Aboriginal Fibrecraft from Windmill Way

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Table of Contents

Table of Figures

List of Tables

Abstract

Approximately 90% of traditional material culture is comprised of organic material, yet these materials do not preserve well in archaeological contexts. The recovery of a large assemblage of macrobotanical material, shell, wood, and faunal bone, along with stone artefacts from Windmill Way rockshelter, near Laura in southeast Cape York Peninsula, Queensland, provides a rare glimpse into Aboriginal material culture in the Late Holocene. This thesis characterises the assemblage of 510 fragments of plant fibre representing several stages in the processing of raw fibre into string and string-based fabrics (netting and looping).

The development of string is argued to be a crucial component in the evolution of culture, enabling humans to adapt to a range of environments, capture and contain resources, and develop composite tools and adornments. Although perishable, indirect evidence for string spans hundreds of thousands of years and remains entwined in all human lifeways. The reliance on string requires intimate knowledge of fibre-bearing plants, and sustained time and effort in manufacture. Ethnographic observations of Aboriginal fibre practice indicate the breadth of specialised fibre traditions and ubiquity of fibrecraft in southeast Cape York Peninsula. These observations were collated and provide a regional base for identifying potential uses of the archaeological fibre. A comparison of the macro-attributes of the fibre assemblage was then compared to a selection of objects made wholly or partly from fibre, provenanced to Laura and held at Queensland Museum. This comparison demonstrated the uniformity of standardised manufacturing techniques of string and of string-based objects such as bags and fishnets and suggested a range of possible source objects for many of the archaeological fibre fragments. These possible uses allow inferences to be made into the lifeways of the Aboriginal peoples who occupied Windmill Way.

Declaration

I certify that this thesis 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.

Signed

Alexandra Snep

November 2024

Acknowledgements

My thanks to the Traditional Owners of Windmill Way and the Laura community who allowed me to work on this important collection of fibre material from tour Old People. Also to the ABM Project members, and Nick Hadnutt and the team of collections management at Queensland Museum for your assistance during recording.

For Sean, Myra, and Elke,

with love.

1 Introduction

1.1. Setting the scene

This thesis characterises an assemblage of plant fibre artefacts excavated from Windmill Way, a rockshelter in the Laura Sandstone Basin, southeast Cape York Peninsula (CYP). This is numerically the largest assemblage of archaeological fibre recovered in Australia and represents a snapshot of the complexity of Indigenous lifeways and plant use in the region and more widely during the late Holocene.

Windmill Way lies at the junction of the Battlecamp Sandstones and Laura Lowlands subregions of the CYP bioregion (Morgan et al. 1995:5). The coarse Jurassic and Cretaceous sandstone plateau that forms the southern rim of the Laura Basin is subject to honeycomb weathering and exfoliation, creating a multitude of rockshelters along the many-tiered escarpments and against the fallen outliers that litter the talus slopes. The escarpment that contains Windmill Way is on the border between the two landforms, and is the last escarpment before the wide, lowland plains to the north and west that characterise the remainder of CYP (Figure 2). These are open, forested plains criss-crossed with drainage channels and creeks. To the east lies the dramatic sandstone escarpment country, consisting of deeply incised valleys flanked by towering table-topped cliffs (Department of Environment and Science 2024).

The escarpment is home to the nationally significant Quinkan Country rock art region, which spans 230,000 ha (although the rock art continues beyond these borders) and contains thousands of rock art sites that have been studied for over 60 years (e.g. Cole 2012; Trezise 1971). Some of the abundant rockshelters also preserve archaeological evidence dating from the late Pleistocene (e.g. Morwood and Hobbs 1995; Rosenfeld et al. 1981). The Traditional Owners of the Laura Basin include at least 12 different language groups in social formations of land-owning and land-using clans. The clan groups known by language names today are thought to be post-contact social formations that include Kuku Thaypan, Guugu Yimithirr, Lamalama, Olkola and Kuku Yalanji (Cole 2004:158–159; Morwood 1995); many people living at Laura today are Kuku Thaypan speakers and have been represented by the Kuku Warra Aboriginal Corporation prescribed body corporate since November 2023, when a Native Title consent determination was made.

Windmill Way is located approximately 19 km northeast of the small town of Laura, and 2.6 km north of the Deighton River. An ephemeral stream runs 180 m to the west of the rockshelter. The 29 m long, west-facing shelter is located in a low, 'single-storey' escarpment surrounded by open woodland (Figure 1). It has an uneven, slightly sloping floor, and several low alcoves extending deep into the sandstone. Approximately 20 discrete panels of rock art line the walls and ceilings, and several grinding patches and an engraved macropod track pair motif were recorded on the northern floor surface (ABM Project, unpublished data).

The northern-most alcove is the location of the assemblage featured in this thesis. It is roughly circular, measuring approximately 3 m in width and 2.5 m in length. Following the excavation of up to approximately 40 cm of disturbed sediment to the bedrock floor, the maximum height of the alcove ceiling was approximately 1 m.

Figure 1. View looking northeast to Windmill Way rockshelter (photo: A. Snep).

Windmill Way was excavated in 2022 as part of the Agayrr Bamangay Milbi Project (ABM Project) (funded by ARC Linkage Grant LP190100194). The ABM Project aims to survey and document cultural heritage sites in the Laura Sandstone Basin, conducted in partnership with multiple Traditional Owner Groups (Balnggarrawarra

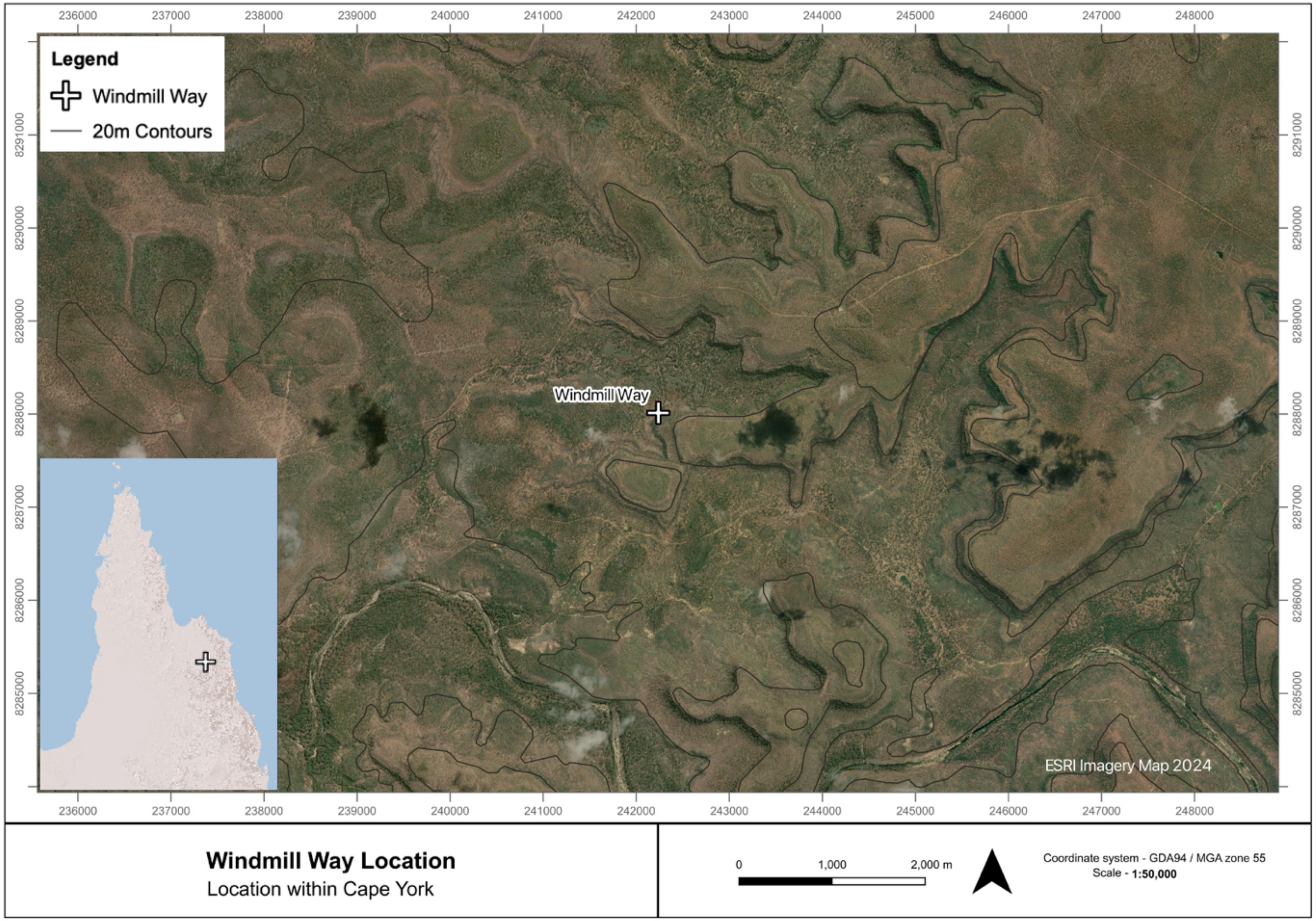

Figure 2. Location map showing Windmill Way at the transition zone between lowlands (west) and escarpment (east), and its position in southeast CYP.

Aboriginal Corporation and Balnggarrawarra Rangers [responsible for Ngaynggarr National Park (NP)], Buubu Gujin Aboriginal Corporation [Juunju Daarrba NP, Muundhi (Jack River) NP and Melsonby NP], Cape Melville, Flinders and Howick Islands Aboriginal Corporation [Cape Melville NP], Laura Indigenous Land and Sea Rangers [Quinkan Country and Rinyurru NP], Waarnthuurr-iin Aboriginal Corporation [Binirr NP], and Normanby Rangers [Melsonby and Normanby NP – see Figure 3) and is supported by the Queensland Parks and Wildlife Service (QPWS), South Cape York Catchments and Wallis Heritage Consulting. During site recording at Windmill Way in 2021, participating Traditional Owners Christine Musgrave (the senior member of the Laura Rangers) and Roseanne George noticed the presence of fibres on the surface of the sandy deposit; ABM Project team members subsequently noted the presence of other organic materials, such as bone, shell and wood, along with stone artefacts. As sandstone is acidic, organic material usually does not preserve well therein, though wooden artefacts had been collected from elsewhere in the escarpment by Trezise (e.g. Flood and Trezise 1981; McLay 2023) in the 1960s and 1970s, faunal bone and string were recovered by Morwood (1989) at Magnificent Shelter and Yam Camp (Morwood and Dagg 1995), and bone by Rosenfeld et al. (1981) from Early Man Shelter. ABM Project team members have also recorded wooden artefacts and string in other shelters during their fieldwork between 2021 and 2024 (ABM Project, unpublished data).

Artefactual material recovered from the excavation of Windmill Way include the 510 fibre fragments analysed for this thesis, other macrobotanical material, bone and wooden artefacts, faunal remains, lithics, and ochre (ABM Project unpublished data). European material, (a strip of woven red cotton cloth and a piece of thick-gauge wire,) demonstrate that the rockshelter was in use during the contact period. Six radiocarbon dates were obtained from charcoal in the deposit, returning dates between 178±19 and 2,112±20 cal BP (ABM Project, unpublished data).

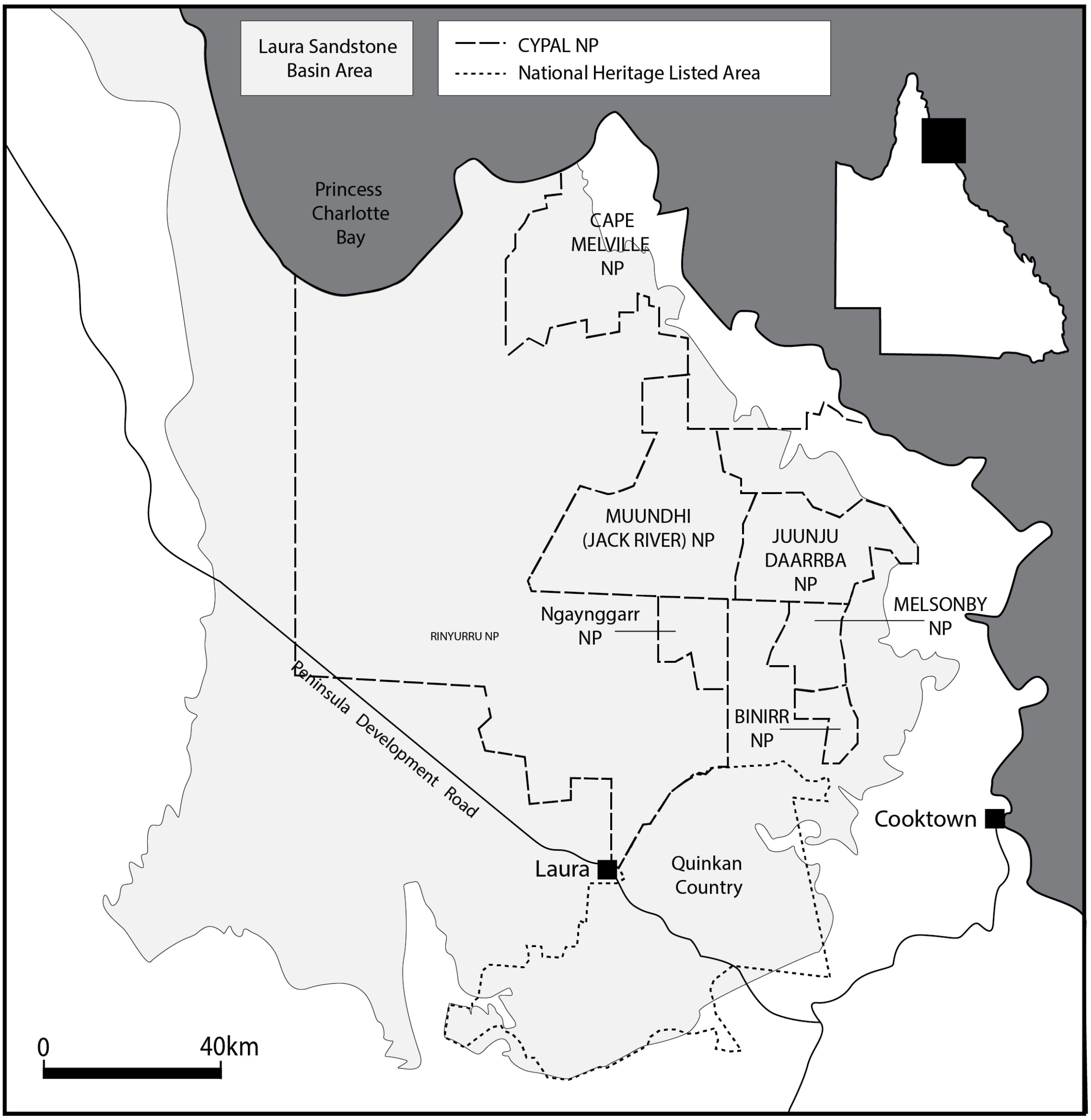

Figure 3. Map of Cape York Peninsula Aboriginal Land National Parks (CYPAL NPs) relevant to the ABM Project (ABM Project spatial data).

1.1 The importance of string

Fibre objects may be manufactured from various materials, but most are made from specific plant parts, fur, hair, or feathers, and have deep-time origins as a human technology (Barber 1995). String can be made from any fibrous material and increasingly complex manufacturing techniques have produced a range of products from thread to rope, fine textile to robust baskets. Plant fibres fall into three main categories:

- Seed hairs that are short and fine and are spun into strands, usually with a spindle (e.g. cotton)
- Grass or leaf fibres, which may be split or used whole and rolled longitudinally or woven flat (e.g. raffia)
- Bast fibre, obtained from the inner layer of plant stems and often further processed to remove any material extraneous to the strong fibres (e.g. linen) (van Dam and Gorschkova 2003:87–88, 94–95).

