....A.................................C..T..........T...................A..T.
P._leo_ETO76      ....A.................................C..T..........T...................A..T.
P._leo_ETO65      ....A.................................C..T..........T...................A..T.
P._leo_PSS993     ....A.................................C..T..........T...................A..T.
R._formosae       C...A.T.....TA...TCAT...T.....A..C.....C.............A..C.....AA.T.....CCCA..G.
M._tuberculata    C..TA..G.....T...T.AT...A...T.T.....T..C.................C..T..AA.G..C..CCCC..A.
C._latrans_1      C..TA..G...........AT...A...........T..A..T..G..C........C.............CACA..AA
C._lupus_1        C...A..G....T......AT...A...........T..A........C........C.....T........CACA..A.
V._vulpes         C...A..G....AT....GATG..T..T...T....T..C.................C..T..T........CACA....
G._gulo           C...A...T...A........CA.......AT....T.....................T...........CCCC....
U._americanus     C...A...TGA.A.................AT.......A.................T...........T.....CCCA..T.
U._arctos         C...A..CT...A...............T..AT.G.....A.................C........T.....CCCA..T.
R._tarandus       ...TA..G....A..C..TAT......TT.G..T.................G..T..C..T..AA.......TCCA..A.
C._elaphus        ....A..G....A..C..TAT...A...T.A..C.....................T........AA.......CCCA..A.
O.arena           C...A..G.......C..CAT...T.....A..C.....C.................C......A.......TCCA..G.
T._hudsonicus     ......TG.........TCAT...A.....A........A..............A..C..T.....T...C.AA.T....
G._sabrinus       ...TA.TG.T...T....CAT.A....T..A..C..TT.A.....................A......C.AA.C..T.
T._hudsonicus_1   ...TA.TG.C..TA.G..TATT..T..T..T..T..T..A.....G..T.....A..........T...CT.A..C..T.
Z._hudsonius      ....A.TG.C..AA....TATTA.T..T..T..C.....A..T...T.T..C.....C..T..T.T...C..TACC..T.
H._sapiens        C..TA.TG...........A..C.............T.G........G.....A..C......CT......CACC...C
C._lupus          C...A..G....T......AT...A...........T..A........C........C.....T........CACA..A.
C._lupus1         C...A..G....T......AT...A...........T..A........C........C.....T........CACA..A.
V.vulpes          C...A..G....AT....GATG..T..T...T....T..C.................C.....T........CACA....
V._vulpes_1       C...A..G....AT....GATG..T..T...T.......C.................C.....T........CACA....
V._vulpes_2       C...A..G....AT....GATG..T..T...T....T..C.................C.....T........CACA....
L._canadensis     C...A.......A.............................T..............C........C.....CCCC..T.
G._gulo_1         C...A...T...A........CA.......AT....T.....................T...........CCCC....
G._gulo_2         C...A...T...A........CA.......AT....T.....................T...........CCCC....
G._gulo_3         C...A...T...A........CA.......AT....T.....................T...........CCCC....
G._gulo_4         C...A...T...A........CA.......AT....T.....................T...........CCCC....
M._amerina_1      C.......T...AT.G........A.....T........C..T..............................CCCC....
M._americana_2    C...A...T...AT.G........A.....T........C..T..............................CCCC....
M._americana_3    C.......T...AT.G........A.....T........C..T..............................CCCC....
M._erminea        C...A.T.....A.................A........C.................C..T.....C.....CCCA....
M._erminea_2      C...A.T.....A.................AT.......C.................T.....C.....CCCA....
N._vison          CG..A.......A...........T.....AT.......C..T.....................T.....CCCA..T.
U._americanus_1   C...A...TGA.A.................AT.......A.................T...........T.....CCCA..T.
U._americanus_2   C...A...TGA.A.................GT.......A.................T...........T.....CCCA..T.
U._americanus_3   C...A...TGA.A.................AT.......A.................T...........T.....CCCA..T.
U._arctos_1       C...A..CT...A...............AT.G.....A.................C........T.....CCCA..T.
U._arctos_2       C...A..CT...A...............AT.G.....A.................C........T.....CCCA..T.
U._arctos_3       C...A..CT...A...............AT.G.....A.................C........T.....CCCA..T.
R._tarandus_27    ...TA..G....A..C..TAT......TT.G..T.................G..T..C..T..AA.......TCCA..A.
R._tarandus_22    ...TA..G....A..C..TAT......TT.G..T.................G..T..C..T..AA.......TCCA..A.
R._tarandus_09    ...TA..G....A..C..TAT......TT.G..T.................G..T..C..T..AA.......TCCA..A.
O._moschatus_1    ....A..GT......C..TAT...A..TT.G..C.....C.................C......A.......TCCA..A.
O._moschatus_2    ....A..GT......C..TAT...A..TT.G..C.....C.................C......A.......TCCA..A.
O._moschatus_3    ....A..GT......C..TAT...A..TT.G..C.....C.................C......A.......TCCA..A.
O._moschatus_4    ....A..GT......C..TAT...A..TT.G..C.....C.................C......A.......TCCA..A.
O._moschatus_17   ....A..GT......C..TAT...A..TT.G..C.....C.................C......A.......TCCA..A.
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O._moschatus_5     ----------------------------------------------------------------------------------------
O._moschatus_6     ----------------------------------------------------------------------------------------
O._moschatus_7     ----------------------------------------------------------------------------------------
O._moschatus_8     ----------------------------------------------------------------------------------------
O._moschatus_9     ----------------------------------------------------------------------------------------
O._moschatus_10    ----------------------------------------------------------------------------------------
O._moschatus_11    ----------------------------------------------------------------------------------------
O._moschatus_12    ----------------------------------------------------------------------------------------
O._moschatus_13    ----------------------------------------------------------------------------------------
O._moschatus_14    ----------------------------------------------------------------------------------------
O._moschatus_15    ----------------------------------------------------------------------------------------
O._moschatus_16    ----------------------------TAA.A..AG..A..GC.TT..TAGG.T.TGTC.TA.CAT.AGGACAAA.ATC
O._moschatus_2.    ....A..GT......C..TAT...A..TT.G..C.....C.................C......A.......TCCA..A.
O._moschatus_39    ....A..GT......C..TAT...A..TT.G..C.....C.................C......A.......TCCA..A.
O._dalli_OD2       C..AA.TG.......C..CAT.........A..C.....C.................C......A.......TCCA..A.
O._dalli_Od1       C..AA.TG.......C..CAT.........A..C.....C.................C......A.......TCCA..A.
O._dalli           ....A.TG.......C..CAT.......??????????????????????????????????????????????????
O._dalli_2         C..AA.TG.......C..CAT.........A..C.....C.................C......A.......TCCA..A.
M._caligata        ....A..G....T....TCAT...T..T..T..T...........G..T.....A..C.....T.....CC.TA.C..T.
M._caligata_2      ....A..G....T....TCAT...T..T..T..T...........G..T.....A..C.....T.....CC.TA.C..T.
M._caligata_3      ....A..G....T....TCAT...T..T..T..T...........G..T.....A..C.....T.....CC.TA.C..T.
M._broweri         ....A..G.........TTAT......T..A..T..T..C..T.....T.....A..C..T........CC.TA.T..T.
M._broweri_2       ....A..G.........TTAT......T..A..T..T..C..T.....T.....A..C..T........CC.TA.T..T.
M._broweri_3       ....A..G.........TTAT...T..T..A..T..T..C..T.....T.....A..C..T........CC.TA.T..T.
M._broweri_4       ....A..G.........TTAT...T..T..A..T..T..C..T.....T.....A..C..T........CC.TA.T..T.
S._parryii_S83     ...TA..G....T....TCAT...T.....T..T..............T.....A..C.....T.....CC.TA.T..T.
S._parryii_S79     ...TA..G....T...A.TAT...T.....T..T..............T.....A..C.....T.....CC.T..T..T.
S._parryii         ...TA..G....T...A.TAT...T.....T..T.....C........T.....A..C...........CC.T..T..T.
S._parryii_2       ...TA..G....T...A.TAT...T.....T..T..............T.....A..C...........CC.T..T..T.
S._parryii_3       ...TA..G....T...A.TAT...T.....T..T.....C........T.....A..C...........CC.T..T..T.
T._hudsonicus_6    ----------------------------------------------------------------------------------------
T._hudsonicus_2    ----------------------------------------------------------------------------------------
T._hudsonicus_3    ----------------------------------------------------------------------------------------
T._hudsonicus_4    ----------------------------------------------------------------------------------------
T._hudsonicus_5    ----------------------------------------------------------------------------------------
C._fiber           C...A..A....A......AT...T........G...T.A..............A..C.....A.T......TAAC..A.
C._fiber_2         C...A..A....A......AT...T........G...T.A..............A..C.....A.T......TAAC..A.
C._fiber_3         C...A..A....A......AT...T.............T.A..............A..C.....A.T......TAAC..A.
Z._hudsonius_49    ....A.TG.C..AA....TATTA.T.....T..C.....A..T...T.T..C.....C..T....T...CC.CACC..T.
Z._hudsonius_47    ....A.TG.C..AA..A.TATTA.T.....T..C.....A..T...T.T..C.....C..T....T...CC.CACC..T.
Z._hudsonius_42    ....A.TG.C..AA....TATTA.T.....T..C.....A..T...T.T..C.....C..T....T...CC.CACC..T.
Z._hudsonius_36    ....A.TG.C..AA....TATTA.T.....T..C.....A..T...T.T..C.....C..T....T...CC.CACC..T.
M._glareolus_159   C...A.TA.......C.TTTTC......T.AT.......A.................C.....AA....TC.AAAC..A.
M._glareolus_152   C...A.TA.......C.TTTTC......T.AT.......A.................C.....AA....TC.AAAC..A.
M._glareolus       C..TA..A.......T.TCTTC.....T..A.......A.................C.....AA....CC.AAAT..A.
D._groenlandicus_3 C...A.TA.........TCTT...A.....TT.....................C..T........A.....CC.AAAC....
D._groenlandicus_2 C...A.TA.........TCTT...A.....TT.....................C..T..C..T..A.....CC.AAAC....
D._groenlandicus_4 C...A.TA....T....TCTT...G.....TT.....................C..T.....T..A.....CC.AAAC....
L._trimucronatus   C...A..A.......C.T.TT......T..TT.........................C......A.T..TC.AAAC....
L._trimucronatus_2 C...A..A.......C.T.TT......T..TT.........................C......A.T..TC.AAAC....
L._trimucronatus_3 C...A..A.......C.T.CT......T..TT.........................C.....TA.T..TC.AAAC....
M._arvalis_139     ...TA.TA.C.....C.T.TT......T..TT.....................T..C.....AA.T...C..AAC..A.
M._arvalis_204     ...TA.TA.C.....C.T.TT......T..TT.....................T..C.....AA.T...C..AAC..A.
M._longicaudus     ...TA.TA.C.......T.CT...T......T.......A.............A..C.....AA.T..TC.TAAC..A.
M._subterraneus    ...TA.TA.......C.T.TT...T.....A.....T..A.............A..C.....AA.C...C.AAAC..A.
M._oeconomus       ...TA..A.C.......T.CTC..A.....AT....T..C.............T..C.....AA.C...C.AAAC..A.
M._oeconomus_2     ...TA..A.C.......T.CTC..A.....AT....T..C.............T..C.....AA.C...C.AAAC..A.
M._oeconomus_3     ...TA.TA.C.......T.CTC..A.....AT.......C.............T..C.....AA.C...C.AAAC..A.
M._maximowiczii    ....A..A.C.......T.CTT........AT....T..A.................C.....AA.C...C..AAT..A.
M._mongolicus      ....A..A.C.......T.CTC.........T.......A...........G.............AA.C...C.AAAC..G.
M._californicus_I  ...TA.TA.C..A..T.T.CT...A...T.A........A...........T..A..C.....AA.C..CC.AAAC..A.
M._californicus_J  ...TA.TA.C..A..C.T.CT...A...T.A........A...........T..A..C.....AA.C..CC.AAAC..A.
E._dorsatum        ...TA..A.G..T....TCAT.A.T.....TT.....................A..............CT.AAAC..T.
O._collaris        ....A..G.T...T...TCATT.....T..A..C.....C...........C..A..C......A.......CA.CC.A.
O._collaris_2      ....A..G.T...T...TCAT.........A..C.....C...........C..A..C......A.......CA.CC.A.
O._collaris_3      ....A..G.T...T...TCAT...T..T..A..C.....C...........C..A..C......A.......CA.CC.A.
O._collaris_4      ....A..G.T...T...TCAT.......T..A..C.....C...........C..A..C......A.......CA.CC.A.
L._othus           C...A..G....A....TGATGA.T...T.A..T.....C..T.....T..C...........A.....T..CCCA..A.
L._timidus         C...A..G....AT...TGATGA.T...T.A..T.....C..T.....T..C.....C.....A.....T..CCCA..A.
L._granatensis     C..TA.TG....A....T.AT.A.T...T.A..T..T.....T.....T..C...........A.....C..CCCA..A.
L._europaeus       ...TA.TG....T....TGAT.A.T...T.A..T.....C..T.....T..C...........A.....C..CCCA..A.
P._largha          CG.A..A.T...T.................A........A..............A..C........C.....CA.A....
P._largha_Pl21     CG.A..A.T...T.................A........A..............A..C........C.....CA.A....
P._largha_Pl16     CG.A..A.T...T.................A........A..............A..C........C.....CA.A....
P._largha_Pl10     CG.A..A.T...T.................A........A..............A..C........C.....CA.A....
E._barbatus        .G.A..A.T...AT................AT.......A..................C........T.....CTC.....
E._barbatus_2      .G.A..A.T...AT................AT.......A..................C........T.....CTC.....
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E._barbatus_3      .G.A..A.T...AT.............AT.......A.............C........T.....CTC.....
ALTAICA4           ACTCAGACAAAATCCCATTCCACCCATACTACACAATTAAAGATATCTTAGGCCTCTTAGTACTAATCCTAACCCTCACA
ALT                ................................................................................
AMO1               ...............................................................................T.
AMO2               ................................................................................
AMO3/COR1          ................................................................................
COR2               ................................................................................
COR3               ................................................................................
COR4               ............T...................................................................T.
COR5               ............T...................................................................T.
COR6               ...............................................................................T.
COR7               ...............................................................................T.
COR8               ...............................................................................T.
SUM1               ..............................................................G............T.
SUM2               ..............................................................G............T.
SUM3               ..............................................................G............T.
SUM4               ..............................................................G............T.
SUM5               ..............................................................G............T.
SUM6               ..............................................................G............T.
SUM7               ..............................................................G............T.
SUM8               ..............................................................G............T.
TIG1               ...............................................................................T.
TIG2               ...............................................................................T.
TIG3               ...............................................................................T.
TIG4               ...............................................................................T.
TIG5               ...............................................................................T.
TIG6               ...............................................................................T.
TIGRIS1            ...............................................................................T.
TIGRIS2            ...............................................................................T.
SUMATRA1           ..............................................................G............T.
SUMATRA2           ..............................................................G............T.
CORBETTI1          ................................................................................
CORBETTI2          .............R.................Y.....Y.....R.....Y.....................Y.
ALTAICA            ...............................................................................T.
S5_cytb            ................................................................................
S3_cytb            ................................................................................
B8_cytb            ...............................................................................T.
C3_cytb            ................................................................................
C2_cytb            ............T...................................................................T.
C1_cytb            ............T...................................................................T.
Su10_cytb          ..............................................................G............T.
Su9_cytb           ..............................................................G............T.
Su7_cytb           ..............................................................G............T.
Su6_cytb           ..............................................................G............T.
Su5_cytb           ..............................................................G............T.
Su4_cytb           ..............................................................G............T.
Su3_cytb           ..............................................................G............T.
Su2_cytb           ..............................................................G............T.
Su1_cytb           ..............................................................G............T.
S15_cytb           ................................................................................
S13_cytb           ................................................................................
S12_cytb           ................................................................................
S11_cytb           ................................................................................
S10_cytb           ................................................................................
S8_cytb            ................................................................................
S7_cytb            ................................................................................
S6_cytb            ................................................................................
S4_cytb            ................................................................................
S2_cytb            ................................................................................
S1_cytb            ................................................................................
B9_cytb            ...............................................................................T.
B7_cytb            ...............................................................................T.
B6_cytb            ...............................................................................T.
B5_cytb            ...............................................................................T.
B4_cytb            ................................................................................
B3_cytb            ................................................................................
B2_cytb            ................................................................................
sondaica1          ..............................................................G............T.
sondaica           ..............................................................G............T.
Pta                ................................................................................
P._pardus          ............T.....................C.........C.G.....TC...........T..G.A....T.
P._pardus2         ............T.....................C.........C.G.....TC...........T..G.A....T.
P._pardus3         ............T.....................C.........C.G.....TC.............G.A....T.
P._pardus1         ............T.....................C.........CGG.....TC.............G.A....T.
P._pardus9         --------------------------------------------------------------------------------
P._pardus_5        --------------------------------------------------------------------------------
P._pardus40        ............T.....................C.........C.G.....TCC.....G.....G.G.A....T.
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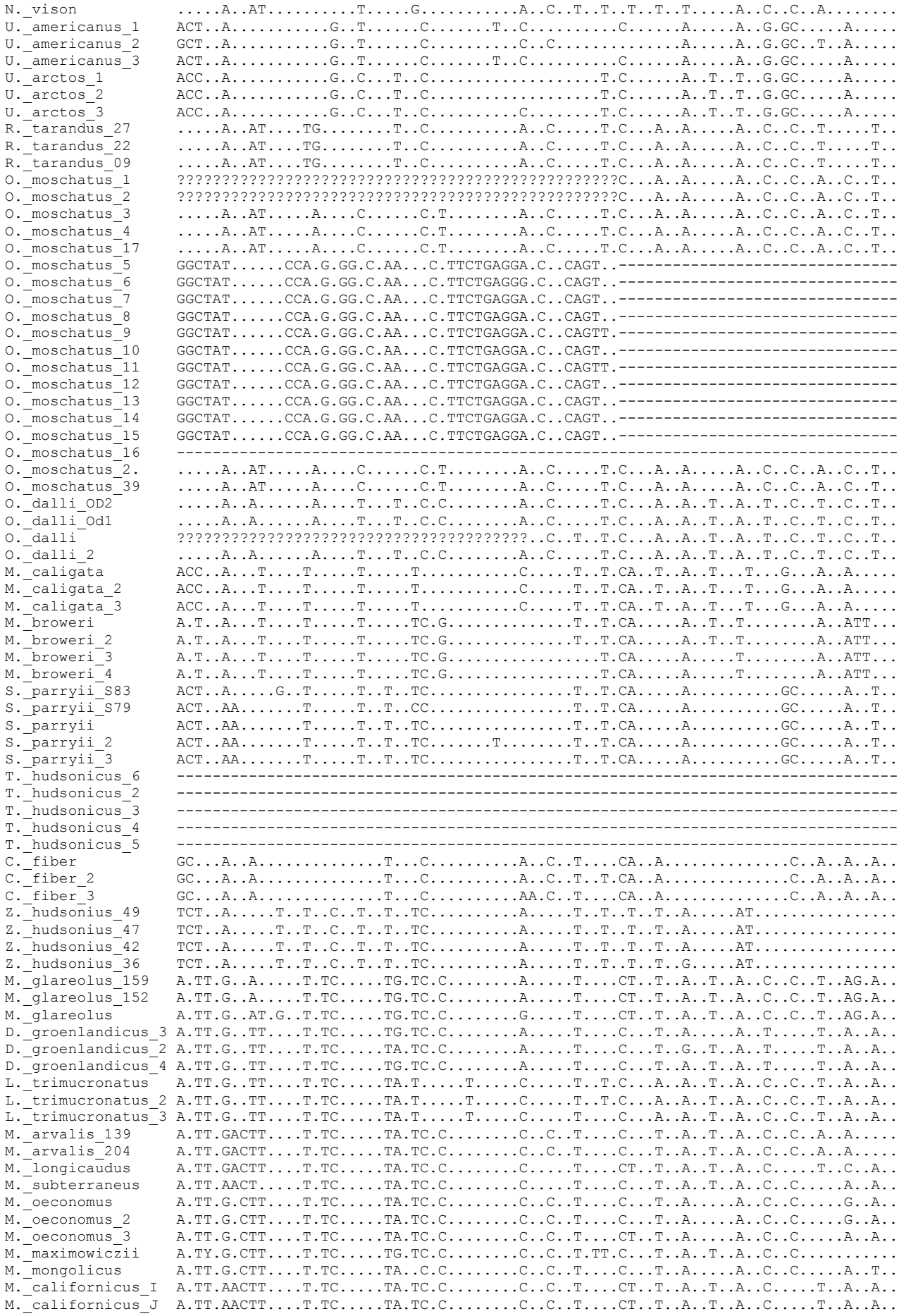
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P._pardus4c       ...TG..T.............T.............C.....C...C.G..T..T...T.C.......G..T...ACTT
P._pardus2c       ...TG..T.............T.............C.....C...C.G..T..T...T.C.......G..T...ACTT
P._pardus3c       ...TG..T.............T.............C.....C...C.G..T..T...T.C.......G..T...ACTT
P._pardus1c       ...TG..T.............T.............C.....C...C.G..T..T...T.C.......G..T...ACTT
P._pardus.o1      ----------------------------------------------------------------------------
P._pardus.o2      ----------------------------------------------------------------------------
P._pardus.03      ----------------------------------------------------------------------------
P._pardus.o4      ----------------------------------------------------------------------------
P._pardus.o5      ----------------------------------------------------------------------------
P._pardus.o6      ----------------------------------------------------------------------------
P._pardus.o7      ............T.....................C.........C.G.....TC..........T..G.A....T.
P._pardus.o8      ............T.....................C.........C.G.....TC..........T..G.A....T.
P._pardus.o9      ............T.....................C.........C.G.....TC..........T..G.A....T.
P._pardus.o10     ............T.....................C.........C.G.....TC..........T..G.A....T.
P._pardus.o11     ............T.....................C.........C.G.....TC..........T..G.A....T.
P._pardus.o12     ............T.....................C.........C.G.....TC..........T..G.A....T.
P._pardus.o13     ............T.....................C.....C...C.G.....TC..........T..G.A....T.
P._pardus.o14     ----------------------------------------------------------------------------
U._uncia1         ........................GC........G.C.....C...C.......T...AC.....C......G....TG
U._uncia          ........................GC........G.C.....C...C.......T...AC.....C......G....TG
A._jubatus_4050   ............T...................T...C..G..C..TC....T...C..A.......TT...TA......
A._jubatus_4237   ............T...................T...C..G..C..TC....T...C..A.......TT...TA......
A._jubatus_4051   ............T...................T...C..G..C..TC....T...C..A.......TT...TA......
P._leo_1          ----------------------------------------------------------------------------
P._leo            .......T.....T........T........T.....C.........C.......TC.......T...T....A....T.
P._leo_2          .......T............T........T.....C.........C.......TC..........T....A....T.
P._leo.p17        ...TG..T.............T.............C.....C...C.G..T..T...T.C.......G..T...ACTT
P._leo.p16        ...TG..T.............T.............C.....C...C.G..T..T...T.C.......G..T...ACTT
P._leo.p15        ...TG..T.............T.............C.....C...C.G..T..T...T.C.......G..T...ACTT
P._leo_TSV3550    .......T.....T........T........T.....C.........C.......TC..........T....A....T.
P._leo_KPR98      .......T.....T........T........T.....C.........C.......TC..........T....A....T.
P._leo_BOT16      .......T.....T........T........T.....C.........C.......TC..........T....A....T.
P._leo_CAP30      .......T.....T........T........T.....C.........C.......TC..........T....A....T.
P._leo_BML22      .......T.....T........T........T.....C.........C.......TC..........T....A....T.
P._leo_ETO76      .......T.....T........T........T.....C.........C.......TC..........T....A....T.
P._leo_ETO65      .......T.....T........T........T.....C.........C.......TC..........T....A....T.
P._leo_PSS993     .......T.....T........T........T.....C.........C.......TC..........T....A....T.
R._formosae       ..AT.....T...T.....................C..C..G..C...C.......TG.CC..A..C..AC.GTAT.A.T.
M._tuberculata    ...T....CT...T.....T.....C.................C...C....AT..G..T.CA..C.AACGG.AT.ATT.
C._latrans_1      ............T.....T.....T............C.....C...C....AGC....C.C...C.....G....A.T.
C._lupus_1        ............T.....T.....T...........C..G......C....AGC....C.C...C......T...A.T.
V._vulpes         ............T..G..T.....C.................C...C....AG.T...C.T..CC.TTC.GTT..A.T.
G._gulo           ....T..T...........T..T........T..C..C..G..C..TC....AGC.C..T.C...GCT...GTA....TG
U._americanus     ..................T..T.....T..T...........CGC.C.....GC.C..C.TT.C......G....A...
U._arctos         ..................T........T........G...........GC.C..C.T..CGC.......T.AG..
R._tarandus       .......T.....T........T..C..T..T..T..C.....C..TC.....A..C..C.C.....T..CTT...T.T.
C._elaphus        ..G............C..T..T..T..T..T..C.................A.....C.T..TG.A..CTT.T.A.T.
O.arena           ..A....T.....T..C........T..T.....C........C...C....TGCTA.CC..........C.T.....TG
T._hudsonicus     .......T........C........C...........C..G..C........AG.....C.C..T..T..TCTAT...T.
G._sabrinus       .......T................T..T.T.T..........C.C.C....AT.....A.C..C...T...T.T...T.
T._hudsonicus_1   ..G.T.............T.....C..T..T..TG.......CGCT.....TG.TC.TT..A..C.G...TTTT.ACTC
Z._hudsonius      .TG..................T..T........T..C.....CG..C.G..T...C..T.TA..C.T..TTTA...CT.
H._sapiens        .T..C..T......A.C........T...........C.....CGC.C.C...T.AC.TC.CT.CC.T..CT..T.A.TG
C._lupus          ............T.....T.....T...........C..G......C....AGC....C.C...C......T...A.T.
C._lupus1         ............T.....T.....T...........C..G......C....AGC....C.C...C......T...A.T.
V.vulpes          ............T..G..T.....C.................C...C....AG.T...C.T..CC.TTC.GTT..A.T.
V._vulpes_1       ............T..G..T.....C.................C...C....AG.T...C.T..CC.TTC.GTT..A.T.
V._vulpes_2       ............T..G..T.....C.................C...C....AG.T...C.T..CC.TTC.GTT..A.T.
L._canadensis     ....T...........C........C........C..C..G...GC.C.....GC.C..C.C.....TT..G.AT.A.T.
G._gulo_1         ....T..T...........T..T........T..C..C..G..C..TC....AGC.C..T.C...GCT...GTA....TG
G._gulo_2         ....T..T...........T..T........T..C..C..G..C..TC....AGC.C..T.C...GCT...GTA....TG
G._gulo_3         ....T..T...........T..T........T..C..C..G..C..TC....AGC.C..T.C...GCT...GTA....TG
G._gulo_4         ....T..T...........T..T........T..C..C..G..C..TC....AGC.C..T.C...GCT...GTA....TG
M._amerina_1      .T..T..............................C..C.....C...C.....GC.C..T.C.........G......T.
M._americana_2    .T..T..............................C..C.....C...C.....GC.C..T.C.........G......T.
M._americana_3    .T..T..............................C..C.....C...C.....GC.C..T.C.........G......T.
M._erminea        ....T.....................T.....T..C..C.....C...C.....GC.C..T.C..T..T.....A..A.T.
M._erminea_2      ....T.....................T.....T..C..C.....C...C.....GC.C..T.C..T..T.....A..A.T.
N._vison          .T..............C..T.....C.....T..C...........C.....GC.C..T.C..C..TT....A..A...
U._americanus_1   ..................T..T.....T..T...........CGC.C.....GC.C..C.TT.C......G....AG..
U._americanus_2   ..................T..T........T...........CGC.C.....GC.C..C.T..C......GT...AG..
U._americanus_3   ..................T..T.....T..T...........CGC.C.....GC.C..C.TT.C......G....AG..
U._arctos_1       ......................T........T........G.....TC.....GC.C..C.T..C.C....G..T.AG..
U._arctos_2       ......................T........T........G.....TC.....GC.C..C.T..C.C....G..T.A...
U._arctos_3       ......................T........T........G.....TC.....GC.C..C.T..C.C....G..T.AG..
R._tarandus_27    .......T.....T........T..C..T..T..T..C.....C..TC.....A..C..C.C.....T..CTT...T.T.
R._tarandus_22    .......T.....T........T..C..T..T..T..C.....C..TC.....A..C..C.C.....T..CTT...T.T.
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R._tarandus_09     .......T.....T........T..C..T..T..T..C.....C..TC.....A..C..C.C.....T..CTT...T.T.
O._moschatus_1     ..A.G.......??????????????????????????????????????????????????????????????????
O._moschatus_2     ..A.G......??????????????????????????????????????????????????????????????????
O._moschatus_3     ..A.G.....................C.....T.....C.....C..TC.....GC.A..C..........T.....T.T.
O._moschatus_4     ..A.G.....................C.....T.....C.....C..TC.....GC.A..C..........T.....T.T.
O._moschatus_17    ..A.G.....................C.....T.....C.....C..TC.....GC.A..C..........T.....T.T.
O._moschatus_5     ---------------.T...TTAGA.ACA.GA.AC..AGGG.TA..TC.TCTA...A..AC.A..GCTAC.G.AT...T.
O._moschatus_6     ---------------.C...TTAGA.ACA.GA.AC..CGGG.TA..TC.TCTA...AC.AC.A..GCTAC.G.AT...T.
O._moschatus_7     ---------------.T...TTAGA.ACA.GA.AC..AGGG.TA..TC.TCTA...A..AC.A..GCTAC.G.AT...T.
O._moschatus_8     ---------------.C...TTAGA.ACA.GA.AC..CGGG.TA..TC.TCTA...AC.AC.A..GCTAC.G.AT...T.
O._moschatus_9     ---------------.C...TTAGA.ACA.GA.AC..CGGG.TA..TC.TCTA...AC.AC.A..GCTAC.G.AT...T.
O._moschatus_10    ---------------.C...TTAGA.ACA.GA.AC..CGGG.TA..TC.TCTA...AC.AC.A..GCTAC.G.AT...T.
O._moschatus_11    ---------------.C...TTAGA.ACA.GA.AC..CGGG.TA..TC.TCTA...AC.AC.A..GCTAC.G.AT...T.
O._moschatus_12    ---------------.T...TTAGA.ACA.GA.AC..AGGG.TA..TC.TCTA...A..AC.A..GCTAC.G.AT...T.
O._moschatus_13    ---------------.T...TTAGA.ACA.GA.AC..AGGG.TA..TC.TCTA...A..AC.A..GCTAC.G.AT...T.
O._moschatus_14    ---------------.T...TTAGA.ACA.GA.AC..AGGG.TA..TC.TCTA...A..AC.A..GCTAC.G.AT...T.
O._moschatus_15    ---------------.T...TTAGA.ACA.GA.AC..AGGG.TA..TC.TCTA...A..AC.A..GCTAC.G.AT...T.
O._moschatus_16    .T..T..GG.GC.A.AG.CA-----------------------------------------------------------
O._moschatus_2.    ..A.G.....................C.....T.....C.....C..TC.....GC.A..C..........T.....T.T.
O._moschatus_39    ..A.G.....................C.....T.....C.....C..TC.....GC.A..C..........T.....T.T.
O._dalli_OD2       ..A.............C........C..T.....C........C...C....TGC.A.CC..........CGT.....T.
O._dalli_Od1       ..A.............C........C..T.....C........C...C....TGC.A.CC..........CGT.....T.
O._dalli           ??????????????????????????????????????????????????????????????????????????????
O._dalli_2         ..A.............C........C..T.....C........C...C....TGC.A.CC..........CGT.....T.
M._caligata        .......T..G.....C..T.....G.....T..C..C..G......C.T..AG.TC.TC.C..T..T....TT..A.T.
M._caligata_2      .......T..G.....C..T.....G.....T..C..C..G......C.T..AG.TC.TC.C..T..T....TT..A.T.
M._caligata_3      .......T..G.....C..T.....G.....T..C..C..G......C.T..AG.TC.TC.T..T..T....TT..A.T.
M._broweri         ................C..T.....G........C..C.........C.T..AGC.G.TC.C..T..TT...T...A.T.
M._broweri_2       ................C..T.....G........C..C.........C.T..AGC.G.TC.C..T..TT...T...A.T.
M._broweri_3       ................C..T.....G....T...C..C.........C.T..AGCTG.TC.C..T..TT...T...A.T.
M._broweri_4       ................C..T.....G....T...C..C.........C.T..AGCTG.TC.C..T..TT...T...A.T.
S._parryii_S83     .T.....T........C..T.....G........C..C.........C.T..AG..C.TC.T..T..TT..G....A.T.
S._parryii_S79     .T.....T...G....C..T.............C..C.........C.T..AG..C.TC.T..T..TT..G....A.T.
S._parryii         .T.....T...G....C..T.............C..C.........C.T..AG..C.TC.T..T..TT..G....A.T.
S._parryii_2       .T.....T...G....C..T.............C..C.........C.T..AG..C.TC.T..T..TT..G....A.T.
S._parryii_3       .T.....T...G....C..T...........T..C..C.........C.T..AG..C.TC.T..T..TT..G....A.T.
T._hudsonicus_6    ---------------------------------------------------------------------------------
T._hudsonicus_2    ---------------------------------------------------------------------------------
T._hudsonicus_3    ---------------------------------------------------------------------------------
T._hudsonicus_4    ---------------------------------------------------------------------------------
T._hudsonicus_5    ---------------------------------------------------------------------------------
C._fiber           ....C.............................C..C.....CTC...T..AT..C..C.C...C.TACCC.A...TT.
C._fiber_2         ....C.............................C..C.....CTC...T..AT..C..C.C...C.TACCC.A...TT.
C._fiber_3         ....C.............................C..C.....CTC...T..AT..C..C.C...C.TACCC.A...TT.
Z._hudsonius_49    .TG.....................T..T........T..C.....CG.TC....T...C..T.TA.GC.T..TTTA...CTT
Z._hudsonius_47    .TG.....................T..T........T..C.....CG.TC....T...C..T.TA.GC.T..TTTA...CTT
Z._hudsonius_42    .TG.....................T..T........T..C.....CG.TC....T...C..T.TA.GC.T..TTTA...CTT
Z._hudsonius_36    .TG.....................T..T........T..C.....CG.TC....T...C..T.TA.GC.T..TTTA...CTT
M._glareolus_159   ..G.G.....................C..T..T.....C......T.T.....GG..C.TA.CT..T.AA..GGT....T.
M._glareolus_152   ..G.G.....................C..T..T.....C......T.T.....GG..C.TA.CT..T.AA..GGT....T.
M._glareolus       ..G.............C..T.....C..........C......T.......GG..C.TA.CT..T.AA..GGT....T.
D._groenlandicus_3 ..G.............C........C..T........C......T.TC....AGC.C.CA.T...T.AA..G.T....T.
D._groenlandicus_2 ..G.............C........C..T........C..G...T.TC....AGC.C.CA.T...T.AA..G.T....T.
D._groenlandicus_4 ..G.............C........C..T........C..G...T.TC....AGC.C.CA.C...T.AA..G.T....T.
L._trimucronatus   ..G....T.....T.....T.....C.....T..C..C.....CC.......GGCTC..C..T..T.AT..G.T....T.
L._trimucronatus_2 ..G....T...........T.....C.....T..C..C.....CC.......GGCTC..C..T..T.AT..G.T....T.
L._trimucronatus_3 .TG....T...........T.....C..T..T..C..C.....CC.......AGCTC.CA..T..T.AT..G.T....T.
M._arvalis_139     ..G.....................C..T..T...G.C......T..C....AG..C.TA.C...T.AA..G.TT...T.
M._arvalis_204     ..G.....................C..T..T...G.C......T..C....AG..C.TA.C...T.AA..G.TT...T.
M._longicaudus     ..G.............G.....T..T....T....G.C......T.T.....GG..C.TA.C...T.GA..GTTT...T.
M._subterraneus    ..G.....................T..T...G.C......T.T.....AG..C.TA.CT..T.AA..G.TT...T.
M._oeconomus       ..A.................T..T..C.....T.....C.....CT.TC.....G..C.CA.CT..T.AA..GTT....T.
M._oeconomus_2     ..A.................T..T..C.....T.....C.....CT.TC.....G..C.CA.CT..T.AA..GTT....T.
M._oeconomus_3     ..A.....................T..C.....T.....C.....CT.TC.....G..C.CA.CT..T.AA..GTT....T.
M._maximowiczii    ..A....T.................C..........G.......CT..C.G..AA..C.TA.C...T.AA..GTTT...T.
M._mongolicus      ..A.................T.....C..........C......T..C.....G..C.TA.C...T.AA..GTTT...T.
M._californicus_I  ..A....T.....T.....................C......T.......AG..C..T..T..T.AA..G.TT...T.
M._californicus_J  ..A....T.....T.....................C......T.......AG..C..T..T..T.AA..G.TT...T.
E._dorsatum        ....G........T.....T........T...T..............C.G..A..TA.CC.TA..T.AT....T..TCTG
O._collaris        ..G.....................C..........C.....CGC.C.....T..C..C.C......TCCCT....CTC
O._collaris_2      ..G.....................C..........C.....CGC.C.....T..C..C.C......TCCCT....CTC
O._collaris_3      ..G.....................C..........C.....C.C.C.....T..C..C.C......TCCCT....CTC
O._collaris_4      ..G.....................C..........C.....CGC.C.....T..C..C.C......TCCCT....CTC
L._othus           ....T..T..G..T..........C..T..............CC.TC....AT.TC.C...-----------------
L._timidus         ....T..T..G..T..........C..T..............CC.TC....AT.TC.C.....T.....CCTA..T.T.
L._granatensis     ....T..T.....T........T..C................GCTC.T..GT.TC.TA....T..T..CCTA....T.
L._europaeus       ....T..T................C................CGCGC....AT.TC.TA....C..T..CCTG....T.
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P._largha          ........................G.....T..............C....GGC.C..C.T..C..T...GT...G...
P._largha_Pl21     ........................G.....T..C...........C....GGC.C..C.T..C..T...GT...G...
P._largha_Pl16     ........................G.....T..............C....GGC.C..C.T..C..T...GT...G...
P._largha_Pl10     ........................G.....T..............C....GGC.C..C.T..C..T...GT...G...
E._barbatus        .......T.....T..................T...G.C..G..C........GGC....C.T.........GTT..T.T.
E._barbatus_2      .......T.....T..................T...G.C..G..C........GGC....C.T.........GTT..T.T.
E._barbatus_3      .......T.....T..................T...G.C..G..C........GGC....C.T.........GTT..T.T.