Of the three fibre types, bast fibres are thought to be the most used worldwide (Baldia and Armitage 2023:798). The paucity of Australian archaeological fibre studies means little is known about the prevalence of fibre types, although all fibre types listed above are known to have been used.

Although organic fibres themselves may not always survive archaeologically, the origins of fibre technology are indirect evidence for the existence of beads and pendants up to 300,000 years old from the Repolusthöhle in Styria, Austria (Mottl 1951). Impressions of string and basketry in pottery have been identified across Eastern Europe up to 27,000 years old (Soffer et al. 2000b). Physical finds of fibre are rare due to the perishable nature of soft organics, yet a tiny fragment of three-ply string was identified in a context dated 47–52,000 years old in Abris du Maras, France (Hardy et al. 2020). Hardy et al. (2020) attributed this context to Neanderthal occupation and were able to identify the fibre source as gymnosperm (e.g. conifer, cycad spp. that reproduce via exposed seeds or woody cones) bast fibre. These factors support the deep antiquity of fibre technology, as the processing techniques to produce bast fibre, coupled with the complexity of technique in producing three-ply cord, suggest the technology was well-developed in Neanderthal populations long before the transfer or independent evolution of the same technological capability in modern human populations.

The development of string, rope, weaving, and binding allowed humans to expand their activities and harness a range of capabilities (Davidson and Noble 1992; Hardy 2008), including developing symbolic behaviours and tailoring solutions to problems of carrying, climbing, hafting, decorating, catching and netting, subsequently developing ever-more complex technologies. The development of secondary fibre objects from string or rope, such as nets, baskets, or bags, enhanced human ability to capture abundance and thrive (Brown 1991:135–136). The manufacture and use of complex and composite fibre artefacts is argued to have revolutionised hunting and collecting strategies (Barber 1995 Hardy 2008:272) and the development of reliable watercraft allowed for the colonisation of islands — such as Australia (Balme 2013; Davidson and Noble 1992). This, in turn, shaped interactions with the environment and lifeways by establishing relationships between people and resources. The significance of reliable resources for the manufacture of increasingly necessary tools is a corollary — if not the driver — of a system of sustainable cultural interactions and reciprocal relationships with the natural world. In Aboriginal Australia this is understood as a spiritual and material connection to Country, expressed as a kinship relationship, with notions of obligation and care maintained through Aboriginal Law (Langton 2002; Rigsby 1999; Rose 1996). These relationships have arguably always existed with food plants (Atchison and Head 2013; Cumpston et al. 2022).

People-plant relationships for purposes other than those associated with subsistence require a separate, yet entwined, set of specific knowledges, protocols and processes. Acknowledging that many plants have multiple uses, seasonal and regional knowledge of fibre plants and procurement is an essential accompaniment to the technological processes employed in the manufacture of string and other fibre artefacts. As a highly labour-intensive occupation, fibre manufacture involves substantial commitments of time and energy to gather and process raw material into string, and further time to create secondary objects, such as bags or nets. Such investments suggest abstract and conceptual thinking in the complex engineering of such tools from plants. They also require significant group dynamics, where time is allocated away from immediate subsistence activities and the necessities of providing shelter, warmth, light, and care to younger and elder group members. Fibre manufacture may be an individual or group activity, requiring co-operative and collaborative skills alongside the technical skills of fibrecraft from those involved in the project at hand. For example, based on the dimensions of an emu net held at the South Australian Museum, Satterthwait (1987:614–615) estimated that an

18.3 x 12.2 m waterfowl net with 5 cm mesh, such as those observed by Eyre in 1845 and Mitchell in 1839, required 7,500–9,000 m of cord and around 90,000 knots. At Lake Tyers Mission, Bulmer (n.d.) observed the manufacture of cord at a rate of "not much more than a [sic] 100 yards a day". When coupled with an observation of contemporary Aboriginal net-making, where knots were made at a rate of seven seconds each, around 97–112 days of labour are required to manufacture the waterfowl net, plus time spent locating, gathering, and processing such large quantities of raw material. A net smaller mesh may then take an individual a year or more to complete and was understandably valued by its owners (Satterthwait 1987:615).

1.2 Strands of fibre research

Fibrework, and string in particular, has a critical role in the construction of material culture, subsistence regimes, and the cultural lives of people across the world. Yet, its integral role in culture and its high propensity to decompose has rendered it somewhat invisible to researchers of past lives and lifeways. Examination of fibre typologies and technologies can provide insights into human interactions with each other and their complex relationships with environments, which in turn contributes to the knowledge of past human lives. European (e.g. Bergfjord and Holst 2010; Martirosyan-Olshansky and Farahani 2023; Gleba and Harris 2019;), North (e.g. Baldia and Armitage 2023; Hammond-Kaarremaa 2018; Soffer and Adovasio 2014)) and South American (e.g. Jolie et al. 2011; Martens and Cameron 2019) colleagues have rich archaeological repositories of fibrework and have developed methods of deep analysis of form and format, reconstructing the technological timeline of early spinners and weavers.

Detailed research has also been undertaken on archaeological textiles and ethnographic fibre production across South-East Asia and the Pacific (e.g. Andersen 2015; Hawkes 2021; Nelson et al. 2020; Paterson et al. 2017; Tamburini et al. 2019). In contrast, fibre research in Australia is an understudied field. Traditional fibrework was often denied as a valid or worthwhile cultural practice by missionaries and was replaced with foreign techniques to provide items for tourist trade (e.g. Barwick 1974;

Keller 2010:32; Nugent 2012). Further, early ethnographers were predominantly male and preoccupied with documenting the complexities of totems and social arrangements, hunting tools, and other men's business, or ignoring women's 'craft' in favour of men's 'art' production, meaning that gender biases compounded the marginalisation of fibrework (Keller 2010:10).

Following the development of archaeology as a professional discipline in Australia in the 1960s, the focus remained on the stones and bones of material culture (Balme and Bulbeck 2008; Beck and Balme 1994), largely because organic materials were simply not expected to preserve in Australian sediments. Subsequent finds of archaeological fibre have been accidental and mostly treated as incidental, while research into extant Indigenous fibrework practice and practitioners remains niche (e.g. Hamby 2007; West 2021). The most detailed investigation of Australian archaeological fibre to date is that by Balme et al. (2022), who identified 19 string fragments from two sites in the Kimberley as bast fibre (n=12), and fur (n=7). They compared the ochre coating identified on two fragments with examples from the WA Museum and discussed the ubiquity and significance of string in Aboriginal material culture (Balme et al. 2022:125). Revisitation of plant remains recovered from archaeological deposits are few (but see Allen and Brockwell 2020) yet could greatly expand knowledge of fibre technologies in pre-invasion Australia by assembling detailed information on the characteristics specific to Australian Aboriginal fibrework.

A second existing body of research into fibre technologies, form and format, species, significance, and method of construction, has been undertaken by ethnographers working in communities, and through studies of museum objects collected in the post-contact period (e.g. Hamby 2007; McAdam 2008; Roth 1901; West 2021). Much can be ascertained about archaeological fibres by comparison with extant objects held in museum collections that showcase a range of technologies and techniques from a broad geographic base. Analyses of fibre objects by anthropologists have developed detailed typologies of manufacturing techniques (Davidson 1933; West 2021) that can be used to aid in the identification and interpretation of archaeological fibres.

This ethnographical and archaeological knowledge of material culture is extremely patchy temporally and geographically and influenced by the biases of collectors and researchers. Although many beautiful fibre objects are held in collections around the world, they often have poor provenance and the maker's names and the conditions under which the objects were used and collected are rarely known (see Hamby 2007; Peterson et al. 2008). Altogether, this constitutes very little knowledge of Indigenous fibrecraft. It is not known how old fibrecraft is in Australia, or the spatial distribution of object types and manufacturing techniques pre-colonisation, and how these changed over time. The full extent techniques used in fibrecrafting is unknown, and little knowledge of plants sources and preparation methods survive. Many Aboriginal communities have lost knowledge of fibrecraft materials and manufacturing through colonial repression and dispossession.

This thesis intertwines two avenues of research — archaeological and collected ethnography and objects — to address some of the gaps in current knowledge of Aboriginal fibre technologies, production, and identification methods. As the first study of the largest body of archaeological fibres found in Australia since the excavation at Anbangbang, NT[1] (Clarke 1985, 1987), and the only fibres found in northern Queensland, it contributes to the understanding of perishable material culture in Aboriginal lifeways, and the range of activities, technologies, and processes maintained through such technology in southeast CYP. The central research question this thesis sets out to address is:

> What can the archaeological fibres from Windmill Way tell us about the complexity of Aboriginal material culture in southeast CYP in the late Holocene?

Subsidiary questions include:

1. What objects, string and knotting or looping patterns from the Laura region are known from ethnographic museum sources?

[1] The assemblage described in this thesis numbers 510 objects, while the assemblage from Anbangbang numbered 72: "65 finds of single segments and seven bundles of string, including one example of netting" (Clarke 1987:157). A further three pieces of resin with string inclusions, 11 pieces of string in preparation, and 15 pieces of "fibrous material" were also recorded (Clarke 1987:139). An unspecified portion of the string was hair and/or fur fibre (1987:158). The larger pieces in the Anbangbang assemblage may make it comparable in volume to the assemblage described here, however, quantifiable data were never been published and Clarke's entire assemblage was lost in the 2003 Canberra bushfires (Clarke 2012:99).

2. How can the adhesion of resin and ochre aid interpretation of the uses of the archaeological fibres?
3. What knowledge of human activity can be drawn from the possible uses of these fibres?

Its core aims are to:

- Characterise the WW fibre assemblage according to potential forms, sources, techniques and styles of fibrework, and, where possible, use this to identify potential objects, activities and uses.
- Situate the WW fibre assemblage within the known ethnographic context of fibre objects in CYP by comparing the archaeological fibres with items from the Laura region held in the collection of the Queensland Museum. This comparison will provide a preliminary base for tracing the similarities and changes in attributes between the collected material from the early twentieth century, and the archaeological material.
- Contribute to knowledge of perishable material culture/fibre technology in the Laura region and return this knowledge to the Traditional Owners.

In the next chapter, a review of the literature of archaeological analysis of fibrework examines the finds from Australian sites and provides an overview of significant milestones in fibre research. Chapter Three outlines the methods used in the analysis of the assemblage of archaeological fibre from Windmill way, and a comparative selection of fibre objects from Laura held at the Queensland Museum. The results of these analyses are detailed in Chapter Five, followed by a discussion and interpretation of the findings in Chapter Six.

A glossary of terms specific to fibrework is provided in Appendix 1: Attributes of fibre.

2 Plant fibre technologies of Aboriginal Australia

2.1 Introduction

Fibre technologies have played a significant role in human lifeways, yet poor preservation of organic materials means our knowledge of the past is largely predicated on items of stone and bone. Similarly, to date, research into plant fibres in Australian archaeology has been limited, and our understanding thereof is deeply reliant on ethnohistoric and ethnographic sources and ethnobotanical research. Although fibre objects may also be made from hair, including human hair, animal fur, and even feathers, this study focusses on plant fibres.

This overview of plant fibres recovered from archaeological contexts across Australia reveals the paucity of interpretations of fibre technologies and analogous human behaviours. To date, as best can be determined from published sources, Aboriginal-made plant fibre has been excavated from sedimentary contexts at just 13 sites: Riwi 1 and Carpenters Gap 1 (Balme et al. 2022), Anbangbang 1 and Djuwarr 1 (Clarke 1987), Currarong (Lampert 1971), Kens Cave (Morwood 1981), Kawambarai Cave (Murphy 1992), Paribari and Jimeri 1 (Schrire 1982), Magnificent Gallery (Morwood 1989), Swan Reach (Hemming et al. 2003), Lower Murray River rockshelters (Westell et al. 2024), and Kongarati Cave (Tindale and Mountford 1936) (see Figure 4 and Table 1). More finds may be recorded in Cultural Heritage Management grey literature, but as these are generally not made public, they cannot be counted or quantified. In contrast, indirect evidence relating to fibre, such as beads (e.g. Mandu Mandu [Balme and O'Connor 2019] and Devils Lair [Dortch 1979]) and depictions in rock art (Grey and BAC 2024; Gunn et al. 2017; Hayes et al. 2018; Hayward et al. 2018; Miller 2021; Veth et al. 2018) is more prolific. This literature review establishes the current state of archaeological research into Australian Indigenous fibre technologies from material excavated from archaeological deposits and retrieved from caches and considers gaps in our current understanding. In doing so, the focus is primarily on fibres recovered from sedimentary contexts, although cultural material from caches contributes significantly to the archaeological record.

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Figure 4. Map showing the major IBRA bioregions representing plant diversity and vegetation structure at a coarse scale (http://www.environment.gov.au/land/nrs/science/ibra) across the continent, and the distribution of select places mentioned in the text where archaeological fibre has been recovered. Bioregion mapping after Brundrett 2017 and Ebach et al. 2015.

2.2 Taphonomy of fibre artefacts

Most of the archaeological record suffers preservation bias and subsequently the materials that do survive inform much of our knowledge of the human past. However, up to 90% of material culture in pre-industrial societies was comprised of organic materials (Hardy 2008; Hurcombe 2014 as cited in Hardy et al. 2020:1; Soffer et al. 2000b:812). When organic materials are preserved archaeologically, they contribute a wealth of information to our knowledge of past lifeways. Soft organics have the fastest decomposition rates and are not expected to survive in archaeological contexts, except in rare cases of extreme desiccation, freezing, or submergence in anaerobic water bodies or bogs (Beck and Dotte-Sarout 2013; Beck 1989). However, Figure 4 shows that fibre has preserved archaeologically in a wide range of bioregions across the Australian continent, including the monsoonal tropics and subtropics. Morwood (1984:549) suggested that heavy metal-rich ochre would be an effective biotoxin and may aid in the preservation of ochred organic objects; however, no investigations into this hypothesis have taken place as yet. It is understood that conditions in most Australian archaeological sites are not conducive for the preservation of organic material (Balme et al. 2022:116), rendering the recovery of soft organics (including fibre) rare.

Consequently, archaeology often turns to sources other than the purely archaeological to contextualise, interpret, or identify fragmentary organic remains. Australian Indigenous archaeology has often relied heavily on ethnography for interpretation of sites and materials (e.g. Allen 1996; Gould 1980; Meehan and Jones 1986). However, historical observations of traditional Indigenous activities are invariably biased, and interpretation has long been made through the deeply gendered lens of White societal norms. Such biases have resulted in an ethnographic record that is skewed by (mostly male) recorders speaking mainly to male informants, predicated on the assumption that men could speak for all members of the group (Rohrlich-Leavitt et al. 1975). The gendered division of knowledge present in many cultures meant men did not have substantial knowledge of women's business to pass on, and women could not share restricted knowledge with male ethnographers (Rohrlich-Leavitt et al. 1975). Where ethnography forms part of the foundation for archaeological interpretation, these biases are compounded. This is evident in the literature, where lithic technologies and hunting tools, assumed to be the sole domain of men, have long dominated, and many female archaeologists operated under the same patriarchal value systems in their research (but see Bird 1993; Gorman 1995). To this end, the manufacture of fibre objects is almost universally attributed to women, despite broad and specific ethnographic evidence of men practicing fibrecraft (e.g. MacKenzie 1991; Roth 1901, 1904:53; Tindale 1948), and significant studies by male researchers into fibre practice (e.g. Davidson 1933; West 2021). Compounded by poor preservation, the neglect of archaeobotany as unimportant women's business has resulted in limited research into fibre objects and technologies.

2.3 String-shaped culture

While humans are not the first or only animals to create and use materials beyond their immediate subsistence and shelter needs, none have gone to the extent of humans (e.g. Brown 1991:135; Hardy 2007:10). Some of the great developmental leaps in human culture are linked to fibre technologies, particularly string and rope, which have been a crucial component in the evolution of culture — what makes us human upon the Earth (Balme 2013; Bednarik 2015; Brown 1991:135; Hardy 2008). Key for Australia in this regard is the necessity of fibre technology to enable the peopling of the continent. Balme (2013) argued that fibre technology was pivotal for the construction of multiple, reliable watercraft required to undertake the successful maritime crossing of Wallacea and the colonisation of Sahul 65,000 or more years ago (Clarkson et al. 2017). Allen and O'Connell (2020) concurred, arguing for colonisation by a population of up to one thousand, based on genomic testing for haplogroups. They reasoned such a sizeable founding population required the construction of multiple craft and several voyages over the span of centuries, demonstrating advanced seafaring and navigation for the journey to be repeated successfully multiple times, and precluding accidental colonisation (Allen and O'Connell 2020:10). String technology is an essential part of the human toolkit that facilitated such activities and part of the evolution of a wealth of cultural objects and uses.

2.4 Global evidence for ancient fibre technologies

Despite preservation challenges, evidence for fibrecraft is of considerable antiquity (Hardy 2007:10–12, 2008:272–274). The indirect evidence for fibre spans some 300,000 years. A perforated bone point and a wolf incisor from Austria, assumed to have been strung like pendants, along with Libyan ostrich eggshell beads imply the oldest fibre dates to 300,000 years (Mottl 1951; Ziegert 2010). Dozens of beads recovered from East Africa, the Levant, India, and Sri Lanka date from 80,000 BP (Bednarik 2015:53–55). The world's oldest surviving manipulated fibre is a 52,000–41,000 year old fragment of cordage from a Neanderthal site in Abri du Maras, France (Hardy et al. 2020). The 6.2 mm fragment of 3-ply string was adhering to a Levallois flake. Minute tufts of fibre were adhered to several other flakes from the same context, but none of these retained enough twist to be confidently declared to be worked fibre (Hardy et al. 2020:2–3). The string was examined microscopically and determined to be made from gymnosperm (likely conifer) bast, or inner bark (Hardy et al. 2020:3–5). Fragments of bast fibre with evidence of spinning and twining were found in sediments dated to 30,000 ka in Dzudzuana Cave in the Caucasus (Kvavadze et al. 2009).

Impressions of woven and looped fibres in pottery sherds also provide an indirect link to sophisticated fibre technology. Soffer et al. (2000b:813–818) recognised the patterns of woven fibre, netting, basketry, and compound string (three strands of two-ply string spun into three-ply cord) imprinted in sherds of pottery recovered from Gravettian- and Magdalenian-aged contexts from Lascaux in France, Gönnersdorf in Germany, Dolni Vestonice I and II and Pavlov I in the Czech Republic, and Kostenki I and Zaraisk in Russia, dated to 28,000ka (Soffer et al. 2000b:813). Until woven and corded fibre impressions were discovered on pottery shards it was thought that fibre craft was developed concurrently with the Agricultural Revolution in the Levant during the terminal Pleistocene (Soffer and Adovasio 2014:424). Instead, the complexity and refinement of the fibrework recognised in the pottery shards led Soffer and Adovasio (2014) to determine that fibre technology was well developed from a much earlier date. Analyses of the 'Venus' figurines of Upper Palaeolithic Eurasia by Soffer et al. (2000a:517–520) found similar fibre forms present in depictions of body adornment, including a range of caps and snoods, woven bandeaux, girdles, and jewellery. In many instances the weaving is detailed enough to deduce the construction, and adornment categories show geographic differences, suggesting stylistic differences in adornment between Western, Central, and Eastern Europe (Soffer et al. 2000a:522–523). Burials of a similar age suggest multiple forms of garments, footwear, hats, and jewellery.

Xiamabei, in northern China, holds some of the oldest evidence of *Homo sapiens* in Eastern Asia (Wang et al. 2022). In a recent excavation, an ochre processing feature and lithic microblade assemblage were found in the main cultural context which was dated 41-39 ka (Wang et al. 2022). Seven flaked stone tools hold evidence of hafting, with deposits of carbonate concretions adhering fragments of bone hafts and retaining impressions of fibre (Wang et al. 2022:3, 6). Four pieces also had ochre staining on the hafted area of the tool (Wang et al. 2022:6). Xiamabei is a significant site, holding evidence of ochre use and microblades around 10,000 years before they appear in the archaeological record elsewhere in China (Wang et al. 2022:5). Although occupation by Denisovan and Neanderthal populations at Xiamabei cannot be ruled out, the prevalence of contemporary *H. sapiens* burials nearby renders occupation by the latter species most likely (Wang et al. 2022:7).

2.5 Australian archaeological fibre research

The earliest plant fibres recorded from an excavation in Australia were associated with a burial in Kongarati Cave on the Fleurieu Peninsula, South Australia (Tindale and Mountford 1936). Tindale and Mountford (1936) excavated quantities of ash and hearth material overlying a discrete layer of seaweed that covered slabs of rough-hewn slate forming a cist (i.e. a stone, coffin-like box). Within the cist, a layer of sea sponge overlay bunches of grasses, some knotted. Below these a kangaroo skin cloak and strips of partially decayed fishing nets covered the body (Tindale and Mountford 1936:489). Perforation in the margins of the kangaroo skin revealed remnants of plant-fibre lashing, similar to the string used in the netting (Tindale and Mountford 1936:497). Excavation beyond the cist uncovered chewed fibre and a further netting fragment (Tindale and Mountford 1936:490). The string diameters varied from 2.5–1.5 mm, with netting mesh sized 10–192 mm (Tindale and Mountford 1936:495). The chewed fibre was tentatively identified as the coastal *Spinifex inermis*, and the string as *Dianella revoluta* (Tindale and Mountford

1936:492–493). Tindale and Mountford (1936:496) suggested the main plant used in the manufacture of netting was *Typha* sp. based on early ethnohistoric accounts in the region. The use of netting in a burial context was reinforced by reports of two net bags with skeletal remains wrapped in grasses and wallaby skins, found in separate caches in the Murray River cliffs (Sheard et al. 1927:175–176). In all instances, the knots used in the net manufacture were the same as used by humans in Europe since the Neolithic (Davidson 1933:257–259; Tindale and Mountford 1936:496). Netting is primarily used for the capture of game and fish (Satterthwait 1986), but also net bags, headbands, and headnets in northern Queensland (Roth 1901:13) and netted bases for mourning caps worn by many peoples of the Murray, Goulbourn, and Darling Rivers (Davidson 1949).

Westell et al. (2024:27–33) reported a series of excavations in Lower Murray River gorge recorded in Tindale's journals held in the archives at South Australia Museum. Although brief, the report described 25 limestone rockshelters and caves with deposits up to 6 m deep, rich with organic and lithic cultural material. Tindale recorded his collection of a spear and part of a string bag from the Wongulla Series while accompanying Harold Sheard to record rock art in 1927. In 1932, Tindale noted chewed rush fibre at Caurnamont and described chewed fibre and twisted rope or cord at Mobilong. Tindale also recorded R. Tuesner's 1961 report of an excavation at Murbko Flat, of a 4ft deposit containing "partly preserved woven rush found at 8 inches depth". Except for the latter, these investigations belong to the era prior to systematic and detailed recording, and consequently many inconsistencies and omissions occur in the reports (1930–1952 in Westell et al. 2024).

Hemming et al. (2003:354–358) reported string, netting, and two small pieces of flattened basket sedge from excavations at the former Swan Reach Mission on the Lower Murray River. The coiled basketry fragments were recovered from a wurley (temporary shelter) site that was occupied as late as the 1960s (Hemming et al. 2003:352), and are consistent with the mats, baskets, fish traps, coffins, and cloaks made by men and women of the Lower Murray at contact, and into the mission period for income and domestic use (Hemming at al. 2003:358). Hemming et al. (1989:10) suggested that the Aboriginal people who occupied the site after colonisation adopted European materials to make nets, and suggested their knots differed slightly to the conventional European netting knot — this knot is erroneously depicted by Davidson (1933:270) in fig. 10, and was not observed by Tindale and Hale (1936:496) at Kongarati Cave, nor has it been observed elsewhere.

Schrire (1982) excavated the Paribari rockshelter in the Alligator Rivers region of the Northern Territory (NT). Paribari held a large shell midden that facilitated good preservation of organics by ameliorating the effects of soil acidity (Schrire 1982:52). Although the final tally is unknown and the antiquity of the fibre is ambiguous, the artefacts from Paribari contribute significantly to the technological record. Three larger fragments of weaving had twined fibres analogous to matting and baskets documented locally in the nineteenth century, each varying in appearance and gauge, suggesting discrete objects (Schrire 1982:66). Several pieces of string were tentatively identified as “either *Hibiscus tiliaceus* (cottonwood tree) or *Brachychiton paradoxum* [red-flowered kurrajong]” (Schrire 1982:66). The fibres were complemented by a large array of wooden and grass-stem objects, several of which were hafted and bore traces of plant fibre string, including the head of a woomera bound with bark-fibre string and resin, and a fish spear with the impression of string remaining in the resin (Schrire 1982:64). Excavations at nearby Jimeri I recovered string and a quantity of resin on the surface, indicating that this was an area for the manufacture or repair of hafted tools (Schrire 1982:189).

Morwood’s (1981) excavation of Ken’s Cave in Central Queensland recovered a large amount of exceptionally well-preserved organic material, including two segments of plant-fibre string. Diagrams show short segments of two-ply string (Morwood 1981:13). Morwood (1981:9) categorised macrobotanical remains into leaves, twigs, wood shavings, etc. to allow inferences about dietary, domestic, and industrial activities within a living space. Edible species were found in proximity to hearths, bedding material by the back wall of the shelter, and wood shavings suggestive of industry were found toward the front of the shelter where the light was best. The locations of the resin, fibre plants, or segments of string were not indicated. While many plants have multiple uses, the plants Morwood recognised as representative of industry are of most interest here: spinifex (*Triodia* sp.) seeds and lumps of resin for hafting tools, among other uses; *Brachychitin rupestre* (Queensland bottle tree, now *B. rupestris*) and *Sida spinosa* (spiny sida, now suggested to be naturalised from the Americas [Weeds of Australia 2016]), both of which yield good fibre; and a quantity of plants known for medicinal use, dyes, poisons, and wood for tool manufacture (Morwood 1981:9–10). The deposit was considered to date to between 2,000–530 BP based upon stone tool typologies rather than direct dating techniques and was truncated by major roof fall (Morwood 1981:15).

Clarke's (1985, 1987) analysis of excavated plant remains from Anbangbang 1 in Kakadu National Park, NT, recorded 65 pieces of string throughout the 800-year-old deposit, this being the largest assemblage recovered from an Australian archaeological site at the time. The finds comprised a mixture of animal and plant fibres, ranging from unprocessed fibre, string of varied appearance, and a fragment of looped fabric (Clarke 1985:90, 92, 1987:157). The plant fibres were all described as 2- and 3-ply bast fibre, featuring a range of knots, and were placed into five categories based on fineness and number of ply (Clarke 1985:78, 90). The simultaneous analysis of macrobotanical material from nearby Djuwarr 1 recorded three fragments of bast-fibre string, including string embedded in resin interpreted as binding from composite artefacts (Clarke 1987:157).

More recently, fibre was reported collectively from two sites in the Kimberley region of Western Australia (Balme et al. 2022). Nineteen fragments of 2-ply plant, animal fur and human hair, each only a few centimetres long, were recovered from Riwi 1 and Carpenters Gap 1, 250 km apart in the southern Kimberley (Balme et al. 2022:121–122). The string was recovered from contexts dated 670±20, 816±27, and 2,746–2,486 cal BP at Riwi, and between 3,828 and 3,383 and the surface date of 723–664 at Carpenters Gap 1 (Balme et al. 2022:121–122). No string was directly dated. Balme et al. (2022:121–125) suggested that most of the 12 fragments of plant fibres are bast, though some appear to be root fibres. All fragments have an ssZ direction of twist (i.e. where two ply are separately spun clockwise then plied together anticlockwise), with the range of fibres being described as "finely teased fibre" through to "relatively unseparated … result[ing] in thick pieces of string" (Balme et al. 2022:121–122). Two fragments have post-manufacture application of ochre on their exterior surfaces, consistent with objects from the region held in the WA Museum (Balme et al. 2022:126). Balme et al. (2022:126) noted there exists a range of research into traditional fibre plant use and fibrecraft construction techniques from the post-contact period that may be useful to contextualise archaeological fibres, although in this instance the small size of the fragments rendered identification of the original artefacts impossible. Table 1 summarises archaeological fibre recovered in Australia.

Table 1. Archaeological fibre found in Australia

SITE	SOURCE	FINDS	AGE DETERMINATION
Kongarati Cave, Fleurieu Peninsula, SA	Tindale and Mountford (1936)	Several strips of fishnets, wads of chewed unspun fibre, cord used to stitch together a kangaroo skin cloak (1936:489–497).	Late Holocene (study was conducted pre-radiometric dating technologies; however, as the site is a sea-cave, it assumed to date after the lowering of sea levels c.2000 BP, as suggested by Dougherty et al. (2019)
Wongulla Series, Caurnamont, Mobilong, and Murbko Flat, Lower Murray River, AS	Westell et al. (2024)	Fragment of string bag (Wongulla Series), chewed rush fibre (Caurnamont), chewed fibre and twisted rope or cord (Mobilong), fragment of woven rush (Murbko Flat.	Undated (likely late Holocene)
Swan Reach, Lower Murray River, SA	Hemming et al. (2003)	Two fragments of coiled sedge basketry, string, and netting.	Likely during Mission times (c.1925–1960s)
Currarong, south coast NSW	Lampert (1971)	One wad of unspun fibre and one knotted piece of two-ply plant string (1971:55)	Late Holocene <1970±80 BP
Paribari, Jimeri 1, Arnhem Land, NT	Schrire (1982)	Three fragments of woven fibre, several pieces of rolled fibre (1982:66), "coiled bark-fibre string" in resin binding on a woomera head and an impression of string in resin on a fragment of *Phragmites* fishspear (1982:64) at Paribari; "a few strands" of rolled plant fibre from the surface at Jimeri I (1982:189).	Contact–Late Holocene <500 years (Jimeri I), <3,000 years (Paribari)
Kens Cave, Central Highlands, QLD	Morwood (1981)	Two segments of plant-fibre string (1981:10)	Late Holocene <2000±80 BP

SITE	SOURCE	FINDS	AGE DETERMINATION
Anbangbang, Kakadu National Park, NT	Clarke (1985, 1987)	65 pieces, including string segments, bundles, and one fragment of netting of bast, fur and hair fibres in two-, three- and four-ply from the surface and upper units (1985:90; 1987:157)	Late Holocene <1,000 years old
Kawambarai Cave, Warrumbungle National Park, NSW	Murphy (1992); Beck and Dotte-Sarout (2013)	Three pieces of "monocot leaf and stem … twisted in a similar manner to 'string'" (1992:102); several pieces of knotted spun and unspun fibre on the surface and three spun pieces from the excavation (2013). "All of these are made from plant fibre. One is two ply and knotted with a half hitch. It was found in the top excavation unit above a date of 761–498 cal BP. Below this, but above a date of 2,310–1,619 cal BP, are a two-ply fragment and one ply fragment both made from bark fibre (Wendy Beck, pers. comm. 2021)" (Balme at al. 2022:116).	~1980 bp–surface
Djurray, Arnhem Land, NT	Gunn et al. (2017)	Bag made of plant fibre for washing yams; two skeins of cord, one of which was "tasselled and ochred" (2017:185).	1731–1780 (bag), string undated
Carpenters Gap 1, Riwi 1, Kimberley, WA	Balme et al. (2022)	19 fragments of two-ply bast fibre string (six each from Riwi and CG1). Also seven fragments of human hair, animal fur, and feather (2022:121–122).	2,746–2,486 cal BP, 816±27 cal BP, and 670±20 cal BP (Riwi); 3,828–3,383 cal BP, and between 3,828 and 3,383 and the surface date of 723–664 cal BP (Carpenters Gap).
Magnificent Gallery, CYP, QLD	Morwood (1989)	String in the uppermost 30 cm of a 1 m sandy deposit (1989:7).	Late Holocene, 965 BP–present (Morwood and Jung 1995:100).