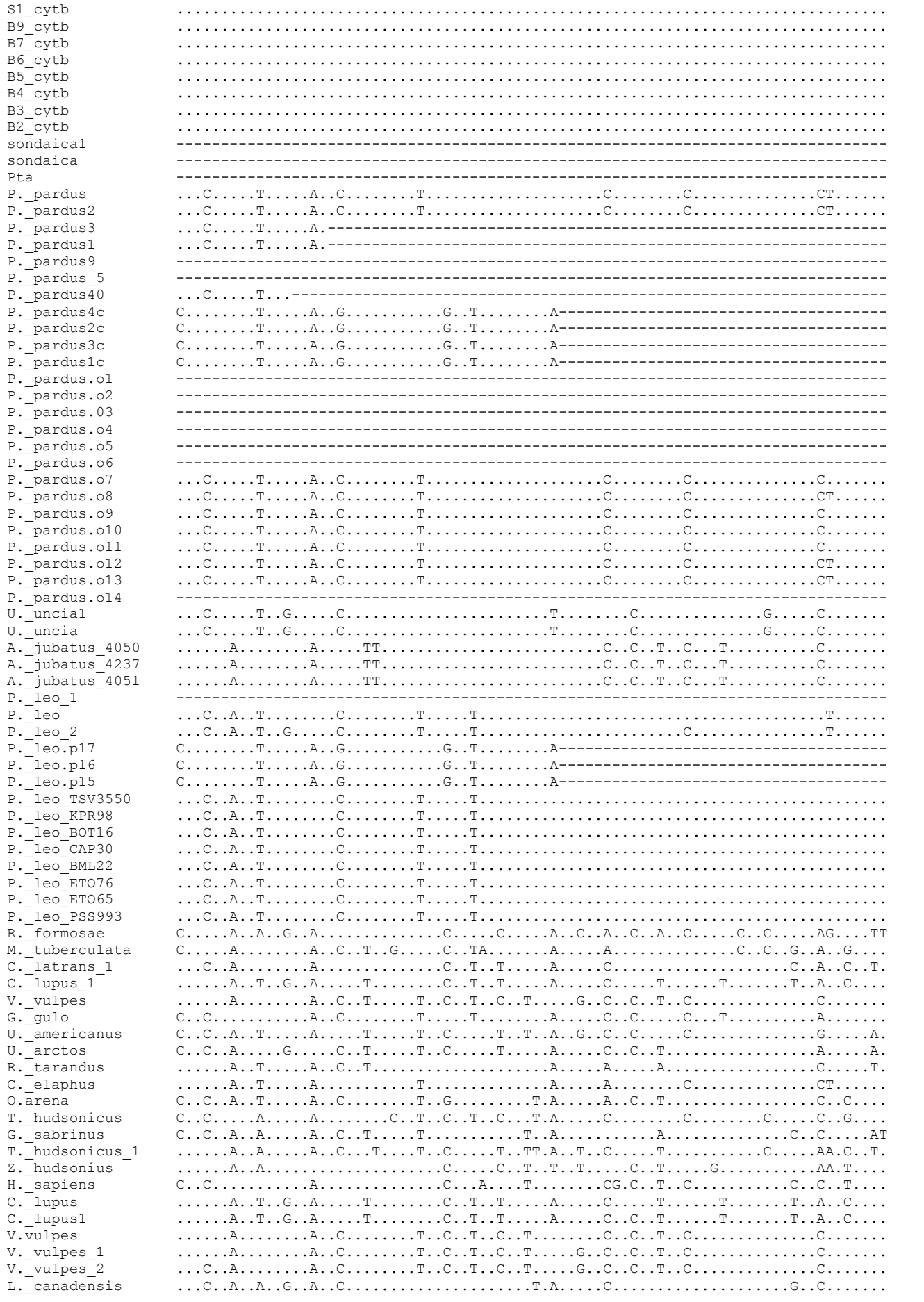

ALTAICA4           CTACTCGTCCTATTCTCACCAGACCTATTAGGAGACCCTGATAACTACATCCCCGCCAACCCCCTAAATACCCCTCCCCA
ALT                ......................------------------------------------------------------------
AMO1               ......................------------------------------------------------------------
AMO2               ......................------------------------------------------------------------
AMO3/COR1          ......................------------------------------------------------------------
COR2               ......................------------------------------------------------------------
COR3               ......................------------------------------------------------------------
COR4               ......................------------------------------------------------------------
COR5               ......................------------------------------------------------------------
COR6               ......................------------------------------------------------------------
COR7               ......................------------------------------------------------------------
COR8               ......................------------------------------------------------------------
SUM1               ......................------------------------------------------------------------
SUM2               ......................------------------------------------------------------------
SUM3               ......................------------------------------------------------------------
SUM4               ......................------------------------------------------------------------
SUM5               ......................------------------------------------------------------------
SUM6               ......................------------------------------------------------------------
SUM7               ......................------------------------------------------------------------
SUM8               ......................------------------------------------------------------------
TIG1               ......................------------------------------------------------------------
TIG2               ......................------------------------------------------------------------
TIG3               ......................------------------------------------------------------------
TIG4               ......................------------------------------------------------------------
TIG5               ......................------------------------------------------------------------
TIG6               ......................------------------------------------------------------------
TIGRIS1            ............................................................................
TIGRIS2            ............................................................................
SUMATRA1           ............................................................................
SUMATRA2           ............................................................................
CORBETTI1          ............................................................................
CORBETTI2          ..............................R.....Y.....................Y.....Y............
ALTAICA            ............................................................................
S5_cytb            ............................................................................
S3_cytb            ............................................................................
B8_cytb            ............................................................................
C3_cytb            ............................................................................
C2_cytb            ............................................................................
C1_cytb            ............................................................................
Su10_cytb          ............................................................................
Su9_cytb           ............................................................................
Su7_cytb           ............................................................................
Su6_cytb           ............................................................................
Su5_cytb           ............................................................................
Su4_cytb           ............................................................................
Su3_cytb           ............................................................................
Su2_cytb           ............................................................................
Su1_cytb           ............................................................................
S15_cytb           ............................................................................
S13_cytb           ............................................................................
S12_cytb           ............................................................................
S11_cytb           ............................................................................
S10_cytb           ............................................................................
S8_cytb            ............................................................................
S7_cytb            ............................................................................
S6_cytb            ............................................................................
S4_cytb            ............................................................................
S2_cytb            ............................................................................
S1_cytb            ............................................................................
B9_cytb            ............................................................................
B7_cytb            ............................................................................
B6_cytb            ............................................................................
B5_cytb            ............................................................................
B4_cytb            ............................................................................
B3_cytb            ............................................................................
B2_cytb            ............................................................................
sondaica1          ....................................-----------------------------------------
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sondaica          ....................................----------------------------------------
Pta               ....................................----------------------------------------
P._pardus         ........................G...........C.....T.................T................
P._pardus2        ........................G...........C.....T.................T................
P._pardus3        ........................G...........C.....................T................
P._pardus1        ........................G...........C.............T........T................
P._pardus9        ----------------------------------------------------------------------------
P._pardus_5       ----------------------------------------------------------------------------
P._pardus40       ........................G.G.........C.............T........T................
P._pardus4c       G.C..AT.TT.CAC......--------..........A..C.......C.T......G..T......CGTT..-..A..
P._pardus2c       G.C..AT.TT.CAC......--------..........A..C.......C.T......G..T......CGTT..-..A..
P._pardus3c       G.C..AT.TT.CAC......--------..........A..C.......C.T......G..T......CGTT..-..A..
P._pardus1c       G.C..AT.TT.CAC......--------..........A..C.......C.T......G..T......CGTT..-..A..
P._pardus.o1      ----------------------------------------------------------------------------
P._pardus.o2      ----------------------------------------------------------------------------
P._pardus.03      ----------------------------------------------------------------------------
P._pardus.o4      ----------------------------------------------------------------------------
P._pardus.o5      ----------------------------------------------------------------------------
P._pardus.o6      ----------------------------------------------------------------------------
P._pardus.o7      ........................G...........C.....................T................
P._pardus.o8      ........................G...........C.....................T................
P._pardus.o9      ........................G...........C.....................T................
P._pardus.o10     ........................G...........C.....................T................
P._pardus.o11     ........................G...........C.....................T................
P._pardus.o12     ........................G...........C.....................T................
P._pardus.o13     ........................G..G........C.....................T................
P._pardus.o14     ----------------------------------------------------------------------------
U._uncia1         .....T.....................................................T..T.....C........T..
U._uncia          .....T.....................................................T..T.....C........T..
A._jubatus_4050   ..........C.............G........T..A..C.....................C..T........
A._jubatus_4237   ..........C.............G........T..A..C.....................C..T........
A._jubatus_4051   ..........C.............G........T..A..C.....................C..T........
P._leo_1          ----------------------------------------------------------------------------
P._leo            ..................................T..C..C.....T.C.........T..T....GC...........
P._leo_2          ..................................T..C..C.....T.C.........T..T....GC...........
P._leo.p17        G.C..AT.TT.CAC......--------..........A..C.......C.T......G..T......CGTT..-..A..
P._leo.p16        G.C..AT.TT.CAC......--------..........A..C.......C.T......G..T......CGTT..-..A..
P._leo.p15        G.C..AT.TT.CAC......--------..........A..C.......C.T......G..T......CGTT..-..A..
P._leo_TSV3550    ..................................T..C..C.....T.C.........T..T....GC...........
P._leo_KPR98      ..................................T..C..C.....T.C.........T..T....GC...........
P._leo_BOT16      ..................................T..C........T.C.........T..T....GC...........
P._leo_CAP30      ..................................T..C........T.C.........T..T....GC...........
P._leo_BML22      ..................................T..C........T.C.........T..T....GC...........
P._leo_ETO76      ..................................T..C........T.C.........T..T....GC...........
P._leo_ETO65      ..................................T..C........T.C.........T..T....GC...........
P._leo_PSS993     ..................................T..C..C.....T.C.........T..T....GC...........
R._formosae       TCC..A..A......G.C..T.....CC.G........C..C.....T.CT..A..T..T..A.....C...........
M._tuberculata    ACCT.A..AT.C........G...T..C..........G.........TCT..A.........T..T.GC..A..A.T...
C._latrans_1      AC...A...T.............................A..........C...T..A..........G......A..A..
C._lupus_1        TC...A..TT....T.....T..................A..........C...T..A..........C........A..
V._vulpes         TC...A.................T..T...........A..C..T....C......A.....T..C.GC..T..C..A..
G._gulo           A....A..A...........C......C..........A..C.......CA............A..C..C..A..G.....
U._americanus     ACT..A...........G..T......C........T..C..........C......A.....A..G.GC.....A.....
U._arctos         ACC..A...........G..C...T..C..................T.C......A..T..A..G.GC..T..A.....
R._tarandus       .....A..AT....TG........T..C..........A..C.......C...A..A.....A..C..C..T.....T..
C._elaphus        T....A..AT.....G............C.T.....T..A..........C...A..A.....A..C..C..A..C..T..
O.arena           .....A..A......A.G..T...T..C.C........A..C.......C...A..A.....A..T..C..T..C..T..
T._hudsonicus     A.T..A...T.G.....T........CC....C.....A..........CA.....T..T.....C..C........A..
G._sabrinus       ACC..A..T..C...A.C..T..T..TC..........A..C.....T.C...A........A..C..C..........
T._hudsonicus_1   TCCT.A.....G.....C..T.....G...........A..C..T..T.C......A.....AT...G...A..C.....
Z._hudsonius      TCT..A.....T..T..C..T..T..CC..........A.....T..T.CT..T..A.....AT...............
H._sapiens        AC.T.AACA..................CC....C.....A..C..T..T.C..TA.........T....C..........
C._lupus          TC...A..TT....T.....T..................A..........C...T..A..........C........A..
C._lupus1         TC...A..TT....T.....T..................A..........C...T..A..........C........A..
V.vulpes          TC...A.................T..T...........A..C..T....C......A.....T..C.GC..T..C..A..
V._vulpes_1       TC...A.................T..T...........A..C..T....C......A.....T..C.GC..T..C..A..
V._vulpes_2       TC...A.................T..T...........A..C.......C......A.....T..C.GC.....C..A..
L._canadensis     AC...A..GT..........C..................G..C........T..T..T.....A..T..C..A..A.....
G._gulo_1         A....A..A...........C......C..........A..C.......CA............A..C..C..A..A.....
G._gulo_2         A....A..A...........C......C..........A..C.......CA............A..C..C..A..A.....
G._gulo_3         A....A..A...........C......C..........A..C.......CA............A..C..C..A..A.....
G._gulo_4         A....A..A...........C......C..........A..C.......CA............A..C..C..A..A.....
M._amerina_1      A....A..A..G........C.....TC.G........A..C....................G..C..C..A..A.....
M._americana_2    A....A..A...........C.....TC.G........A..C....................G..C..C..A..A.....
M._americana_3    A....A..A...........C.....TC.G........A..C....................G..C..C..A..A.....
M._erminea        .....A..A...........T.....GC..........A..C.....T.....A...........C..C..A........
M._erminea_2      .....A..A...........T.....GC..........A..C.....T.....A...........C..C..A........
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E._dorsatum       ACT..AAC...G.............C........T.....C.......CT..A..A..T...T....C..A..A..T..
O._collaris       ACC..A..A..G.....C........CC..........A..C.......C...T........A..C..C..A.....A..
O._collaris_2     ACC..A..A..G.....C........CC..........A..C.......C...T........A..C..C..A.....A..
O._collaris_3     ACC..A..A..G.....C........CC..........A..C.......C...T........A..C..C..A.....A..
O._collaris_4     ACC..A..A..G.....C........CC..........A..C.......C...T........A..C..C..A..A..A..
L._othus          ------------------------------------------------------------------------------
L._timidus        ..C..A...T.......C..T.....TC.C........A..C.......C...T.....T..T..C..C..T........
L._granatensis    ..C..A...T.......T..T.....TC.C..C.....A..C.....T.C...T.....T.....C..C...........
L._europaeus      ..C..A...T.......C..T..T..TC.C..G.....A..C..T..T.C...T...........C..C..T.....T..
P._largha         .....A..A...........C.....G...........C..C.....T.....T.....T........C.....A..A..
P._largha_Pl21    .....A..A...........C.....G...........C..C.....T.....T.....T........C.....A..A..
P._largha_Pl16    .....A..A...........C.....G...........C..C.....T.....T.....T........C.....A..A..
P._largha_Pl10    .....A..A...........C.....G...........C..C.....T.....T.....T........C.....A..A..
E._barbatus       ..T..A..G...........C......C.G.....T..C..C.......CT.....T..........GC.....A..A..
E._barbatus_2     ..T..A..G...........C......C.G.....T..C..C.......CT.....T..........GC.....A..A..
E._barbatus_3     ..T..A..G...........C......C.G.....T..C..C.......CT.....T..........GC.....A..A..


ALTAICA4          TATTAAGCCCGAATGGTATTTCCTATTCGCATACGCAATCCTCCGATCTATTCCCAATAAACTAGGAGGAGTTCTAGCCC
ALT               ------------------------------------------------------------------------------
AMO1              ------------------------------------------------------------------------------
AMO2              ------------------------------------------------------------------------------
AMO3/COR1         ------------------------------------------------------------------------------
COR2              ------------------------------------------------------------------------------
COR3              ------------------------------------------------------------------------------
COR4              ------------------------------------------------------------------------------
COR5              ------------------------------------------------------------------------------
COR6              ------------------------------------------------------------------------------
COR7              ------------------------------------------------------------------------------
COR8              ------------------------------------------------------------------------------
SUM1              ------------------------------------------------------------------------------
SUM2              ------------------------------------------------------------------------------
SUM3              ------------------------------------------------------------------------------
SUM4              ------------------------------------------------------------------------------
SUM5              ------------------------------------------------------------------------------
SUM6              ------------------------------------------------------------------------------
SUM7              ------------------------------------------------------------------------------
SUM8              ------------------------------------------------------------------------------
TIG1              ------------------------------------------------------------------------------
TIG2              ------------------------------------------------------------------------------
TIG3              ------------------------------------------------------------------------------
TIG4              ------------------------------------------------------------------------------
TIG5              ------------------------------------------------------------------------------
TIG6              ------------------------------------------------------------------------------
TIGRIS1           ..............................................................................
TIGRIS2           ..............................................................................
SUMATRA1          ..............................................................................
SUMATRA2          ..............................................................................
CORBETTI1         ..............................................................................
CORBETTI2         ...Y....S.................Y.....................................R......Y......
ALTAICA           ..............................................................................
S5_cytb           ..............................................................................
S3_cytb           ..............................................................................
B8_cytb           ..............................................................................
C3_cytb           ..............................................................................
C2_cytb           ..............................................................................
C1_cytb           ..............................................................................
Su10_cytb         ..............................................................................
Su9_cytb          ..............................................................................
Su7_cytb          ..............................................................................
Su6_cytb          ..............................................................................
Su5_cytb          ..............................................................................
Su4_cytb          ..............................................................................
Su3_cytb          ..............................................................................
Su2_cytb          ..............................................................................
Su1_cytb          ..............................................................................
S15_cytb          ..............................................................................
S13_cytb          ..............................................................................
S12_cytb          ..............................................................................
S11_cytb          ..............................................................................
S10_cytb          ..............................................................................
S8_cytb           ..............................................................................
S7_cytb           ..............................................................................
S6_cytb           ..............................................................................
S4_cytb           ..............................................................................
S2_cytb           ..............................................................................
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S1_cytb
B9_cytb
B7_cytb
B6_cytb
B5_cytb
B4_cytb
B3_cytb
B2_cytb
sondaica1
sondaica
Pta
P._pardus
P._pardus2
P._pardus3
P._pardus1
P._pardus9
P._pardus_5
P._pardus40
P._pardus4c
P._pardus2c
P._pardus3c
P._pardus1c
P._pardus.o1
P._pardus.o2
P._pardus.03
P._pardus.o4
P._pardus.o5
P._pardus.o6
P._pardus.o7
P._pardus.o8
P._pardus.o9
P._pardus.o10
P._pardus.o11
P._pardus.o12
P._pardus.o13
P._pardus.o14
U._uncia1
U._uncia
A._jubatus_4050
A._jubatus_4237
A._jubatus_4051
P._leo_1
P._leo
P._leo_2
P._leo.p17
P._leo.p16
P._leo.p15
P._leo_TSV3550
P._leo_KPR98
P._leo_BOT16
P._leo_CAP30
P._leo_BML22
P._leo_ETO76
P._leo_ETO65
P._leo_PSS993
R._formosae
M._tuberculata
C._latrans_1
C._lupus_1
V._vulpes
G._gulo
U._americanus
U._arctos
R._tarandus
C._elaphus
O.arena
T._hudsonicus
G._sabrinus
T._hudsonicus_1
Z._hudsonius
H._sapiens
C._lupus
C._lupus1
V.vulpes
V._vulpes_1
V._vulpes_2
L._canadensis

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G._gulo_1          C..C..........A..C........T.....T........A.....C..C.....C...T..........A.......
G._gulo_2          C..C..........A..C........T.....T........A.....C..C.....C...T..........A.......
G._gulo_3          C..C..........A..C........T.....T........A.....C..C.....C...T..........A.......
G._gulo_4          C..C..........A..C........T.....T........A.....C..C.....C...T..........A.......
M._amerina_1       ......A..T..G..A..C.....G........T........G.....C..C.....C..............A.......
M._americana_2     ......A..T..G..A..C.....G........T........G.....C..C.....C..............A.......
M._americana_3     ......A..T..G..A..C.....G........T........G.....C..C.....C..............A.......
M._erminea         C.....A..T..G.....C..............T..T.....A..............C...T..........A......T
M._erminea_2       C.....A..T..G..A..C..............T..T.....A..............C...T..........A......T
N._vison           ...C..A..T........C..............T..T.....A.....C..C..T..................A..T...T
U._americanus_1    C..C..A..T.....A.....T.....T..C.....T..T..A..G..C..C.....C..............G.....A.
U._americanus_2    C..C..A..T..G..A.....T.....T..C.....T.....A..G..C..C.....C............G..A.....A.
U._americanus_3    C..C..A..T.....A.....T.....T..C.....T..T..A..G..C..C.....C..............G.....A.
U._arctos_1        C..C..A.....G.....C..T.....T..C.....T.....A.....C..C..T..................A.....A.
U._arctos_2        C..C..A.....G.....C..T.....T..C.....T.....A.....C..C..T..................A.....A.
U._arctos_3        C..C..A.....G.....C..T.....T..C.....T.....A.....C..C..T..................A.....A.
R._tarandus_27     ......A..T.....A..C..T.....................A.....A.....A..................C.....T.
R._tarandus_22     ......A..T.....A..C..T.....................A.....A.....A..................C.....T.
R._tarandus_09     ......A..T.....A..C..T.....................A.....A.....A..................C.....T.
O._moschatus_1     C.....A..A..G..A..C........T..............A.....A.....T..C........C..............
O._moschatus_2     C.....A..A..G..A..C........T..............A.....A.....T..C........C..............
O._moschatus_3     C.....A..A..G..A..C........T..............A.....A.....T..C........C..............
O._moschatus_4     C.....A..A..G..A..C........T..............A.....A.....T..C........C..............
O._moschatus_17    C.....A..A..G..A..C........T..............A.....A.....T..C........C..............
O._moschatus_5     ---------------------------------------------------------------------------------
O._moschatus_6     ---------------------------------------------------------------------------------
O._moschatus_7     ---------------------------------------------------------------------------------
O._moschatus_8     ---------------------------------------------------------------------------------
O._moschatus_9     ---------------------------------------------------------------------------------
O._moschatus_10    ---------------------------------------------------------------------------------
O._moschatus_11    ---------------------------------------------------------------------------------
O._moschatus_12    ---------------------------------------------------------------------------------
O._moschatus_13    ---------------------------------------------------------------------------------
O._moschatus_14    ---------------------------------------------------------------------------------
O._moschatus_15    ---------------------------------------------------------------------------------
O._moschatus_16    ---------------------------------------------------------------------------------
O._moschatus_2.    C.....A..A..G..A..C........T..............A.....A.....T..C........C..............
O._moschatus_39    C.....A..A..G..A..C........T..............A.....A.....T..C........C..............
O._dalli_OD2       C..C..A..T.....A..........T............T.A.....A..C.....C..............C..C....
O._dalli_Od1       C..C..A..T.....A..........T............T.A.....A..C.....C..............C..C....
O._dalli           C..C..A..T.....A..........T............T.A.....A..C.....C..............C..C....
O._dalli_2         C..C..A..T.....A..........T............T.A.....A..C.....C..............C..C....
M._caligata        ......A..A.....A..........T..C.....T.....A..G..C..C.....C...........C...T......
M._caligata_2      ......A..A.....A..........T..C.....T.....A..G..C..C.....C...........C...T......
M._caligata_3      ......A..A.....A..........T..C.....T.....A..G..C..C.....C...........C...T......
M._broweri         ......A..A.....A..........T..C.....T.....A........C.....C...T..........C.......
M._broweri_2       ......A..A.....A..........T..C.....T.....A........C.....C...T..........C.......
M._broweri_3       ......A..A.....A......T....T..C.....T.....A........C.....C...T..........C.......
M._broweri_4       ......A..A.....A......T....T..C.....T.....A........C.....C...T..........C.......
S._parryii_S83     C..C..A..A.....A..........T..C.....T..............C.....C...........T..AT.....T
S._parryii_S79     C..C..A..A.....A..C.......T..C.....T..............C.....C........G..T..AT.....T
S._parryii         C..C..A..A.....A..C.......T..C.....T..............C.....C........G..T..AT.....T
S._parryii_2       C..C..A..A.....A..C.......T..C.....T..............C.....C........G..T..AT.....T
S._parryii_3       C..C..A..A.....A..C.......T..C.....T..............C.....C........G..T..AT.....T
T._hudsonicus_6    ---------------------------------------------------------------------------------
T._hudsonicus_2    ---------------------------------------------------------------------------------
T._hudsonicus_3    ---------------------------------------------------------------------------------
T._hudsonicus_4    ---------------------------------------------------------------------------------
T._hudsonicus_5    ---------------------------------------------------------------------------------
C._fiber           C.....A..A.....A..C......................A.....C..C.....C.....C..T.....AG....T.
C._fiber_2         C.....A..A.....A..C......................A.....C..C.....C.....C..T.....AG....T.
C._fiber_3         C.....A..A.....A..C......................A.....C..C.....C.....C..T.....AG....T.
Z._hudsonius_49    ......A..A.....A..........T..C.....T..T..A..C.........................AA.T....
Z._hudsonius_47    ......A..A.....A..........T..C.....T..T..A..C.........................AA.T....
Z._hudsonius_42    ......A..A.....A..........T..C.....T..T..A..C.........................AA.T....
Z._hudsonius_36    ......A..A.....A..........T..C.....T..T..A..C.........................AA.T....
M._glareolus_159   C.....A..A.....A.....T..C.....C.....C.....T..C.....C..T..............C..CT......
M._glareolus_152   C.....A..A.....A.....T..C.....C.....C.....T..C.....C..T..............C..CT......
M._glareolus       C.....A..A.....A..C..T..T.....T.....C.....A..C.....C..T...........G..C..CT......
D._groenlandicus_3 C.....A..A.....A........C.....C.....C..TT.A..............C..............C.....T.
D._groenlandicus_2 C.....A..A.....A........C.....C.....C..TT.A..............C..............C.....T.
D._groenlandicus_4 C.....A..A.....A........C.....C.....C..TT.A..............C..............C.....T.
L._trimucronatus   C........A.....A..C..........C.....T..........C..C.....C..............A.......
L._trimucronatus_2 C........A..G..A..C..........C.....T..........C..C.....C..............GT......
L._trimucronatus_3 C........A..G..A..C..T.......C.....C..........C..C.....C.....G..G.....C.......
M._arvalis_139     ...C..A..A.....A..C........T..C.....C..T..A........C.....C........T..C..A.....A.
M._arvalis_204     ...C..A..A.....A..C........T..C.....C..T..A........C.....C........T..C..A.....A.
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M._longicaudus     C.....A..A.....A.....T..T..T........T..T..A........C.....C........T..T..C.....AT
M._subterraneus    C.....A..A.....----------------------------------------------------------------
M._oeconomus       C.....A..A.....A..C.....C.....C.....C.....A.....A..C.....C........C.....C.......
M._oeconomus_2     C.....A..A.....A..C.....C.....C.....C.....A.....A..C.....C........C.....C.......
M._oeconomus_3     C.....A..A.....A........C.....C.....C.....A.....A..C.....C........C.....C.......
M._maximowiczii    C.....A..A.....A..C..T..CY....C.....T..T..A.....C..C.....C........C.....C.......
M._mongolicus      C........A.....A..C..T..G.....C.....C..T..A........C..T..C..............A.......
M._californicus_I  C.....A..A..G.....C.....C.....C..T..C...T.A..T..C..C..T...........T..C..C.....A.
M._californicus_J  C.....A..A..G.....C.....C.....C..T..C...T.A..T..C..C..T...........T..C..C.....A.
E._dorsatum        ......A..A.....A..................T..C........T..A..C..T..C........G.....A.......
O._collaris        ...C..A..A..G.....C...........C..T..T........C..C..C..A........T..C..C..AT......
O._collaris_2      C..C..A..A........C...........C..T..T........C..C..C..A........T..C..C..AT......
O._collaris_3      ...C..A..A..G.....C...........C..T..T........C..C..C..A..C.....T..C..C..AT......
O._collaris_4      ...C..A..A..G.....C...........C..T..T........C..C..C..A..C.....T..C..C..AT......
L._othus           ----------------------------------------------------------------------------------
L._timidus         C..C..A..T...........T.....T..C.....C..TT.A..C..C..C..T..C...........T..........
L._granatensis     C..C..A..T.....A..C........T..C..T..C..TT.G..C..C..C..T.............C..C.......
L._europaeus       C..C..A..T..G..A...........T..C.....C.....A..T..C..C..T...........T..T..........
P._largha          ...C..A...........C........T..C.........T.A.....C..C.....C..............A.......
P._largha_Pl21     ...C..A...........C........T..C.........T.A.....C..C.....C..............A.......
P._largha_Pl16     ...C..A...........C........T..C.........T.A.....C..C.....C..T...........A.......
P._largha_Pl10     ...C..A...........C........T..C.........T.A.....C..C.....C..............A.......
E._barbatus        ..............A..............C..T........A.....C..C.....C.....T........A.......
E._barbatus_2      ..............A..............C..T........A.....C..C.....C.....T........A.......
E._barbatus_3      ..............A..............C..T........A.....C..C.....C.....T........A.......
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ALTAICA4           TAGTCTTATCCATCTTAATCTTAGCCACTATCCCTGCCCTCCACACATCCAAACAACGAGGAATAATGTTTCGACCGCTA
ALT                ----------------------------------------------------------------------------------
AMO1               ----------------------------------------------------------------------------------
AMO2               ----------------------------------------------------------------------------------
AMO3/COR1          ----------------------------------------------------------------------------------
COR2               ----------------------------------------------------------------------------------
COR3               ----------------------------------------------------------------------------------
COR4               ----------------------------------------------------------------------------------
COR5               ----------------------------------------------------------------------------------
COR6               ----------------------------------------------------------------------------------
COR7               ----------------------------------------------------------------------------------
COR8               ----------------------------------------------------------------------------------
SUM1               ----------------------------------------------------------------------------------
SUM2               ----------------------------------------------------------------------------------
SUM3               ----------------------------------------------------------------------------------
SUM4               ----------------------------------------------------------------------------------
SUM5               ----------------------------------------------------------------------------------
SUM6               ----------------------------------------------------------------------------------
SUM7               ----------------------------------------------------------------------------------
SUM8               ----------------------------------------------------------------------------------
TIG1               ----------------------------------------------------------------------------------
TIG2               ----------------------------------------------------------------------------------
TIG3               ----------------------------------------------------------------------------------
TIG4               ----------------------------------------------------------------------------------
TIG5               ----------------------------------------------------------------------------------
TIG6               ----------------------------------------------------------------------------------
TIGRIS1            ........................T.........................................................
TIGRIS2            ........................T.........................................................
SUMATRA1           ........................T.....................................................A...
SUMATRA2           ........................T.....................................................A...
CORBETTI1          ........................T.....................................................A...
CORBETTI2          Y....Y..................T......Y..................................................R......
ALTAICA            ........................T.........................................................
S5_cytb            ..........................................................................
S3_cytb            ..........................................................................
B8_cytb            ........................T.........................................................
C3_cytb            ..........................................................................
C2_cytb            ........................T.........................................................
C1_cytb            ........................T.........................................................
Su10_cytb          ........................T.....................................................A...
Su9_cytb           ........................T.....................................................A...
Su7_cytb           ........................T.....................................................A...
Su6_cytb           ........................T.....................................................A...
Su5_cytb           ........................T.....................................................A...
Su4_cytb           ........................T.....................................................A...
Su3_cytb           ........................T.....................................................A...
Su2_cytb           ........................T.....................................................A...
Su1_cytb           ........................T.....................................................A...
S15_cytb           ..........................................................................
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S13_cytb          ..........................................................................
S12_cytb          ..........................................................................
S11_cytb          ..........................................................................
S10_cytb          ..........................................................................
S8_cytb           ..........................................................................
S7_cytb           ..........................................................................
S6_cytb           ..........................................................................
S4_cytb           ..........................................................................
S2_cytb           ..........................................................................
S1_cytb           ..........................................................................
B9_cytb           ........................T.................................................
B7_cytb           ........................T.................................................
B6_cytb           ........................T.................................................
B5_cytb           ........................T.................................................
B4_cytb           ..........................................................................
B3_cytb           ..........................................................................
B2_cytb           ........................T.................................................
sondaica1         --------------------------------------------------------------------------
sondaica          --------------------------------------------------------------------------
Pta               --------------------------------------------------------------------------
P._pardus         .....C........C..........AGT......C..T........T..............G..............AT..
P._pardus2        .....C........C..........AGT......C..T........T..............G..............AT..
P._pardus3        --------------------------------------------------------------------------
P._pardus1        --------------------------------------------------------------------------
P._pardus9        --------------------------------------------------------------------------
P._pardus_5       --------------------------------------------------------------------------
P._pardus40       --------------------------------------------------------------------------
P._pardus4c       --------------------------------------------------------------------------
P._pardus2c       --------------------------------------------------------------------------
P._pardus3c       --------------------------------------------------------------------------
P._pardus1c       --------------------------------------------------------------------------
P._pardus.o1      --------------------------------------------------------------------------
P._pardus.o2      --------------------------------------------------------------------------
P._pardus.03      --------------------------------------------------------------------------
P._pardus.o4      --------------------------------------------------------------------------
P._pardus.o5      --------------------------------------------------------------------------
P._pardus.o6      --------------------------------------------------------------------------
P._pardus.o7      .....C........C..........AGTC.....C-------------------------------------------
P._pardus.o8      .....C........C..........AGT......C-------------------------------------------
P._pardus.o9      .....C........C..........AGTC.....C-------------------------------------------
P._pardus.o10     .....C........C..........AGTC.....C-------------------------------------------
P._pardus.o11     .....C........C..........AGTC.....C-------------------------------------------
P._pardus.o12     .....C........C..........AGT......C-------------------------------------------
P._pardus.o13     .....C........C..........AGT......C-------------------------------------------
P._pardus.o14     --------------------------------------------------------------------------
U._uncia1         .....C..............C..A.A.T......C...........T...........G..G..............A...
U._uncia          .....C..............C..A.A.T......C...........T...........G..G..............A...
A._jubatus_4050   ..A.A..C......C.....C....A.TC..T..AATTT.......C.................A........A...
A._jubatus_4237   ..A.A..C......C.....C....A.TC..T..AATTT.......C.................A........A...
A._jubatus_4051   ..A.A..C......C.....C....A.TC..T..AATTT.......C.................A........A...
P._leo_1          --------------------------------------------------------------------------
P._leo            ....TC...................A.T..................T........G......T.............A...
P._leo_2          ....TC...................A.T..................T........G......T.............A...
P._leo.p17        --------------------------------------------------------------------------
P._leo.p16        --------------------------------------------------------------------------
P._leo.p15        --------------------------------------------------------------------------
P._leo_TSV3550    ....TC.......T...........A.T..................T........G...................A...
P._leo_KPR98      ....TC.......T...........A.T..................T........G...................A...
P._leo_BOT16      ....TC...................A.T..................T........G...................A...
P._leo_CAP30      ....TC...................A.T..................T........G...................A...
P._leo_BML22      ....TC...................A.T..................T........G...................A...
P._leo_ETO76      ....TC...................A.T..................T........G...................A...
P._leo_ETO65      ....TC...................A.T..................T........G...................A...
P._leo_PSS993     ....TC...................A.T..................T........G...................A...
R._formosae       .....C....T..TC.T...C.....G........CTAT.A..T..............TA.C...GCA..C.....C...
M._tuberculata    ..........T...C.....C...TTG.CC.A..CATA..T..................A.C....CA..C..T..CA.T
C._latrans_1      ....A..C.......C.....C.G..ATTCG.T..ATT.............T........CA.C.....A..C.....C...
C._lupus_1        ....A..C......C.....C.G..ATTC..T..ACT.............T..G.....CA.C.....A..C..G..C..T
V._vulpes         ....G..C..A...C..........ACT......CCA...A.....C..A........T..G.....A..C.....C..T
G._gulo           .....C.T......C..G..C......T...T..CCTG..G.....C..A...........C..G.....C..C..A..C
U._americanus     ..A.T..C..T...C.....C....T.T......CCTT..A...........G..................C.....C...
U._arctos         ..A.T..C.....TC.....C......TC..T...CT...A.....G.................G..A..C.....C...
R._tarandus       ......C...T...C........ATTCT...A...TTA..T..T...........G..TA.C.....A..C.....AT.C
C._elaphus        ......C.......C..G.....ATTCTC..G...CTT..T.................CA.C..G..A..C.....AT.C
O.arena           ..A..C.C..A...C..G..C...TA.T...A..CCT......T.....A..G.....GA.C.....A..C.....AA.C
T._hudsonicus     ....A..T..T..TC.T...C.CAT.CTAT.T..CATT.....TGT...A..G..G..TA.T........C..T..C..C
G._sabrinus       ....A..T.....TC.C...C.TATATTAT....AAT...T..T.T............CA.C.....A..C.....A...
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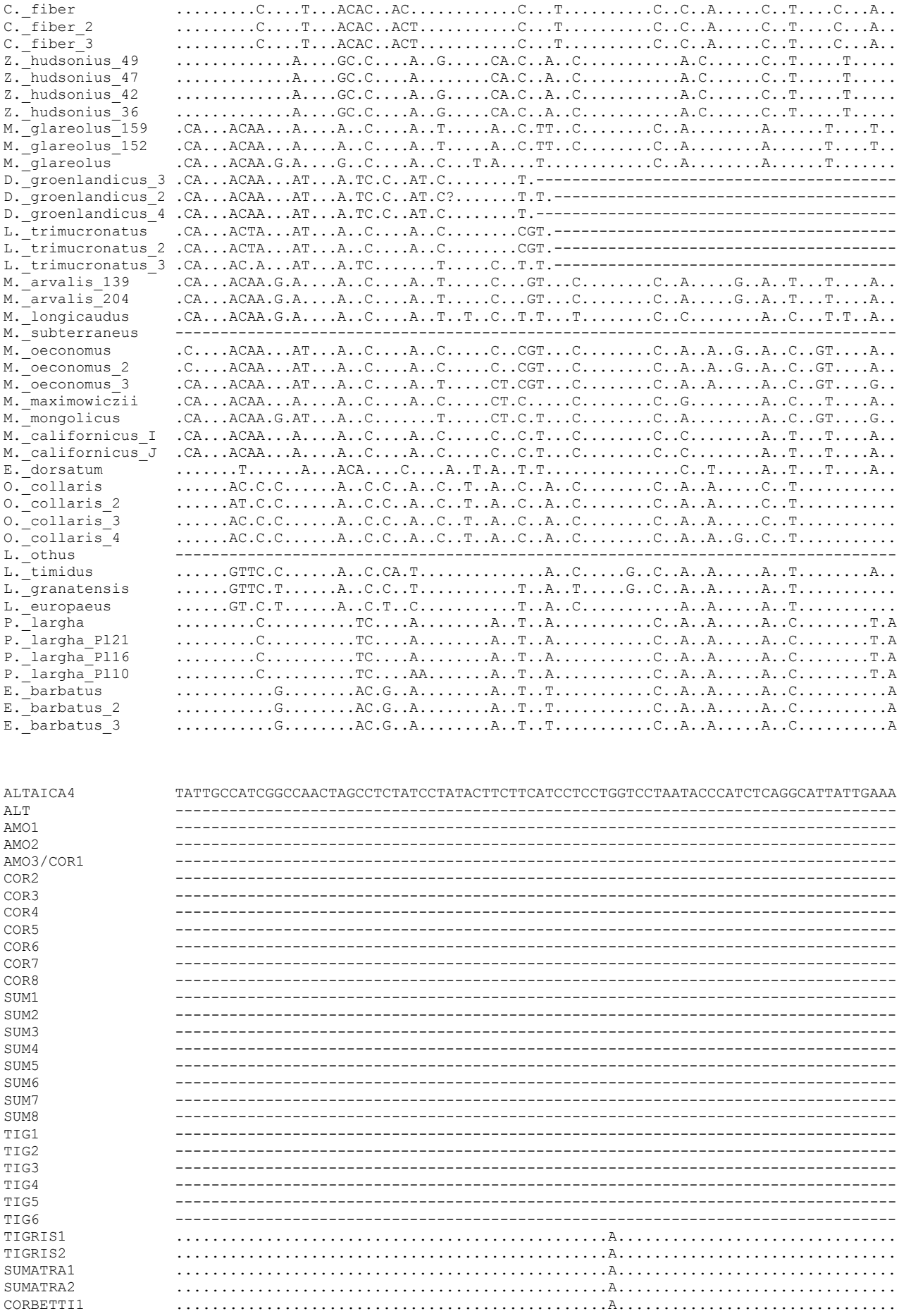
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T._hudsonicus_1    .....C.C..A..TC.TG..C......TCG.T..ATTA..A..T.ATG.T..T.....TA.C..G..C..C.....AA.T
Z._hudsonius       ..A.TC.C..T..TC.C..TC......T.G....ATTT..T....ACG.T..C.....TA.T.....T..C.....TA.T
H._sapiens         ..T.AC........C.C...C....A.TA.....CAT......T.T...........A.A.C.....A.....C..A...
C._lupus           ....A..C......C.......G..ATTC..T..ACT............T..G.....CA.C.....A..C..G..C..T
C._lupus1          ....A..C......C.......G..ATTC..T..ACT............T..G.....CA.C.....A..C..G..C..T
V.vulpes           ....G..C..A...C..........ACT......CCA...A.....C..A........T..G.....A..C.....C..T
V._vulpes_1        ....G..C..A...C..........ACT......CCA...A.....C..A........T..G.....A..C.....C..T
V._vulpes_2        ....G..C..A...C..........ACT......CCA...A.....C..A........T..G.....A..C.....C..T
L._canadensis      ...C.C.C......C..G.........TC.....CCTA..G.....C..G........G..C..G.....C..T..A...
G._gulo_1          .....C.T......C..G..C......T...T..CCTG..G.....C..A..........C..G..A..C..C..A..C
G._gulo_2          .....C.T......C..G..C......T...T..CCTG..G.....C..A..........C..G..A..C..C..A..C
G._gulo_3          .....C.T......C..G..C......T...T..CCTG..G.....C..A..........C..G..A..C..C..A..C
G._gulo_4          .....C.T......C..G..C......T...T..CCTG..G.....C..A..........C..G..A..C..C..A..C
M._amerina_1       .......C......C..G..C.G..A.T.G....ATTG.....T..T..A..........C..G..A..C..C..A..C
M._americana_2     .......C......C..G..C.G..A.T.G....ATTG.....T..T..A..........C..G..A..C..C..A..C
M._americana_3     .......C......C..G..C.G..A.T.G....ATTG.....T..T..A..........C..G..A..C..C..A..C
M._erminea         .......C......C..G.AC......TC.CT..CCTA.........C..A.........A.T.....A..C..C..A...
M._erminea_2       .......C......C..G.AC......TC..T..CCTA.........C..A.........A.T.....A..C..C..A...
N._vison           ....T..T..T..TC..G.TC....T.TC..T..CCTA..G.....C..A.........A.C..G..A..C..C..A...
U._americanus_1    ..A.T..C..T...C.....C....T.T......CCTT..A..........G.................C.....C...
U._americanus_2    ..A.T..C..T...C.....C....T.T......CCTT..A..........G.................C.....C...
U._americanus_3    ..A.T..C..T...C.....C....T.T......CCTT..A..........G.................C.....C...
U._arctos_1        ..A.T..C.....TC.....C......TC..T...CTT..A.....G..................G..A..C..G..C...
U._arctos_2        ..A.T..C.....TC.....C......TC..T...CTT..A.....G..................G..A..C..G..C...
U._arctos_3        ..A.T..C.....TC...C.C......TC..T...CTT..A.....G..................G..A..C..G..C...
R._tarandus_27     ......C...T...C........ATTCT...A...TTA..T..T..........G..TA.C.....A..C.....AT.C
R._tarandus_22     ......C...T...C........ATTCT...A...TTA..T..T..........G..TA.C.....A..C.....AT.C
R._tarandus_09     ......C...T...C........ATTCT...A...TTA..T..T..........G..TA.C.....A..C.....AT.T
O._moschatus_1     ..C..C.C..A..TC....TC....ACTCG.A...TT.....................A.C.....A..C.....AA.C
O._moschatus_2     ..C..C.C..A..TC....TC....ACTCG.A...TT.....................A.C.....A..C.....AA.C
O._moschatus_3     ..C..C.C..A..TC....TC....ACTCG.A...TT.....................A.C.....A..C.....AA.C
O._moschatus_4     ..C..C.C..A..TC....TC....ACTCG.A...TT.....................A.C.....A..C.....AA.C
O._moschatus_17    ..C..C.C..A..TC....TC....ACTCG.A...TT.....................A.C.....A..C.....AA.C
O._moschatus_5     ----------------------------------------------------------------------------------
O._moschatus_6     ----------------------------------------------------------------------------------
O._moschatus_7     ----------------------------------------------------------------------------------
O._moschatus_8     ----------------------------------------------------------------------------------
O._moschatus_9     ----------------------------------------------------------------------------------
O._moschatus_10    ----------------------------------------------------------------------------------
O._moschatus_11    ----------------------------------------------------------------------------------
O._moschatus_12    ----------------------------------------------------------------------------------
O._moschatus_13    ----------------------------------------------------------------------------------
O._moschatus_14    ----------------------------------------------------------------------------------
O._moschatus_15    ----------------------------------------------------------------------------------
O._moschatus_16    ----------------------------------------------------------------------------------
O._moschatus_2.    ..C..C.C..A..TC....TC....ACTCG.A...TT.....................A.C.....A..C.....AA.C
O._moschatus_39    ..C..C.C..A..TC....TC....ACTCG.A...TT.....................A.C.....A..C.....AA.C
O._dalli_OD2       ..A..C.C..A...C..G..C...TA.TC..G..CCT............A..G.....A.C.....A..C.....AA.C
O._dalli_Od1       ..A..C.C..A...C..G..C...TA.TC..G..CCT............A..G.....A.C.....A..C.....AA.C
O._dalli           ..A..C.C..A...C..G..C...TA.TC..G..CCT............A..G.....A.C.....A..C.....AA.C
O._dalli_2         ..A..C.C..A...C..G..C...TA.TC..G..CCT............A..G.....A.C.....A..C.....AA.C
M._caligata        ....A..T..A..TC.T..T...ATACTCT....ACTA.....TT...T........TA.T.....A..C.....AT..
M._caligata_2      ....A..T..A..TC.T..T...ATACTCT....ACTA.....TT...T........TA.T.....A..C.....AT..
M._caligata_3      ....A..T..A..TC.T..T...ATACTCT....ACTA.....TT...T........TA.T.....A..C.....AT..
M._broweri         ..A....C..G..TC.T..T...ATACTCT....ATTA..T..TCTG..T..G.....CA.C.....A........AT..
M._broweri_2       ..A....C..G..TC.T..T...ATACTCT....ATTA..T..TCTG..T..G.....CA.C.....A........AT..
M._broweri_3       ..A....C..G..TC.T..T...ATACTCT....ACTA..T..TCT...T..G.....CA.C.....A........AT..
M._broweri_4       ..A....C..G..TC.T..T...ATACTCT....ACTA..T..TCT...T..G.....CA.C.....A........AT..
S._parryii_S83     ....AC.C..A..TC.C...C..ATACT.T....ACTA.....TTT...T...........C.....A........A...
S._parryii_S79     ...CG..C..A..TC.C...C..ATACT.T....ACTA..T..TCT...T.........A.C.....A........A...
S._parryii         ...CG..C..A..TC.T...C..ATACT.T....ACTA..T..TCT...T.........A.C.....A........A...
S._parryii_2       ...CG..C..A..TC.C...C..ATACT.T....ACTA..T..TCT...T.........A.C.....A........A...
S._parryii_3       ...CG..C..A..TC.C...C..ATACT.T....ACTA..T..TCT...T.........A.C.....A........A...
T._hudsonicus_6    ----------------------------------------------------------------------------------
T._hudsonicus_2    ----------------------------------------------------------------------------------
T._hudsonicus_3    ----------------------------------------------------------------------------------
T._hudsonicus_4    ----------------------------------------------------------------------------------
T._hudsonicus_5    ----------------------------------------------------------------------------------
C._fiber           .CA.AC....A...C..G..C....AG.CT....ACT............A.........A.CC....A..C..T..AA.C
C._fiber_2         .CA.GC....A...C..G..C....AG.CT....ACT............A.........A.CC....A..C..T..AA.C
C._fiber_3         .CA.GC....A...C..G..C....AG.CT....ACT............A.........A.CC....A..C..T..AA.C
Z._hudsonius_49    ..A.TC.C..T..TC.C...C......T.G....ATTT..T..T.ATG.T..C.....TA.C..G..T..C.....TA.C
Z._hudsonius_47    ..A.TC.C..T..TC.C...C......T.G....ATTT..T..T.ATG.T..C.....TA.C.....T........TA.C
Z._hudsonius_42    ..A.TC.C..T..TC.C...C......T.G....ATTT..T..T.ATG.T..C.....TA.C..G..T..C.....TA.C
Z._hudsonius_36    ..A.TC.C..T..TC.C...C......T.G....ATTT..T..T.ATG.T..C.....TA.C..G..T..C.....TA.C
M._glareolus_159   ..A..C....A...C.....C.....CT.C.A..ACT......T..C..A........C..GC.C.CC..C.....AA.C
M._glareolus_152   ..A..C....A...C.....C.....CT.C.A..ACT......T..C..A........C..GC.C.CC..C.....AA.C
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M._glareolus       ..A..C....A...C.....C.....CTCC.A..ACT...T.....C..A........C...C.C.CC..C.....AA.T
D._groenlandicus_3 .CA..C....A..T...G.TC.....CTC..A..?TT...T.....C.............?CC...CA..C..C..AA.C
D._groenlandicus_2 .CA..C....A..T...G.TC.....CTC..A...TT...T.....C.............CC...CA..C..C..AA.C
D._groenlandicus_4 .CA..C....A..T...G.TC.....CTC..A...TT...T.....C.............CC...CA..C..C..AA.C
L._trimucronatus   ..A....G..A..T......C.....CTC..A..ACTT........C..A..G.........C.T.CC..C.....CA.C
L._trimucronatus_2 ..A....G..A..T......C.....CTC..A..ACTT........C..A..G.........C.T.CC..C.....CA.T
L._trimucronatus_3 ..A.......A...C.C...C.....CT...A..GTT.........C..A..G........GC.T.CC..C.....TA.T
M._arvalis_139     .GA..C....A...G.....C.....TT...A..ACT.........T..A..........C.T.G.CT..C..C..AA.C
M._arvalis_204     .GA..C....A...G.....C.....TT...A..ACT.........T..A..........C.T.G.CT..C..C..AA.C
M._longicaudus     ..A..C....A...C.....C.....CT...A..ACTA..T.....C..G..........C.C.C..C..C..T..AA.C
M._subterraneus    --------------------------------------------------------------------------------
M._oeconomus       ..A..C....A...C.....C.....CTC..A..ACTA..T.....C..A..........C.C.C.CC..C..C..AA.T
M._oeconomus_2     ..A..C....A...C.....C.....CTC..A..ACTA..T.....C..A..........C.C.C.CC..C..C..AA.T
M._oeconomus_3     ..A..C....A...C.....C.....CTC..A..ACTA..T.....C..A..........C.C.C.CC..C..C..AA.T
M._maximowiczii    ..........A...C...........CT...A..GATA..T.....C..A..........CTC.C.CC..C..C..AA.C
M._mongolicus      .....C....A...C...........CTC..A..AAT...T.....C..A..........CGC.C.CC..C..C..AA.C
M._californicus_I  ..A.TC....T.............TCTC..A...CT.........C..A......AA.AC.C...CT..C..C..AA.C
M._californicus_J  ..A.TC....T.............TCTC..A...CT.........C..A......AA.AC.C...CT..C..C..AA.C
E._dorsatum        ....AC.C..A...C.T...C.....CTA..G..ATT...A...T.C..A.........AAC...TCA.....C..CA.C
O._collaris        .TA..C....A..TGCT..TC.C..T.TC..A..CCT...........A.........A.C.....A..C.....AA.C
O._collaris_2      .TA.......A..TGCT..TC.C..T.TC..A..CCT...........A.........A.C.....A..C.....AA.C
O._collaris_3      .TA..C....A..TGCT..TC.C..T.TC..A..CCT...........A.........A.C.....A..C.....AA.C
O._collaris_4      .TA..C....A..TGCT..TC.C..T.TC..A..CCT...........A.........A.C.....A..C.....AA.C
L._othus           --------------------------------------------------------------------------------
L._timidus         ....TA....A..TC.C...C....A.T......CTT........T...........CA.C.....A..C......A.T
L._granatensis     .G..TA....A..TC.T...C....A.T.T....CTT........T...........TA.C.....A..C.....TA.T
L._europaeus       ....TA....A..TC.T...C....A.T......CTT...T..T.T...........CA.C.....A..C..C..CA.T
P._largha          ....AC.C.....TC.T...C.C..T.TCG.A..CCTA........G..A..............G..A..C..G..CA.C
P._largha_Pl21     ....AC.C.....TC.T...C.C..T.TCG.A..CCTA........G..A..............G..A..C..G..CA.C
P._largha_Pl16     ....AC.C.....TC.T...C.C..T.TCG.A..CCTA........G..A..............G..A..C..G..CA.C
P._largha_Pl10     ....AC.C.....TC.T...C.C..T.TCG.A..CCTA........G..A..............G..A..C..G..CA.C
E._barbatus        ....GC.C..T...C.....C.C....TCGCT..CCTA.....T.....A..............A..C.....CA.C
E._barbatus_2      ....GC.C..T...C.....C.C....TCGCT..CCTA.....T.....A..............A..C.....CA.C
E._barbatus_3      ....GC.C..T...C.....C.C....TCGCT..CCTA.....T.....A..............A..C.....CA.C
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ALTAICA4           AGCCAATGCTTATTCTGACTCTTAGTGGCAGACCTTCTAACCCTAACATGAATTGGTGGCCAACCTGTAGAACACCCCTT
ALT                --------------------------------------------------------------------------------
AMO1               --------------------------------------------------------------------------------
AMO2               --------------------------------------------------------------------------------
AMO3/COR1          --------------------------------------------------------------------------------
COR2               --------------------------------------------------------------------------------
COR3               --------------------------------------------------------------------------------
COR4               --------------------------------------------------------------------------------
COR5               --------------------------------------------------------------------------------
COR6               --------------------------------------------------------------------------------
COR7               --------------------------------------------------------------------------------
COR8               --------------------------------------------------------------------------------
SUM1               --------------------------------------------------------------------------------
SUM2               --------------------------------------------------------------------------------
SUM3               --------------------------------------------------------------------------------
SUM4               --------------------------------------------------------------------------------
SUM5               --------------------------------------------------------------------------------
SUM6               --------------------------------------------------------------------------------
SUM7               --------------------------------------------------------------------------------
SUM8               --------------------------------------------------------------------------------
TIG1               --------------------------------------------------------------------------------
TIG2               --------------------------------------------------------------------------------
TIG3               --------------------------------------------------------------------------------
TIG4               --------------------------------------------------------------------------------
TIG5               --------------------------------------------------------------------------------
TIG6               --------------------------------------------------------------------------------
TIGRIS1            ....................................G...........................................
TIGRIS2            ....................................G...........................................
SUMATRA1           ....................................G...........................................
SUMATRA2           ....................................G...........................................
CORBETTI1          ................................................................................
CORBETTI2          .....R....Y.......Y..........R........G.....R...........Y..................Y.....
ALTAICA            ....................................G...........................................
S5_cytb            ....................................G...........................................
S3_cytb            ................................................................................
B8_cytb            ....................................G...........................................
C3_cytb            ................................................................................
C2_cytb            ....................................G...........................................
C1_cytb            ....................................G...........................................
Su10_cytb          ....................................G...........................................
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Su9_cytb          ....................................G.....................................
Su7_cytb          ....................................G.....................................
Su6_cytb          ....................................G.....................................
Su5_cytb          ....................................G.....................................
Su4_cytb          ....................................G.....................................
Su3_cytb          ....................................G.....................................
Su2_cytb          ....................................G.....................................
Su1_cytb          ....................................G.....................................
S15_cytb          ....................................G.....................................
S13_cytb          ....................................G.....................................
S12_cytb          ....................................G.....................................
S11_cytb          ....................................G.....................................
S10_cytb          ....................................G.....................................
S8_cytb           ....................................G.....................................
S7_cytb           ....................................G.....................................
S6_cytb           ....................................G.....................................
S4_cytb           ....................................G.....................................
S2_cytb           ....................................G.....................................
S1_cytb           ....................................G.....................................
B9_cytb           ....................................G.....................................
B7_cytb           ....................................G.....................................
B6_cytb           ....................................G.....................................
B5_cytb           ....................................G.....................................
B4_cytb           ....................................G.....................................
B3_cytb           ....................................G.....................................
B2_cytb           ....................................G.....................................
sondaica1         ------------------------------------------------------------------------
sondaica          ------------------------------------------------------------------------
Pta               ------------------------------------------------------------------------
P._pardus         .....G...........T..C....A..G.........G....G..G.........................
P._pardus2        .....G...........T..C....A..G.........G....G..G.........................
P._pardus3        ------------------------------------------------------------------------
P._pardus1        ------------------------------------------------------------------------
P._pardus9        ------------------------------------------------------------------------
P._pardus_5       ------------------------------------------------------------------------
P._pardus40       ------------------------------------------------------------------------
P._pardus4c       ------------------------------------------------------------------------
P._pardus2c       ------------------------------------------------------------------------
P._pardus3c       ------------------------------------------------------------------------
P._pardus1c       ------------------------------------------------------------------------
P._pardus.o1      ------------------------------------------------------------------------
P._pardus.o2      ------------------------------------------------------------------------
P._pardus.03      ------------------------------------------------------------------------
P._pardus.o4      ------------------------------------------------------------------------
P._pardus.o5      ------------------------------------------------------------------------
P._pardus.o6      ------------------------------------------------------------------------
P._pardus.o7      ------------------------------------------------------------------------
P._pardus.o8      ------------------------------------------------------------------------
P._pardus.o9      ------------------------------------------------------------------------
P._pardus.o10     ------------------------------------------------------------------------
P._pardus.o11     ------------------------------------------------------------------------
P._pardus.o12     ------------------------------------------------------------------------
P._pardus.o13     ------------------------------------------------------------------------
P._pardus.o14     ------------------------------------------------------------------------
U._uncia1         .....G...........T..C....A..........G.....G..........C.....G..C......T.T..T..
U._uncia          .....G...........T..C....A..........G.....G..........C.....G..C......T.T..T..
A._jubatus_4050   ..................C....A........C..C................C.....................
A._jubatus_4237   ..................C....A........C..C................C.....................
A._jubatus_4051   ..................C....A........C..C................C.....................
P._leo_1          ------------------------------------------------------------------------
P._leo            ..T.............T..C....A..G........G.....G.....................................
P._leo_2          ..T.............T..C....A..G........G.....G.....................................
P._leo.p17        ------------------------------------------------------------------------
P._leo.p16        ------------------------------------------------------------------------
P._leo.p15        ------------------------------------------------------------------------
P._leo_TSV3550    ..T.............T..C....A..G........G.....G.....................................
P._leo_KPR98      ..T.............T..C....A..G........G.....G.....................................
P._leo_BOT16      ..T.............T..C....A..G........G.....G.....................................
P._leo_CAP30      ..T.............T..C....A..G........G.....G.....................................
P._leo_BML22      ..T.............T..C....A..G........G.....G.....................................
P._leo_ETO76      ..T.............T..C....A..G........G.....G.....................................
P._leo_ETO65      ..T.............T..C....A..G........G.....G.....................................
P._leo_PSS993     ..T.............T..C....A..G........G.....G.................G.....................
R._formosae       ........TC....T......C....A........CT....A.....C........A...........C........A..
M._tuberculata    .......T.C.G..T.....TC.............A..C..A.....C........G........A..T........T.A
C._latrans_1      .........C.G........T.....C..C..T.....C...T..........C..A..A.....A..T........T..
C._lupus_1        .........C..........T.....C..C..T.....C..TT.............A..A.....A..T........T..
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V._vulpes          ..T......C..........TC..ACC........C..C...T....T.....C..A..G..G..A..............
G._gulo            .........C....T.....GC....A..C.....C..C...T.G..C........G.......A...........A..
U._americanus      .........C..........TC....A........A.....A...........C..A..G.....A..............
U._arctos          .........C....T.....TC....A........A.....A..............A..A.....A........T.....
R._tarandus        ..T......C........A.T.....A.....T..A.....A..C...........A..A.....A..T.....T.....
C._elaphus         ..T......C........A.......A.....T..A.....A..T........C..A..A.....A..C...T.......
O.arena            ..T.....TA........A..C....A..C.....AT....A..C...........A.....G..A..T..........A
T._hudsonicus      ..T..............A..........G..T..CT.T........C.....C..A..A..G..A......T.T..A..
G._sabrinus        .........C.T......A..C.C..A..C..T..CT.T...T............C........A..T...T.......
T._hudsonicus_1    ..T..........A....GC.C....A..T......A.G..A..T..G.....C..A..T.....G..C....CT..A..
Z._hudsonius       ............A....GC.C....A.....T..CA.C..A..C...........A.CT.....C..T...T.......
H._sapiens         .......CAC.T.AT......C...CC........C..C.TT.....C.....C..A..A.....A...AGCT....T..
C._lupus           .........C..........T.....C..C..T.....C..TT.............A..A.....A..T........T..
C._lupus1          .........C..........T.....C..C..T.....C..TT.............A..A.....A..T........T..
V.vulpes           ..T......C..........TC..ACC........C..C...T....T.....C..A..G..G..A..............
V._vulpes_1        ..T......C..........TC..ACC..G.....C..C...T....T.....C..A..G..G..A..............
V._vulpes_2        ..T......C..........TC..ACC........C..C...T....T.....C..A..G..G..A..............
L._canadensis      .........C..........GC..ACA..T...T.A..T...T..........C..C........A...........A..
G._gulo_1          ..............T.....GC....A..C.....C..C...T.G..C........G.......A...........A..
G._gulo_2          ..............T.....GC....A..C.....C..C...T.G..C........G.......A...........A..
G._gulo_3          ..............T.....GC....A..C.....C..C...T.G..C........G.......A...........A..
G._gulo_4          ..............T.....GC....A..C.....C..C...T.G..C........G.......A...........A..
M._amerina_1       .........C..........A.....A..T.....C..T...T....C..G.....A..A..G..C...........A..
M._americana_2     .........C..........A........T.....C..T...T....C..G.....A..A..G..C...........A..
M._americana_3     .........C..........A.....A..T.....C..T...T....C..G.....A..A..G..C...........A..
M._erminea         ....................GC....A..T.....CT..........C.....C...........A...........A..
M._erminea_2       ....................GC....A..T.....CT..........C.....C...........A...........A..
N._vison           .....G.....G......T.AC....A..T..T..C..T..A.....C.....C..C........A...........A..
U._americanus_1    .........C..........TC....A........A.....A...........C..A..G.....A..............
U._americanus_2    .........C...........C...CA........A.....A...........C..A..A.....A..............
U._americanus_3    .........C..........TC....A........A.....A...........C..A..G.....A..............
U._arctos_1        .........C....T.....TC....A........A.....A...........C..A..A.....A........T.....
U._arctos_2        .........C....T.....TC....A........A.....A...........C..A..A.....A........T.....
U._arctos_3        .........C....T.....TC....A........A.....A..............A..A.....A........T.....
R._tarandus_27     ..T......C........A.T.....A.....T..A.....A..C...........A..A.....A..T.....T.....
R._tarandus_22     ..T......C........A.T.....A.....T..A.....A..C...........A..A.....A..T.....T.....
R._tarandus_09     ..T......C........A.T.....A.....T..A.....A..C...........A..A.....A..T.....T.....
O._moschatus_1     ........TA........A.AC....A......T.A..G..A..C...........A..A..G..G..C........T.A
O._moschatus_2     ........TA........A.AC....A......T.A..G..A..C...........A..A..G..G..C........T.A
O._moschatus_3     ........TA........A.AC....A......T.A..G..A..C...........A..A..G..G..C........T.A
O._moschatus_4     ........TA........A.AC....A......T.A..G..A..C...........A..A..G..G..C........T.A
O._moschatus_17    ........TA........A.AC....A......T.A..G..A..C...........A..A..G..G..C........T.A
O._moschatus_5     --------------------------------------------------------------------------------
O._moschatus_6     --------------------------------------------------------------------------------
O._moschatus_7     --------------------------------------------------------------------------------
O._moschatus_8     --------------------------------------------------------------------------------
O._moschatus_9     --------------------------------------------------------------------------------
O._moschatus_10    --------------------------------------------------------------------------------
O._moschatus_11    --------------------------------------------------------------------------------
O._moschatus_12    --------------------------------------------------------------------------------
O._moschatus_13    --------------------------------------------------------------------------------
O._moschatus_14    --------------------------------------------------------------------------------
O._moschatus_15    --------------------------------------------------------------------------------
O._moschatus_16    --------------------------------------------------------------------------------
O._moschatus_2.    ........TA........A.AC....A......T.A..G..A..C...........A..A..G..G..C........T.A
O._moschatus_39    ........TA........A.AC....A......T.A..G..A..C...........A..A..G..G..C........T.A
O._dalli_OD2       .........A........A.TC....A..C.....A.....A..C...........A.....G..A..T..........A
O._dalli_Od1       .........A........A.TC....A..C.....A.....A..C...........A.....G..A..T..........A
O._dalli           .........A........A.TC....A..C.....A.....A..C...........A.....G..A..T..........A
O._dalli_2         .........A........A.TC....A..C.....A.....A..C...........A.....G..A..T..........A
M._caligata        ........TA....T...A.TC....A........AT.T..A..G..C.....C..A..A.....C..T...T....A.A
M._caligata_2      ........TA....T...A.TC....A........AT.T..A..G..C.....C..A..A.....C..T...T....A.A
M._caligata_3      ........TA....T...A.TC....A........AT.T..A..G..C.....C..A..A.....C..T...T....A.A
M._broweri         ........TA....T...A.T.....A........AA.T..A.....C.....C..A..A...T..ACT...T....A.A
M._broweri_2       ........TA....T...A.T.....A........AA.T..A.....C.....C..A..A...T..ACT...T....A.A
M._broweri_3       ........TG....T...A.T.....A........AA.T..A.....C.....C..A..A...T..ACT...T....A.A
M._broweri_4       ........TG....T...A.T.....A........AA.T..A.....C.....C..A..A...T..ACT...T....A.A
S._parryii_S83     ..T......A........A.TC....A........AT.T..AT....C........A..A.....C..T...T....A..
S._parryii_S79     ..T......G....T...A.TC....A........AT.T..AT....C........A..A.....C..T...T....A..
S._parryii         ..T......G....T...A.TC....A........AT.T..AT....C........A..A.....C..T...T....A..
S._parryii_2       ..T......G....T...A.TC....A........AT.T..AT....C........A..A.....C..T...T....A..
S._parryii_3       ..T......G....T...A.TC....A........AT.T..AT....C........A..A.....C..T...T....A..
T._hudsonicus_6    --------------------------------------------------------------------------------
T._hudsonicus_2    --------------------------------------------------------------------------------
T._hudsonicus_3    --------------------------------------------------------------------------------
T._hudsonicus_4    --------------------------------------------------------------------------------
T._hudsonicus_5    --------------------------------------------------------------------------------
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C._fiber .....C....T...ACAC..AC.....C...T.....C..C..A.....C..T....C...A..
C._fiber_2 .....C....T...ACAC..ACT.....C...T.....C..C..A.....C..T....C...A..
C._fiber_3 .....C....T...ACAC..ACT.....C...T.....C..C..A.....C..T....C...A..
Z._hudsonius_49 .....A....GC.C....A..G.....CA.C..A..C.....A.C.....C..T.....T.....
Z._hudsonius_47 .....A....GC.C....A.....CA.C..A..C.....A.C.....C..T.....T.....
Z._hudsonius_42 .....A....GC.C....A..G.....CA.C..A..C.....A.C.....C..T.....T.....
Z._hudsonius_36 .....A....GC.C....A..G.....CA.C..A..C.....A.C.....C..T.....T.....
M._glareolus_159 .CA...ACAA...A....A..C....A..T.....A..C.TT..C.....C..A.....A.....T....T..
M._glareolus_152 .CA...ACAA...A....A..C....A..T.....A..C.TT..C.....C..A.....A.....T....T..
M._glareolus .CA...ACAA.G.A....G..C....A..C...T.A....T.....C..A.....A.....T.....
D._groenlandicus_3 .CA...ACAA...AT...A.TC.C..AT.C.....T.----------
D._groenlandicus_2 .CA...ACAA...AT...A.TC.C..AT.C?.....T.T.----------
D._groenlandicus_4 .CA...ACAA...AT...A.TC.C..AT.C.....T.----------
L._trimucronatus .CA...ACTA...AT...A..C....A..C.....CGT.----------
L._trimucronatus_2 .CA...ACTA...AT...A..C....A..C.....CGT.----------
L._trimucronatus_3 .CA...AC.A...AT...A.TC.....T.....C..T.T.----------
M._arvalis_139 .CA...ACAA.G.A....A..C....A..T.....C...GT...C.....C..A.....G..A..T...T....A..
M._arvalis_204 .CA...ACAA.G.A....A..C....A..T.....C...GT...C.....C..A.....G..A..T...T....A..
M._longicaudus .CA...ACAA.G.A....A..C....A..T..T..C..T.T...T.....C..C.....A..C...T.T..A..
M._subterraneus ----------
M._oeconomus .C....ACAA...AT...A..C....A..C.....C..CGT...C.....C..A..A..G..A..C..GT....A..
M._oeconomus_2 .C....ACAA...AT...A..C....A..C.....C..CGT...C.....C..A..A..G..A..C..GT....A..
M._oeconomus_3 .CA...ACAA...AT...A..C....A..T.....CT.CGT...C.....C..A..A.....A..C..GT....G..
M._maximowiczii .CA...ACAA...A....A..C....A..C.....CT.C.....C.....C..G.....A..C...T....A..
M._mongolicus .CA...ACAA.G.AT...A..C.....T.....CT.C.T...C.....C..A.....A..C..GT....G..
M._californicus_I .CA...ACAA...A....A..C....A..C.....C..C.T...C.....C..C.....A..T...T....A..
M._californicus_J .CA...ACAA...A....A..C....A..C.....C..C.T...C.....C..C.....A..T...T....A..
E._dorsatum .....T.....A...ACA....C....A..T.A..T.T.....C..T.....A..T...T....A..
O._collaris .....AC.C.C.....A..C.C..A..C..T..A..C..A..C.....C..A..A.....C..T.....
O._collaris_2 .....AT.C.C.....A..C.C..A..C..T..A..C..A..C.....C..A..A.....C..T.....
O._collaris_3 .....AC.C.C.....A..C.C..A..C..T..A..C..A..C.....C..A..A.....C..T.....
O._collaris_4 .....AC.C.C.....A..C.C..A..C..T..A..C..A..C.....C..A..A..G..C..T.....
L._othus ----------
L._timidus .....GTTC.C.....A..C.CA.T.....A..C.....G..C..A..A.....A..T.....A..
L._granatensis .....GTTC.T.....A..C.C..T.....T..A..T.....G..C..A..A.....A..T.....
L._europaeus .....GT.C.T.....A..C.T..C.....T..A..C.....A..A.....A..T.....
P._largha .....C.....TC....A.....A..T..A.....C..A..A.....A..C.....T.A
P._largha_Pl21 .....C.....TC....A.....A..T..A.....C..A..A.....A..C.....T.A
P._largha_Pl16 .....C.....TC....A.....A..T..A.....C..A..A.....A..C.....T.A
P._largha_Pl10 .....C.....TC....AA.....A..T..A.....C..A..A.....A..C.....T.A
E._barbatus .....G.....AC.G..A.....A..T..T.....C..A..A.....A..C.....A
E._barbatus_2 .....G.....AC.G..A.....A..T..T.....C..A..A.....A..C.....A
E._barbatus_3 .....G.....AC.G..A.....A..T..T.....C..A..A.....A..C.....A
ALTAICA4 TATTGCCATCGGCCAACTAGCCTCTATCCTATACTTCTTCATCCTCCTGGTCCTAATACCCATCTCAGGCATTATTGAAA
ALT ----------
AMO1 ----------
AMO2 ----------
AMO3/COR1 ----------
COR2 ----------
COR3 ----------
COR4 ----------
COR5 ----------
COR6 ----------
COR7 ----------
COR8 ----------
SUM1 ----------
SUM2 ----------
SUM3 ----------
SUM4 ----------
SUM5 ----------
SUM6 ----------
SUM7 ----------
SUM8 ----------
TIG1 ----------
TIG2 ----------
TIG3 ----------
TIG4 ----------
TIG5 ----------
TIG6 ----------
TIGRIS1 .....A.....
TIGRIS2 .....A.....
SUMATRA1 .....A.....
SUMATRA2 .....A.....
CORBETTI1 .....A.....