The primary form of indirect evidence for fibre technology comes from rock art sites across northern Australia. Although notoriously difficult to date, some depictions of fibre objects significantly predate the few recoveries of physical fibres — as early as the Irregular Infill and Gwion Periods (17–12 ka) in the Kimbery art repertoire (Grey 2024:229–231; Veth et al. 2018). Veth et al.'s (2018) synthesis of depictions of plants in 3750 rock art sites across the Kimberly region of northwest Australia focussed on the deep time connection to plants, and how these depictions changed in frequency throughout the stylistic repertoire. Depictions of material culture such as dillybags and hafted tools, and imprints of ochre-soaked string, appeared in the rock art from the Irregular Infill Period and continued to appear regularly through to Static Polychrome Period (around 9 ka) (Veth et al. 2018:31). Veth et al. (2018:31–32) considered the correlation of major climatic shifts in the initiation of new art styles, concluding that representations of material culture increased during the Gwion and Static Polychrome Periods (17–12 ka, 14–9 ka), including a high frequency of female figures shown holding dillybags and digging sticks. Male figures are conversely often depicted with headdresses and hafted tools. This places the dillybag and other objects in regular use by the terminal Pleistocene (Veth et al. 2018:38). The relative resource abundance of the end of the last glacial maximum (LGM) and the rapid warming and subsequent sea level rises has been argued as a period of low-intensity food production and subsequently the impetus of increased material cultures and rock art depictions of such objects (Grey and BAC 2024:232; Williams et al. 2015).

In western Arnhem Land, Miller (2021) explored 208 motifs of bags or baskets, headdresses, and other fibre objects, identifying most as objects in traditional use in the nineteenth and early twentieth century. These included biting bags worn by warriors to increase power during ceremony and combat, and a motif of an Ancestral Being carrying 15 bags or baskets suspended from her head (Miller 2021:53–55). This Being is sometimes known as Yingarna, and the image depicts a Creation story of a woman who travels through the land distributing her bags, which contain children, yams and language in different locations (Miller 2021:55–56). Hayward et al. (2018) surmised that stencilled fibre objects from Mirarr Country memorialised important domestic items of material culture. They noted that bags and baskets were the second-most frequent type of artefact stencil after boomerangs, and documented stencils of a pair of armlets or necklets, and a pair of headdresses.

Beads provide another form of indirect evidence for Indigenous fibre technology (McAdam 2008), with examples from Mandu Mandu and Riwi dated to around 30,000 ka (Balme and Morse 2006), and at Devils Lair dated to 19–12,000 ka (Dortch 1979). In each case, usewear analyses determined that perforated seashells and bone had been strung onto thread that abraded the edges of the perforations with use. One Mandu Mandu shell has a wisp of fibre caught in an abraded crevice (Balme and Morse 2006:804). A growing catalogue of sites where glass beads have been recovered evidences the widespread early colonial practice of gifting and bartering strings of bright beads to Aboriginal people (e.g. Lister et al. 2024a; Lister et al. 2024b; McLay 2023; Wesley and Lister 2015).

Further indirect evidence of fibre technology can be gleaned from tools such as stone sinkers used in conjunction with fishnets, and fishhooks and *muduks* (a bi-pointed bone attached to a line and used in the manner of a fishhook [Freeman et al. 2021:307–309; Massola 1956]), which imply the existence of fishing line. Fishing was, and remains, a significant economic activity for many Aboriginal peoples although the methods differed significantly: men exclusively used multi-pronged fish-spears, while women fished from canoes with hook and line (Attenbrow 2010; Bowdler 1976). Ethnographic accounts (e.g. Collins 1798:461; Hunter 1793:63; Tench 1793:191; Worgan 1788:18) record mostly plant fibre in the manufacture of fishing line; usually two-ply bast fibre from a variety of trees and shrubs. Women were observed making hooks from mollusc shell on the central and southern NSW coast (e.g. Bradley 1786:93, 134; Tench 1793:191; Threlkeld 1825:5) and coconut and turtle shell along the tropical coasts from north Queensland to the Kimberley (Attenbrow 2010:26; Gerritsen 2001:19; Langley et al. 2023; Roth 1904:33) with stone and coral files. Bone and wooden hooks were found at Lake Tyers Mission at the Gippsland Lakes and the central-south coast of Victoria (Howitt 1904; Smyth 1878). Fishhooks have not been found on the western or southern coasts, from the Pilbara to western Victoria (Massola 1956). Few fishhooks have been recorded ethnographically or archaeologically inland except on the Lower Murray-Darling Rivers (Berndt et al. 1993: 14, 96-97; Gerritson 2001). *Muduks* extend from the western Victorian coastline (Massola 1956:4–5) through the Willandra Lakes to the NSW south coast (Freeman et al. 2021:4–6). Shell fishhooks have been reliably dated to 1000 years in middens at Birubi on the NSW central coast (Dyall 2004) and Currarong 1 on the NSW south coast (Attenbrow 2010:27; Lampert 1971). Although no surviving fragments of line have been recovered from middens or shelters in context with fishhooks (Gerritsen 2001), a single hank of plant fibre line with a carved bone fishhook was collected from Lake Tyers Mission (Attenbrow 2010:25).

In all parts of the continent fishing with nets and traps is known ethnographically (Attenbrow 2010:18; Satterthwait 1987), except Tasmania, where only woven baskets were used to trap fish (Satterthwait 1986:31–32). Few nets have been recorded from the arid zones of the continent, although ethnographic recordings of bountiful fishing in the arid interior (Kimber 1984; Reynen and Morse 2016:7–9) and rock art depictions of nets in the Kimberley (Balme et al. 2022:117) provide evidence to the contrary. As fishhooks are not known to have been used in inland regions (Gerritsen 2001:19), it is probable that nets were the primary fishing tool employed both in the Pilbara (Reynen and Morse 2016:7) and in the lower Darling River system, where Balme (1995:15–16) has suggested that nets were utilised alongside fish traps for a period spanning 30,000 years. Fish traps may be made from woven fibre, as well as stone, to direct and capture tidal and seasonal influxes of fish. Stone fish trap complexes, such as the Lake Condah eel trap complexes and those located long the Darling River (*Baaka*), were recorded as having gaps for water and fish to pass through and into waiting nets or woven fishtraps (Clark 2000:141; Dawson 1881:94–95; Krefft 1865:368; Martin et al. 2023:106–108; McNiven and Bell 2010:87–88; Roth 1901:23). With either method — nets or lines with hooks — fibre is an essential component of the fishing toolkit.

In the Pilbara region of northwestern WA, grindstones and grinding grooves from across the Abydos Plain have been used for the manufacture of spinifex fibre from *Triodia* spp. Of the two types of spinifex, hard spinifex grows in spiky tussocks in the arid zones and soft spinifex grows across the north of the continent (Pitman and Wallis 2012:110–112). Fibre for neat and strong string and netting was obtained by pounding spinifex leaves on a rock, a process well documented ethnographically (Bates 1985:248, 250, 253; Bindon 1996:257; Gregory and Gregory 1884:71).

Similarly, hard spinifex fibre was beaten to obtain resin, known to be one of the strongest natural adhesives, widely used and found in the archaeological record (Pitman and Wallis 2012). Hayes et al. (2018) and Fullagar and Wallis (2014) conducted studied of usewear on grindstones, investigating the signatures of spinifex grinding for food, resin, and fibre. Hayes et al. (2018:9–11) could not determine conclusively that grindstones and grinding grooves were used exclusively for processing fibre, when the beating of clumps of spinifex for resin would also introduce phytoliths, starch, and resin to the grindstone. Fullagar and Wallis (2014:17–18) found abundant spinifex phytoliths on highly polished grinding surfaces with varied striations and suggested that variations resulted from processing different plant parts for different purposes. In the absence of any specialised tool used only for processing fibre, it is likely that the same stones were used to procure all three resources, complicating the usewear signatures (Hayes et al. 2018:10–11). However, given that spinifex fibre and resin were extensively used across all regions where spinifex grows abundantly, it is reasonable to accept both uses for many grinding patches, and that many grindstones have multiple uses, including processing multiple species of plants (Hayes 2018:10–11).

Cached archaeological fibres from Australian sites number higher than those from sedimentary contexts. The Mt Inglis rockshelter in central Queensland contained a collection of fibre-based objects, including several items of adornment, fragments of net and looped bags, wads of unprocessed fibre, and 26 incomplete lengths of twine (Morwood 1984:542–545). In all instances, the plant fibre was 2-ply bark string, several items were ochred, and the simple looping and loop-and-twist techniques were used for multiple items (Morwood 1984:548). A later study of mortuary practices in the Central Queensland Highlands noted the prevalence of ‘grave goods’ found inside cached bark coffins including nets, bags, woven headbands, and necklaces, alongside other organic and non-organic artefacts, while skeletons were often bound with string made from a range of fibre sources (L’Oste-Brown et al. 2002:45; Morwood 1984:551).

In Arnhem Land, a dillybag was collected from the surface of a rockshelter, along with a skein of string and two ochred cord tassels (Gunn et al. 2017:185). The dillybag appears to be of a twined construction and was identified by a Traditional

Owner as a sieve bag for yam washing. It was subsequently dated to 1731–1780 cal. BP (Gunn et al. 2017:188).

Most relevant to this project is a dillybag collected from a rockshelter in the sandstone escarpment of Quinkan Country, near Laura, in 1975. This dillybag was mostly intact and contained an intriguing array of items from the contact era, including several thousand glass beads and a silver-plated spoon. The bag itself was constructed from a finely spun bast fibre in a double looping pattern, and striped transversely with bicoloured fibre manufactured from two different plant sources (McLay 2023; Site card EP:A97). Cached materials have been noted to extend ethnographic observations beyond a simplicity of lifestyle based on simplified technologies and activities, to illustrate complexity of lifeways and material culture (Morwood 1984:551).

Caches were routinely sought for ethnological 'specimens' throughout the late 19th and early twentieth centuries (e.g. Meston 1901) with the result that many such items are now held in museums, removed from their contexts and the reach of systematic archaeological retrieval. Morwood (1985:546–548, 551) noted that collected items were "biased towards the hunting and fighting implements of men", such as the extensive collections of spears displayed in all major museums and the large kurrajong (*Brachychiton populneus*) kangaroo hunting net in the Queensland Museum (QE3617; L'Oste-Brown et al. 2002:47). Other items in museum collections include objects collected and sometimes commissioned from Aboriginal people.

2.6 Ethnography of fibrework

The ethnographic record is rich with a wide assortment of items made from fibres of animal and plant origin, and archaeology is heavily reliant on it. The small quantity of plant fibres recovered to date have mostly been fragmentary in nature, but, when coupled with ethnographies, ethnohistorical accounts and collected objects, their interpretations become richer. Historical observations hold valuable descriptions of the manufacture and use of Aboriginal fibre objects in CYP from writers such as Walter Roth, the first Northern Protector of Aboriginal people (Roth 1901, 1904), and anthropologists Ursula McConnel (1953, 1957), Donald Thompson (1933, 1939), and D.S. Davidson (1933).

Roth is perhaps the most prolific source of ethno-historical information, and collector of artefacts of traditional lifeways and activities of the Indigenous peoples of north Queensland (McGregor and Fuary 2016:43). As Protector, Roth was required to travel extensively throughout his jurisdiction. However, Roth's travelling schedule, described as "onerous" by McGregor and Fuary (2016:47), may have limited his ethnographic endeavours with the little time spent in each location inhibiting research into language and social customs, and perhaps leading Roth to focus on material culture. Roth's self-reported good relations with Aboriginal people across the northern districts allowed him to collect many artefacts and document processes in many communities (Khan 2016:187), however, he was closely associated with the police and this may have influenced his ability to procure goods and information. Roth issued a series of 18 *Bulletins* to his superiors in Brisbane between 1901 and 1910, as well as five ethnographic studies on different peoples of north Queensland, each containing many valuable observations of the activities, tools, and stories of the Indigenous people among whom he spent time. But his focus on material culture resulted in the collection of over 2,500 objects (McGregor and Fuary 2016:45). As an ethnographer, Roth was notable for

> … the precision and exactitude of his observations … devoted to the specific and the concrete: to material culture as a domain worthy of scientific study in and of itself rather than merely as an adjunct to sociological speculation or as a commentary on curios (McGregor and Fuary 2016:48).

Such observations were recorded in meticulous detail, accompanied by sketches and explanations and provenances, and focussed on the manufacture and use of technologies and artefacts of daily living, not just the unusual or spectacular. This means, though, that little information of the people themselves, their languages and traditions, or relationships to their environs, is recorded, nor theories or interpretations of material use. The limited time Roth spent with different Aboriginal communities becomes evident as he compared and contrasted the distributions and manufacturing techniques of material culture; however, no singular, rounded picture of an individual or community can be found (McGregor and Fuary 2016:50–51). Roth was arguably authoritarian and paternalistic, and his writings contain attitudes now outdated and unacceptable, yet he was a great defender of the rich culture and rights of Aboriginal people (Khan 2016:190; McGregor and Fuary 2016:52–53).

Roth structured his Bulletins as encyclopedias, organised by theme. Each edition featured a collection of observations gathered from communities during travels across north Queensland, interspersed with few comments (McGregor and Fuary 2016:48–49). Of most use in this study are:

- *Bulletin No. 1: String and Other Forms of Strand: Basketry-, Woven Bag-, and Net-Work* (1901)
- *Bulletin No. 7: Domestic Implements, Arts, Manufactures* (1904)
- *Bulletin No. 15: Decoration, Deformation, and Clothing* (1910).

Bulletin No. 1 (1901) details the many variations of form observed across northern Queensland, with occasional comparative references to materials or techniques known to Aboriginal peoples of the south-east of the state. Similar careful observations produced detailed diagrams of knots, looping and stitching patterns, and comparative information on the distribution of each category of fibrework. Roth delivered his reports with the dry accuracy of directly observed activities and empirical examinations, entirely devoid of interpretation or personal details, resulting in an emotionless but valuable compilation of data.

Daniel Sutherland (D.S.) Davidson's much-referenced *Australian Netting and Basketry Techniques* (1933) remains a substantial resource of netting and looping techniques. The American anthropologist visited Australia in 1930–31 and 1938–40 to undertake fieldwork and examine private and museum collections of Aboriginal artefacts (McCarthy 1981), likely including the substantial Roth collection at the Australian Museum, Sydney, and the smaller Roth collection donated to the Queensland Museum (McGregor and Fuary 2016:46–47). Fieldwork was undertaken in several locations across northern Australia, including excavations in Wardaman Country, NT (Davidson 1935a). Davidson wrote widely on topics such as rock art and decorative art, string figures, fire-making (1947), canoes (1935b), weapons (1934, 1936), and utensils, and the cultural connections between Indigenous Australian, Tasmanians, Melanesians, Indonesians, and Tierra del Fuegians (e.g. 1937a, 1937b, 1938a). However, Davidson's most important contributions are his (now dated) monographs on social institutions and tribal distributions of Indigenous people (1926, 1938b), art (1952), and material culture (McCarthy 1981). In these works, as in *Australian Netting and Basketry Techniques* (1933), Davidson argued that technologies employed by Aboriginal peoples in Australia were primitive and likely imported from Papua New Guinea or Melanesia. To demonstrate this hypothesis, Davidson compiled published works and examined museum collections to illustrate maps showing the distribution of technologies and techniques, and diffusion of such technologies from an entry point of Cape York, as the Papuan stylistic catalogue of techniques employed in the making of *bilums* (bags) is significantly larger and more complex (Davidson 1933:258, 260, 263, 265, 269, 274, 277; MacKenzie 1991). Nevertheless, Davidson's illustrations of knotting, looping, and coiling methods are clear and accurate and provide an especially useful source for recognising and defining Indigenous fibrework.