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CORBETTI2          Y...R.................Y.................YY.AR.............................
ALTAICA            ..................................................A.....................
S5_cytb            ..................................................A.....................
S3_cytb            .................................................A......................
B8_cytb            .................................................A......................
C3_cytb            .................................................A......................
C2_cytb            .................................................A......................
C1_cytb            .................................................A......................
Su10_cytb          .................................................A......................
Su9_cytb           .................................................A......................
Su7_cytb           .................................................A......................
Su6_cytb           .................................................A......................
Su5_cytb           .................................................A......................
Su4_cytb           .................................................A......................
Su3_cytb           .................................................A......................
Su2_cytb           .................................................A......................
Su1_cytb           .................................................A......................
S15_cytb           .................................................A......................
S13_cytb           ..................................................A.....................
S12_cytb           .................................................A......................
S11_cytb           ..................................................A.....................
S10_cytb           ..................................................A.....................
S8_cytb            .................................................A......................
S7_cytb            .................................................A......................
S6_cytb            .................................................A......................
S4_cytb            .................................................A......................
S2_cytb            .................................................A......................
S1_cytb            .................................................A......................
B9_cytb            .................................................A......................
B7_cytb            .................................................A......................
B6_cytb            .................................................A......................
B5_cytb            .................................................A......................
B4_cytb            .................................................A......................
B3_cytb            .................................................A......................
B2_cytb            .................................................A......................
sondaica1          ------------------------------------------------------------------------
sondaica           ------------------------------------------------------------------------
Pta                ------------------------------------------------------------------------
P._pardus          C...A.................C.............C.........A...........T...............
P._pardus2         C...A.................C.............C.........A...........T...............
P._pardus3         ------------------------------------------------------------------------
P._pardus1         ------------------------------------------------------------------------
P._pardus9         ------------------------------------------------------------------------
P._pardus_5        ------------------------------------------------------------------------
P._pardus40        ------------------------------------------------------------------------
P._pardus4c        ------------------------------------------------------------------------
P._pardus2c        ------------------------------------------------------------------------
P._pardus3c        ------------------------------------------------------------------------
P._pardus1c        ------------------------------------------------------------------------
P._pardus.o1       ------------------------------------------------------------------------
P._pardus.o2       ------------------------------------------------------------------------
P._pardus.03       ------------------------------------------------------------------------
P._pardus.o4       ------------------------------------------------------------------------
P._pardus.o5       ------------------------------------------------------------------------
P._pardus.o6       ------------------------------------------------------------------------
P._pardus.o7       ------------------------------------------------------------------------
P._pardus.o8       ------------------------------------------------------------------------
P._pardus.o9       ------------------------------------------------------------------------
P._pardus.o10      ------------------------------------------------------------------------
P._pardus.o11      ------------------------------------------------------------------------
P._pardus.o12      ------------------------------------------------------------------------
P._pardus.o13      ------------------------------------------------------------------------
P._pardus.o14      ------------------------------------------------------------------------
U._uncia1          C..CA.......G...........C........T....CT..T.....A.............................
U._uncia           C..CA.......G...........C........T....CT..T.....A.............................
A._jubatus_4050    ....A.................C..T..........CA.C......A..T........T..T........C..C....
A._jubatus_4237    ....A.................C..T..........CA.C......A..T........T..T........C..C....
A._jubatus_4051    ....A.................C..T..........CA.C......A..T........T..T........C..C....
P._leo_1           ------------------------------------------------------------------------
P._leo             C..CA.................C.............C...T..T..AA.............................
P._leo_2           C..CA.................C.............C...T..T..AA.............................
P._leo.p17         ------------------------------------------------------------------------
P._leo.p16         ------------------------------------------------------------------------
P._leo.p15         ------------------------------------------------------------------------
P._leo_TSV3550     C..CA....T.............C.............C...T..T..AA.......................C....
P._leo_KPR98       C..CA....T.............C.............C...T..T..AA.......................C....
P._leo_BOT16       C..CA.................C.............C..CT..T..AA.............................
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P._leo_CAP30      C..CA.................C.............C..CT..T..AA.............................
P._leo_BML22      C..CA.................C.............C..CT..T..AA.............................
P._leo_ETO76      C..CA.................C.............C..CT..T..AA.............................
P._leo_ETO65      C..CA.................C.............C..CT..T..AA.............................
P._leo_PSS993     C..CA.................C.............C...T..T..AA.............................
R._formosae       ...CATA.....A........A..C...T....T...C.A...A.T..AA.T.....GA.AC..G..A...GCGCA....
M._tuberculata    C..ACTA..T......AC......A.....C.......CTC..A....AA..T.C..G..TT.AG.C..T..CGCA....
C._latrans_1      C..CAT......A...G.C.....AG.T.....T...AC....T.AT..A.T........A..AATTA..G....C....
C._lupus_1        C..CATT.....A...G.C..T..A...T....T...AC....T.AT..A.........A.CAGTTA..G....C....
V._vulpes         ...CAT...T......A.T.....C.....G..T..TGCT...T.AT..A.T.....G..A.C.ATTA.......C....
G._gulo           ...CA..................A.....C..T...GC.........AA.TT.C.....AG..G.CA....CG.C..G.
U._americanus     ...CATT........GT.G...........C......ACA........A..G..C..G..T...G.T..G..C........
U._arctos         C...ATT.....A...........C..T..C.....TACA........A..A..T......G..G.T..A..........
R._tarandus       ....A.G..T..A...T....A..A..T..............TA.T..A..A..T.....A..TA.CA.T..A..C....
C._elaphus        ...CATT..T..A........A...G..T....T........TA....A.....C.....A...A.CA...CA..C....
O.arena           C..CATT..T..A........A.....TA....T...C.T...A.T..A...A.......AG.AG.TA....C..C....
T._hudsonicus     C...A.T..T...........A..C............TACT...A.T..CT.TGCCC.C...C.AATCA.TC.GC......
G._sabrinus       ...CA.T.....A...G....A..A.....C..T..TACT..TA.T..CA..T..C.C...C..ATCA..T.AC.C..G.
T._hudsonicus_1   C...ATA.....A...G.G..................T.CA-----------------------------------------
Z._hudsonius      .G.CATT..T..A...G..........T..C..T..T.CA-----------------------------------------
H._sapiens        ..CCAT...T..A...G....A..CG.A.........ACA.CAA....AA..........A.CTATCTC.C.A........
C._lupus          C.CCATT.....A...G.C..T..A...T....T...AC....T.AT..A..........A.CAGTTA..G....C....
C._lupus1         C.CCATT.....A...G.C..T..A...T....T...AC....T.AT..A..........A.CAGTTA..G....C....
V.vulpes          ...CAT...T......A.T.....C.....G..T..TGCT...T.AT..A.T.....G..A.C.ATTA.......C....
V._vulpes_1       ...CAT...T......A.T.....C.....G..T..TGCT...T.AT..A.T.....G..A.C.ATTA.......C....
V._vulpes_2       ...CAT...T......A.T.....C.....G..T..TGCT...T.AT..A.TT....G..A.C.ATTA.......C....
L._canadensis     C..CAT...T..............A.....C......ACA.....A...A....C.....AGC.GTCA.....G.C..G.
G._gulo_1         ...CA..................A.....C..T...GC.........AA.TT.C.....AG..G.CA....CG.C..G.
G._gulo_2         ...CA..................A.....C..T...GC.........AA.TT.C.....AG..G.CA....CG.C..G.
G._gulo_3         ...CA..................A.....C..T...GC.........AA.TT.C.....AG..G.CA....CG.C..G.
G._gulo_4         ...CA..................A.....C..T...GC.........AA.TT.C.....AG..G.CA....CG.C..G.
M._amerina_1      C..CA.T.....T...........A.....C......GCA.....T..AA....T..G..AGC.ATTA.............
M._americana_2    C..CA.T.....T...........A.....C......GCA.....T..AA....T..G..AGC.ATTA.............
M._americana_3    C..CA.T.....T...........A.....C......GCA.....T..AA....T..G..AGC.ATTA.............
M._erminea        C..CA....T..............A..T..C......A.A......T.A.....T.....A..TATTA.......C....
M._erminea_2      C..CA....T..............A..T..C......A.A......T.A.....T.....A..TATTA.......C....
N._vison          C..CA.T.........T....T..A.....C..T...A.A........A...T.C..G..A...GTCA.T..C........
U._americanus_1   ...CATT........GT.G...........C......ACA........A..G..C..G..T...G.T..G..C........
U._americanus_2   ...CATT.....A..G..G.....CG....C......ACA....C...A..G..C..G......G.T..G..C........
U._americanus_3   ...CATT........GT.G...........C......ACA........A..G..C..G..T...G.T..G..C........
U._arctos_1       C..CATT.....A...........C..T..C.....TACA........A..A..T.........G.T..A..........
U._arctos_2       C..CATT.....A...........C..T..C.....TACA........A..A..T.........G.T..A..........
U._arctos_3       C..CATT.....A...........C..T..C.....TACA........A..A..T.........G.T..A..........
R._tarandus_27    ....A.G..T..A...T....A..A..T..............TA....A..A..T.....A..TA.CA.T.CA..C....
R._tarandus_22    ....A.A..T..A...T....A..A..T...........T..TA....A..A..T.....A..TA.CA...CA..C....
R._tarandus_09    ....A.A..T..A...T....A..A..T...........T..TA....A..A..T.....A..TA.CA...CA..C....
O._moschatus_1    ...CATT..T..A........A..C...A........C.....A.......G.....G..A..GG.TA...C...C....
O._moschatus_2    ...CATT..T..A........A..C...A........C.....A.......G.....G..A..GG.TA...C...C....
O._moschatus_3    ...CATT..T..A........A..C...A........C.....A.......G.....G..A..GG.TA...C...C....
O._moschatus_4    ...CATT..T..A........A..C...A........C.....A.......G.....G..A..GG.TA...C...C....
O._moschatus_17   ...CATT..T..A........A..C...A........C.....A.......G.....G..A..GG.TA...C...C....
O._moschatus_5    -------------------------------------------------------------------------------
O._moschatus_6    -------------------------------------------------------------------------------
O._moschatus_7    -------------------------------------------------------------------------------
O._moschatus_8    -------------------------------------------------------------------------------
O._moschatus_9    -------------------------------------------------------------------------------
O._moschatus_10   -------------------------------------------------------------------------------
O._moschatus_11   -------------------------------------------------------------------------------
O._moschatus_12   -------------------------------------------------------------------------------
O._moschatus_13   -------------------------------------------------------------------------------
O._moschatus_14   -------------------------------------------------------------------------------
O._moschatus_15   -------------------------------------------------------------------------------
O._moschatus_16   -------------------------------------------------------------------------------
O._moschatus_2.   ...CATT..T..A........A..C...A........C.....A.......G.....G..A..GG.TA...C...C....
O._moschatus_39   ...CATT..T..A........A..C...A........C..-----------------------------------------
O._dalli_OD2      C...ATT..T..A...T....G......A....T...C.....A.T..A..TA.......AG.AG.TA....C..C....
O._dalli_Od1      C...ATT..T..A...T....G......A....T...C.....A.T..A..TA.......AG.AG.TA....C..C....
O._dalli          C...ATT..T..A...T....G......A....T...C.....A.T..A..TA.......AG.AG.TA....C..C....
O._dalli_2        C...ATT..T..A...T....G......A....T...C.....A.T..A..TA.......AG.AG.TA....C..C....
M._caligata       ....AT..............A..A.....C..T...GCT..TA.T..CT.AA.TT....A.CTATTA.TC.A........
M._caligata_2     ....AT..............A..A.....C..T...GCT..TA.T..CT.AA.TT....A.CTATTA.TC.A........
M._caligata_3     ....AT..............A..A.....C..T...GCT..TA.T..CT.AA.TT....A.CTATTA.TC.A........
M._broweri        ..A.AT...T..A...T....A..A..T.........GCT..TA.T..CT.AA.CT....A.CTATTA..C.A........
M._broweri_2      ..A.AT...T..A...T....A..A..T.........GCT..TA.T..CT.AA.CT....A.CTATTA..C.A........
M._broweri_3      ..A.AT...T..A...T....A..A..T.........GCT..TA.T..CT.AA.CT....A.CTATTA..C.A........
M._broweri_4      ..A.AT...T..A...T....A..A..T.........GCT..TA.T..CT.AA.CT....A.CTATTA..C.A........
S._parryii_S83    ...CATT..T...........A..A........T...AC...TA.T..CC.AA.CT....A.C.GTCA..C.A........
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S._parryii_S79     ....ATT..T..........A..A...........ACA..TA.T..CC.AA.CT....A.C.GTCA..C.A..C....
S._parryii         ....ATT..T..........A..A...........ACA..TA.T..CC.AA.CT....A.C.GTCA..C.A..C....
S._parryii_2       ....ATT..T..........A..A...........ACA..TA.T..CC.AA.CT....A.C.GTCA..C.A..C....
S._parryii_3       ....ATT..T..........A..A...........ACA.CTA.T..CC.AA.CT....A.C.GTCA..C.A..C....
T._hudsonicus_6    ----------------------------------------------------------------------------
T._hudsonicus_2    ----------------------------------------------------------------------------
T._hudsonicus_3    ----------------------------------------------------------------------------
T._hudsonicus_4    ----------------------------------------------------------------------------
T._hudsonicus_5    ----------------------------------------------------------------------------
C._fiber           C...AT...T......A....A..A...........C....A....C.....C.......CTG.TA..C.A..C....
C._fiber_2         C...AT...T......A....A..A...........C....A....C.....C.......CTG.TA..C.A..C....
C._fiber_3         C...AT...T......A....A..A...........C....A....CA....C.......CTG.TA..C.A..C....
Z._hudsonius_49    ....AT...T..A...G..........T..C..T....CA----------------------------------------
Z._hudsonius_47    ....AT...T..A...G..........T..C..T....CA----------------------------------------
Z._hudsonius_42    ....AT...T..A...G..........T..C..T....CA----------------------------------------
Z._hudsonius_36    ....AT...T..A...G..........T..C..T....CA----------------------------------------
M._glareolus_159   C..CATT.....A...A.......A...ACC..T..TGC....A..G.CA.TT.C.....A..AG....A..AT.-----
M._glareolus_152   C..CATT.....A...A.......A...ACC..T..TGC....A..G.CA.TT.C.....A.------------------
M._glareolus       C...ATT..T..A..GA.......A...GCC......GC...TA..G----------------------------------
D._groenlandicus_3 ----------------------------------------------------------------------------
D._groenlandicus_2 ----------------------------------------------------------------------------
D._groenlandicus_4 ----------------------------------------------------------------------------
L._trimucronatus   ----------------------------------------------------------------------------
L._trimucronatus_2 ----------------------------------------------------------------------------
L._trimucronatus_3 ----------------------------------------------------------------------------
M._arvalis_139     C..CAT...T......AC...T..A..TGCC.....TGCT...A..G.TA..T.C.....A..T----------------
M._arvalis_204     C..CAT...T......AC...T..A..TGCC.....TGCT...A..G.TA..T------------------------
M._longicaudus     C..CATT..T......GC......A..TGCC......GCT..TA.TG.AA....C.....A...G....T..G..C....
M._subterraneus    ----------------------------------------------------------------------------
M._oeconomus       C..CAT......A...TC......A..TGCC......GCT...A..G.AA.T..C.....A...G....T..A.......
M._oeconomus_2     C..CAT......A...AC......A..TGCC......GCT...A..G.AA.T..C.....A...G....T..A.......
M._oeconomus_3     C..CAT......A...AC......A..TGCC......ACT...A.TG.AA.T..C.....A...G.......A.......
M._maximowiczii    C...AT......G..GG.T.....AG..GCC......ACT..TA..ACAA.T..C.........A..AAT.CA..C....
M._mongolicus      C..CAT......A..GAC......A..TGCT......ACT...A..A.AA..........A..TA..A.TC.A.W.....
M._californicus_I  C...AT...T..A...GC......A..TGCC......AC....A..G.AA.T........A...G....A..A..C....
M._californicus_J  C...AT...T..A...GC......A..TGCC......AC....A..G.AA.T........A...G....A..A..C....
E._dorsatum        ...CCTA.CT..............C..TACT..T.........A..T.AA....C......C.AA..A....A..A....
O._collaris        C..CATT..............A..AT....T.........C.AA....A.....C..G..AGC..GCA..T.A.....G.
O._collaris_2      C..CATT..............A..AT....T.........C.AA....A.....C..G..AGC..GCA..T.A.....G.
O._collaris_3      C..CATT..............A..AT....T.........C.AA....A.....C..G..AGC..GCA..T.A.....G.
O._collaris_4      C..CATT..............A..AT....T.........C.AA....A.....C..G..AGC..GCA..T.A.....G.
L._othus           ----------------------------------------------------------------------------
L._timidus         ....A.T..T..A...G....A........C.......CT...A....TA....T......C.TG..A..T.A.......
L._granatensis     ...CA.T..T..A...G....A..A..T..T......AC....A....CA....T......C..G..A..T.AG.C..G.
L._europaeus       ...CA.T..T..T...G....A..............C....A....TA....C.....TC..G..A..C.AG.C..G.
P._largha          ...CA....T..T..........A...........TACA........A..A..C.........TG.CA....CG.C....
P._largha_Pl21     ...CA....T..T..........A...........TACA........A..A..C.........TG.CA.....G.C....
P._largha_Pl16     ...CA....T..T..........A...........TACA........A..A..C.........TG.CA.....G.C....
P._largha_Pl10     ...CA....T..T..........A...........TACA........A..A..C.........TG.CA....CG.C....
E._barbatus        C..CA.......A...T.......A...........TGCA........A..AT.T..G......G.CA.......C....
E._barbatus_2      C..CA.......A...T.......A...........TGCA........A..AT.T..G......G.CA.......C....
E._barbatus_3      C..CA.......A...T.......A...........TGCA........A..AT.T..G......G.CA.......C....
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ALTAICA4           ACCGCCTCCTTAAATGA
ALT                -----------------
AMO1               -----------------
AMO2               -----------------
AMO3/COR1          -----------------
COR2               -----------------
COR3               -----------------
COR4               -----------------
COR5               -----------------
COR6               -----------------
COR7               -----------------
COR8               -----------------
SUM1               -----------------
SUM2               -----------------
SUM3               -----------------
SUM4               -----------------
SUM5               -----------------
SUM6               -----------------
SUM7               -----------------
SUM8               -----------------
TIG1               -----------------
TIG2               -----------------
```

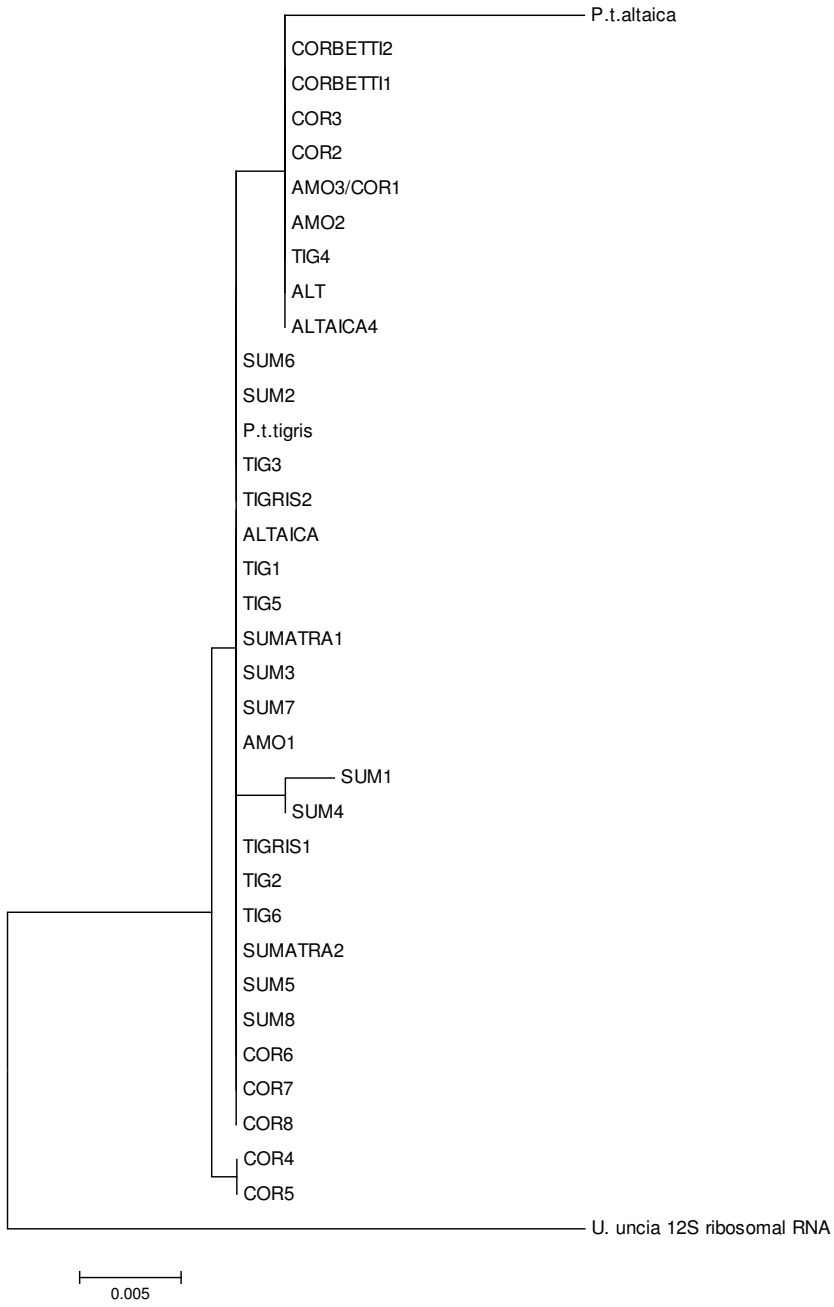
```
TIG3              -----------------
TIG4              -----------------
TIG5              -----------------
TIG6              -----------------
TIGRIS1           .................
TIGRIS2           .................
SUMATRA1          .................
SUMATRA2          .................
CORBETTI1         .............-----
CORBETTI2         .................
ALTAICA           .................
S5_cytb           .................
S3_cytb           .................
B8_cytb           .................
C3_cytb           .................
C2_cytb           .................
C1_cytb           .................
Su10_cytb         .................
Su9_cytb          .................
Su7_cytb          .................
Su6_cytb          .................
Su5_cytb          .................
Su4_cytb          .................
Su3_cytb          .................
Su2_cytb          .................
Su1_cytb          .................
S15_cytb          .................
S13_cytb          .................
S12_cytb          .................
S11_cytb          .................
S10_cytb          .................
S8_cytb           .................
S7_cytb           .................
S6_cytb           .................
S4_cytb           .................
S2_cytb           .................
S1_cytb           .................
B9_cytb           .................
B7_cytb           .................
B6_cytb           .................
B5_cytb           .................
B4_cytb           .................
B3_cytb           .................
B2_cytb           .................
sondaica1         -----------------
sondaica          -----------------
Pta               -----------------
P._pardus         .................
P._pardus2        .................
P._pardus3        -----------------
P._pardus1        -----------------
P._pardus9        -----------------
P._pardus_5       -----------------
P._pardus40       -----------------
P._pardus4c       -----------------
P._pardus2c       -----------------
P._pardus3c       -----------------
P._pardus1c       -----------------
P._pardus.o1      -----------------
P._pardus.o2      -----------------
P._pardus.03      -----------------
P._pardus.o4      -----------------
P._pardus.o5      -----------------
P._pardus.o6      -----------------
P._pardus.o7      -----------------
P._pardus.o8      -----------------
P._pardus.o9      -----------------
P._pardus.o10     -----------------
P._pardus.o11     -----------------
P._pardus.o12     -----------------
P._pardus.o13     -----------------
P._pardus.o14     -----------------
U._uncia1         .................
U._uncia          .................
A._jubatus_4050   ..........A......
A._jubatus_4237   ..........A......
A._jubatus_4051   ..........A......
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P._leo_1            -----------------
P._leo              .......T..C......
P._leo_2            ..........C......
P._leo.p17          -----------------
P._leo.p16          -----------------
P._leo.p15          -----------------
P._leo_TSV3550      ..........C......
P._leo_KPR98        ..........C......
P._leo_BOT16        ..........C......
P._leo_CAP30        ..........C......
P._leo_BML22        ..........C......
P._leo_ETO76        ..........C......
P._leo_ETO65        ..........C......
P._leo_PSS993       .T........C......
R._formosae         ...AT..AT.A......
M._tuberculata      .T.A...TA.A......
C._latrans_1        .TAA...T..A......
C._lupus_1          ..AA...T..A......
V._vulpes           ..AAT.....A......
G._gulo             .TAAT..TT.A......
U._americanus       .TAA....TCA......
U._arctos           ..AA....T.A..G..G
R._tarandus         .TAAT.....A......
C._elaphus          ..AA......A......
O.arena             ..AA......A......
T._hudsonicus       ..AAA............
G._sabrinus         .TAAA..T..A......
T._hudsonicus_1     -----------------
Z._hudsonius        -----------------
H._sapiens          ..AAAA.A..C.....G
C._lupus            ..AA......A......
C._lupus1           ..AA......A......
V.vulpes            ..AAT.....A......
V._vulpes_1         ..AAT.....A......
V._vulpes_2         ..AAT.....A......
L._canadensis       .TAA...A..G......
G._gulo_1           .TAAT..TT.A......
G._gulo_2           .TAAT..TT.A......
G._gulo_3           .TAAT..TT.A......
G._gulo_4           .TAAT..TT.A......
M._amerina_1        .TAA...AT.A......
M._americana_2      .TAA...AT.A......
M._americana_3      .TAA...AT.A......
M._erminea          .TAA.A.AT.A......
M._erminea_2        .TAA.A.AT.A......
N._vison            .TAAT..AT.A......
U._americanus_1     .TAA....TCA......
U._americanus_2     ..AA....TCA......
U._americanus_3     .TAA....TCA......
U._arctos_1         ..AA....T.A..G..G
U._arctos_2         ..AA....T.A..G..G
U._arctos_3         ..AA....T.A..G..G
R._tarandus_27      .TAAT.....A......
R._tarandus_22      .TAAT.....A......
R._tarandus_09      .TAAT.....A......
O._moschatus_1      ..AA......A......
O._moschatus_2      ..AA......A......
O._moschatus_3      ..AA......A......
O._moschatus_4      ..AA......A......
O._moschatus_17     ..AA......A......
O._moschatus_5      -----------------
O._moschatus_6      -----------------
O._moschatus_7      -----------------
O._moschatus_8      -----------------
O._moschatus_9      -----------------
O._moschatus_10     -----------------
O._moschatus_11     -----------------
O._moschatus_12     -----------------
O._moschatus_13     -----------------
O._moschatus_14     -----------------
O._moschatus_15     -----------------
O._moschatus_16     -----------------
O._moschatus_2.     ..AA......A......
O._moschatus_39     -----------------
O._dalli_OD2        .TAA...T..A......
O._dalli_Od1        .TAA...T..A......
O._dalli            .TAA...T..A......
```

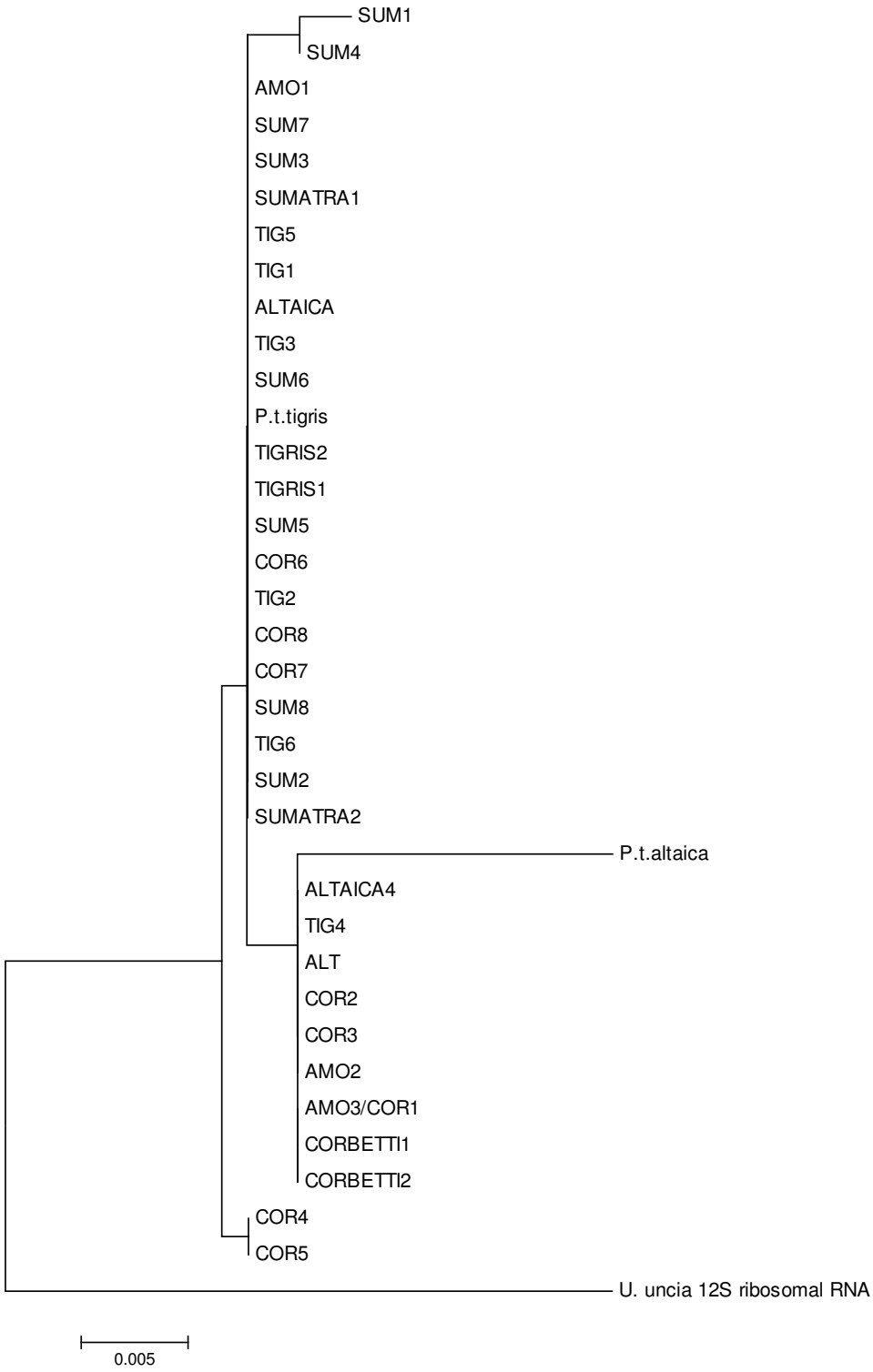
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O._dalli_2          .TAA...T..A......
M._caligata         ..AAA............
M._caligata_2       ..AAA............
M._caligata_3       ..AAA............
M._broweri          ..AAA..T.........
M._broweri_2        ..AAA..T.........
M._broweri_3        ..AAA..T.........
M._broweri_4        ..AAA..T.........
S._parryii_S83      .TAAA..T.........
S._parryii_S79      .TAAA..T.........
S._parryii          .TAAA..T.........
S._parryii_2        .TAAA..T.........
S._parryii_3        .TAAA..T.........
T._hudsonicus_6     ----------------
T._hudsonicus_2     ----------------
T._hudsonicus_3     ----------------
T._hudsonicus_4     ----------------
T._hudsonicus_5     ----------------
C._fiber            ..AAAA.A..C......
C._fiber_2          ..AAAA.A..C......
C._fiber_3          ..AAAA.A..C......
Z._hudsonius_49     ----------------
Z._hudsonius_47     ----------------
Z._hudsonius_42     ----------------
Z._hudsonius_36     ----------------
M._glareolus_159    ----------------
M._glareolus_152    ----------------
M._glareolus        ----------------
D._groenlandicus_3  ----------------
D._groenlandicus_2  ----------------
D._groenlandicus_4  ----------------
L._trimucronatus    ----------------
L._trimucronatus_2  ----------------
L._trimucronatus_3  ----------------
M._arvalis_139      ----------------
M._arvalis_204      ----------------
M._longicaudus      ..AA.A....AG.CCT.
M._subterraneus     ----------------
M._oeconomus        .TAA.A.TT.A..CCT.
M._oeconomus_2      .TAA.A.TT.A..CCT.
M._oeconomus_3      .TAA.A.TT.A..CCT.
M._maximowiczii     ..AATA.T..AG.C.T.
M._mongolicus       ..AA.A.T..A..CCT.
M._californicus_I   ..AA.A....AG.CCT.
M._californicus_J   ..AA.A....AG.CCT.
E._dorsatum         ..AAA..T..C......
O._collaris         ..AAA..A..C......
O._collaris_2       ..AAA..A..C......
O._collaris_3       ..AAA..A..C......
O._collaris_4       ..AAA..A..C......
L._othus            ----------------
L._timidus          .TAAAA...........
L._granatensis      .TAAAA....C......
L._europaeus        .TAAAA....C......
P._largha           .TAA.A....A......
P._largha_Pl21      .TAA.A....A......
P._largha_Pl16      .TAA.A..G.A......
P._largha_Pl10      .TAA.A....A......
E._barbatus         .TAATA....A......
E._barbatus_2       .TAATA....A......
E._barbatus_3       .TAATA....A......
```

6.6 Appendix 6: The phylogenetic trees reconstructed from 37 tiger mitochondrial genes by using five different methods: neighbour-joining, minimum evolution, maximum parsimony, UPGMA, and Mr.Bayes method.

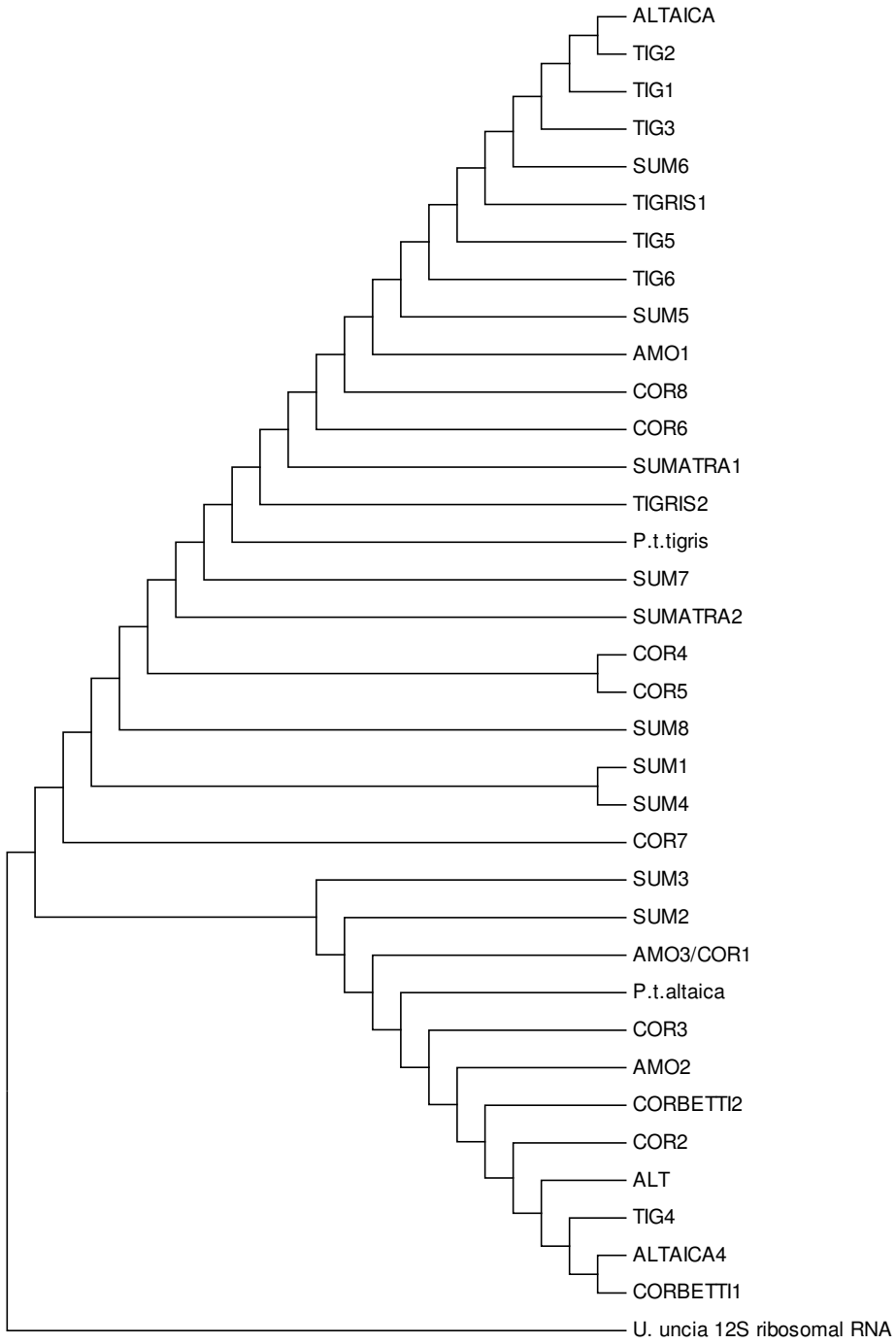
12S rRNA_Neighbour-joining



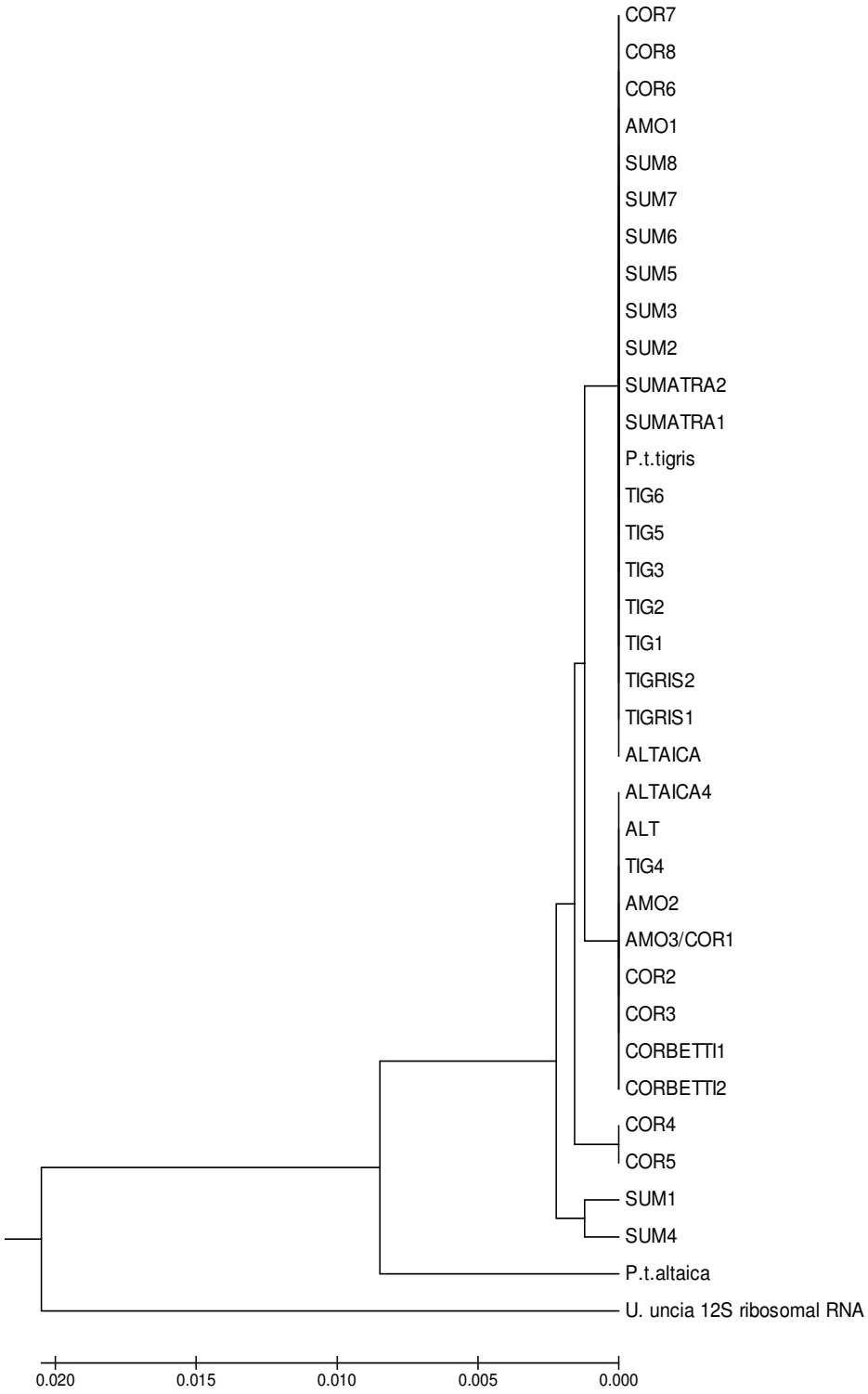
12S rRNA_Minimum evolution



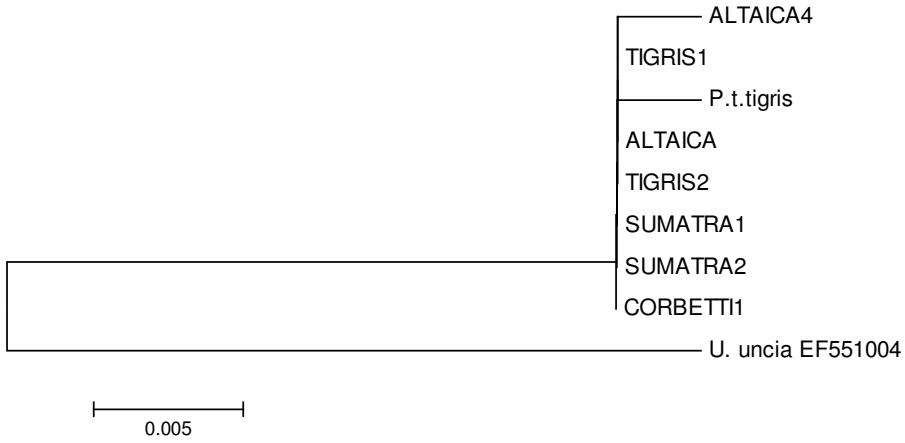
12S rRNA_Parsimony



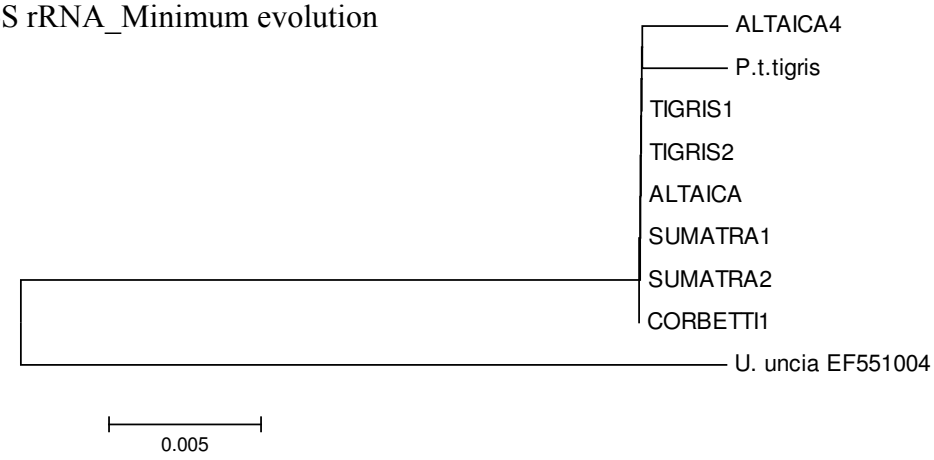
12S rRNA_UPGMA



16S rRNA_Neighbour-joining

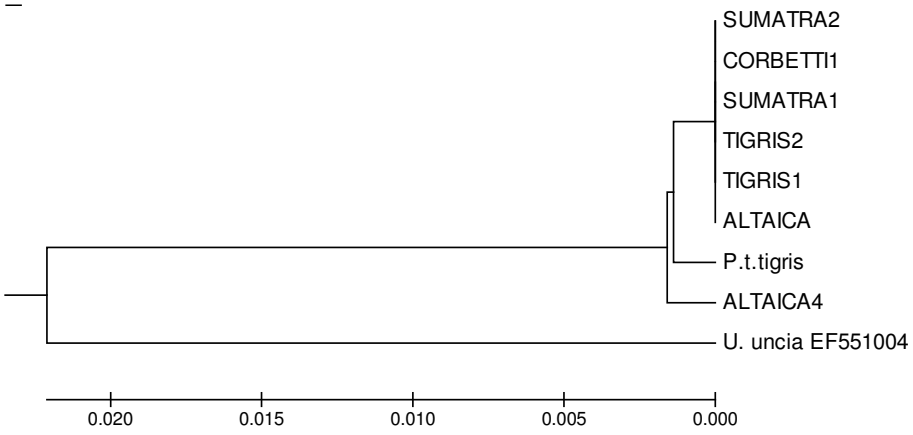


16S rRNA_Minimum evolution

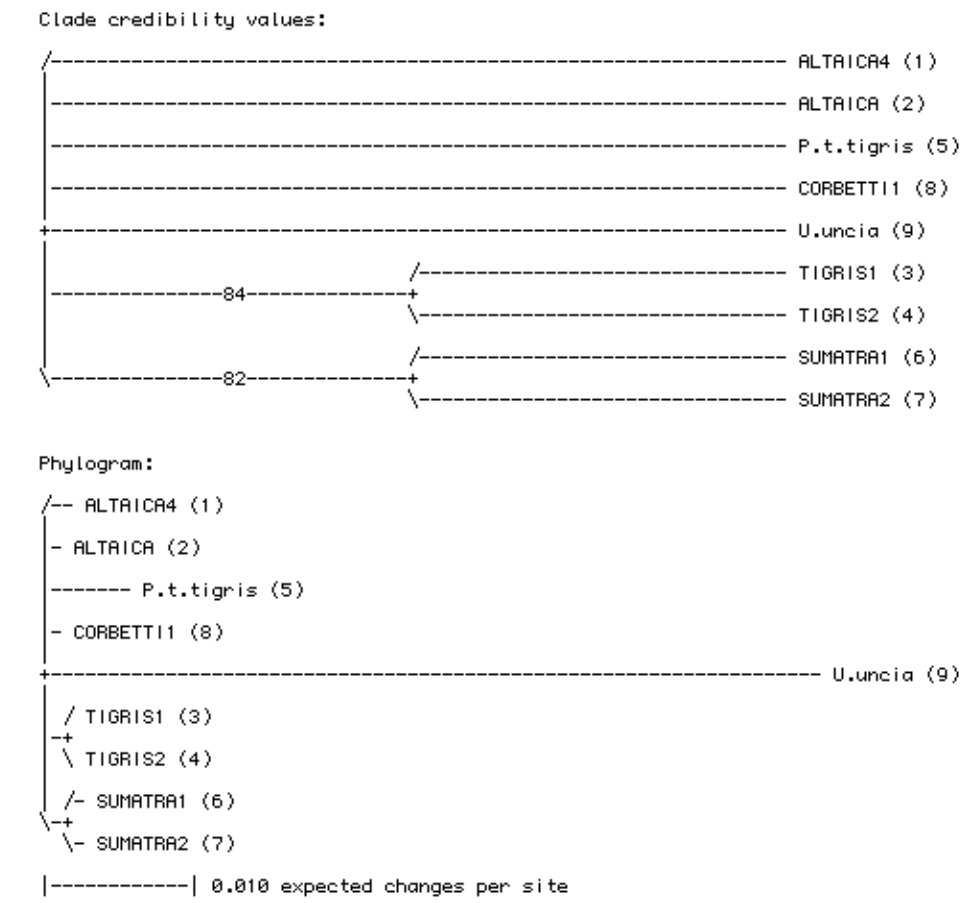


16S_Parsimony (Not enough parisomy sites)

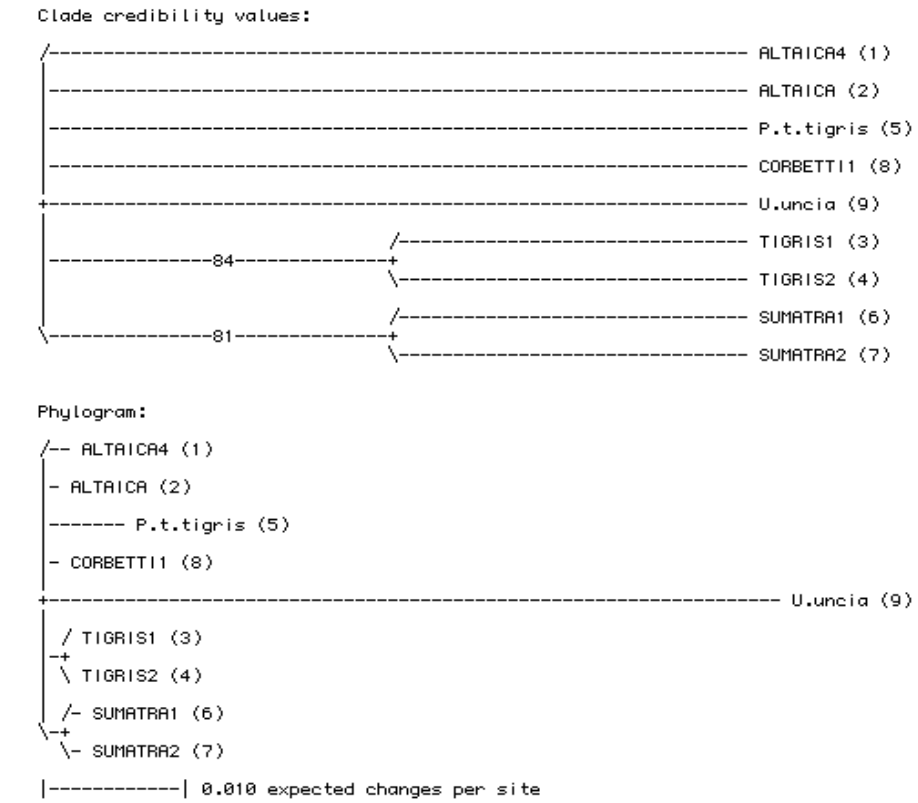
16S_UPGMA



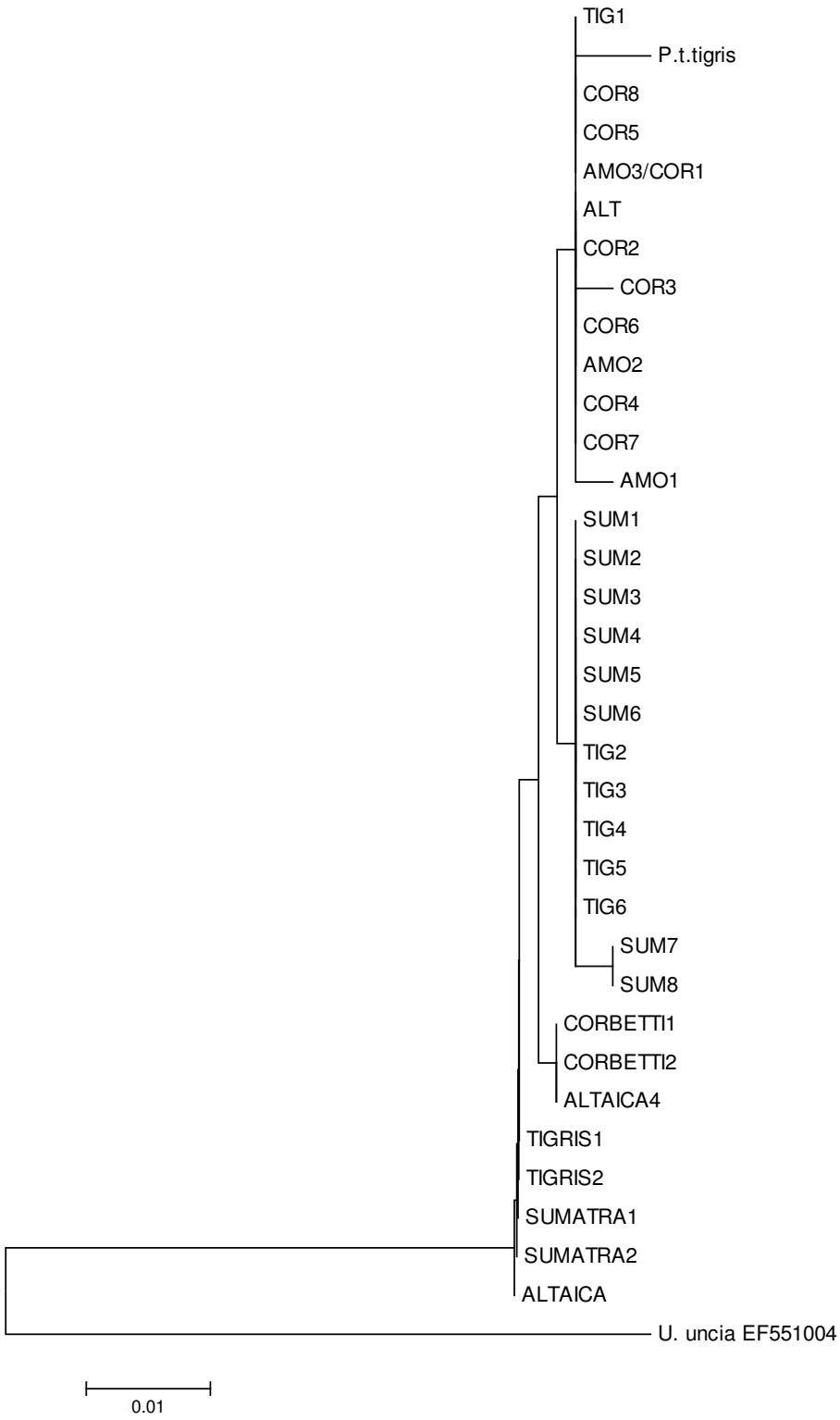
16S_MrBayes (4by4)



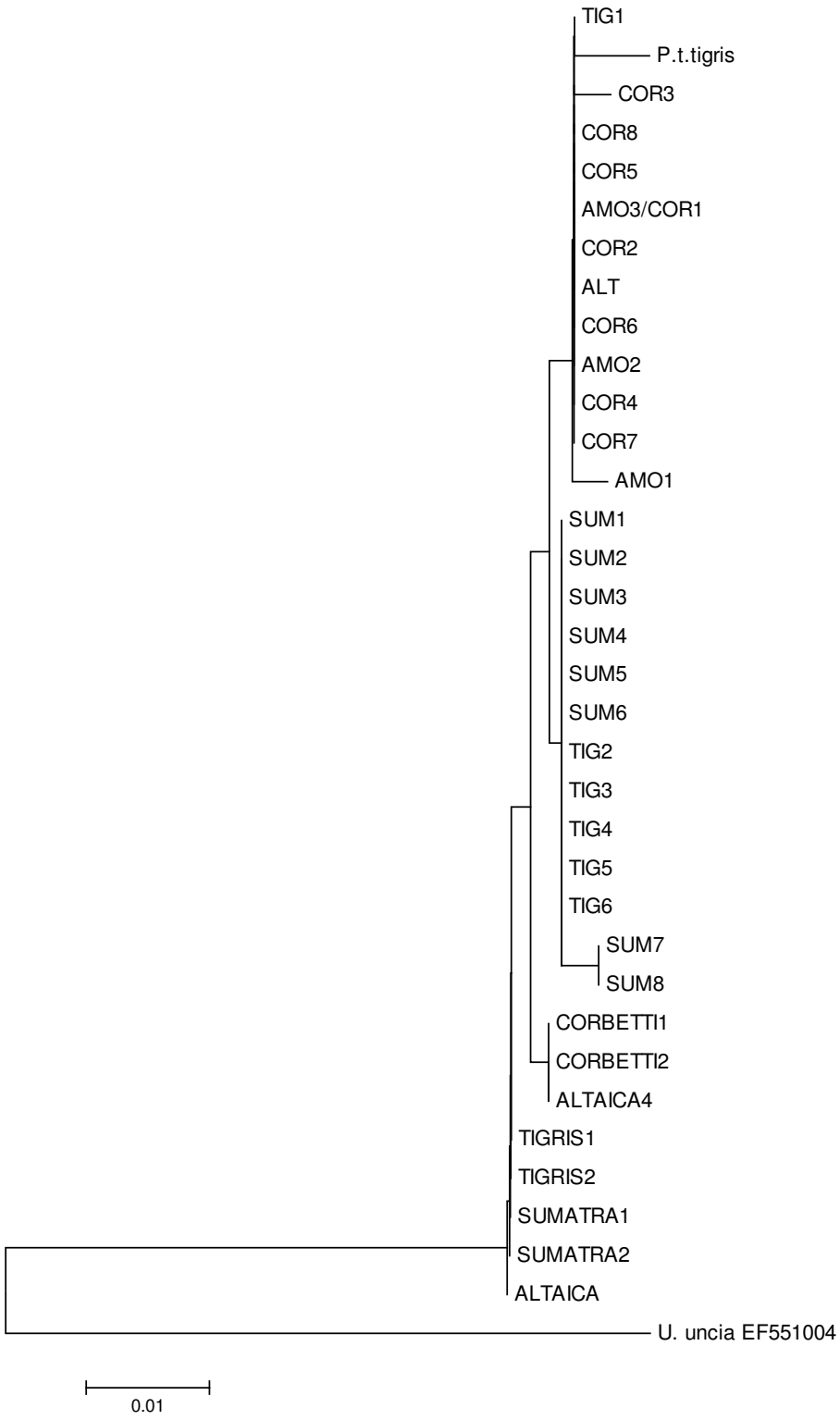
16S_codon model



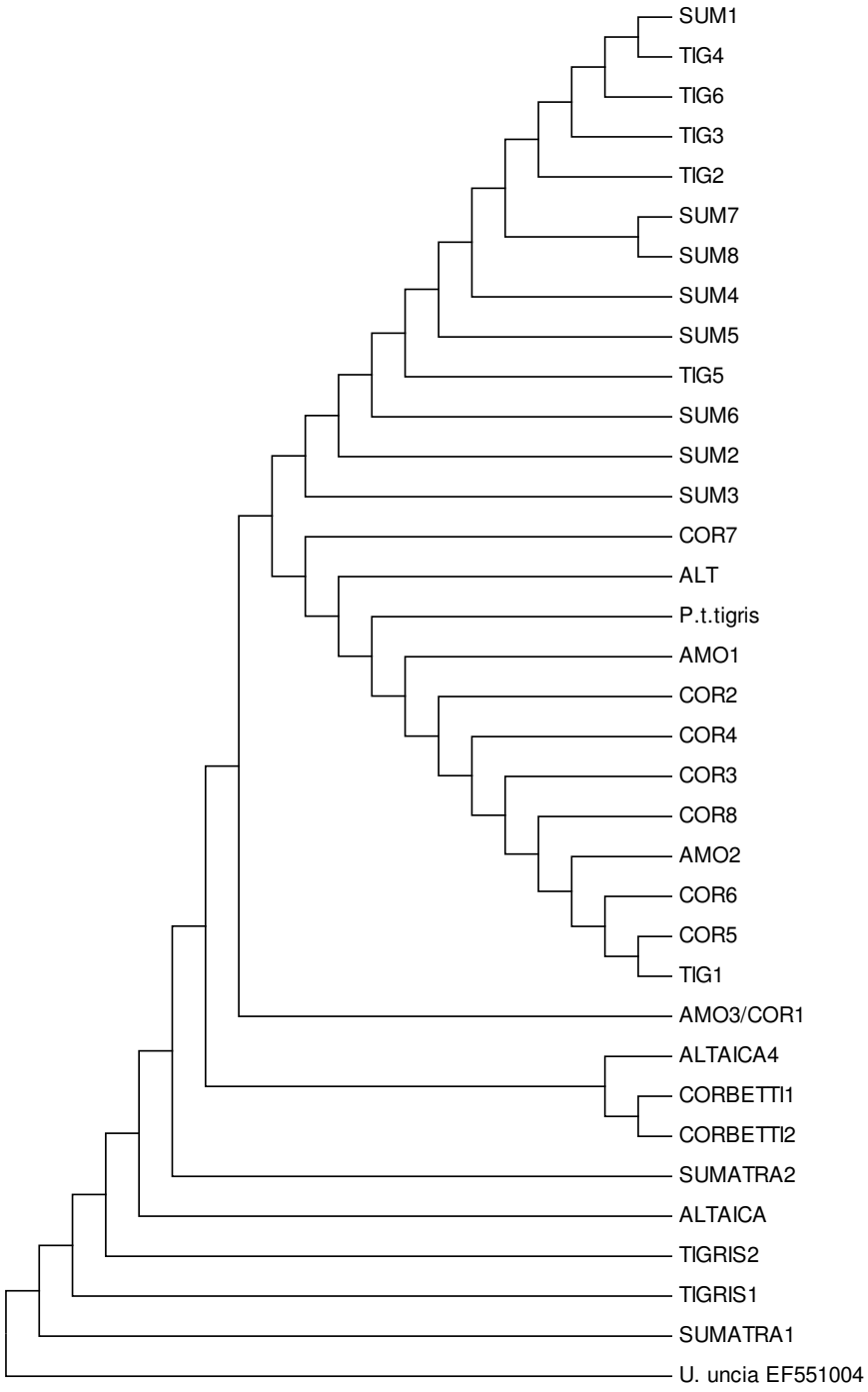
ND1_Neighbour-joining



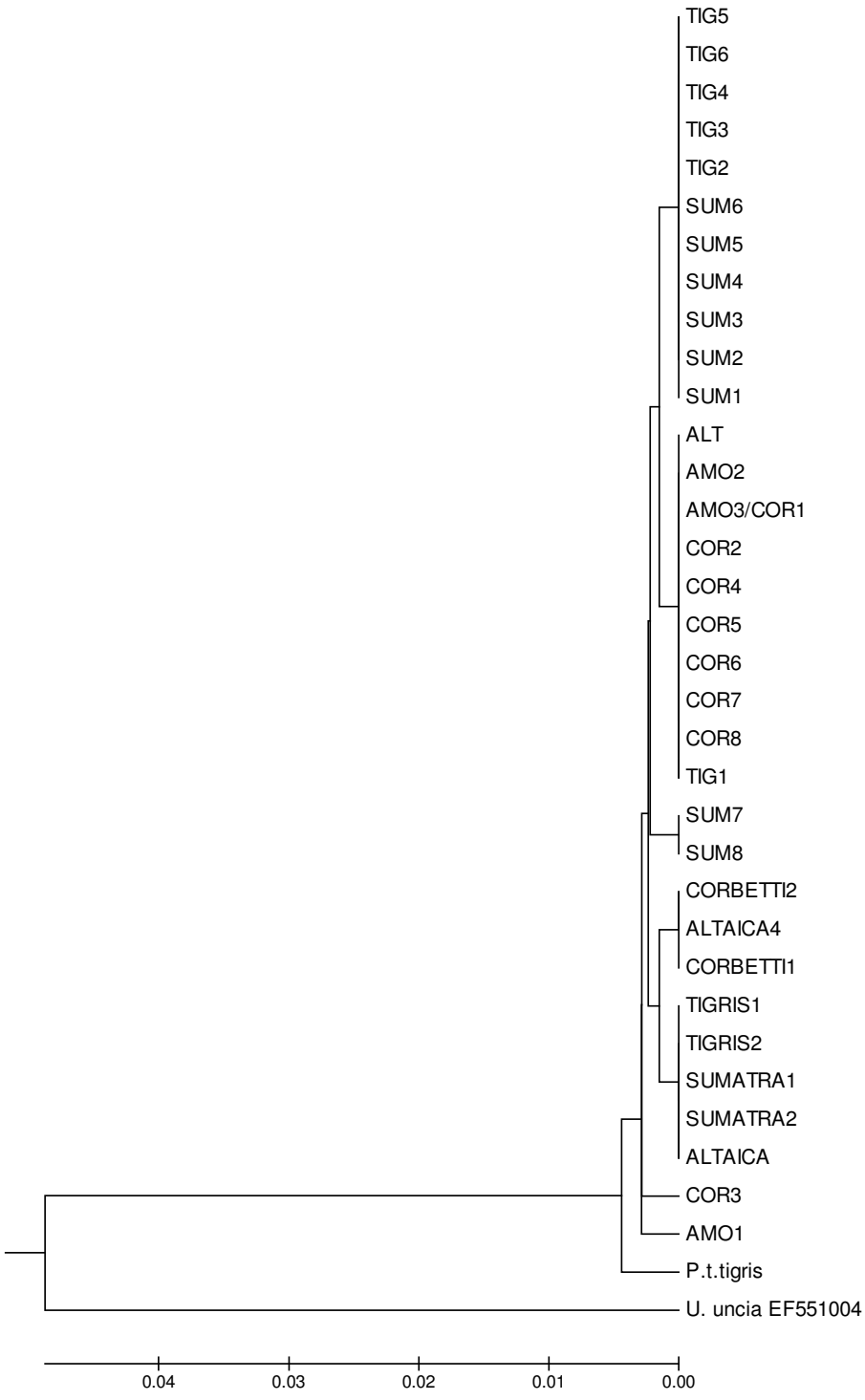
ND1_Minimum evolution



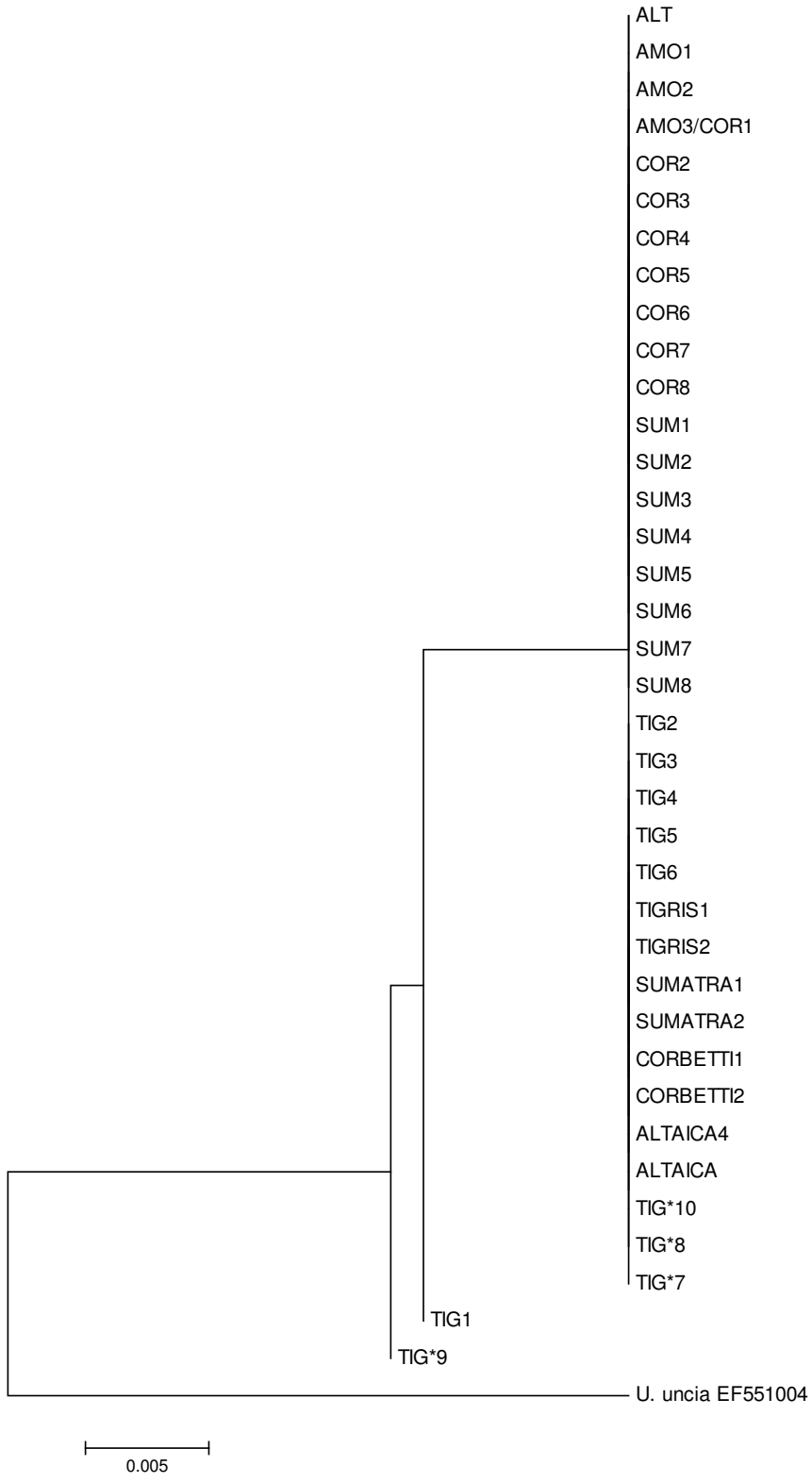
ND1_Parsimony



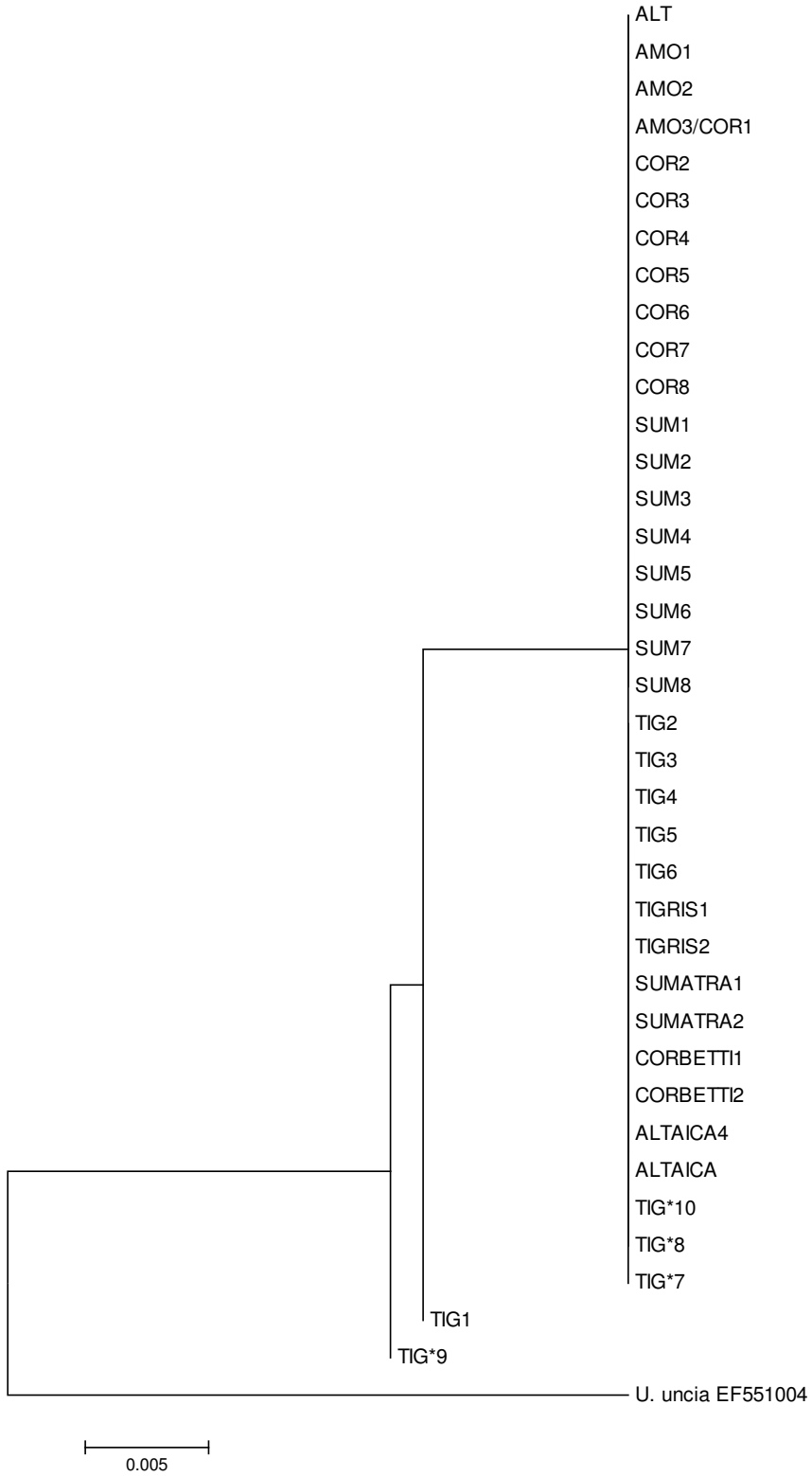
ND1_UPGMA


TIG5
TIG6
TIG4
TIG3
TIG2
SUM6
SUM5
SUM4
SUM3
SUM2
SUM1
ALT
AMO2
AMO3/COR1
COR2
COR4
COR5
COR6
COR7
COR8
TIG1
SUM7
SUM8
CORBETTI2
ALTAICA4
CORBETTI1
TIGRIS1
TIGRIS2
SUMATRA1
SUMATRA2
ALTAICA
COR3
AMO1
P.t.tigris
U. uncia EF551004
0.04
0.03
0.02
0.01
0.00