Alan West developed Davidson's (1933) work with his detailed study of string bags. West was Curator of Anthropology at Museums Victoria from 1967 to 1980 and from 1983 to 1986, when he undertook several seasons of anthropological fieldwork at Aurukun and Edwards River in western CYP (Raberts et al. 2017:37; West 1980). There, West observed and documented the processing of fibre and the many forms of manufacturing string bags practiced by the Wik people. West compiled a study of techniques used to manufacture of string bags, including detailed notes and drawing of the steps involved in the construction. This study formed West's Master's thesis, which was extended through the study of numerous examples held in the Museum and subsequently published as a book, *Aboriginal String Bags, Nets and Cordage*. The extensive detail recorded and illustrated in the book form the most comprehensive directory of string bag manufacturing techniques in Australia.

More recent systematic ethnobotanical enquiries into people-plant relationships have assembled contemporary traditional Indigenous knowledge of specific plant interactions. Anthropologist Louise Hamby has researched past and present fibrecraft praxis in Arnhem Land, NT. Drawing together archival material held in museums across the country and the world, Hamby has explored the continuities and evolution of Indigenous fibrework in communities (e.g. Hamby 2001, 2005, 2022). Australian ethnobotanist Philip Clarke has compiled extensive detail of Traditional Ecological Knowledge from across Indigenous Australia. Drawing on primary sources and a mixture of ethnobotanical, archaeological, and botanical studies from the 1980s and 1990s. Clarke's synthesis provides an overview of the plants used for fibre manufacture in the chapter ‘Plants as tools’ in his book *Aboriginal People and Their Plants* (2007). Australian weaver Pat Dale’s (2021) book *Australian Plants and Fibres: As Used by First Nations People* drew together data from ethnography, botanical studies, community reports, and personal fieldwork to compile a wide-ranging list of fibre plants, with notes on their specific uses across the continent. Enmeshing ethnobotanical sources such as these with empirical data from extant examples of fibrecraft would create a valuable and comprehensive resource.

2.7 Conclusion

Fibrecraft forms a large part of Aboriginal material culture and is used in a range of contexts, from hunting to adornment. Of the 13 published archaeological sites where fibre has been found in sedimentary contexts in Australia, only cursory detail has been included in the reporting, in favour of larger assemblages of stone and bone. Archaeological fibres are rarely recovered from Australian contexts and thus it is important to draw as much information as possible from what is found. Most academic sources of Aboriginal fibrecraft are found in the firsthand observations of ethnographers, and in the objects collected by ethnographers, anthropologists, and others. This disjunction between the thorough typologies of collected objects and the paucity of detail on archaeological Aboriginal fibre technology means that form, function, style, and technique of fibrecraft from the vast pre-contact period remains largely unknown. Using ethnography and collected objects in the interpretation of archaeological fibre will bring together both fields of study for greater effect and enhance knowledge of ancient fibrecraft.

3 An ethnohistory of Aboriginal life in SE CYP

Southeast CYP was occupied by several patrilineal, patrilocal clans of 25–50 people at the time of European contact (Sutton and Rigsby 1982). The size of clan lands varied with the bio-density of the local landscape, thus, groups who lived by the coast and had access to marine resources owned a smaller estate than those who lived in the drier, sparsely vegetated interior regions (Morwood 1995:33; von Sturmer 1978:3). Neighbouring clans shared customs, met regularly for ceremony and spoke dialects of the same language. These language groups were named for the Country which they occupied, with the prefix *Koko* or *Gugu* (meaning language or speech), for example *Koko Warra*, whose Country extends north from Laura, and *Koko Yimidir*, who occupied the tract from the Deighton River headwaters to Cooktown, and *Koko Yellanji*, who lived to the south of Laura (Morwood 1995:34–36; Roth 1898a:6). Peoples occupying certain tracts of land may be landowners, or participants in a complex and subtle mixture of visitation or occupation rights to places on neighbouring Country (David and Cole 1990:791–792). Extensive social networks for ceremony, trade, warfare, and intermarriage were documented across southeast CYP (Roth 1899a:3). However, David and Cole (1990) noted that there was a trade barrier at the Walsh River, meaning that people and property from SE CYP did not participate in the long-distance networks that operated across northern and western Queensland.

Plant foods are estimated to comprise approximately 50% of the diets of peoples who inhabited the tropical north of Australia pre-colonisation (Meehan 1989). These foods included species opportunistically foraged throughout the seasonal cycles, but also staple crops that were managed by the transplantation of favoured trees close to favoured campsites (Cribb et al. 1988; Hynes and Chase 1982:40; Jones 1975:24; von Sturmer 1978:470), and the replanting of yam tops during tuber harvest (Atchison and Head 2012:66, 2013:171). While animal resources were fairly consistent year-round, plant foods are highly seasonal, particularly inland. The early dry season (June–September) was abundant, with fruits and vegetable foods, and yams, bulbs, and cycad nuts available in the later dry season (October–November). These staples were stored for consumption in the wet (Anderson 1985:102–106). The early wet season (November to mid-December) was a time of scarcity, relieved by the abundance of waterfowl eggs around February (Anderson 1985:106–107; Morwood 1995:37).

People were most mobile during the early dry season, when foraging and social schedules were enabled by the drying of the landscape, allowing passage and providing abundant freshwater. When freshwater dried up in the later dry season, people stayed close to permanent water sources. The wet season signalled a retreat to higher ground in the Laura escarpments, above both the floods and mosquitoes (Cole 2004:159–160). This was a time for making utensils and refurbishing weapons in more or less permanent camps and was likely the time of most intensive use of rockshelters (Cole 2004:159–160; Morwood 1995:37–38).

The earliest dated occupation in the region is 31,900 BP at Sandy Creek 1, a rockshelter southwest of Laura (Morwood et al. 1995). The occupation sequence at Sandy Creek 1, like most sites investigated in the region, was inconsistent, meaning that groups moved gradually into the area (Morwood 1995:38–39). Occupation persisted through the LGM, however, when conditions deteriorated, decreasing resources and surface water availability (Williams et al. 2013; although see Cadd et al. 2024 for a proposed model of increased precipitation during the LGM-terminal Pleistocene). Many of the springs that feed the headwaters of the creeks dissecting the sandstone escarpments are permanent; thus plants, animals, and humans were able to occupy the region throughout this era (Morwood 1995:38–39). The period of thaw following the LGM was warmer and wetter during the terminal Pleistocene and early-Holocene compared to the mid- and late-Holocene, allowing biological life to flourish. The slight depression of climatic conditions and decline of sea levels by 1 m in the late Holocene created estuarine conditions in coastal regions and swamps across SE CYP, both being landscapes of high resource productivity. This, in turn would have enabled human populations to flourish and prompted subsequent increases in social management and material culture that can be seen in the archaeology.

The escarpment shelters of the Laura Sandstone Basin show use well into the contact period. During this time, these remote strongholds sheltered Aboriginal people from the depredations of goldminers, pastoralists, and Native Mounted Police (NMP): springs are abundant in the sandstone aquifers and a variety of plant foods are available, while also being beyond range of the NMP in the dry season due to lack of feed for the horses and boggy conditions in the wet (Cole 2004:176–177). Several large rock art galleries are scattered among the escarpments, featuring depictions of the NMP, horses, pigs, and other elements of non-Indigenous life, such as ships, clay pipes, and guns (ABM Project unpublished data; Cole 2004:176, 2010). Seven NMP camps are known to have been established in the Laura Sandstone Basin between 1873 and 1906 (Burke and Wallis 2019), ostensibly to protect the interests of the pastoralists and miners who flocked to the Palmer River between 1873 and 1879 and occupied the wider region thereafter (Cole 2004:160–161). Much conflict was recorded between the Aboriginal people and colonists in the early years of occupation, resulting in calls for more policing and culminating in many killings (Cole 2004). Some people remained on Country as pastoral workers on stations, although their traditional lives were disrupted, and it is suggested that a small group maintained a traditional lifeway in the rugged escarpments well into the twentieth century (Ruig and Morwood 1995:49; Trezise 1971).

Early ethnographers took careful note of many aspects of Aboriginal life, particularly those that differed significantly from European customs. Where possible, observations with neighbouring groups allowed observers to compare and contrast social and material differences. Although he arrived in the region some 25 years after the massive disruptions of the NMP violence, Roth was particularly interested in mapping the distinct groups occupying the regions through which he travelled, and as a prolific writer, his works are valuable to reconstructing knowledge of traditional fibrecraft practice. Roth's ethnography, however detailed, is rarely contextual, so despite lengthy lists of fibre plants and language names, he did not record nuances, such as when they were harvested and by who, if plants were valued for attributes other than strength or colour, or why bicolour striping was employed in the making of some dillybags and not others. It is not clear if Roth ever visited Laura, though he met Aboriginal informers from the Laura region in 1898 when he travelled a circuit of SE CYP from his base in Cooktown (travelling Cooktown-Musgrave-Morehead-Kennedy-Normanby-Birthday Ck-Bowen Bay-Jeannie and Starcke Rivers-Cooktown), and in his more detailed recordings at Butchers Hill (now Lakeland) and Bloomfield Missions (Roth 1898b, 1898c, 1898d).

Ethnographic works from the late nineteenth and early twentieth centuries (Roth especially), demonstrate the diversity of material culture of SE CYP, and how, as in most places, plant materials are used in all forms of implements (Morwood 1995:37). Fighting and hunting weapons were made from wood and reeds, sometimes with stone, bone, or shell hafted to digging sticks, spears, or woomeras with resin and string. Boomerangs were not in use north of the Palmer River during Roth's time (1909:201) but have been found cached (Flood and Trezise 1981) and stencilled (ABM Project unpublished data; Cole 2010:24) in rockshelters in and around Laura, indicating their recent presence in the repertoire. Soft paperbark was used for bedding, bandages, and wrappings; tougher barks for containers, shields, canoes, and shelter; and fibrous bark for string. Other plants, such as sedges, reeds, and palm and pandanus leaf cortex, were also used for string and other fibrework. String, of course, has a multitude of uses, such as being core to the fabrication of dillybags and nets, as well as many items of personal ornamentation (Roth 1901, 1910). Few fibrous plants were used in ways that did not require processing into string first, such as pandanus armbands or plaits (Roth 1901:11). Plants yielding fibre were recorded by Roth during his travels, and those used in SE CYP are recorded in Table 2:

Table 2. Fibre plant observed by Roth in SE CYP.

SPECIES	**OBSERVATIONS**
Livistona australis (cabbage palm) (Roth 1898a:36).	Fibre was obtained by peeling the outer cortex from young, unopened leaves using an ironwood pin or point, or kangaroo-bone drill, which was then sun-dried and rolled into string. It was used for dillybags and fishnets by the Koko Warra at Musgrave NMP camp.
Drymoploeus normanbyi (now *Normanbya normanbyi*) (black palm) (Roth 1901:8).	Fibres were pulled from the leaf base and cleaned with the nails and made into sieve bags on the Bloomfield River.
Acacia flavescens (toothed wattle), *A. leptocarpa* (mangarr mangal), and *A. latifolia* (wattle) (Roth 1898a:36–37, 1901:8–9).	Bast fibres were separated from the outer bark before being soaked for several hours in water, sundried, then split and rolled. A. flavescens was soaked in brackish water to draw out the deep red colour of the fibre. All were used for fishnets, and dillybags.
A. lysiphloia (turpentine) (Roth 1901:9).	Harvested in the dry by the Koko-minni at the Middle Palmer River.

SPECIES	OBSERVATIONS
Triodia spp. (Spinifex) (Roth 1899a:24, 1901:10).	Did not require splitting but was rolled and formed into twined sieve-bags or looped dillybags and was used for dillybags on the Starcke River.
Haemodorum coccineum (scarlet bloodroot) (Roth 1898a:36, 1899a:24).	The long, strap-like leaves were dried then moistened and split with the fingernails and used to make twined sieve-bags by Koko Warra and Kokorarmool people at the Musgrave NMP, and Koko-minni people at Middle Palmer River.
Pandanus spp. (Roth 1901:9).	Young leaves were split and twined for sieve bags by Koko-minni at East Palmer River.
Malaisia tortuosa (now *M. scandens*) (crow ash or burney vine) (Roth 1898a:27).	Recorded in use for dillybags and fishnets by Koko Warra and Kokorarmool people at the Musgrave NMP.
Sterculia caudata (now *Brachychiton diversifolius*) (kurrajong) (Roth 1898a:27).	Recorded in use for dillybags and fishnets by Koko Warra and Kokorarmool people at the Musgrave NMP.
Sterculia diversifolia (now *B. populneus*) (black kurrajong) (Roth 1901:10).	Inner bark was sundried, shredded and used for dillybags by the Kokko-minni.
Macaranga tanarius (blush macaranga) (Roth 1898a:27).	Recorded in use for dillybags and fishnets by Koko Warra and Kokorarmool people at the Musgrave NMP.
Ficus fasciculata (now *F. congesta*) (red-leaf fig) (Roth 1898a:27, 1901:9).	Recorded in use for dillybags on the Morehead and Starcke Rivers, and by Koko Warra and Kokorarmool people at the Musgrave NMP.
Careya australis (now *Planchonia careya*) (cocky apple) (Roth 1901:9).	Made into twine for tying corpses and mourning strings, and the tassels of women's apron-belts.
Xerotes longifolia (now *Lomandra longifolia*) (Roth 1901:10).	Used on the Starcke and Bloomfield Rivers for dillybags.
Xerotes multiflora (now *L. multiflora*) (Roth 1901:10).	Used for dillybags on the Starcke and Bloomfield Rivers.

In dillybags, fibres were used in simple-loop, loop and single-twist, loop and double-twist, hourglass, and fishnet patterns (Roth 1901:12–13). *Acacia* was generally employed in double looping pattern and was sometimes alternated with *Malaisia* or *Sterculia* to produce striped fabrics (Roth 1898a:27). Roth collected three bags matching this description from the Bloomfield River, two of which were accessioned to the Australian Museum with the note “probably made at Laura” (Khan 1993:106). An early observer noted that the form of dillybags made by Aboriginal people on the Palmer River was more similar in form to the bilums of Papua New Guinea than to bags made by coastal people around Cooktown (*Darling Downs Gazette and General Advertiser* 1874), possibly referencing the bicornual baskets made by rainforest peoples of split lawyer cane in a distinctive ‘two-horned’ shape. Roth reported that dillybags were made exclusively by women and were used by women for ordinary family objects and food, but when used by men the bag and contents were regarded as sacred (Khan 1993:106).

Nets were made in a ‘bag’ form similar to dillybags by both *Koko Warra* and *Koko-minni* people. The oversized, looped bags were made from *Livistona* or *Acacia* fibre and had an oval of lawyer-cane threaded through the upper rows of looping, with the joins lashed together (Roth 1898a:36–38). Roth saw these nets made and used on the Palmer, Morehead, Musgrave, Normanby, Pennefather, Wenlock (Batavia), and Embley Rivers, and at Laura. Although stating that fishnets were not used on the Bloomfield or Endeavour Rivers, Roth collected one of these oval-framed nets on the Bloomfield River, which was labelled upon accession at the Australian Museum in 1905 as “made at the Laura or Deighton” (Khan 1993:138–139). Although bags were made with square mesh netting by *Koko Warra* and *Koko-minni* peoples (Roth 1899a:24), only the *Kokolamalama* people of Princess Charlotte Bay were recorded by Roth using this mesh to make fishnets. *Kokolamalama* nets had a folding frame, hinged at either side to form a ‘purse’ shape; these purse-nets were traded inland, although Roth did not specify where (Roth 1898a:36–38). In use, the frame was held by two people standing in the water, while others disturbed the waters ahead and drove fish into the net.