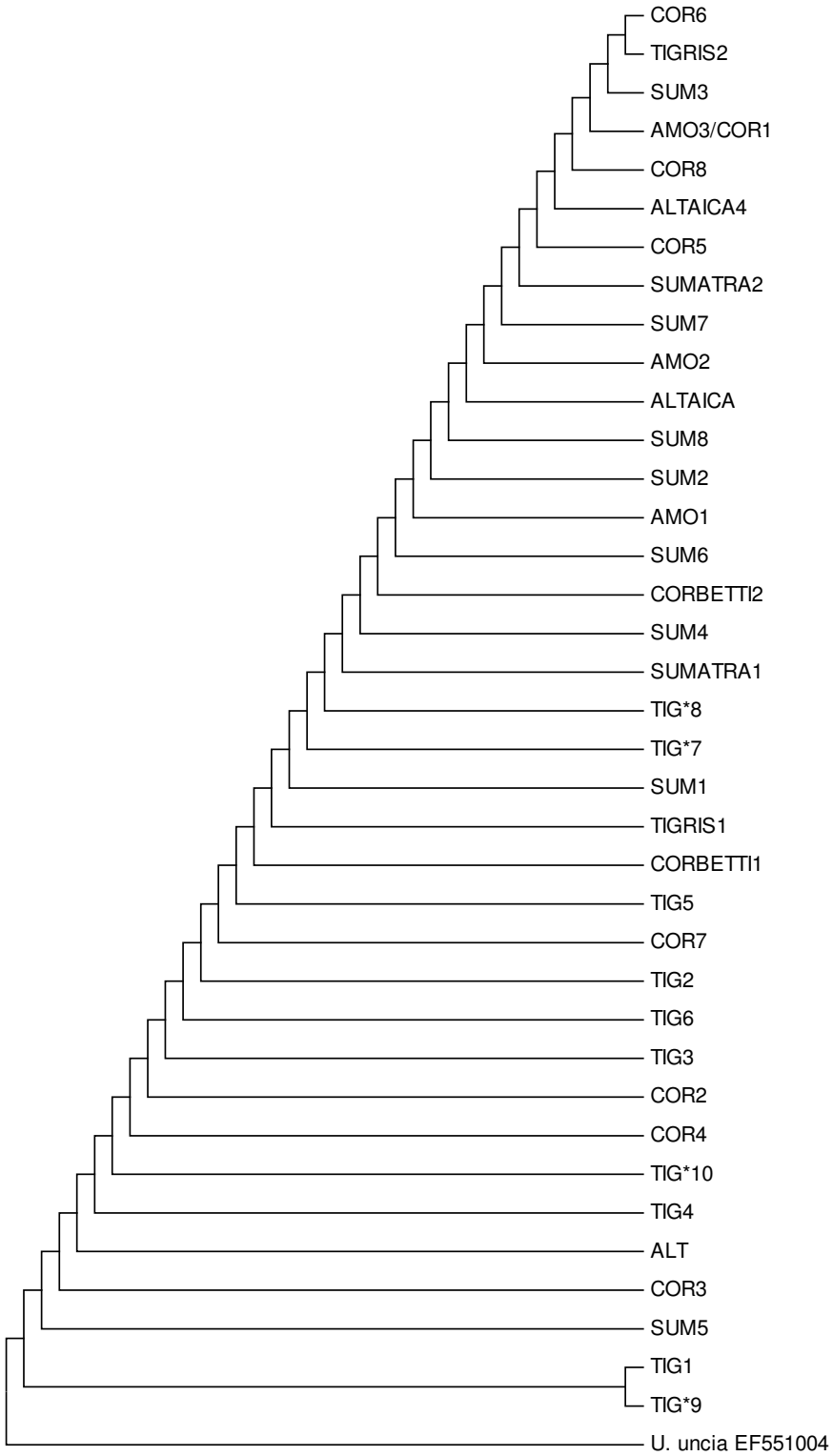
ND2 (Partial)_Neighbour-joining



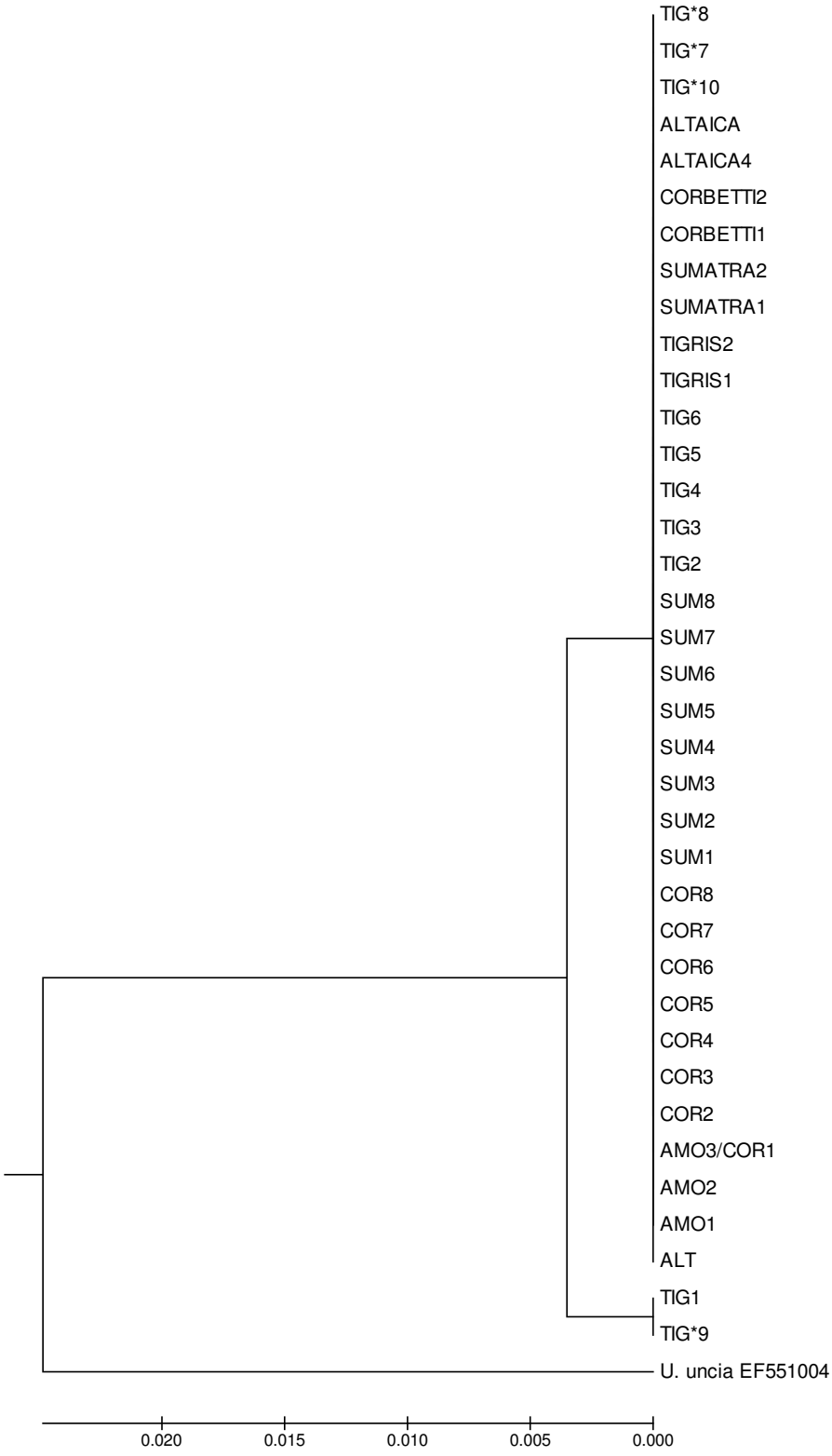
ND2 (Partial)_Minimum evolution



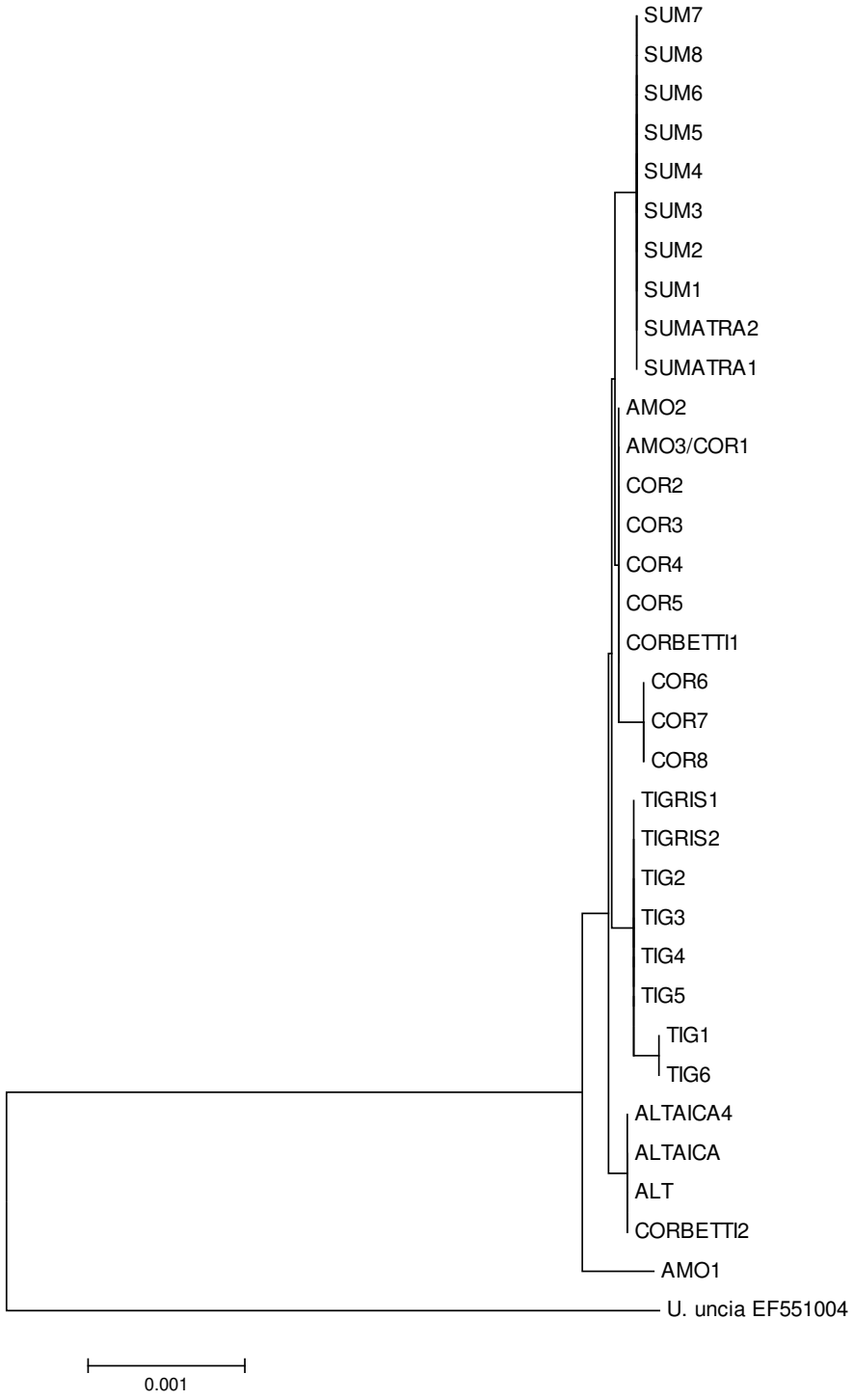
ND2 (Partial)_Parsimony



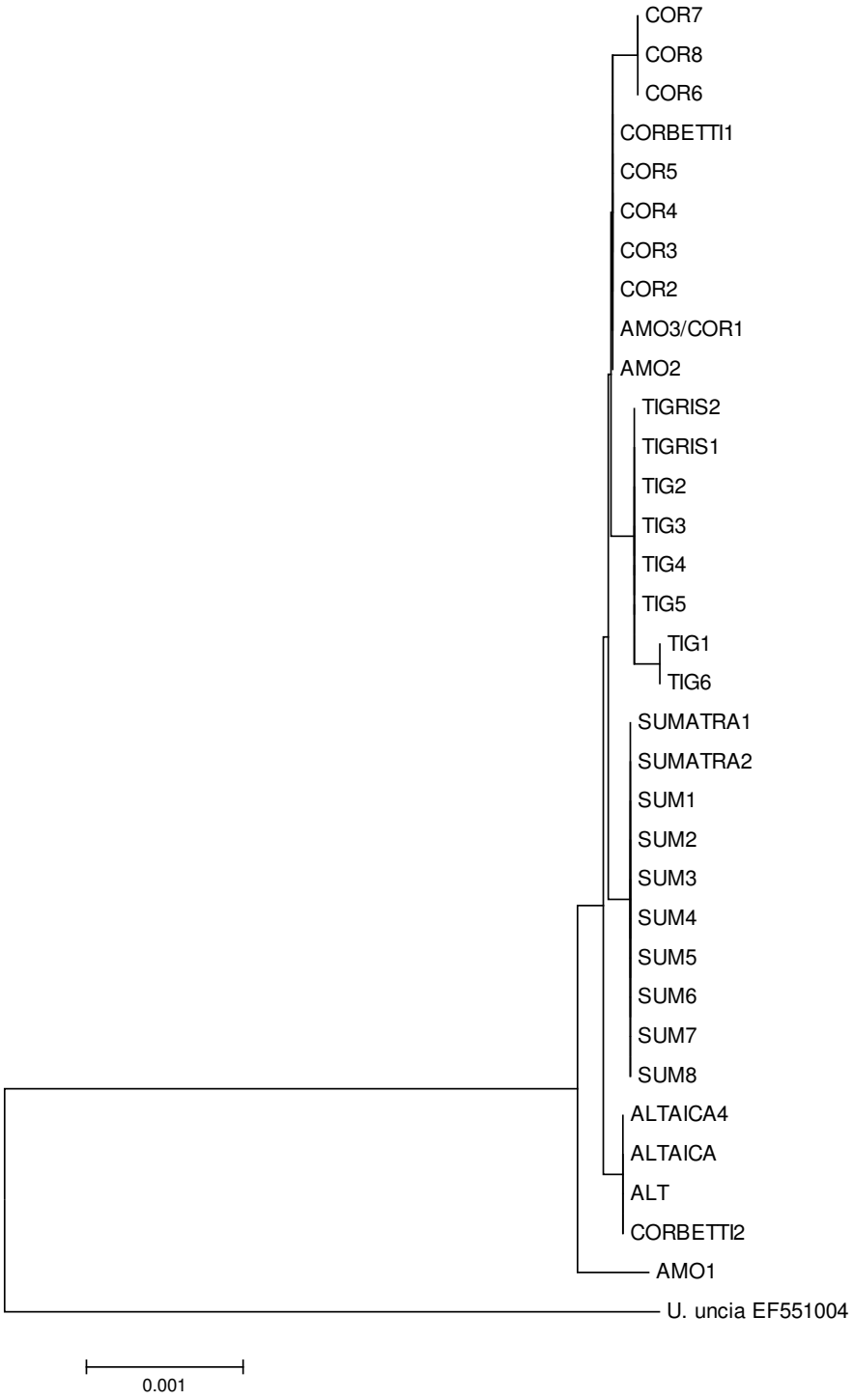
ND2 (Partial)_UPGMA



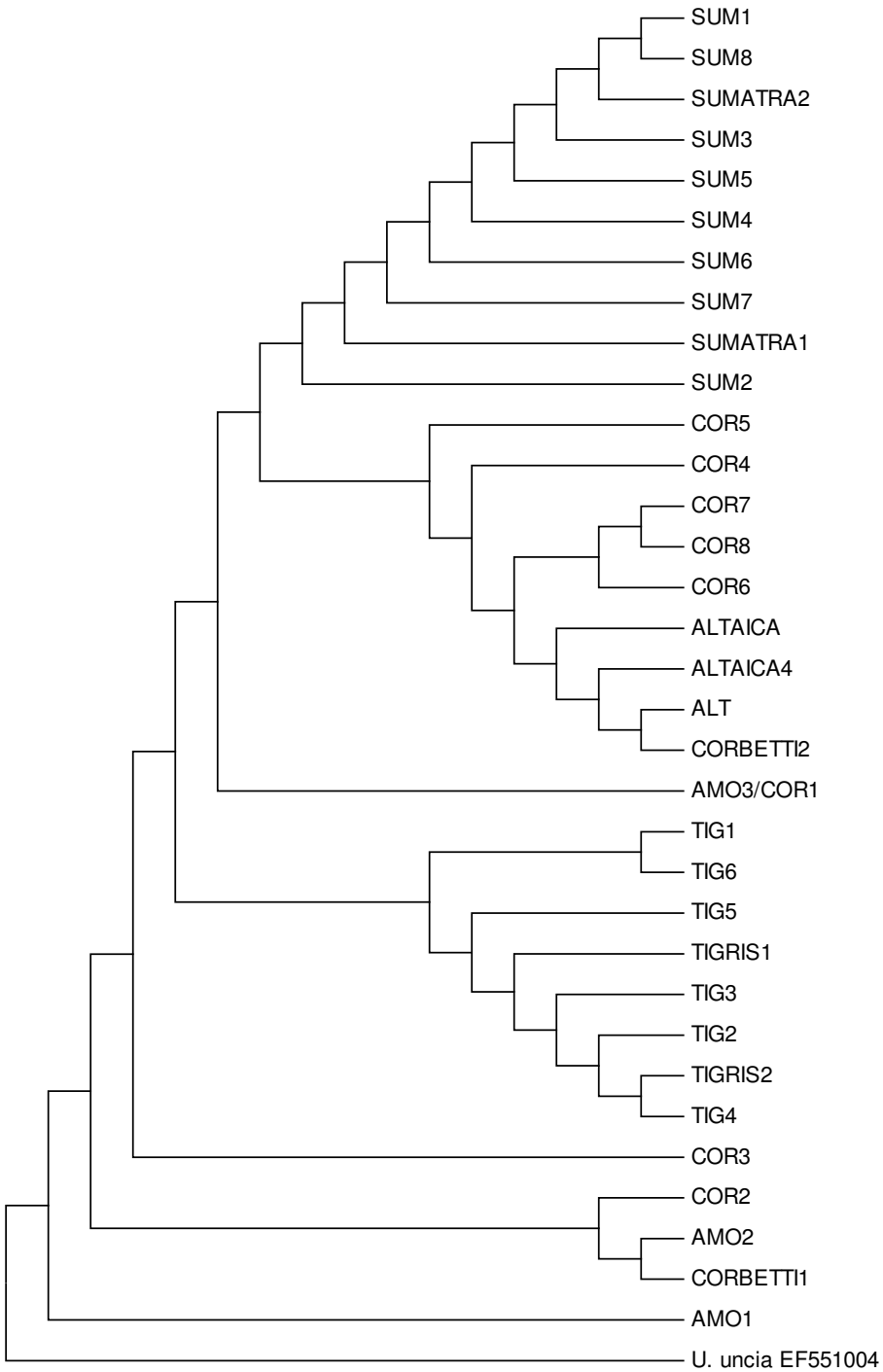
ND2 (422 bp)_Neighbour-joining



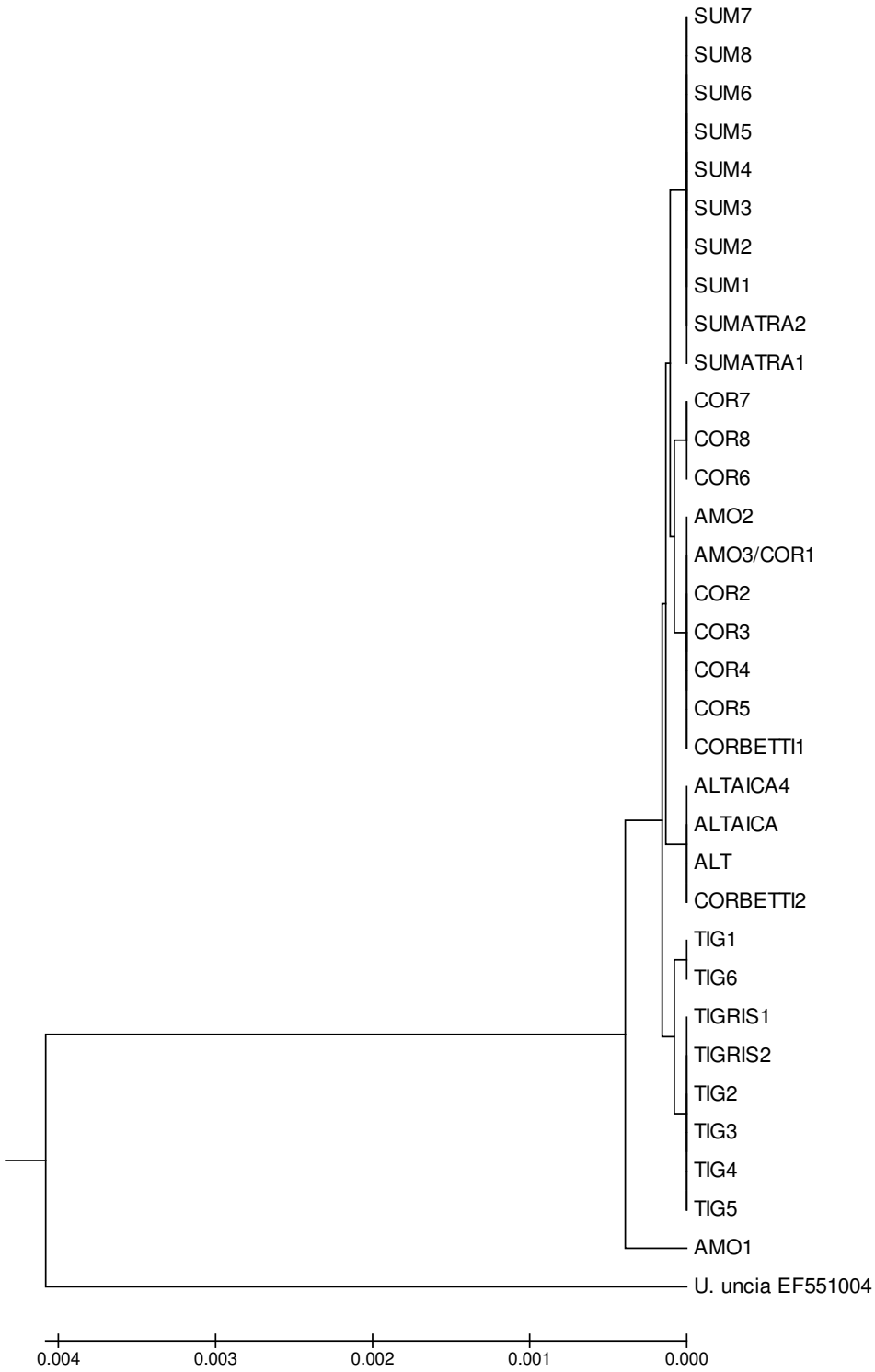
ND2 (422 bp)_Minimum evolution



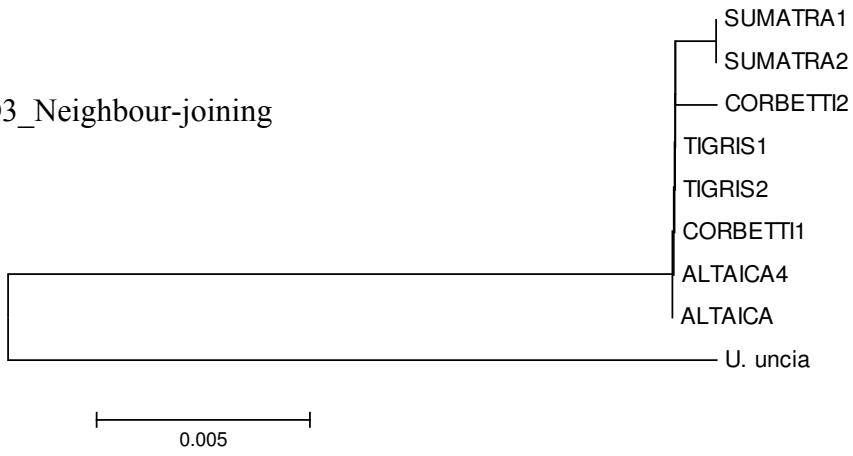
ND2 (422 bp)_Parsimony



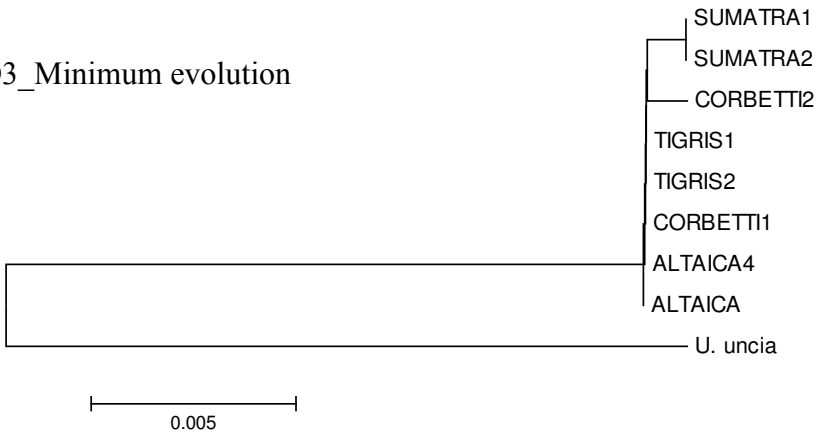
ND2 (422 bp)_UPGMA



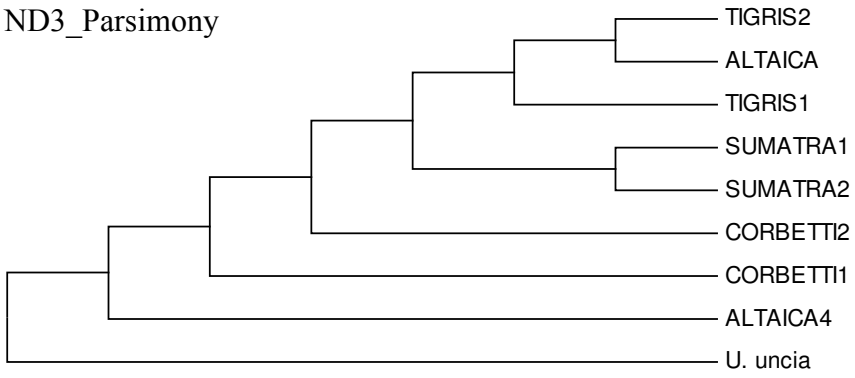
ND3_Neighbour-joining



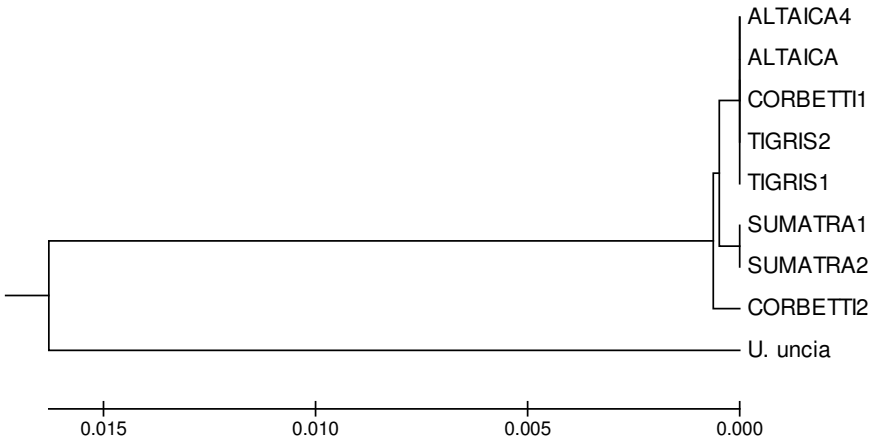
ND3_Minimum evolution



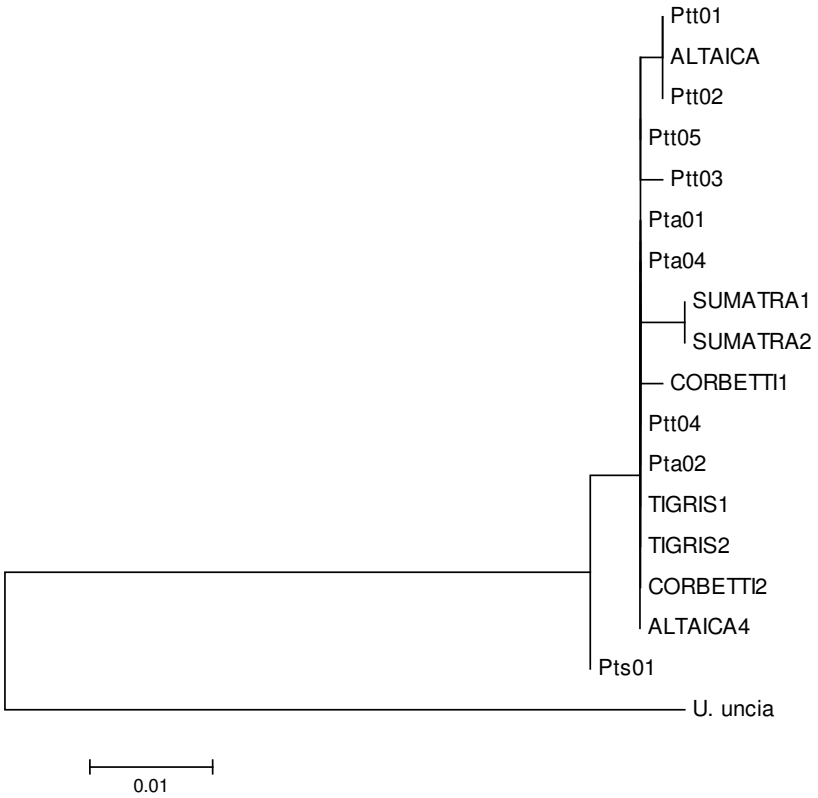
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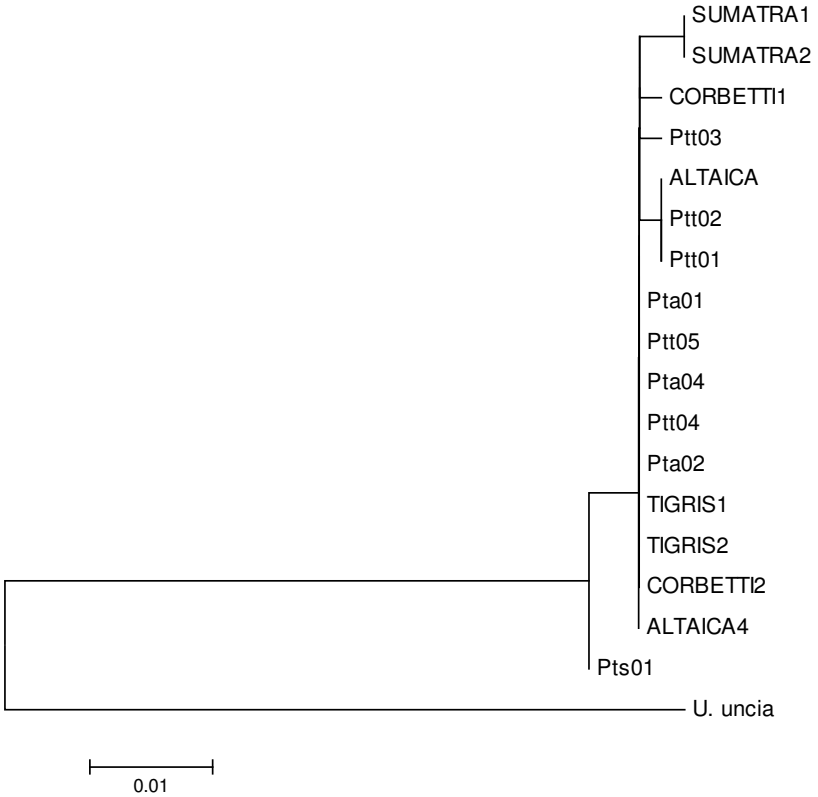
ND3_UPGMA



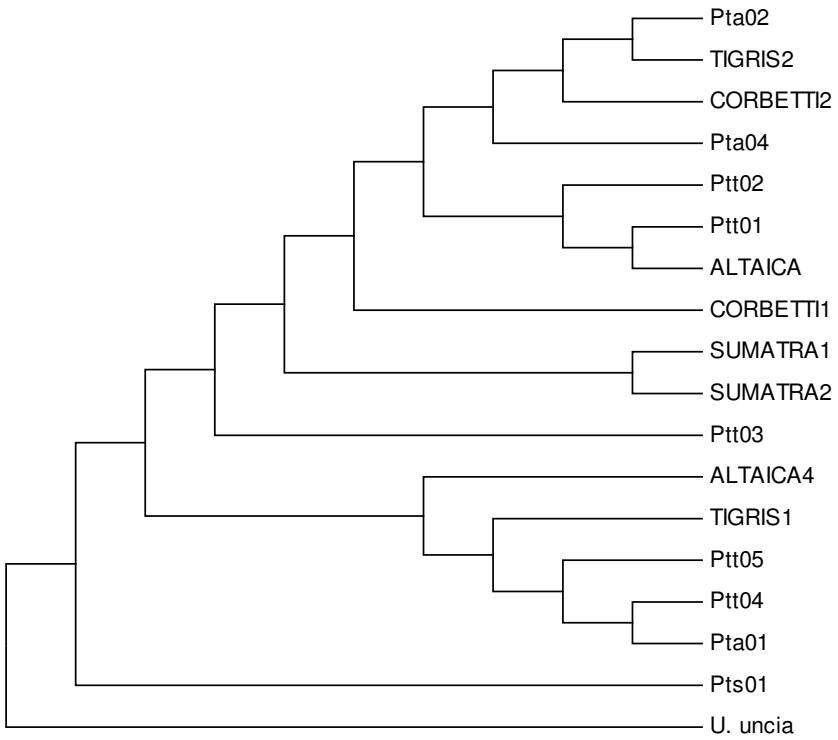
ND4_Neighbour-joining



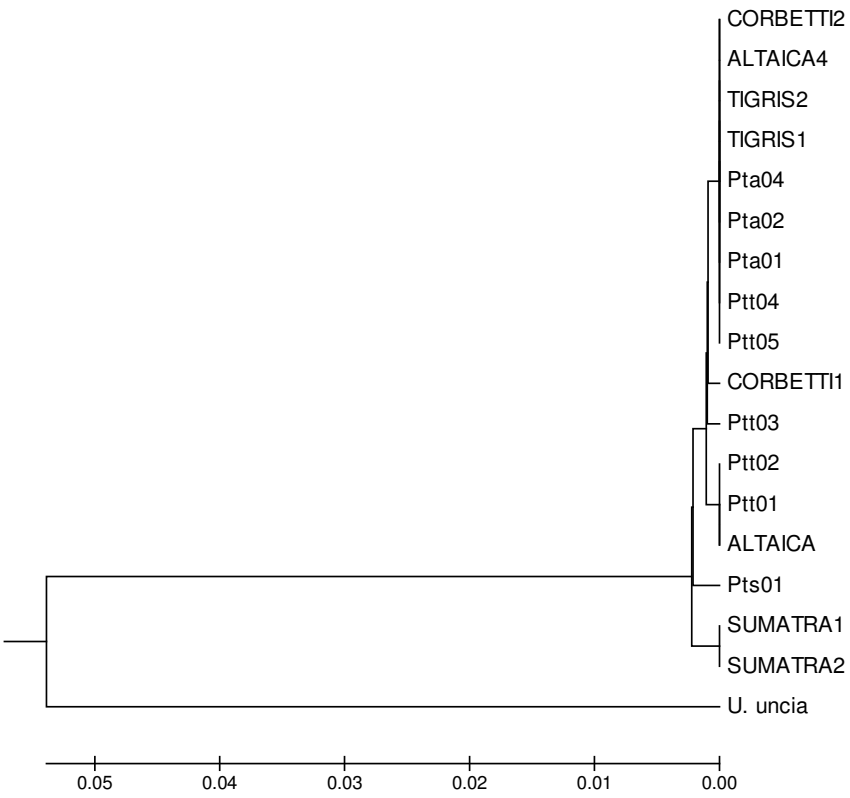
ND4_Minimum evolution



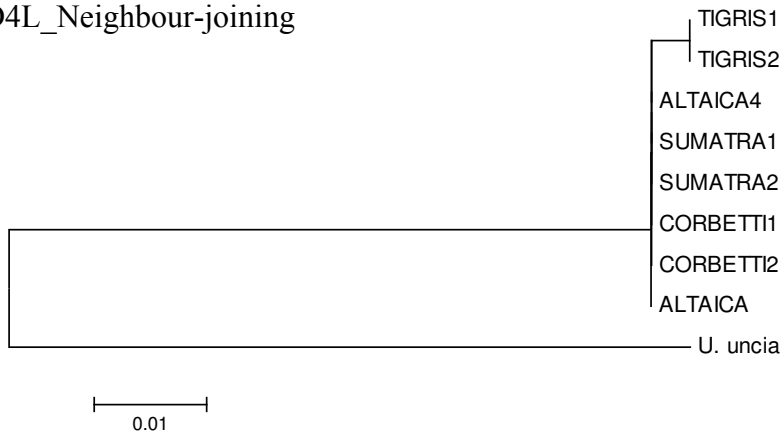
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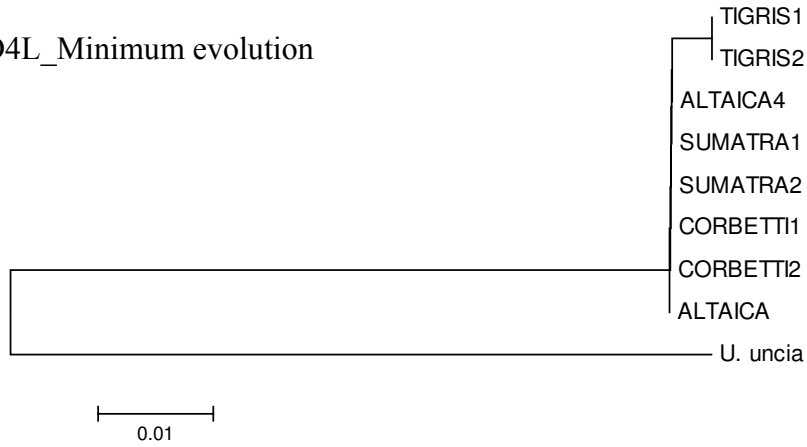
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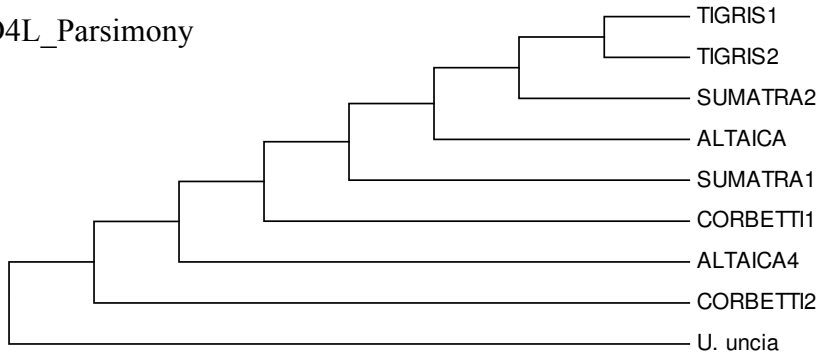
ND4L_Neighbour-joining