Personal ornamentation was often made from human and animal hair, as well as plant-fibre. Hair ornaments may be softer to wear on the skin, but human hair especially may have had special significance (Roth 1901:7–8, 1910). Necklaces or filets with *Nautilus* shell beads were observed across CYP. Those made on the east coast had shell cut into rectangular beads with a hole drilled and twined with two plant-fibre strings. On the west and Gulf coast, the shells were ovate, and strands from both coasts were widely traded (Roth 1910:27–28). On the coasts, men wore the strands as a filet and women as a necklace, but inland both sexes wore them as necklaces.

Uses of string for less utilitarian purposes occurred too but are less known. Mourning strings were worn by men and women around the waist, around the neck, or around the neck and under one armpit (Roth 1901:11). This use was described in ethnography such as Roth (1901:11–12), who described chainwork formed in a series of links made from loops of string and worn across southern CYP. The loops were larger in the south and grew smaller at the northern extremity of their use, around Princess Charlotte Bay. In all regions, mourning string were also made with a single core string of plant or hair, overcast with a plant-fibre string.

String games were recorded by Roth across Queensland and into the Torres Strait. Known to Europeans at ‘cat’s cradle’, the string manipulation games were observed delighting children and adults with a variety of iterations (Roth 1902:10–11).

Medicine strings were used in two forms: ligatures or sucking strings. Ligatures were strings of human hair, possum fur or plant-fibre tied around the afflicted part of the body or a proxy body part such as ankles or wrists, during pain or sickness (Roth 1903:37). The *Koko-minni* on the Palmer River used *A. leptocarpa*, *A. lysiphloia* or *S. diversifolia* string, and the rainforest people used *Calamus* (lawyer-cane) or *Imperata* grasses (Roth 1903:37–37). Sucking strings were used to ‘suck’ the bad blood from the afflicted person. This operation was performed by a woman closely related to the patient. She tied a string made from hair, fur, or plant, possibly including feathers, around the afflicted body part and rubbed the end across her lower lip until it bled. The ‘bad’ blood was spat out into a shell and thrown into a creek or swamp (for males) or buried in an ant-hill (for females) (Roth 1903:38).

The diversity of plant forms that supported lifeways in SE CYP was extensive and employed in many aspects, from food and shelter to tools and ornamentation, games and medicine. The fibre-plant list provided by Roth represents just those observed at a time of great upheaval, when new materials were assimilated into traditional practices while the same traditions were under threat from violence and assimilation policies. The knowledge presented here is just a small window into the people-plant relationships that spanned over 30,000 years of occupation of the region.

4 Methods

Windmill Way was excavated by the ABM Project team in June/July 2022. The team quickly established that the stratigraphy of the deposit was compromised, with the presence of pig hair throughout being evidence that the deposit was mixed, likely from a combination of macropods, dingoes, and wild pigs using the rockshelter. The deposit was divided into six 1 m-wide strips (labelled “Squares” A1–A6, Figure 5, Figure 6) spanning the alcove, each of which was excavated to the bedrock, and recovered materials passed through nested sieves on site. The 7 mm sieve residue was preliminarily sorted in the field and returned to Griffith University, Brisbane, where it was separated further into raw material types such as stone, bone, and macrobotanicals. The 3 mm sieve residue was fully retained and sorted into raw material categories in the laboratory.

Figure removed due to copyright restriction

Figure 5. Windmill Way site profile (Wallis and Burke 2024 unpublished data).

Figure removed due to copyright restriction

Figure 6. Windmill Way site plan (Wallis and Burke 2024 unpublished data). The excavation units Sq A1–A6 are shown in the northern alcove.

4.1 Cataloguing the archaeological assemblage

This thesis project commenced with the cataloguing of the sorted fibres from the 7 mm and 3 mm sieve fractions, recording their attributes while photographing each item with an Olympus DSX1000 microscope, and uploading the data to the password-protected, community-controlled online ABM Project database.

Attributes recorded from the fibre fragments are listed in Table 3. Weight was measured with digital gunpowder scales. Length was determined with a steel ruler with submillimetre gradations, and inflexible fragments and sections of fabric were measured to their maximum dimensions in their current, set shape. The raw material was first identified, and the form categorised according to the degree of processing. The number of ply, direction of ply, and presence or absence of a ply fold were noted. Knots were identified and the presence or absence of resin and ochre were noted for each object. If the fibre was formed into a fabric (defined as the development of a planar surface constructed from one or more strands of fibre), the form was recorded (single looping, double/hourglass looping, interlocking, woven, or netting). Netting gauge was noted in the comments when applicable. Colour was determined not to be a useful attribute due to ochre, resin, and/or dirt staining, and potential for colours to change due to seasonal variability, plant maturity, taphonomic processes. While seasonal variability would be useful to track, a comparison of the characteristics of season and maturity was beyond the scope of this thesis.

Table 3. Attributes and variables measured during cataloguing of both archaeological and museum objects

VARIABLE	ATTRIBUTE
Length	Millimetres
Weight	Grams
Raw material	Leaf, bast, hair
Fibre form	Unprocessed, string, netting, looping, woven, twined
Number of ply	1, 2, 3
Ply fold	Present/absent
Knots	Overhand, double, clove hitch, sheet bend, sliding, other
Direction of ply	ssZ, zzS, sssZ, zzzS
Ochre	Present/absent
Resin	Present/absent
Fabric type	Single, double/hourglass, interlocking, woven, netting
Mesh size (netting gauge)	Millimetres
Interpretation	Bag, basket, binding, firestick sheath, necklace, necklet, net, pendant, pubic tassel belt (QM objects only)

See Appendix 1: Attributes of fibre for descriptions of terms used.

Fragments of netting were recorded twice: once in the category of netting and once in the category of knot, as a sheet bend. Sheet bends are the knot traditionally used in the construction of square-mesh netting across the globe and involve the joining of two ends by interlinking loops or ‘bends’ in both strands (see p.107 for a fuller description and diagram). Single examples of sheet bend knots were also included in the category of netting, as that is their most likely source; although netting was used for objects other than fishnets in other parts of the country, sheet bends have not been recorded in any context other than netting in Australia (Davidson 1933:257–259; Roth 1901:13). The total number of knots in a fragment of netting was not captured, as this would skew the data with the false appearance of more knotted objects than were actually present. Instead, the measurement of the mesh was recorded to assess gauge.

4.2 Cataloguing attributes of museum objects

A collection of 39 objects held by the Queensland Museum, made wholly or in part with plant fibre, were selected for comparative analysis of their attributes. All objects were provenanced to Laura and collected between 1900 and 1975. The objects were selected by QM staff based on the presence of fibre in their internal catalogue description. Information later became available that there are other objects in QM with fibre from Laura, but the fibre is not listed in the catalogue, and they were consequently overlooked. The objects made available were bags, necklaces, woomeras, nets, and a firestick with sheath. The objects were examined to provide data from a range of fibrework objects and uses employed in Laura to compare to the attributes of the archaeological fibre, with the intention of aiding the identification and interpretation of this material.

The collectors of these objects were Daniel Fitzgibbon (n=39) and Percy Trezise (n=1). Trezise was a Cairns-based pilot turned amateur rock art authority, who noted the locations of potential rockshelter galleries in the Laura escarpment while flying over the area in the 1960s, and then spent subsequent decades conducting pedestrian survey and recording rock art. On one such expedition in 1975, Trezise located dillybag S549.1 cached in a rockshelter, along with spears and an axe, the latter items of which were never accessioned (Cole 2001; Site card EP:A97). The dillybag contained thousands of glass beads used for trade and placation of Aboriginal peoples, a metal tin, and a silver-plated spoon, indicating its deposition post-colonisation (McLay 2023). Constable Daniel Joseph Fitzgibbon was stationed at Laura by 1904 until after 1913 and was associated with the NMP (Burke and Wallis 2019). Fitzgibbon’s two children, Edward and Constance, were born at Laura. Edward donated 32 of the objects in this study to the QM in 1980, and a further seven dillybags came from a donation by Constance in 1988. It is not known whether any were collected by their father, though this seems the most parsimonious explanation.

Each object was measured; its collector, donor and provenance noted; and photographed with an iPhone camera. The same range of variables were recorded as for the archaeological samples, with the addition of the Queensland Museum identifying number, the collector and donor of the object, and the object type. These data allowed observations to be made about attributes specific to a particular object type that could then be compared to attributes in the archaeological assemblage.

5 Results

In this chapter the results of the fibre analysis are presented, commencing with the archaeological fibres from Windmill Way (WW), and then followed by the objects in the Queensland Museum (QM) collection.

5.1 Archaeological fibres

There were 510 fragments of fibre recovered from the WW deposit, ranging in weight from 0.001–2.78 g, with a mean of 0.03 g, and a cumulative weight of 39.54 g. These were composed of unprocessed or partially processed fibre, as well as processed fibre in the form of string, sometimes with knots or formed into netting or looped fabric. All fragments were identified as bast fibre — no human or animal hair was identified.

The concentration of fibre fragments increased moving toward the back of the alcove and with increasing deposit depth, with a maximum number of 140 fragments recovered in Square A5 (Figure 7 and Table 4). As shown, the bulk of the 3 mm assemblage consisted of processed fibre, with just 27 examples of unprocessed fibre, although the bulk of the macrobotanical material recovered from the 7 mm sieve is not yet fully sorted and these numbers will likely change.

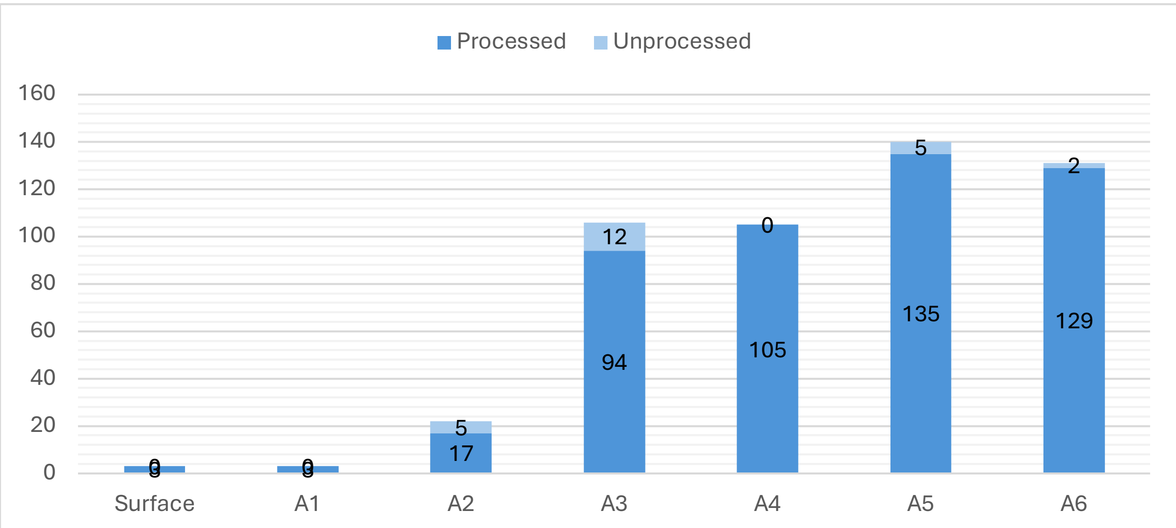

Figure 7. Number of fragments of fibre recovered from each excavation square in WW.

Table 4. Number of fragments of fibre recovered from each context in WW

CONTEXT	SURFACE	A1	A2	A3	A4	A5	A6	TOTAL
Processed fibre	3	3	17	94	105	135	129	486
Unprocessed fibre	0	0	5	12	0	5	2	24
Total Number	**3**	**3**	**22**	**106**	**105**	**140**	**131**	**510**

The unprocessed fibres consist of bast fibre that has been removed from the bark and may have undergone some refinement but has not been processed into string. A total of 24 pieces fall into this category. Those with the least refinement presented as strips of bast, three of which are knotted (2 x overhand, 1 x carrick bend). The most heavily refined pieces had been shredded, scraped, chewed, or otherwise teased to remove the extraneous plant cells and separate the individual fibres until the mass resembled carded wool (Figure 8).

Figure 8. Archaeological fibre fragment FIBRE00012 (left) demonstrating the least amount of processing. Archaeological fibre fragment FIBRE00001 (right), fully processed fibre ready to spin into string.

All samples of processed fibre match the criteria of 2-ply string, including five pieces of single ply which show crimping along their length, indicating they have unravelled from 2-ply string. Many of the smaller fragments of archaeological string (n=330, or 64.7%) do not have secondary attributes, such as knots, that may indicate their final form or use, and thus their identification could only be to the level of string rather than to a specific object. Almost half of these smaller fragments of string (n=155, 47%, or 30.4% of the assemblage) are set in curved shapes that resemble the curves and twists of double looping (Figure 9). The average length of the 451 string fragments was 31.23 mm, with a mean of 21 mm.

Figure 9. Examples of string set in a curve or twist (L-R FIBRE00218, FIBRE00442, FIBRE00427).

Diagnostic characteristics of the remaining string fragments (n=180) include looping, overcast string, and several types of knots (Table 5).

Table 5. Presence of attributes of the processed fibre sorted by context. Numbers in cells are indicated in brackets.

CONTEXT OF PROCESSED FIBRE	Surface (n=3)	A1 (n=3)	A2 (n=17)	A3 (n=94)	A4 (n=103)	A5 (n=35)	A6 (n=127)
Ply fold	-	-	-	5	2	3	3
No. of ply	2-ply (3)	2-ply (3)	2-ply (17)	2-ply (94)	1-ply (1) 2-ply (104)	1-ply (2) 2-ply (133)	1-ply (2) 2-ply (127)
Type of Knot	Sheet bend (1)	-	-	Overhand (4) Sheet bend (3)	Overhand (3) Sheet bend (1) Clove hitch (1) Double knot (1)	Overhand (9) Sheet bend (4) Clove hitch (5) Half hitch (1) Carrick bend (1) [Carrick bend in A5 unprocessed fibre (1)]	Overhand (7)

CONTEXT OF PROCESSED FIBRE	Surface (n=3)	A1 (n=3)	A2 (n=17)	A3 (n=94)	A4 (n=103)	A5 (n=35)	A6 (n=127)
Presence of resin	-	-	3	16	32	34 [plus (1) unprocessed fibre with resin]	34
Presence of ochre	-	-	1	3	9	6	4
Presence of looping	-	-	1	4	7	3	13
Presence of netting	-	-	-	3	1	4	-
Wound string	-	-	-	-	-	1	2
Clove hitches on base string	-	-	-	-	-	3	-

Knots were represented in 8% of the assemblage, as summarised in Table 5. Overhand knots were the most common knot type in the assemblage (n=23), followed by sheet bend (n=9), clove hitch (n=6), carrick bend (n=2), double knot (n=1), and half hitch (n=1) (Figure 10).

Figure 10. Examples of knots (clockwise from top left): Sheet bend (FIBRE00419), carrick bend (FIBRE00418), clove hitch (FIBRE00494), double (FIBRE00189), and overhand (FIBRE00458).

Traces of resin were identified on 120 fibre fragments (Figure 11). This included six fragments of looping and two of unprocessed fibre. Light ochre staining was observed on 23 fragments of string that varied in length from 11–110 mm, one of which also had an overhand knot (Figure 12). None of the fibre exhibited evidence of dye.

Figure 11. String with resin adhering (L-R: FIBRE00307, FIBRE00021, and FIBRE00376).

Figure 12. String with ochre staining (L-R: FIBRE00147, FIBRE00347, and FIBRE00134).

5.1.1 Composite string fragments

Three fragments of overcast string — a string wound around one or more base strings — were identified (A5:1, A6:2, Figure 13, Figure 14, Figure 15). Fragment FIBRE00117 has four core strings with five loops of binding string, FIBRE00482 has a single string with four loops of binding, and FIBRE00087 has 16 core string and 20 loops of binding string. Another three fragments of a single base string supporting clove hitches were identified, all in Square A5 (Figure 15). One is a single clove hitch (FIBRE00484), another supports four clove hitches (FIBRE00499). The third fragment is 3-ply sssZ string supporting 25 loops of 2-ply string (FIBRE00492) — four of these loops comprise two definitive clove hitches, but the 'tails' of the hitches have broken away and the other loops remain fragmentary. They do not exhibit a spiral around the base string and are thus not overcast. It is most likely that these 25 fragments were also tied in clove hitches.

Figure 13. Examples of overcast string (L-R): FIBRE00117, FIBRE00482.

Figure 14. Overcast string FIBRE00087.

Figure 15. Clove hitches on base string (L-R): FIBRE00499, FIBRE00484, and FIBRE00492.

5.1.2 String-based fabric

Twenty-nine fragments of looped fabric (Figure 16) and eight fragments of netting were identified (Figure 17, Figure 18). All of the looped fabric was identified as double looping, consistent with looping found in dillybags and fishing nets (see below). The netting (Table 6) was square gauge constructed with sheet bends — a technique used across the world. The gauge of the nets ranged between 7 and 15 mm.

Table 6. Attributes of the netting fragments.

ID Number	Gauge (mm)	Max. width (mm)	Weight (g)	Knots (*n*=)
00083	7	45	0.52	23
00084	10	45	0.4	10
00085	10	130	2.78	69
00137	15	80	0.38	9
00261	Indeterminate	20	0.06	1
00397	Indeterminate	15	0.025	1
00411	Indeterminate	15	0.03	1
00418	Indeterminate	15	0.04	1
00476	Indeterminate	27	0.02	2

Figure 16. Examples of double looping (L-R): FIBRE00111, FIBRE00113, FIBRE00359, and FIBRE00498.

Figure 17. Fragment of netting FIBRE00085.

Figure 18. Fragment of netting FIBRE00137.

A strip of faded red fabric was recovered from Square A5 of the excavation. The strip measures 300 x 22 mm and has one straight end and one angled (Figure 19). It appears to be woven with a 2/1 twill pattern in cotton fibre. This object has not been examined under a microscope due to time and access constraints, and consequently the precise fibre type is not known. However, 2/1 twills are the simplest of twill patterns, where the weft thread weaves under one warp thread and over two. This results in a pattern that replicates every third weft strand and is known as a right-hand twill, or ‘Z twill’, because the twill line runs from upper right to lower left (Wingate 1979:636).

Figure 19. Strip of fabric from Square A5 (FABR00001).

5.2 Museum fibre objects

The QM holds a small but significant collection of objects provenanced to Laura. Of these, 39 objects recorded as having fibre components were examined in July 2024. The object types were a firestick and sheath (n=1), dillybags (n=23), woomeras (n=4), nets (n=3), and shell necklaces (n=8). Their attributes are summarised and tabulated below (Table 7, Table 8, Table 9, Table 10, Table 11). Almost two-thirds of the objects at the QM appear to be unused, with the exceptions of the shell necklaces, two of the nets, woomeras, firesticks, and a specific dillybag found by Trezise.

5.2.1 Firesticks and sheath

The firesticks and sheath consisted of a pair of hardwood sticks with a moulded sheath that fits over the ends (Table 7). The sticks did not contain any fibre components and thus were not examined any further. The sheath consisted of a pair of hollowed reeds cut to around 15 cm length, coated with resin and bound with undyed string (Figure 20). The string had further resin applied over the top and in a large ball at one end, the latter of which was studded with *Arbrus* sp. seeds. The string used to bind the reeds was a 2-ply bast fibre with many small, white feathers incorporated into the twist. Many of the barbs and barbules had worn away, leaving the rachis protruding from the string. No knots or ply fold were visible owing to the resin coating which obscured large sections of the string. The sheath measured 152 mm long, 32 mm wide and 20 mm thick.

Table 7. Firestick sheath attributes.

Object Number	2-ply ssZ	Ply fold present?	Knots present?	Resin present?
QE10860	1	Indeterminate	Indeterminate	X

Figure 20. Left: firestick sheath QM10860. Right: detailed view of the firestick sheath binding showing feather rachis protruding from the twisted fibre and the patchy resin coating.

5.2.2 Bags

The 23 dillybags examined were uniformly 2-ply ssZ bast fibre string, except for one which was constructed in zzS twist (Figure 22). All were fabricated with a double-looping pattern, though there was variation in the degree of completion: several bags had unfinished rims, usually with a simple drawstring threaded through the uppermost loops and lacked handles. The most ‘finished’ bags had a handle comprised of four strings, which were resin coated then wrapped with European-made cotton cloth strips (seven red, one brown, and one red and brown). Colour variation in the bags was due to the use of different fibre types (i.e. different plant species), and not dye. Bags varied in size from 200–575 mm (bag length) and 150–415 mm (bag width), with handles from 430–780 mm long, where present.

Overhand knots were present in all bags, while double knots were noted in two, and a clove hitch and a half hitch were noted in two other bags (one in each). In four bags, knots were noted in the rim bindings, four bags had knots in the drawstrings, two had knots in the handle, and three had knots in the less substantial hanging strings. Eleven bags had knots in more than one of these locations (Table 8).

Table 8. Dillybag attributes.

Object number	2-ply ssZ	2-ply zzS	Ply fold	Double looping	Overhand knot	Double knot	Clove hitch	Half hitch	Resin present?
QE10822	X		X	X	X				
QE10823	X			X	X				X
QE10824	X			X	X				X
QE10825	X		X	X	X				
QE10826	X			X	X				
QE10827	X			X	X				
QE10828	X			X	X				X
QE10829	X			X	X			X	X
QE10830	X			X	X				
QE10831		X	X	X	X				
QE10832	X			X	X				
QE10833	X			X	X		X		
QE10834	X			X	X				X
QE10835	X			X	X	X			
QE10836	X		X	X	X				X
QE11284	X		X	X	X				
QE11285	X		X	X	X				
QE11286	X		X	X	X				
QE11287	X		X	X	X				
QE11288	X		X	X	X	X			X
QE11289	X		X	X	X				
QE11290	X			X	X				X
S549.1	X			X	X				X

All bags had knots in the looping that formed the body of the bag, except QE10824 (Figure 21). This example is striped through the alternation of two fibres with markedly different visual characteristics, with the joins formed by clearly defined splices instead of knots. The differences in the fibres are natural variations in colour between plant species, and do not result from dye. QE10824 was not the only bag to have splice-joined stripes; six other bags were striped in the same manner, with up to four different fibre types, and a further four (QE10830, QE10833, QE11290, S549.1) included small sections of red or green European-derived fibre spliced into the bast fibre string (Figure 21).

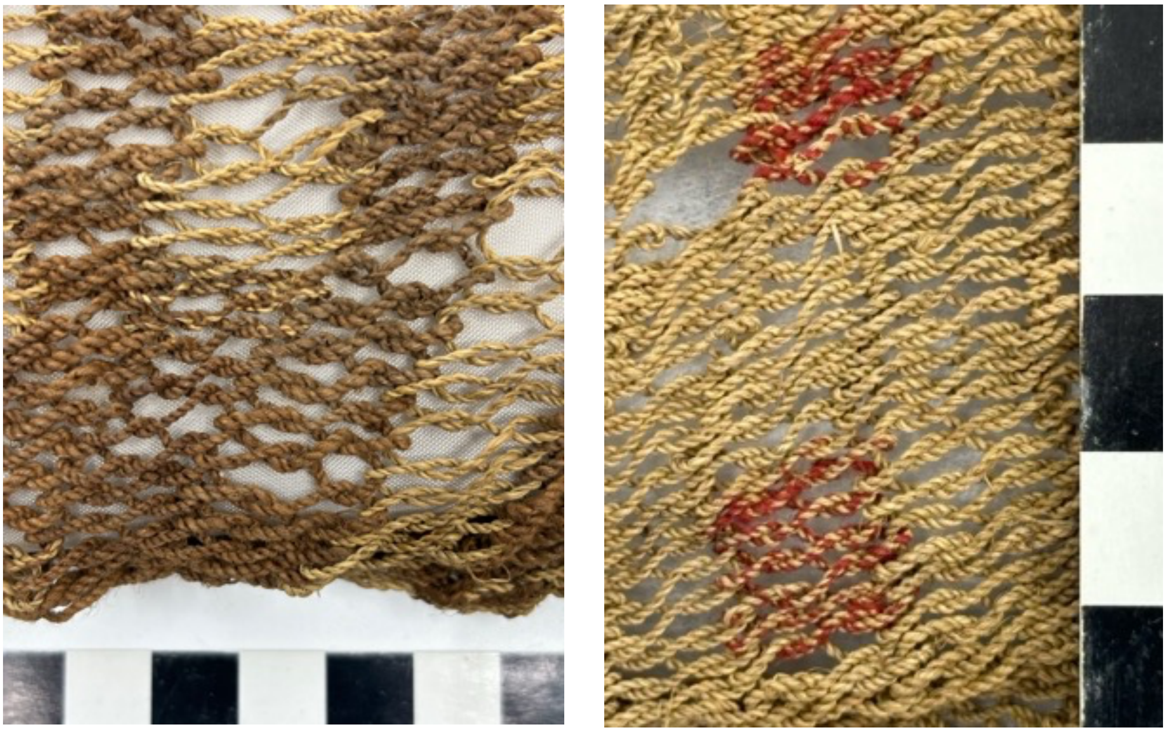

Figure 21. Left: dillybag QE10824 showing the markedly different hues of two fibres used alternately to create stripes. Right: QE10833 showing patches of red fibre incorporated into the string.

Figure 22. A selection of the 23 dillybags at Queensland Museum (top row: QM11288, QM10823, QM10826. Middle row: QM10833, QM11289, QM10827. Bottom row: QM10836, QM10835, QM10830).

An unusual method of joining two strings was observed in the body of nine bags from the QM collection (e.g. Figure 23). This join was made during the construction of the bags, and not during any later repairs. The method of joining was to pass the open end of a string through the ply fold of the previous string and secure it with an overhand knot, similar in form to the "button and loop" closure observed on kangaroo-twine waist-belts on the Middle Palmer River (Roth 1901:11, Figure 23, Figure 24). This indicates that these bags were worked with pre-made lengths of string, with the open end of the ply secured first before the commencement of looping. This method of joining string with an overhand knot through the ply fold was noted in all seven bags donated by Constance Fitzgibbon, and two of those donated by Edward Fitzgibbon.

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Figure 23. Left: Magnified view of a ply fold overhand knot from QE11287. The ply fold is in the right-hand strand, and the end of the left-hand strand passes through the fold and is secured with an overhand knot. Right: The 'button and loop' used to join kangaroo-twine waist-belts at the Middle Palmer River (Roth 1901:11, Plate III).

The construction of QE11284's handle (Figure 24), however, is quite different to Roth's (1901:10–11) observation that construction began with the ply fold-end of the string, with additional fibre spliced into the working string as required. Splicing fibre into the working string allows for variation of tasks during construction, as fibre could be obtained, prepared and spliced into the working string at intervals.

This is a simpler method of construction, as it precludes the difficulties of looping with an unwieldy length of string.

Figure 24. The ply knot in the handle of dillybag QE11284. Inset: Context of the knot location in the bag's handle.

The red, brown, and black cloth strips added to the bag handles do not show uneven wear consistent with use, but do appear uniformly well-worn, almost threadbare, suggesting that the cloth had reached the end of its useable lifespan as clothing and was repurposed and incorporated into traditional forms of fibrework (Figure 25). The cloth-bound handles, necklace strings, and patches of red and green fibre incorporated into the bag string indicates their manufacture in the post-colonial era.

Figure 25. Cloth binding on the handle of QE10827. Inset: the entire bag.

5.2.3 Woomeras

The four woomeras examined were similar in construction and known as shell-type woomeras (Wallis et al. 2024), although all shells are now lost. The body was a thin, flat piece of wood, curved to a narrow handle at one end and narrowing to the peg attachment at the opposite end. The handles were wrapped with string then thickly coated with resin, which obscured much of the string and made attribute recording challenging (Table 9, Figure 26). The dimensions of the woomeras were 800–840 mm long, 68–86 mm wide in the centre, with a thickness of 4–14 mm.

Table 9. Woomera attributes.

Object number	2-ply ssZ	2-ply zzS	3-ply sssZ	Indeterminate ply	Ply fold	Knots present	Resin present
QE10855			X		Indeterminate	Indeterminate	X
QE10856		X			Indeterminate	Indeterminate	X
QE10858	X				Indeterminate	Overhand bend	X
QE10859				X	Indeterminate	Indeterminate	X

One woomera had a folded section of folded bark attached to the handle end, with a loose binding of unprocessed strips of bast fibre. Two had loose strings threaded through a hole drilled in the handle that once supported the shells. The peg of the woomera was lashed in place with string threaded through 2-3 holes drilled into both the body of the woomera and the peg. The lashing was then covered in a thick coating of resin. In most places, the resin covered the string sufficiently that no attributes were visible. However, the shell strings and small sections of string visible under chipped resin allowed the ply-twist to be recorded on three of the woomeras: 2-ply ssZ and zzS twist, and 3-ply sssZ twist. No knots or ply folds were visible.

Figure 26. Left: small sections of string visible under chipped resin on woomera QE10856. Right: The loose shell string on the handle of woomera QE10858.

5.2.4 Nets

The three QM nets examined were “bag nets”, constructed of double looping in an enlarged version of the dillybags described above: QE10837, QE10838, and QE10839. The three bags appear unfinished, with no rim binding, drawstring, or other finish to the top edge of the looping. All are shallow (0.28–0.91 m) comparative to their width (1.6–2.7 m). The final row of looping in QE10837 is a light brown fibre spliced into the deep red fibre of the rest of the net, with an overhand knot securing the splice. After looping a row more than halfway around the bag, the string is left with a short, unsecured tail. QE10839 has several short, broken strings, possibly of European origin due to their loose ply and highly processed fibres, tied at each side of the opening as if it may have been hung up. All nets had several holes, some of which had been repaired by rejoining broken strands with overhand bend knots (Table 10, Figure 27, Figure 28).

Table 10. Net attributes.

Object number	2-ply ssZ	Ply fold present?	Double looping	Overhand bends	Other knots	Resin present?
QE10837	X	X	X	X		
QE10838	X		X	X		
QE10839	X	Indeterminate	X	X		

Figure 27. The three nets studied at Queensland Museum (L-R) QE10839, QE10837, and QE10838.