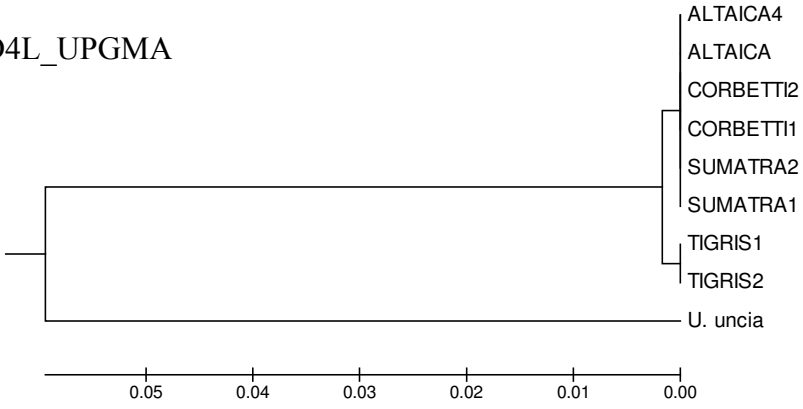
ND4L_Minimum evolution



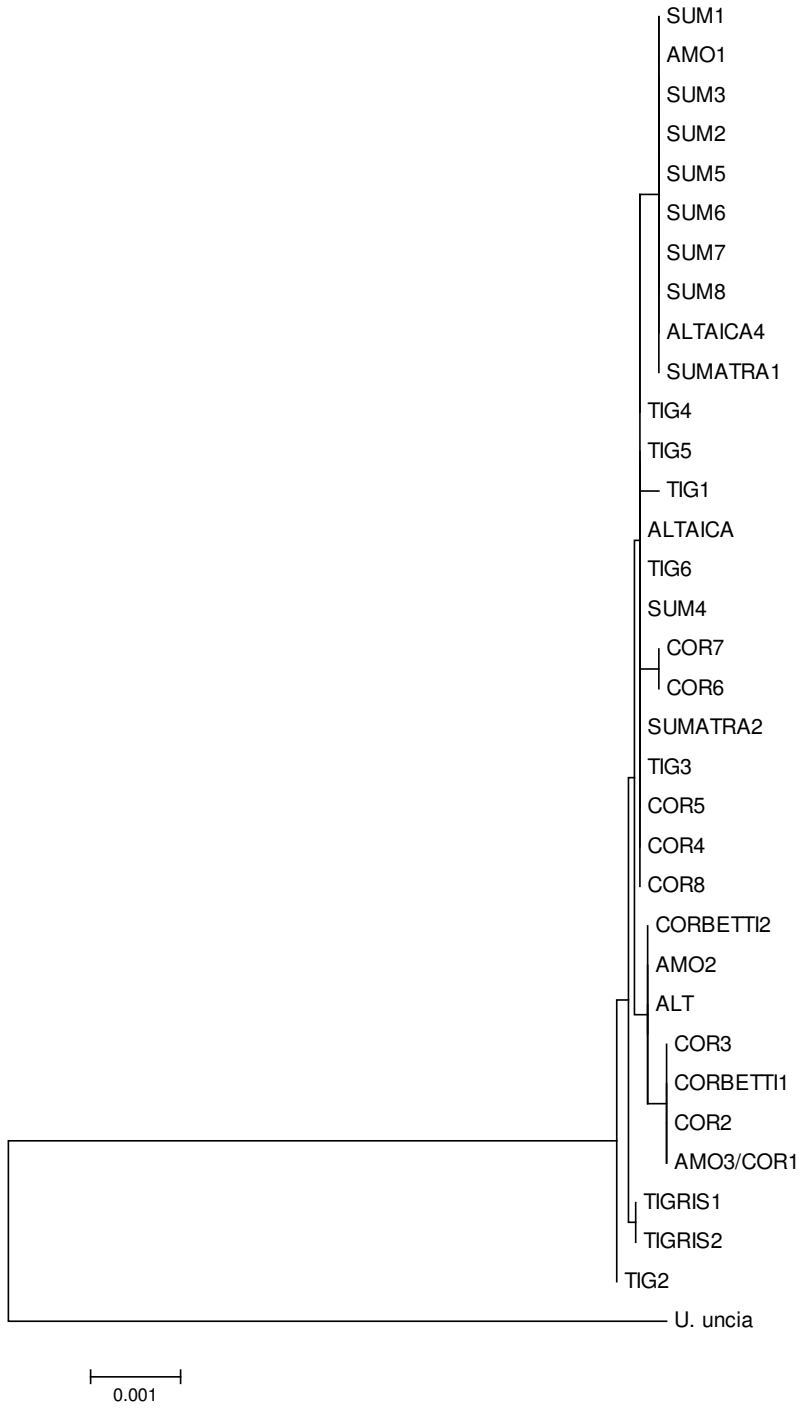
ND4L_Parsimony



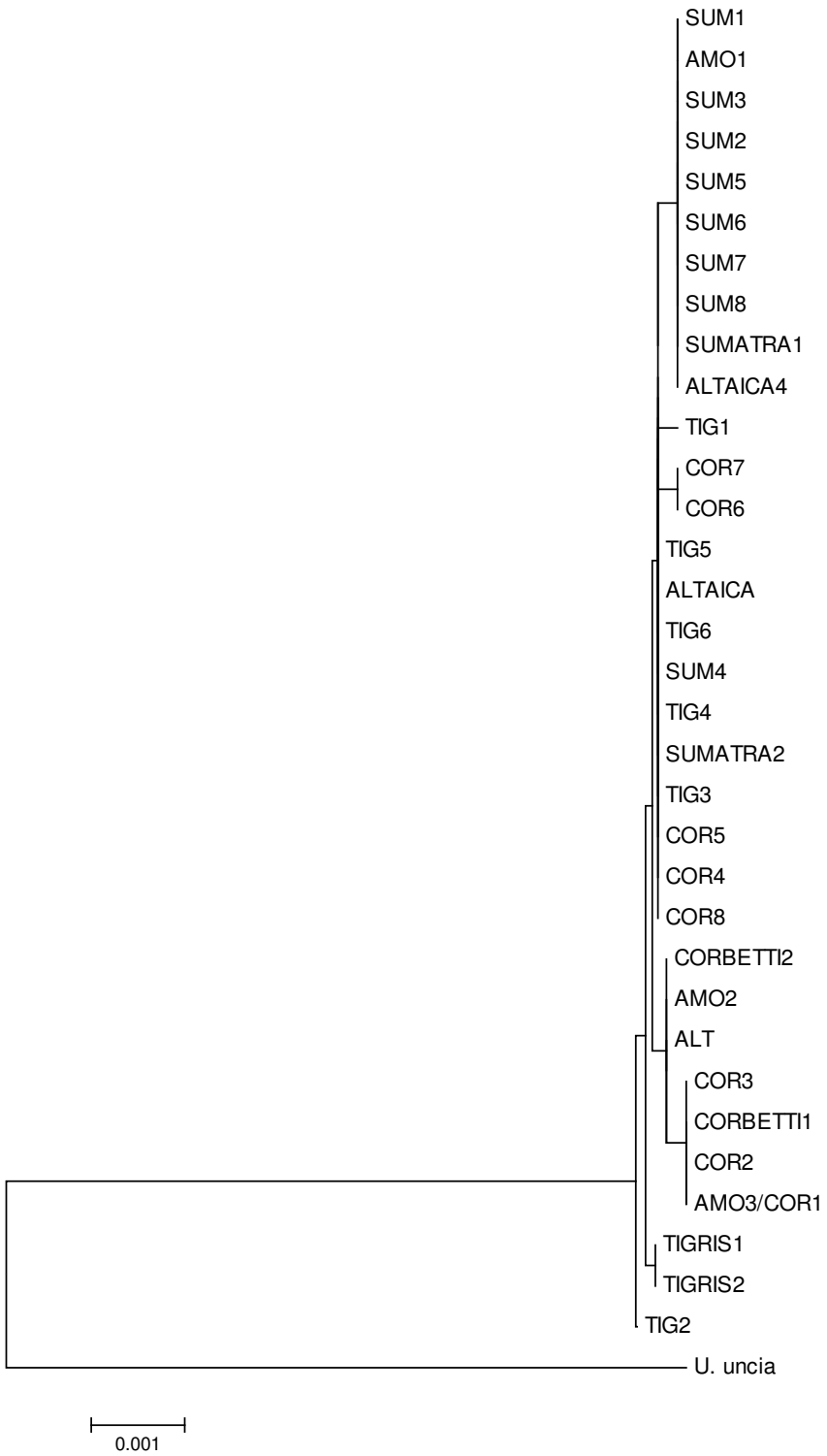
ND4L_UPGMA



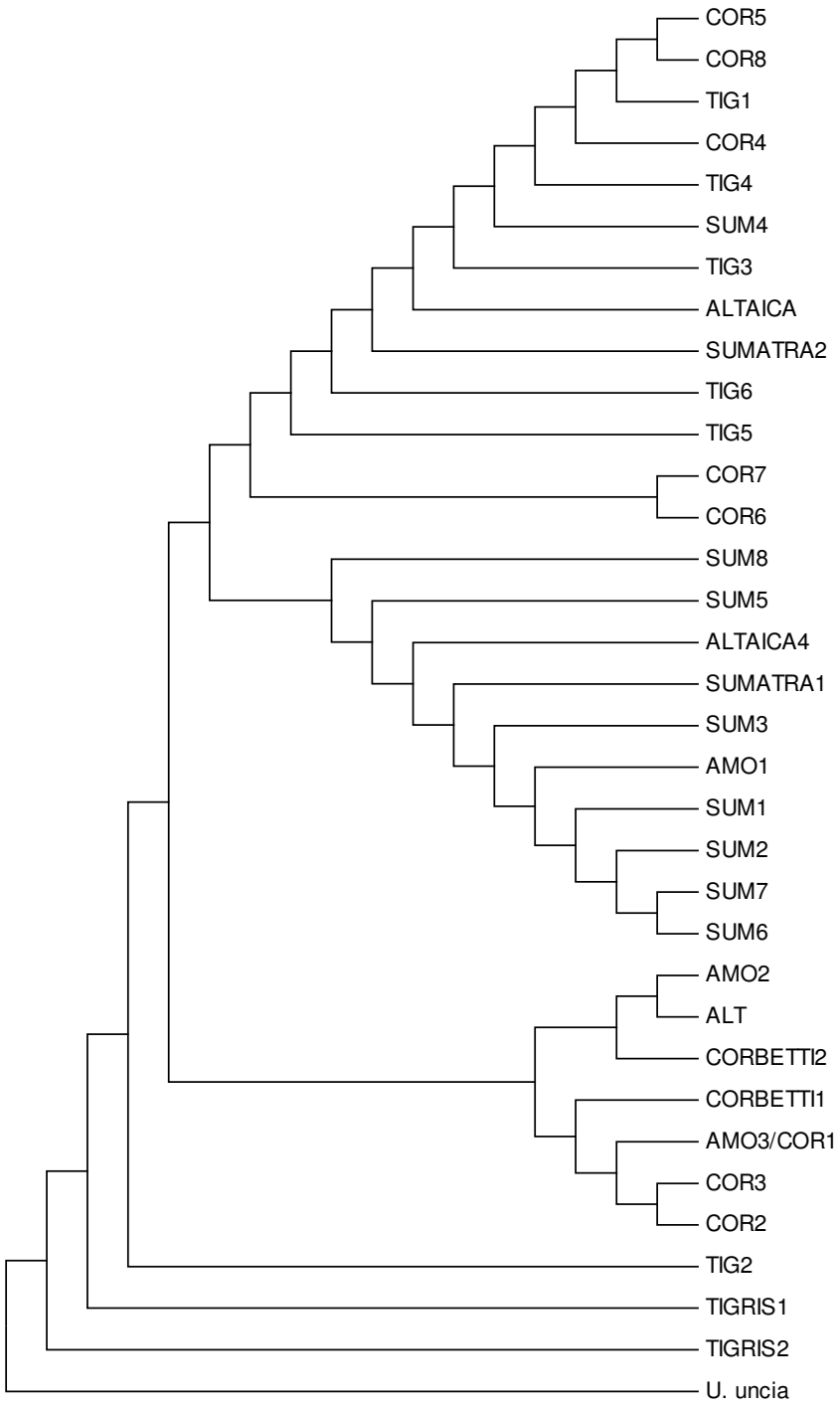
ND5 (Partial1)_Neighbour-joining



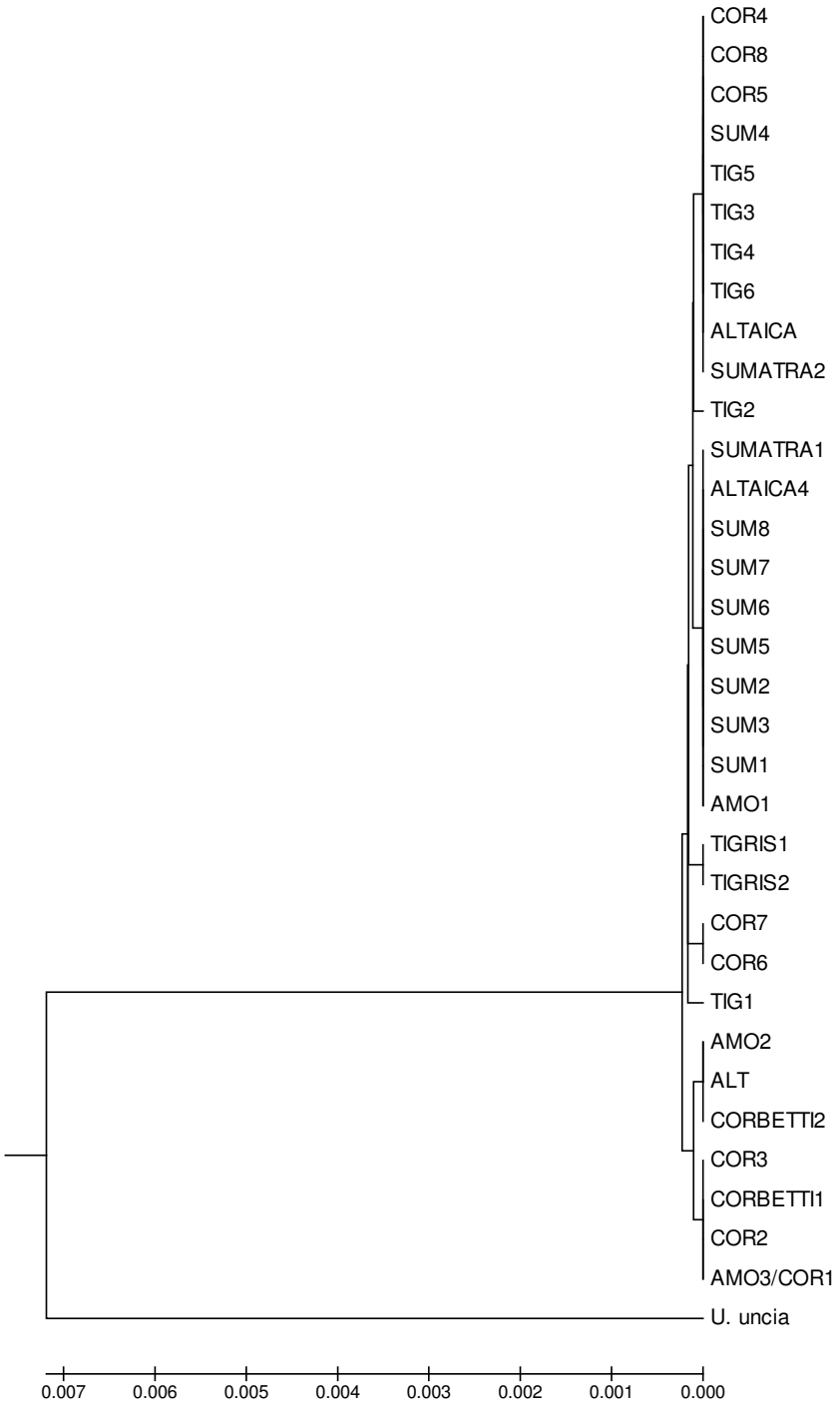
ND5 (Partial 1)_Minimum evolution



ND5 (Partial1)_Parsimony



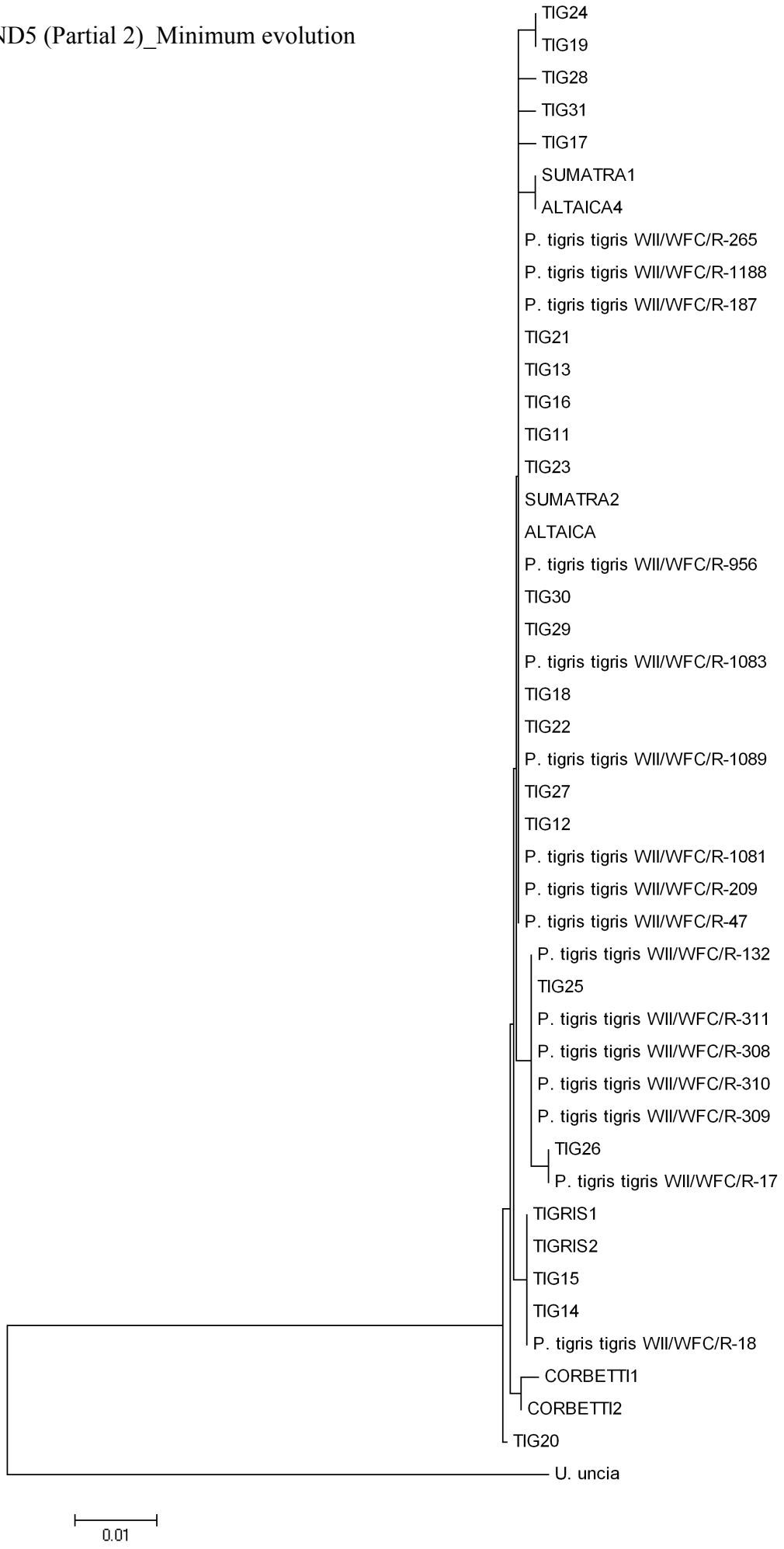
ND5 (Partial1)_UPGMA



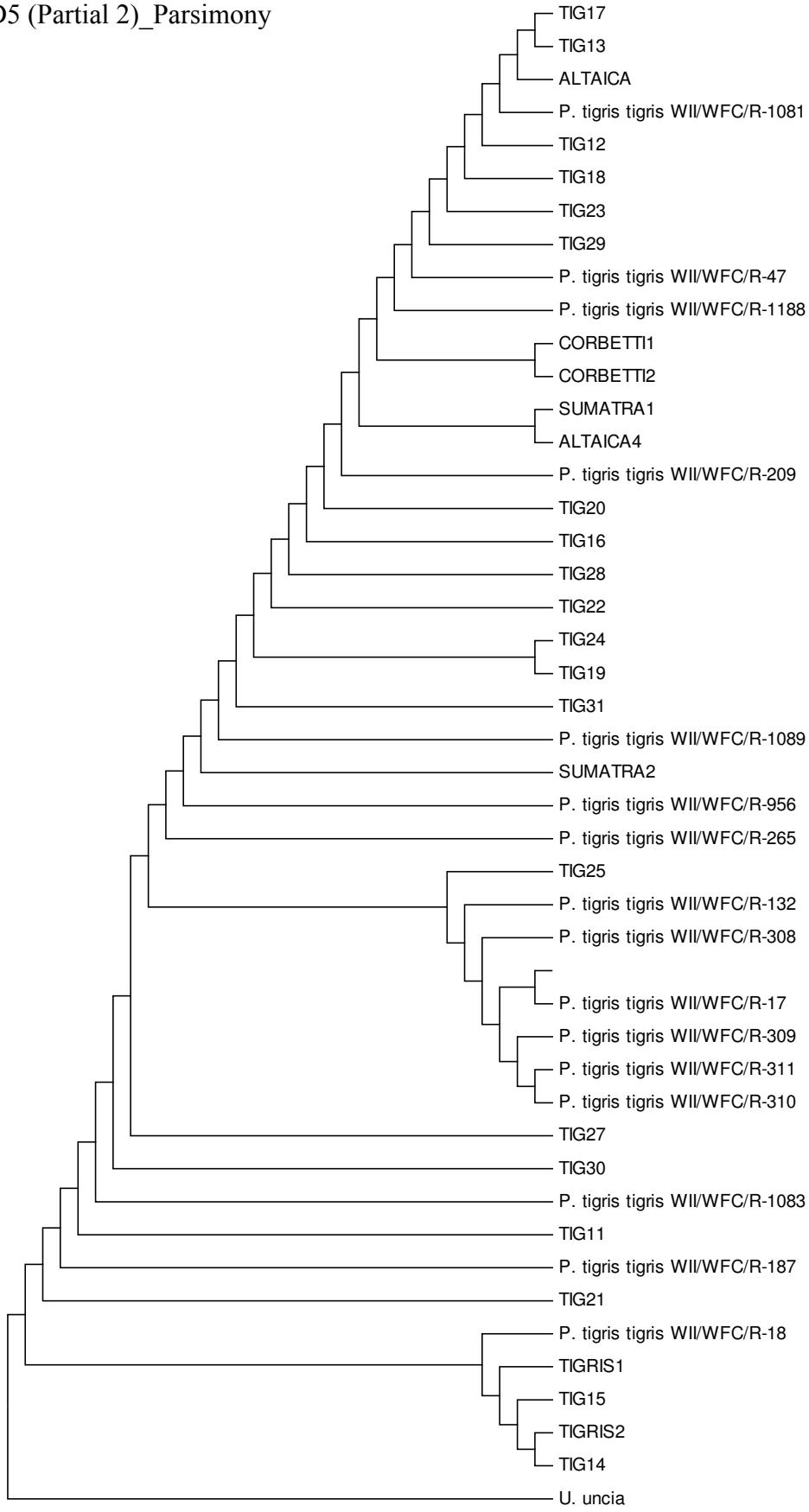
ND5 (Partial 2)_Neighbour-joining



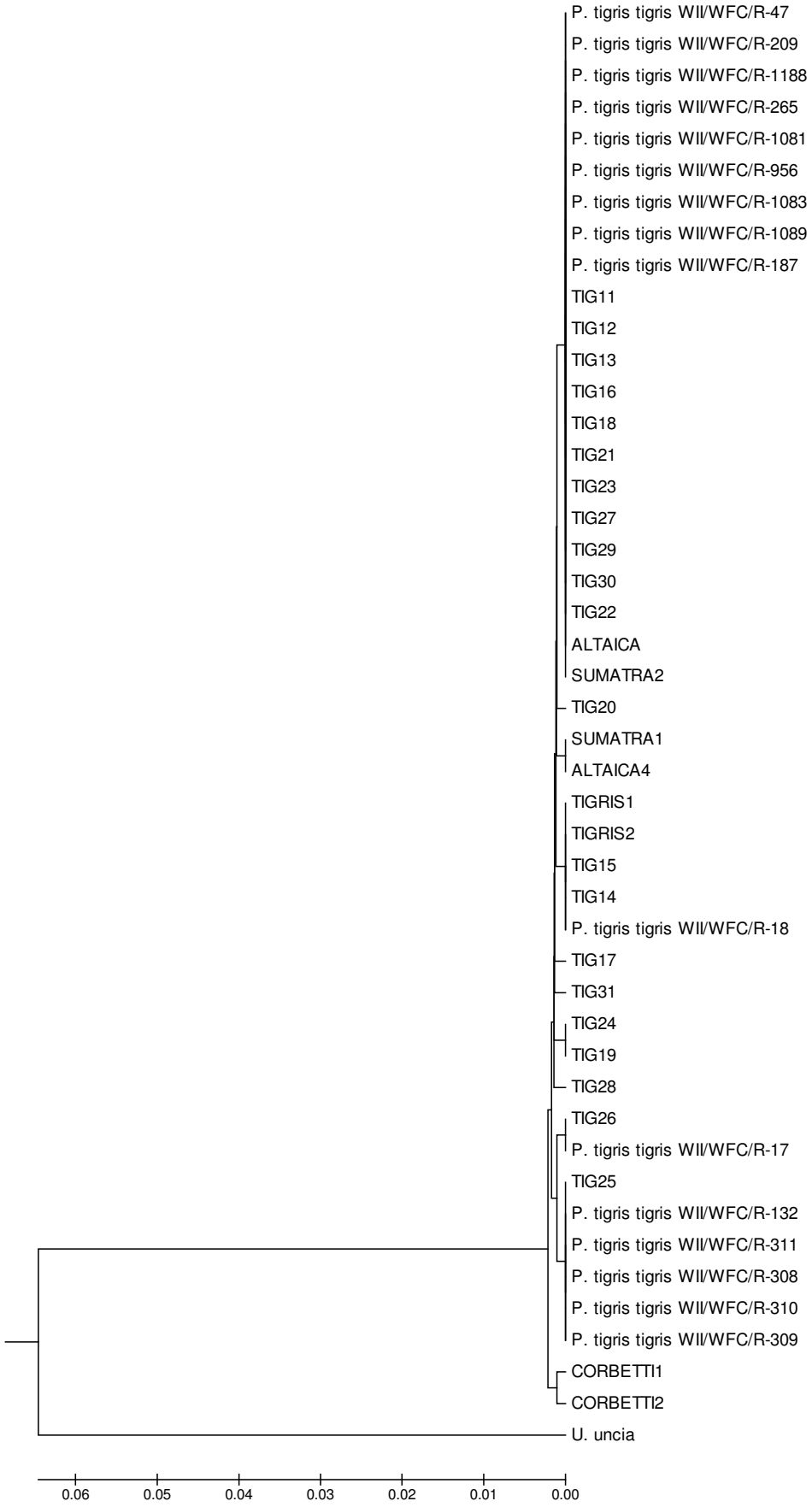
ND5 (Partial 2)_Minimum evolution



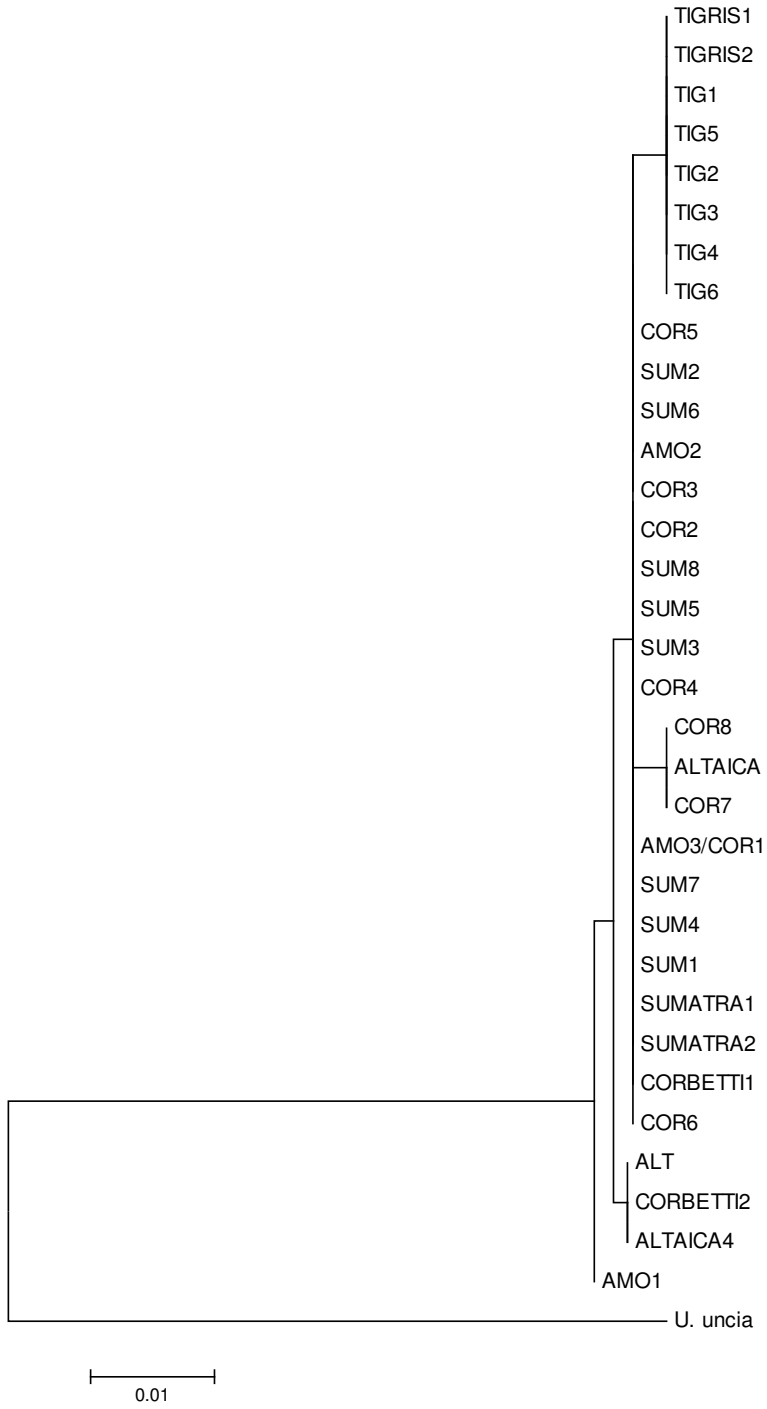
ND5 (Partial 2)_Parsimony



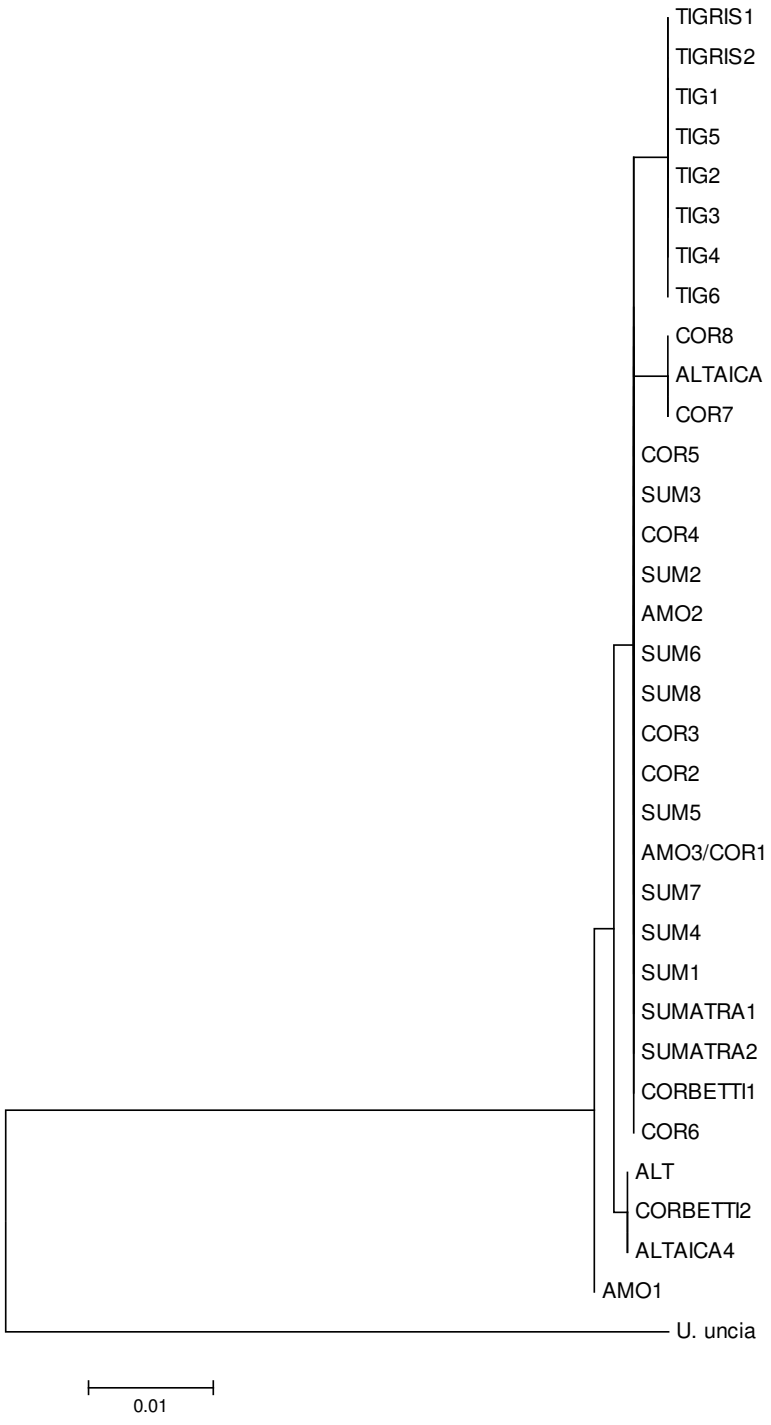
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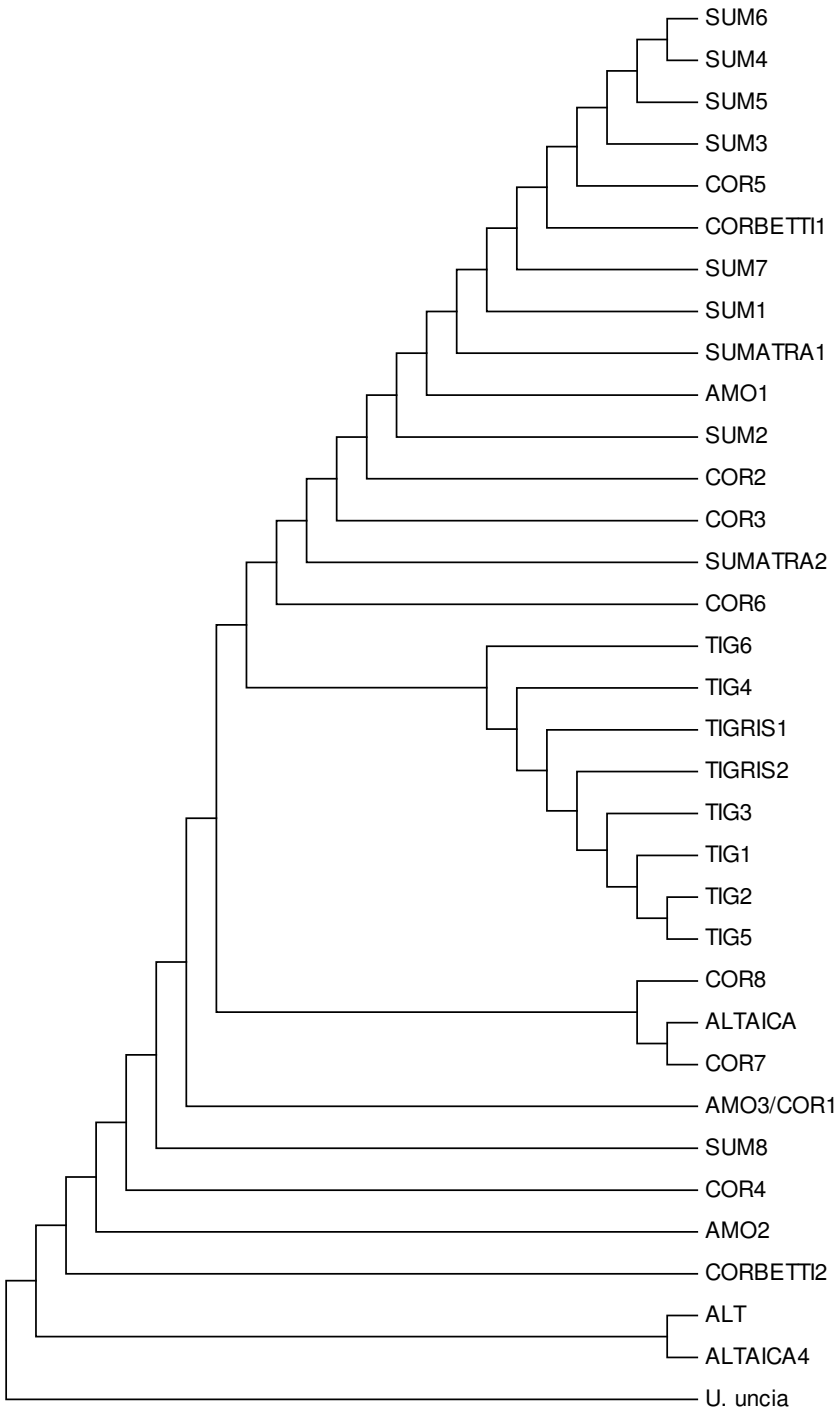
ND6_Neighbour-joining



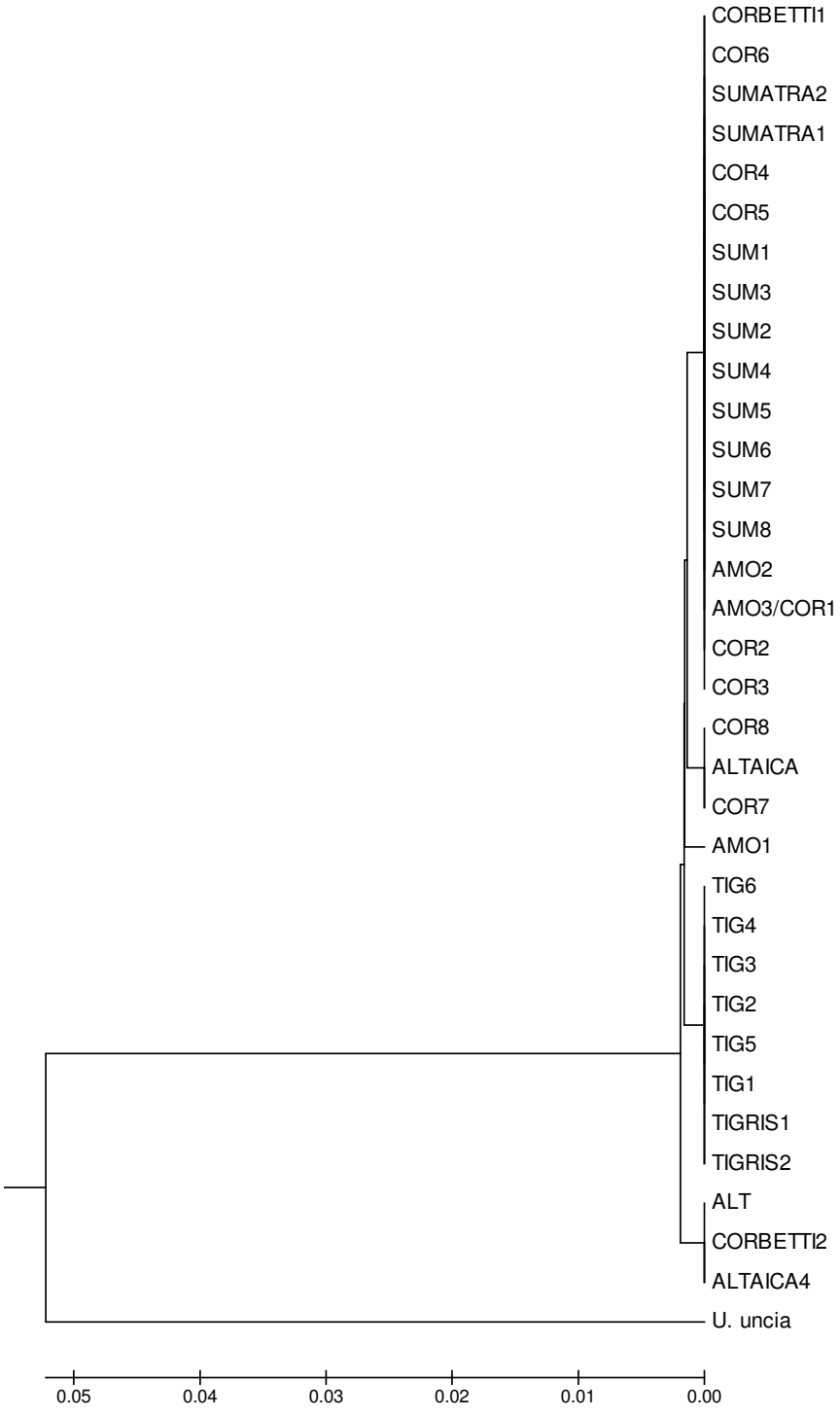
ND6_Minimum evolution



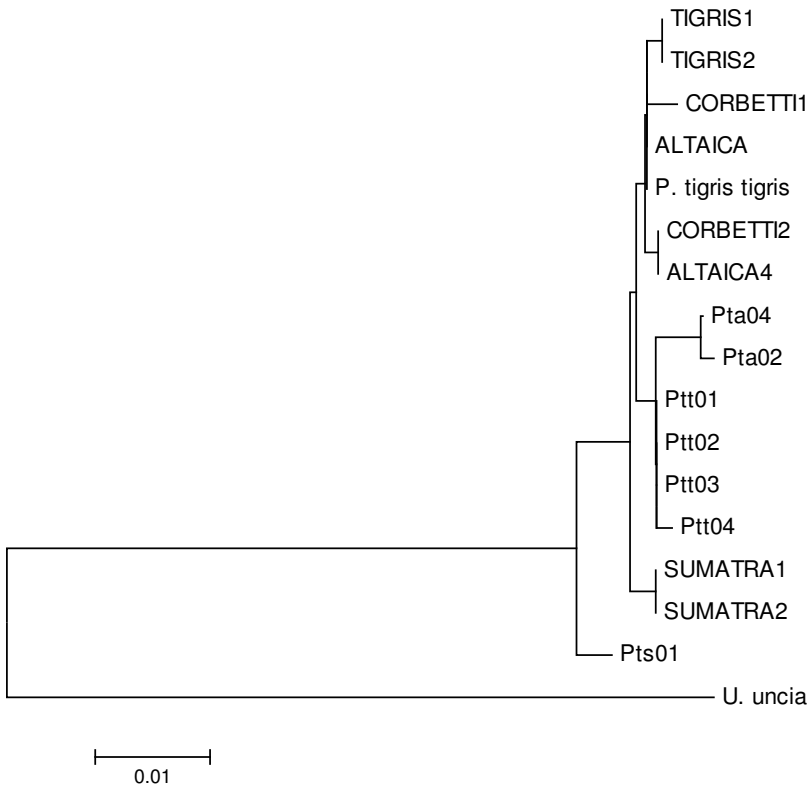
ND6_Parsimony



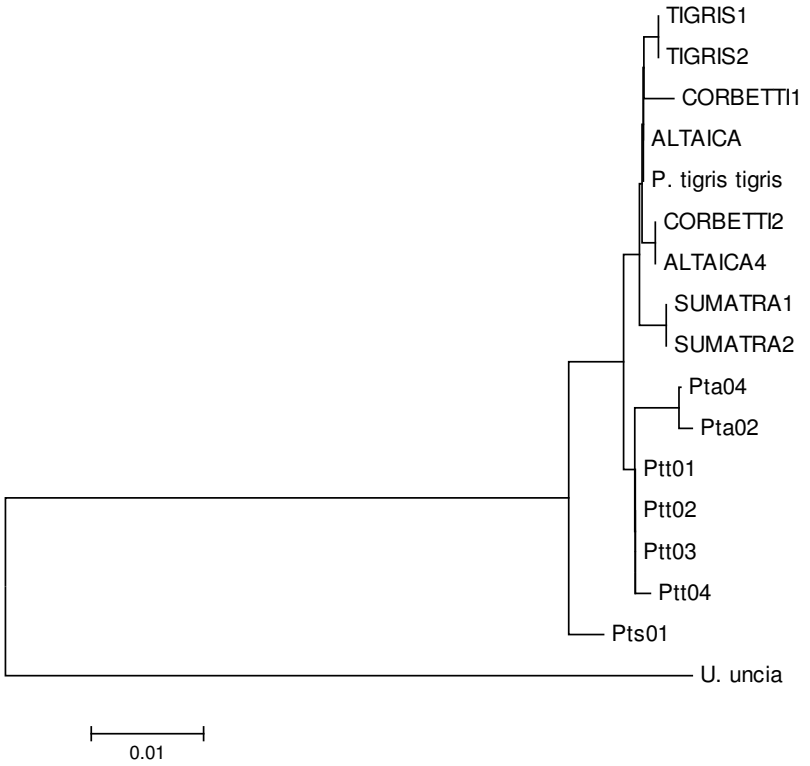
ND6_UPGMA


CORBETTI1
COR6
SUMATRA2
SUMATRA1
COR4
COR5
SUM1
SUM3
SUM2
SUM4
SUM5
SUM6
SUM7
SUM8
AMO2
AMO3/COR1
COR2
COR3
COR8
ALTAICA
COR7
AMO1
TIG6
TIG4
TIG3
TIG2
TIG5
TIG1
TIGRIS1
TIGRIS2
ALT
CORBETTI2
ALTAICA4
U. uncia
0.05
0.04
0.03
0.02
0.01
0.00

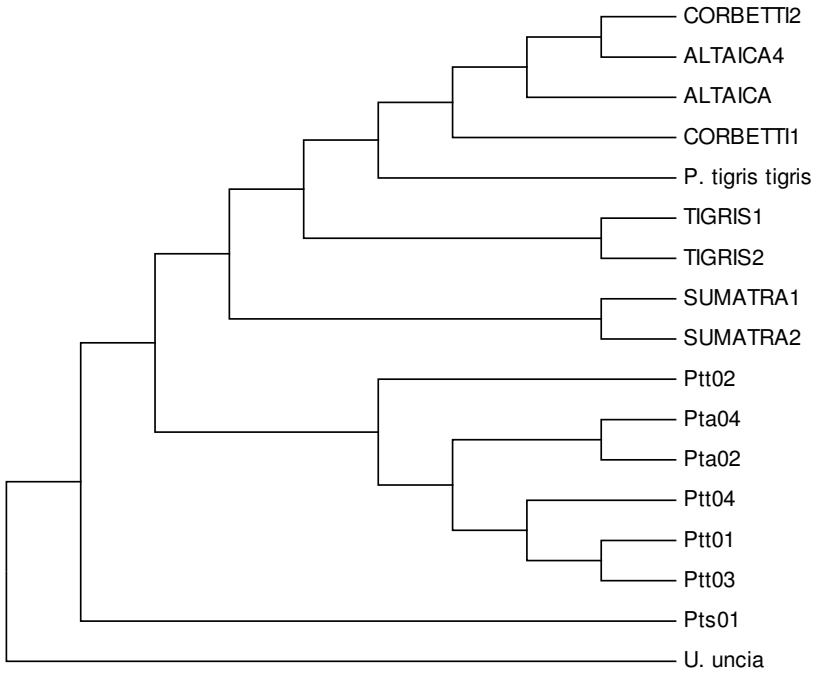
COI (Partial 1)_Neighbour-joining



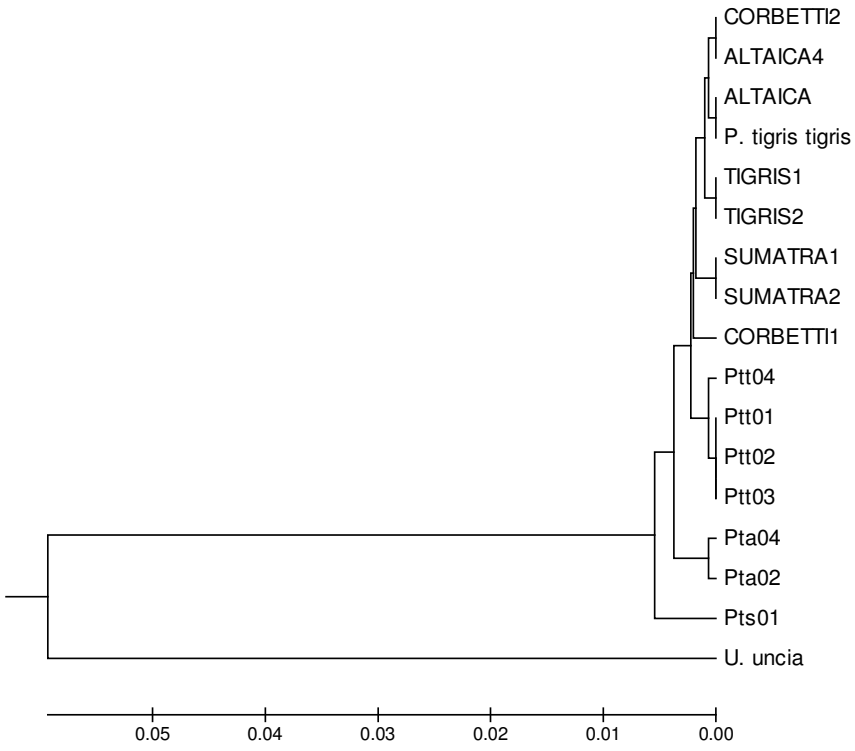
COI (Partial 1)_Minimum evolution



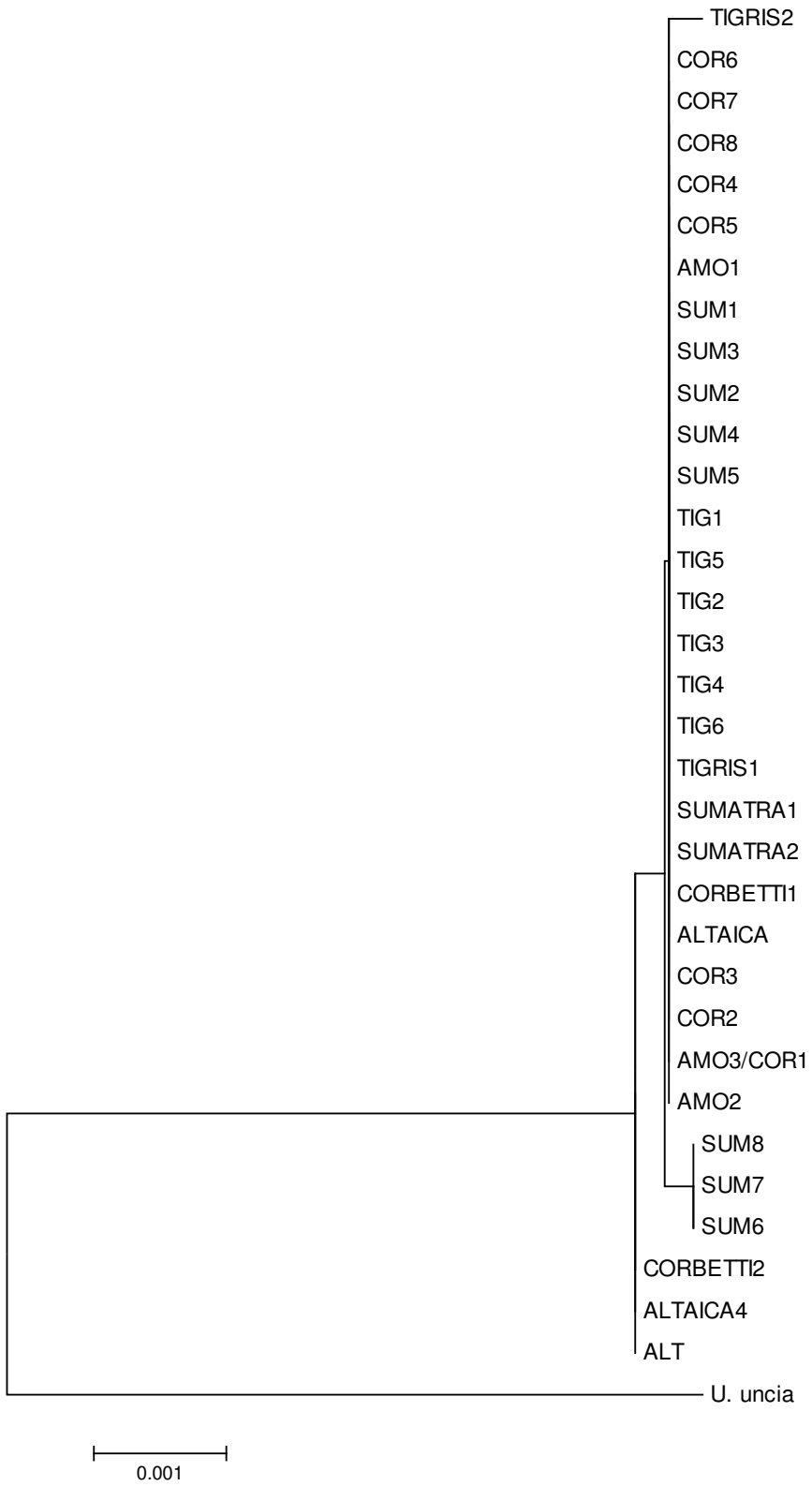
COI (Partial 1)_Parsimony



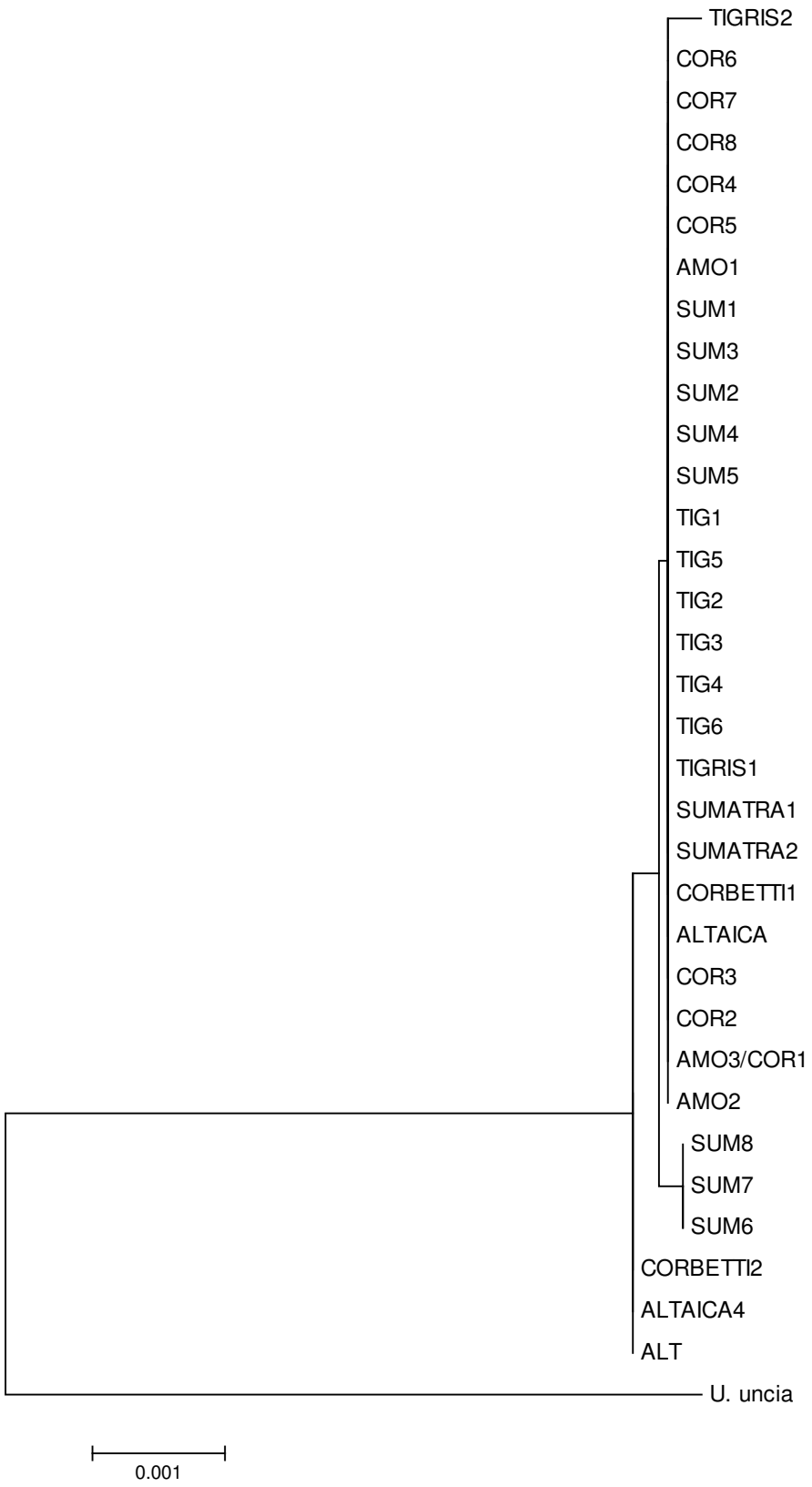
COI (Partial 1)_UPGMA



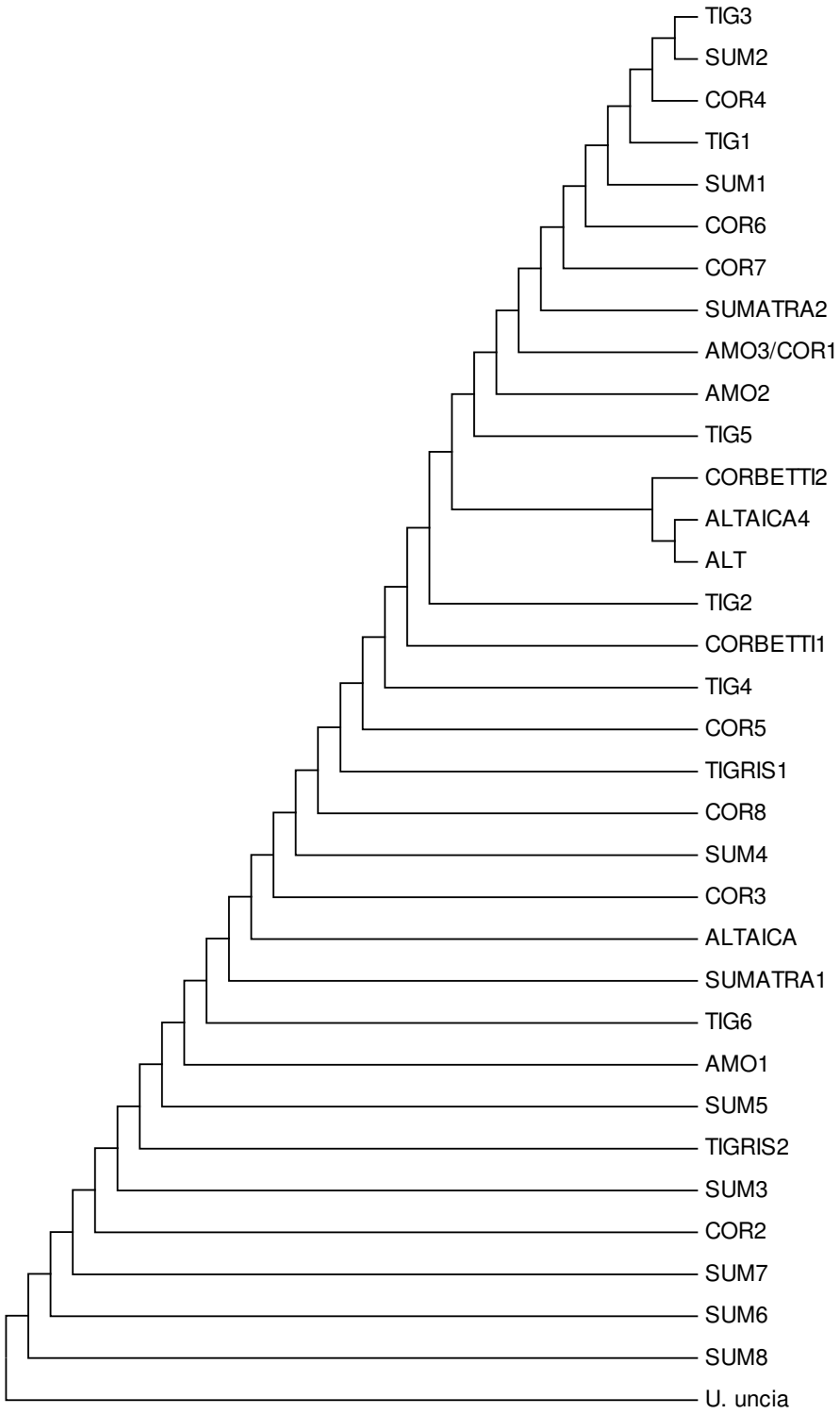
COI (Partial 2)_Neighbour joining



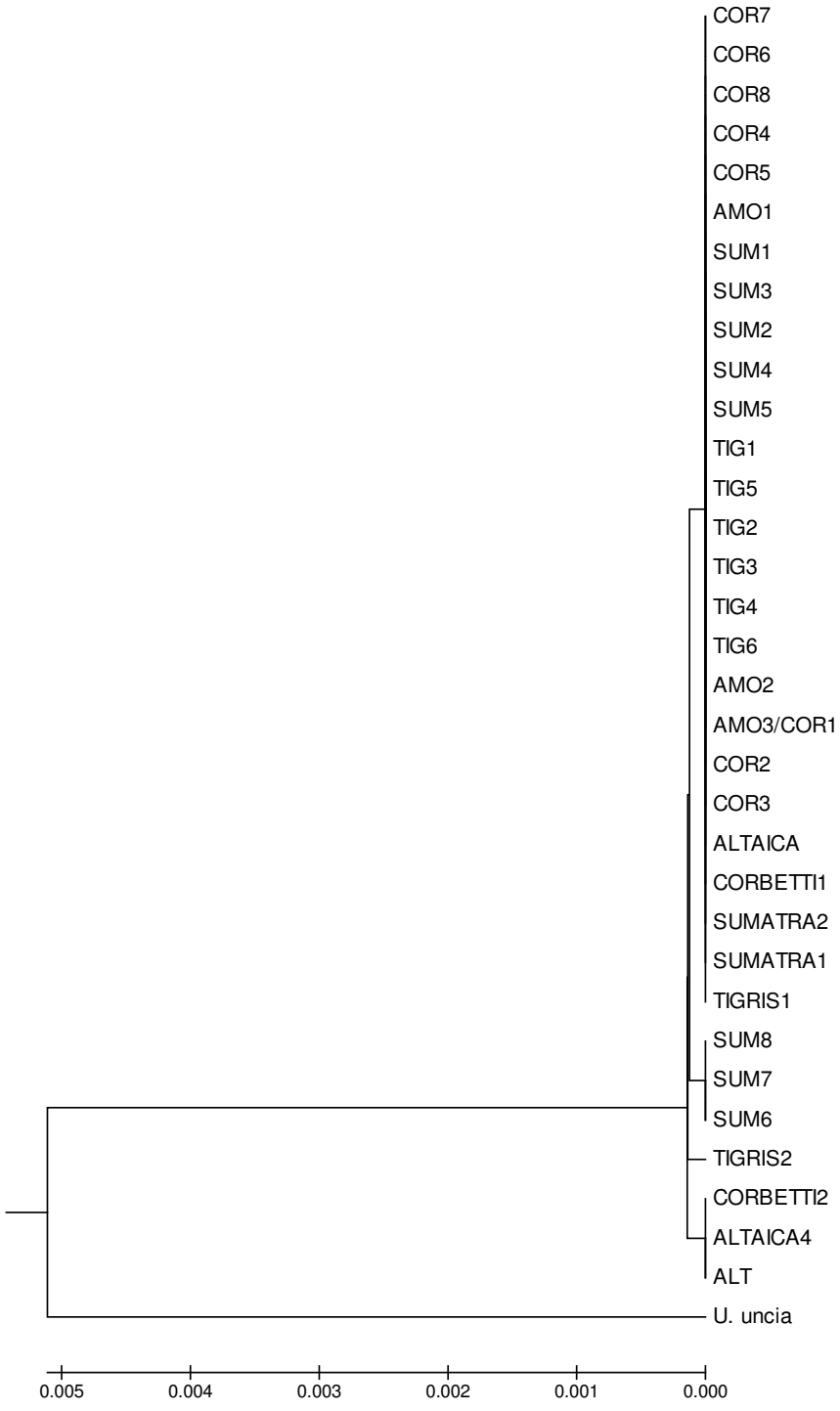
COI (Partial 2)_Minimum evolution



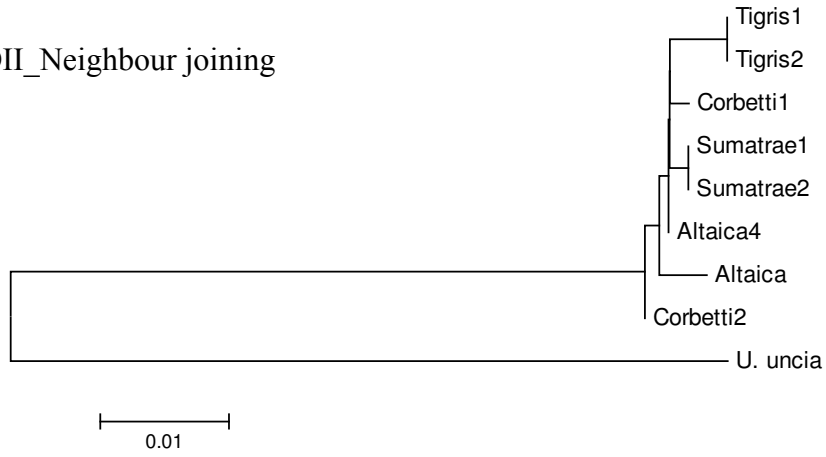
COI (Partial 2)_Parsimony



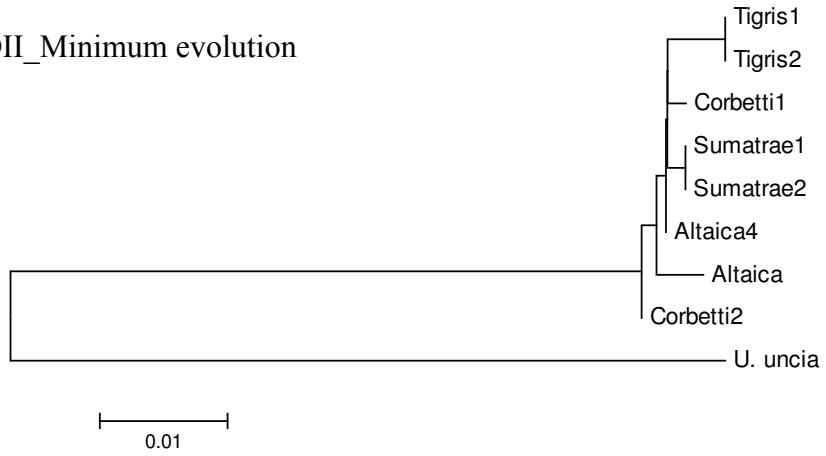
COI (Partial 2)_UPGMA



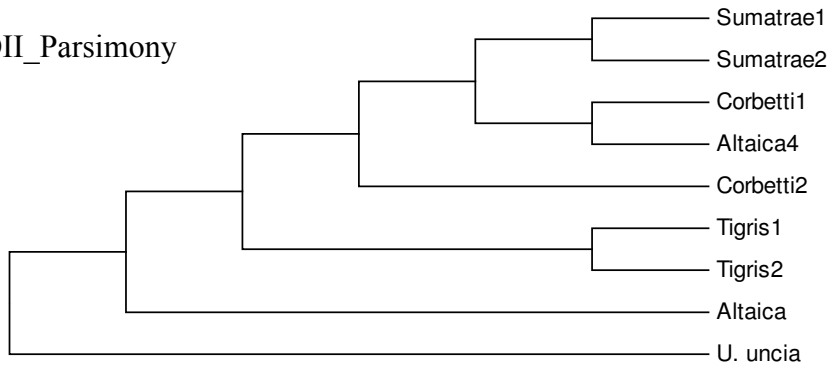
COII_Neighbour joining



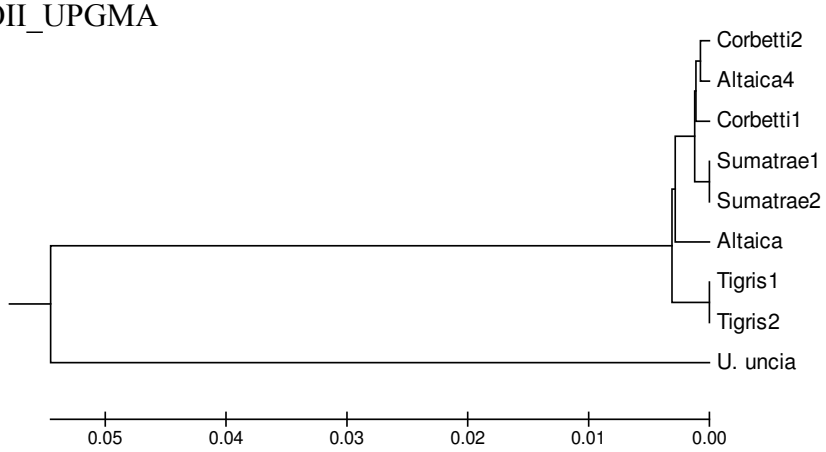
COII_Minimum evolution



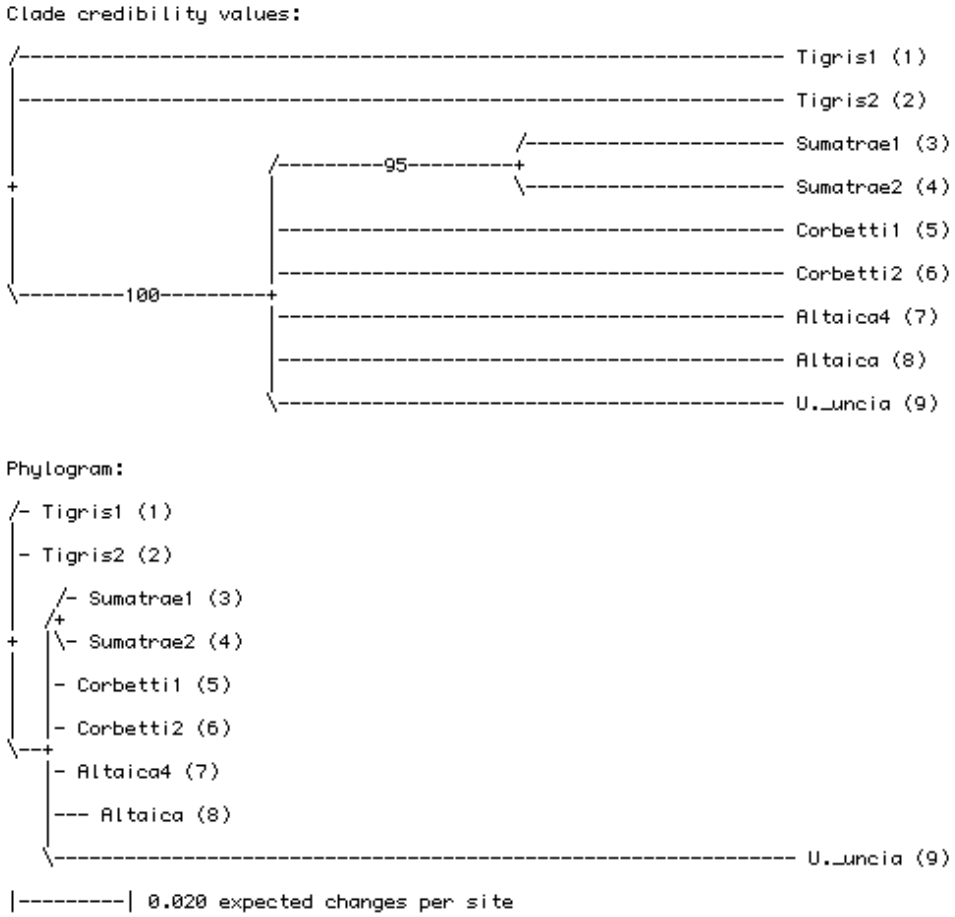
COII_Parsimony



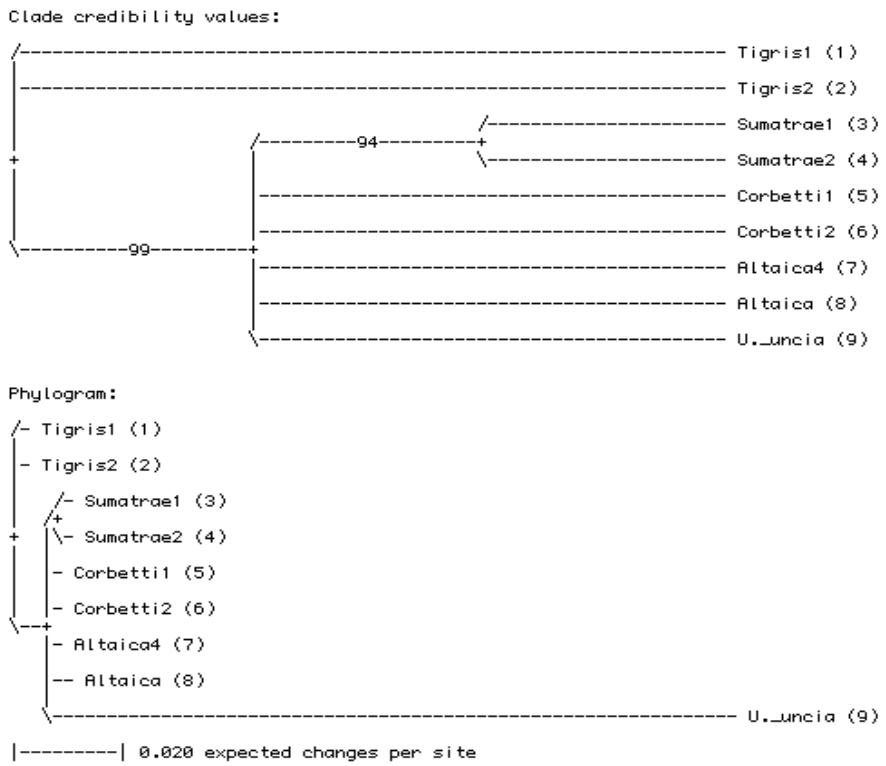
COII_UPGMA



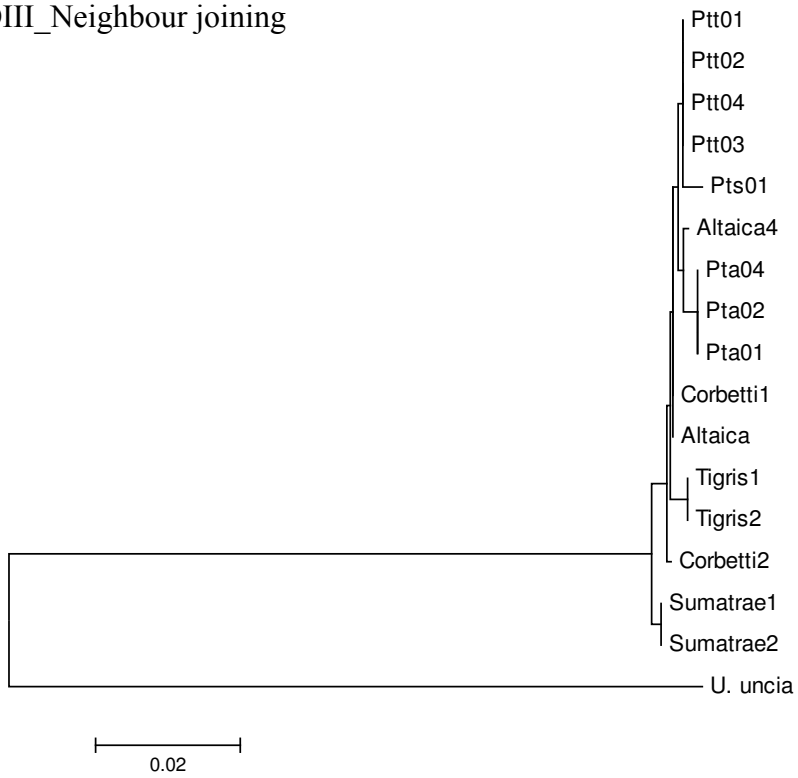
COII_MrBayes (4by4)



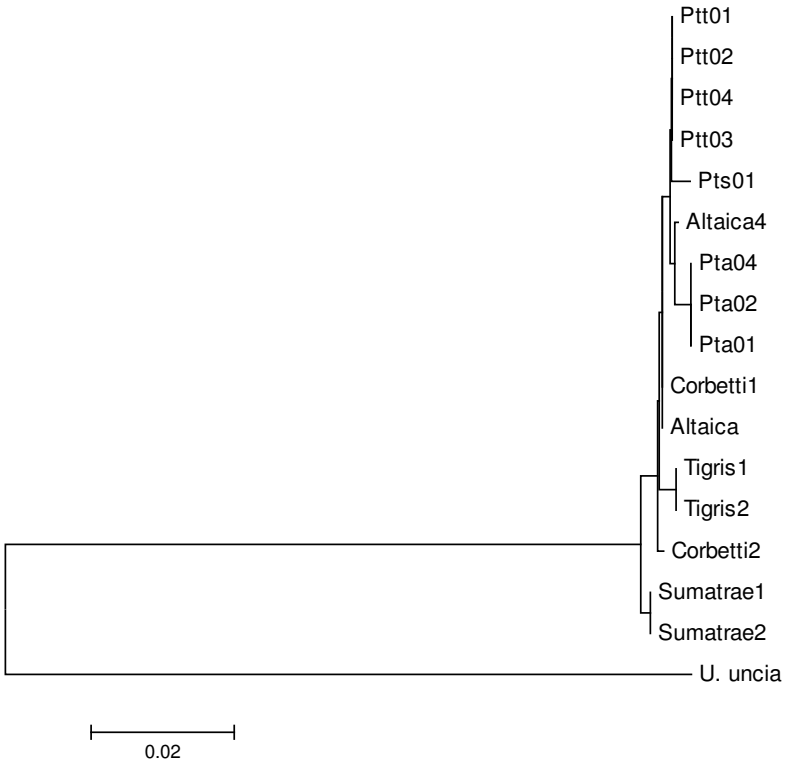
COII_MrBayes (codon model)



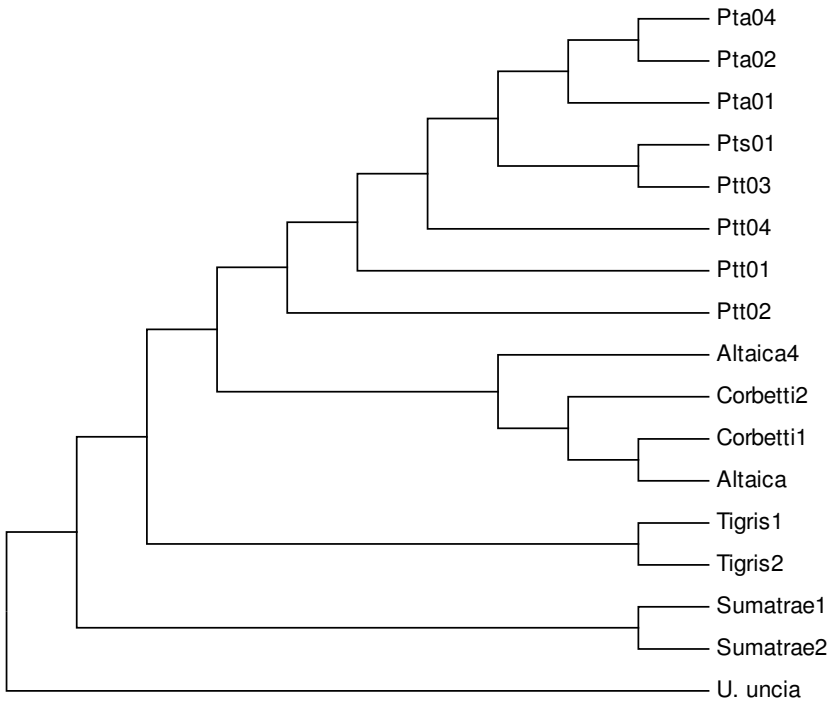
COIII_Neighbour joining



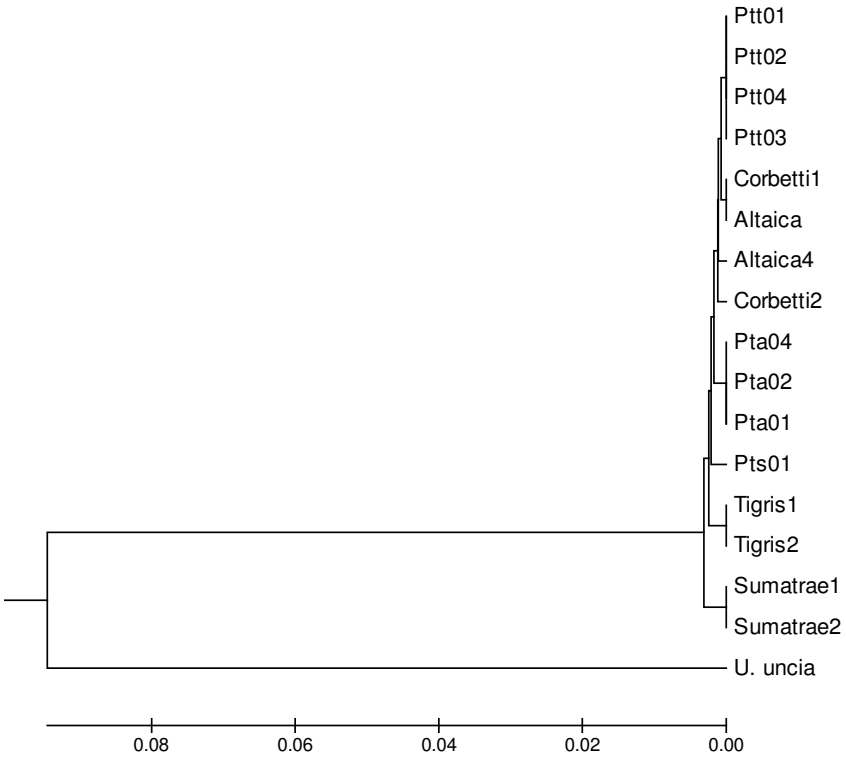
COIII_Minimum evolution



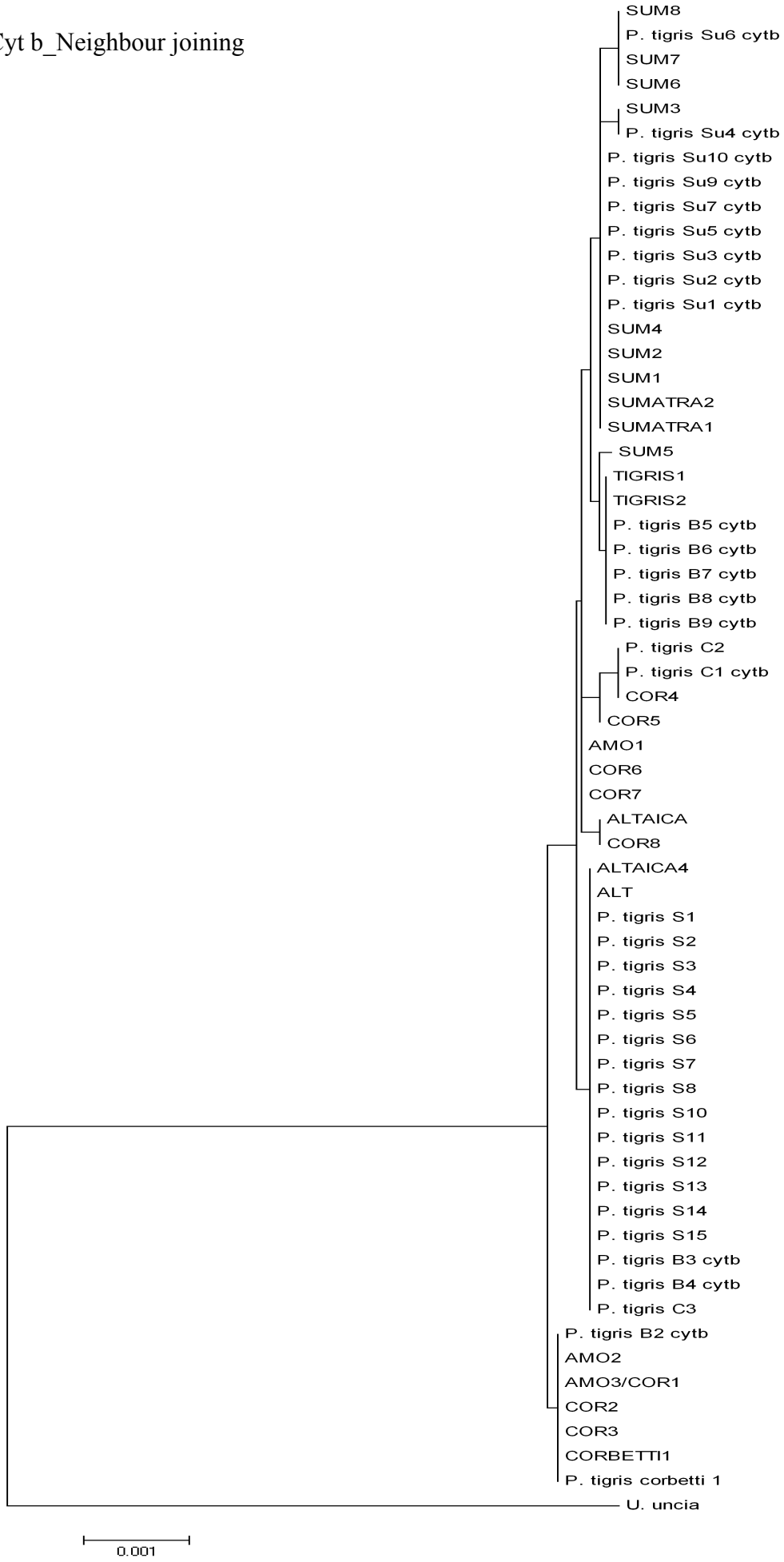
COIII_Parsimony



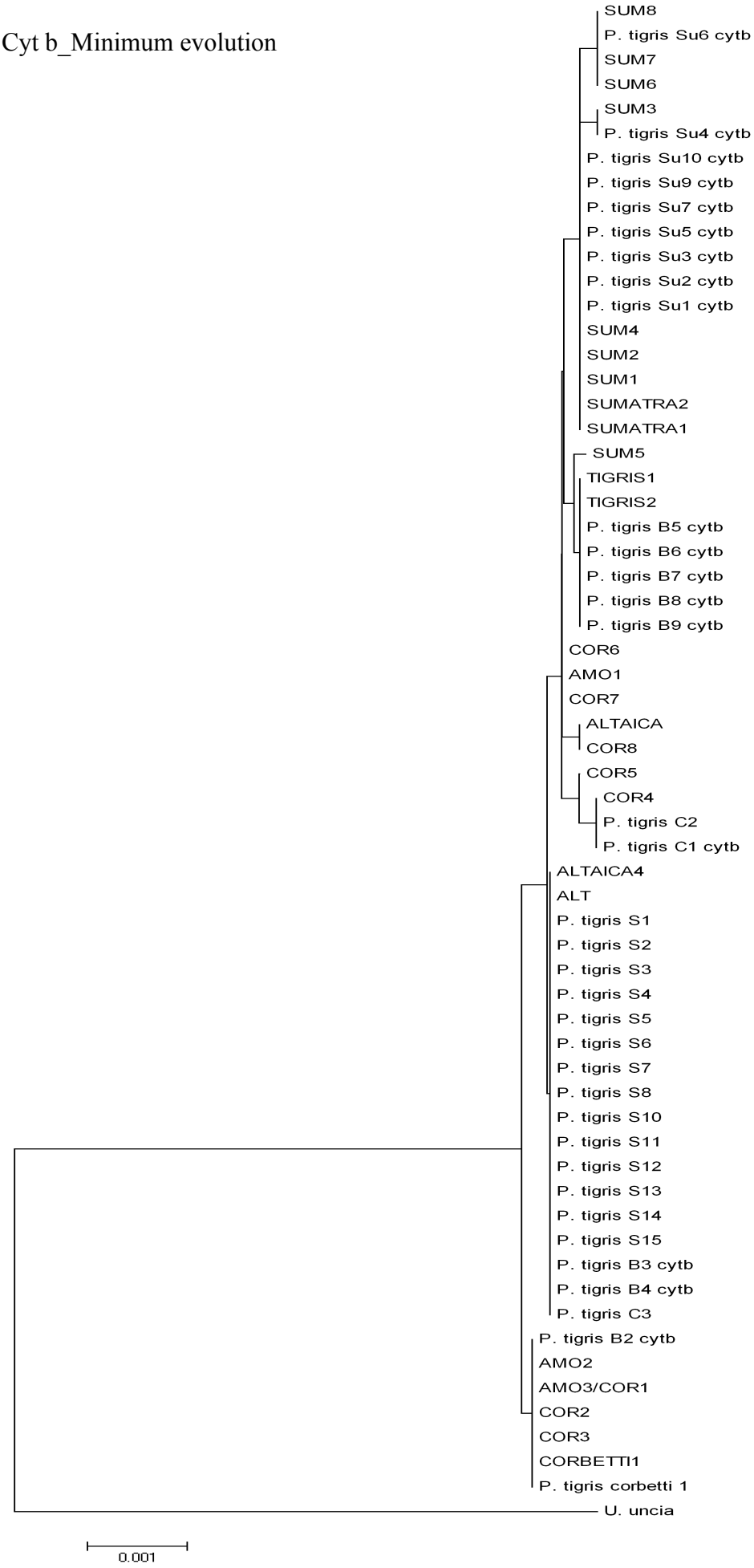
COIII_UPGMA



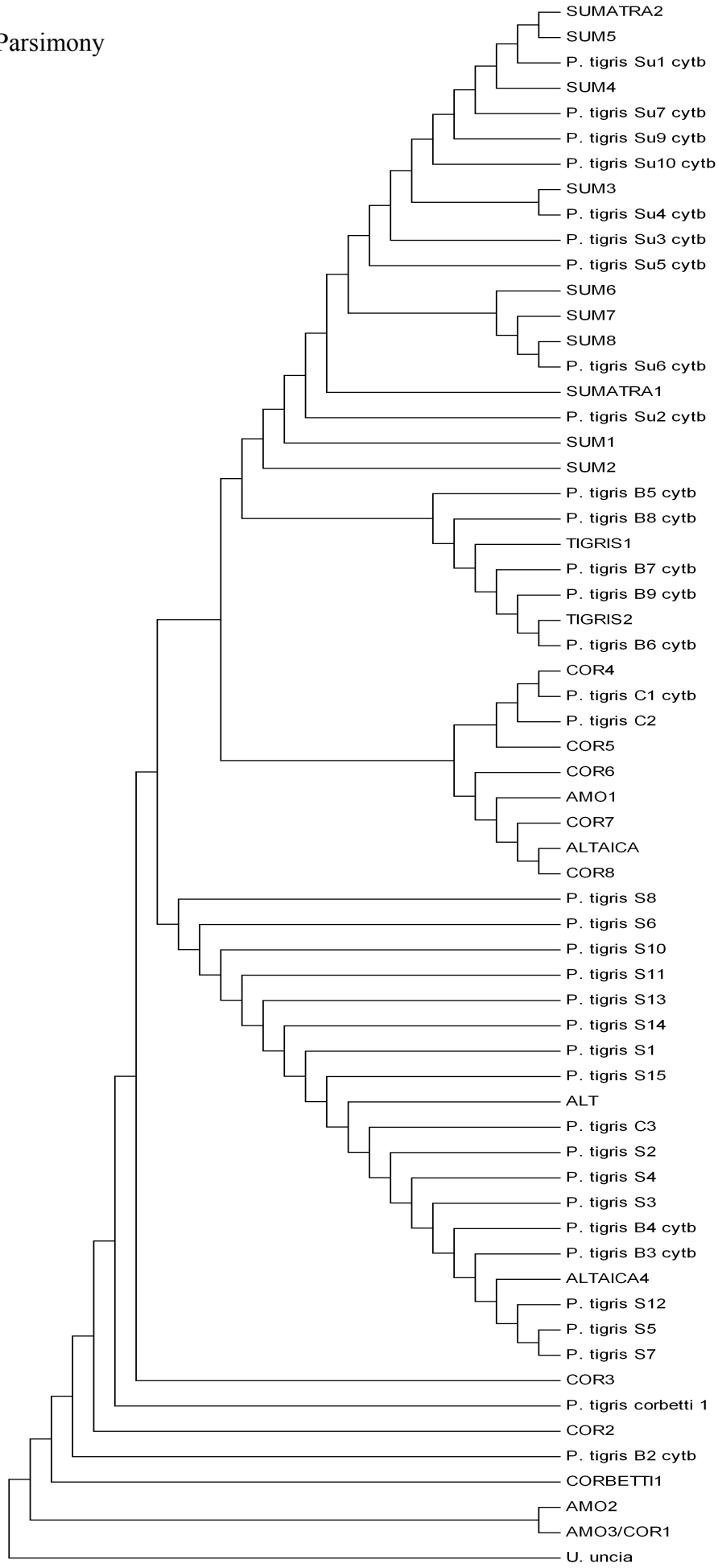
Cyt b_Neighbour joining



Cyt b_Minimum evolution



Cyt b_Parsimony



Cyt b _UPGMA


P. tigris B4 cytb
P. tigris C3
P. tigris B3 cytb
P. tigris S15
P. tigris S14
P. tigris S13
P. tigris S12
P. tigris S11
P. tigris S10
P. tigris S8
P. tigris S7
P. tigris S6
P. tigris S5
P. tigris S4
P. tigris S3
P. tigris S2
P. tigris S1
ALT
ALTAICA4
ALTAICA
COR8
COR5
AMO1
COR6
COR7
SUM5
TIGRIS1
TIGRIS2
P. tigris B5 cytb
P. tigris B6 cytb
P. tigris B7 cytb
P. tigris B8 cytb
P. tigris B9 cytb
SUM3
P. tigris Su4 cytb
SUM8
P. tigris Su6 cytb
SUM7
SUM6
SUMATRA1
SUMATRA2
SUM1
SUM2
SUM4
P. tigris Su1 cytb
P. tigris Su2 cytb
P. tigris Su3 cytb
P. tigris Su5 cytb
P. tigris Su7 cytb
P. tigris Su9 cytb
P. tigris Su10 cytb
COR4
P. tigris C2
P. tigris C1 cytb
P. tigris B2 cytb
AMO2
AMO3/COR1
COR2
COR3
CORBETTI1
P. tigris corbetti 1
U. uncia
0.005
0.004
0.003
0.002
0.001
0.000