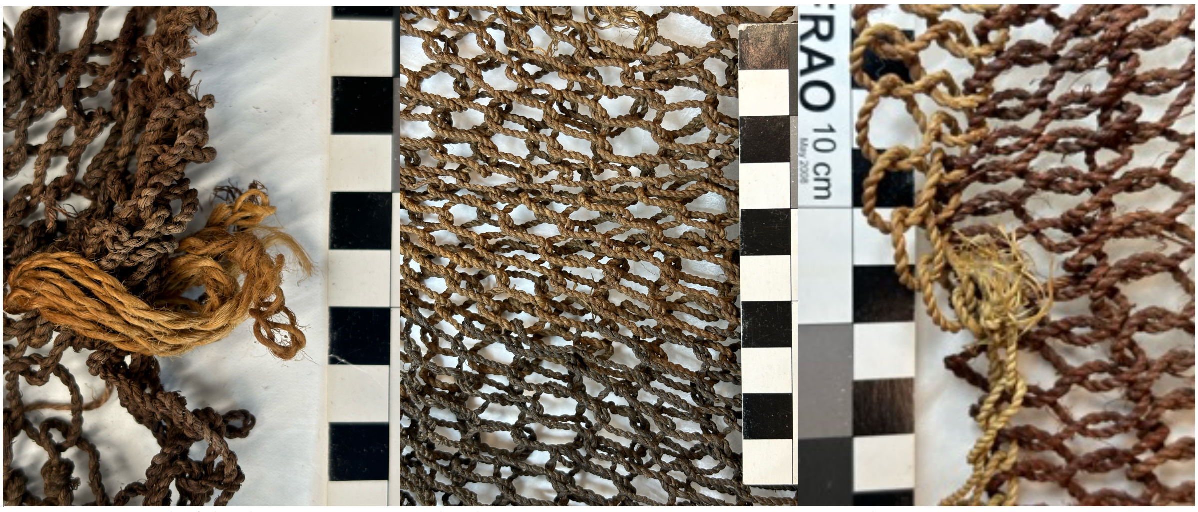

Figure 28. Detail of the three nets at Queensland Museum (L-R) QE10839, QE10837, and QE10838.

5.2.5 Necklaces

The collection of shell necklaces were composite objects, each with several types of fibre (Table 11). The rectangular shell beads were uniform amongst the necklaces, with 20–65 beads per necklace twined with two matching strings (Figure 30). QE10846 had dual strands of beads joined in the same way to form a single necklace. The twining strings were then tied to one or more different strings, with the join overcast, or bound, with a third string and tied with a simple hitch, twist hitch, or rolling hitch (Figure 29).

The necklace shells show wear, where the nacre has chipped or abraded from the surface to varying degrees. The string that secures these shells appears to be the same across all eight necklaces, and is worn, broken, or all but disappeared (QE10848). All string used in the necklaces is of a much looser twist and of less refined appearance, suggesting a European origin, with the exception of QE10840, which incorporated a length of bush string as well.

The shell beads resemble those depicted and described by Roth (1910:27-28) inland and on the east coast of CYP and are rectangular shaped sections of Nautilus shell drilled with a single aperture, “through which the double-strand connecting string is woven on a chain-twist pattern”. In the coastal regions of southeast CYP, they were worn by women as necklaces, and by men as fillets, but by the time they were traded inland to the Middle Palmer River, both sexes wore them as necklaces (Roth 1910:28). QM recorded these objects as ‘headbands’ at the time of accession.

Figure 29. Left: QE10856 showing the juncture of multiple strands of fibre. Right: QE10840 showing the juncture of multiple types of fibre.

In two necklaces, black or red European-made cloth was tied onto the bead strings. QE10847 had lost these added strings, but the remaining fibre showed crimping, demonstrating where the additions had been tied on, and the ends of the bead strings have attained a deep pink hue, probably through contact with red cloth. QE10858 was a collection of 67 beads with wisps of fibre caught in the bead holes, four small fragments of separated s-ply, and a single overhand knot of 2-ply ssZ string. The lengths of the seven intact necklaces ranged from 610–1000 mm.

Table 11. Shell necklace attributes.

Object number	2-ply ssZ	2-ply zzS	3-ply zzzS	3-ply sssZ	4-ply zzzzS	Over-hand knot	Rolling hitch	Twist hitch	Simple hitch
QE10840	X						X	X	
QE10842	X								X
QE10843			X	X					x
QE10844	X					X		X	
QE10845			X			X	X		x
QE10846		X					X		
QE10847					X				
QE19848	X					X			

Figure 30. The eight shell necklaces studied at Queensland Museum.

Most of the shell necklace strings did not appear similar to the Indigenous-made ‘bush string’ that appeared throughout the rest of the objects. Instead, these appeared to be of European origin, as the fibre they were formed from was more processed, less tightly twisted, and in many cases in 3- and 4-ply twists, which are unusual in the context of the rest of the assemblage. The European-made cloth, in both the necklaces and the dillybags, was a soft plain weave or herringbone weave cotton.

Having now described the archaeological fibres from WW and string material culture in the QM collection, the following chapter interprets these results to develop a greater understanding of fibre technologies in the late Holocene in the Laura region.

6 Discussion

Like the archaeological samples, the analysis of the QM objects suggests that fibre-based material culture is largely consistent and regular in form in SE CYP. This regularity and uniformity of attributes such as the number of ply and consistent use of knots and looping techniques across categories of object, allows comparison with the attributes of the archaeological fibre, and predictive statements to be made about their final form and use.

The archaeological fibres from WW are highly fragmented, making detailed interpretations difficult to draw for much of the material. What can be ascertained from the analyses of the attributes, however, is the uniformity of the assemblage: the string was mostly 2-ply ssZ twist and the knots identified were of six known types. The unprocessed fibre was mostly shredded and teased until fine enough to spin into string. The netting knots and gauge were uniform *within* each fragment, although gauge varied between fragments, and the looping fragments all had the same pattern. This demonstrates a refined fibrecraft practice with regular patterns and techniques used for specific purposes. The identified attributes are known from the ethnographic literature and their general distribution across CYP was recorded by Roth and others.

String itself is used for a multitude of purposes but is also the basis for all components of dillybags, including looping, handles and drawstrings; fish nets; and personal adornment such as headbands. As several of the QM's dillybags show, strings made from fibre species with differing colours and textures were used interchangeably to create stripes. One bag (QE10827) contained four different fibre types woven together to create the pattern. Two fragments of looping from the archaeological assemblage are similarly made from visually different fibre-types looped together (FIBRE00044 and FIBRE00104). Their fragmentary nature meant that spliced or knotted joins, such as were observed in the QM objects, were not present. Many of the smaller fragments of archaeological string are hardened or set in curved shapes that resemble the curves and twists of double looping, and it is plausible that some or all of these could have derived from a single looped object constructed from multiple forms of fibre, such as that observed in QE10827.

One of the largest pieces, FIBRE00085, is a fragment of netting collected from the surface of WW. At 130 mm and 2.78 g it is one of the largest pieces of the assemblage (Figure 31). The netting is square-mesh, with a 10 mm gauge and 72 sheet bend knots. The small gauge precludes it from being a fragment of game or bird net. It is more likely to have come from a dillybag, or a fishnet.

Figure 31. FIBRE00085, the largest fragment of netting in the assemblage.

FIBRE00137 (Square A4) is also a fragment of square-mesh netting and is 80 mm long and 0.38 g (Figure 32). The netting gauge is approximately 15 mm, and six sheet bend knots are present. As with FIBRE00085, above, the gauge is unnecessarily small to be a game or bird net. However, 15 mm mesh is larger than the holes in most looped dillybags observed at QM, suggesting that this fragment may be from a fishnet.

Figure 32. FIBRE00137 is a smaller fragment of netting.

FIBRE00088 (Figure 33) and FIBRE00089 (Figure 34) are both fragments of double looping from Square A6. The fragments are similar in colour and string diameter, and the looping appears to be consistent in size and tension, suggesting they are from the same object. The closeness of the looping suggests the object was likely a dillybag, as fishnets have looser looping. FIBRE00088 has two short fragments of a lighter coloured string drawn through the looping, one of which terminates in two overhand knots. The fragments are 45 mm and 0.73 g, and 45 mm and 0.77 g respectively.

Figure 33. FIBRE00088, a fragment of double looping.

Figure 34. FIBRE00089, a fragment of double looping.

FIBRE00492 is a core string 65 mm long, supporting 25 loops of string with a total weight of 0.91 g (Figure 35). Two of the loops are complete clove hitches, and the remaining loops appear to be clove hitches with their ‘tails’ broken off, as they are separate and do not spiral like an overcasting string. The form of many clove hitches on a single core string matches that of a tasselled pubic-apron (see below).

Figure 35. FIBRE00492 is a series of clove hitches on a core string.

FIBRE00087 is a fragment of overcast fibre, comprised of 20 loops of 2-ply string wound around 16 2-ply core strings (Figure 36). This bears most similarity to the dillybag handles observed at QM, the more substantial of which consist of four core strings wound with fibre or cloth. Roth (1901:12) recorded overcast string in the waistband of pubic-aprons and in mourning string, although Roth’s examples only had a single core string. The fragment is 85 mm long and weighs 1.3 g.

Figure 36. FIBRE00087, a fragment of overcast fibre.

Overcast string was observed in the QM collection on the handle of one dillybag (QE10829, the remaining bags with true handles were bound with strips of cotton cloth). Bag handles were made by threading two strings through the rim of the bag, then doubling them to form four strings. A thin coating of resin was applied, and another string wound around the group along the entire length of the of the handle. This technique was not documented by Roth or other observers, although this could be the source of the resin on the fragments of archaeological fibre. Roth (1898a:27) observed that bags were commonly carried by “slip[ping] the handle string over the forehead, the bag hanging behind, between the shoulders”. The addition of cloth binding would have increased the comfort of this method of carrying. The shape and fabric type of the archaeological strip of cloth appears superficially similar to that on the bag handles, although it has not been examined microscopically.

The cloth strips used in the binding of the bag handles and necklace strings appear to match the faded red cotton strip excavated from WW. Twill weave creates a stronger, firmer fabric that has multiple, use-specific variations (Wingate 1979:636). It is likely that both the cotton strip from Windmill Way and the cotton strips binding the dillybag handles at QM are made of a fabric known as ‘Turkey red’. Turkey red was an inexpensive, colour-fast, red dye discovered in 1785 that was commonly applied to cotton calico (plain-weave) and twill, and mass produced in Europe (Lowengard 2022). Large quantities were exported to colonial Australia to clothe the settlers (e.g. Queenslander 1876), but pieces of turkey-red were often used as gifts, payment, or in trade with Aboriginal peoples, alongside glass beads, tobacco, and tomahawks (e.g. Gore 1911; Spencer 1928:4). Roth issued “a hundred Government-issued red shirts, a hundred turkey-red dresses” and other goods to Aboriginal people who assisted in the aftermath of Cyclone Mahina at Bathurst Bay, on the northern tip of Cape Melville in 1899b (McDougall 2015:48; Roth 1899b), and Howard (Chief Protector succeeding Roth, 1911:8) recorded gifting the Lardil people of Mornington Island “turkey red calico, … empty tins and bottles”. Members of the Police reported similar distributions, such as Sergeant James Whiteford (1897) of Musgrave NMP Station who distributed “12 tomahawks, 12yds of turkey red, 12 fishing lines, 1 box of fishhooks, and 6 lbs of tobacco” to Aboriginal people at 18 Mile Lagoon. Khan (2008:181–182) noted that Roth collected several traditionally made objects incorporating strips of European cloth, including bark-fibre bags with handles bound with coloured wool, and the ends of necklaces and headbands bound with strips of fabric or wool. Government-issue blankets were also distributed to Aboriginal people from depots across the state. The blankets were manufactured with coloured stripes to distinguish them, and these stripes were sometimes unpicked, and the strands incorporated into bags and baskets (Khan 2008:181) — this may be the source of the red and green yarn incorporated into some of the museum’s bags.

Dillybag rims were often overcast, a process in which 2-3 strings are threaded through the upper row of looping, and then bound by another string to stabilise the looped body of the bag and strengthen the opening. This technique was observed in the rims of 15 bags from the QM collection and was documented by Roth (1901:12). Three fragments of overcast string were identified in the archaeological assemblage. None of these resembled a bound dillybag rim, as evidence of the body of the bag was not present. Two overcast fragments (FIBRE00117 and FIBRE00087) contain multiple strings (four and 16 strings, respectively). These may be fragments of dillybag handles, with core strings and a binding string. The single core string with binding may be a fragment of a pubic-apron tying string, as these were recorded by Roth (1901:12) to be formed on a single core string. Mourning strings were sometimes made by overcasting a single core string with bark fibre twine and worn by men around the waist. Roth donated two such mourning strings collected from Cape Bedford and Maytown to the Australian Museum in 1905 (Khan 1996:53) and described the technique in the mourning strings of the Middle Palmer River, and "the belt portion of … [fringed] apron-belts" and waist-circlets, in which the core string/s may be human hair, possum fur, or plant fibre (Roth 1901:12, 1910:37–38).

The tasselled pubic-apron was commonly worn by women across Queensland but sometimes worn as a necklace by men (Roth 1910:39–40, Figure 38). Comprised of a series of loops secured with clove hitches to a top string, each loop was rolled to form a tassel (Figure 37). Two of the three fragments of clove hitches on a basal string from the archaeological collection (FIBRE00492 and FIBRE00499) are likely to be fragments of a tasselled apron-belt. The third archaeological fragment (FIBRE00484) using a similar technique is a single clove hitch on a longer string, but its precise purpose cannot at present be identified.

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Figure 37. Left: Diagram of the making of a tasselled apron-belt, showing the clove hitches that secure the fringe to the top string (Roth 1901:9–10, Plate VII). Right: The loops were then rolled on the thigh to create the tassels, thus finishing the fringed apron-belt (Roth 1901:9–10, Plate VII).

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Figure 38. A tasselled apron-belt (or skirt) with overcast top string and fringe constructed with clove hitches, collected by Roth at Palmer River Native Police Camp in 1899, and subsequently accessioned by the Australian Museum, Sydney (figure reproduced from Khan 2004:31).

Four archaeological fragments of netting had more than one knot, the distance between which is the gauge. This ranged between 7 and 15 mm, a gauge better suited to fishing nets rather than bird or game nets, since Satterthwait (1987:615) reported waterfowl nets with meshes of 5 cm, and game nets much larger. The fishing nets analysed at the QM were constructed with double looping, not square-mesh netting. The looping resulted in a mesh of similar gauge to the square netting, however, and would surely trap similarly sized fish (Figure 39). Roth observed both square-mesh and looped fishing nets in use of all the coastal regions and main rivers of south-east CYP, including the Laura River, often with a cane frame inserted at the mouth of the net (Khan 2004:34, 47). One example, “made at the Laura or Deighton” measured 137 cm by 45 cm in width, with double looping loops 9 cm long (Khan 1993:139). These cane-framed nets were called ‘purse-nets’ and were used only by women; Roth (1901:13) described their construction as “made on exactly identical plan and pattern as the dillybags, but of course on much larger scale”. In this case

Roth was referring to both bags and nets constructed from square-mesh netting, but the same is true for the construction of looped bags and nets. The nets studied at the QM fit this description, but did not have the cane frames. Small gauge netting has also been documented in dillybags, such as observed by Roth on the Palmer River, and the Gulf coast of Western CYP [Khan 2004:56], and in headbands and skullcaps observed at Boulia and the Upper Georgina River, central-west QLD (Roth 1910:23–24).

Figure 39. Close-up of the double looping of net QE10838, showing the small gauge of the mesh.

Resin was observed adhered to samples of looping (n=6), unprocessed fibre (n=2), and string (n=113). The resin tended to be patchy, probably remnant after the remainder had crumbled away. Ochre was observed on 29 samples of string, 12 of which also had resin. No ochre was observed on any QM objects, but resin was noted on all handle strings of bags (not drawstrings), essentially gluing the string together beneath the string or cloth binding. Resin was also thickly applied over the string on woomeras, and the string that bound the two reed shafts of the firestick sheath. Examples of north Queensland ochred fibre objects now held by the Australian Museum include a bicornual (two-horned in form) men's basket with ochred designs, and cockatoo feathered headdresses bound with red-ochred string collected in Atherton by Roth (Khan 1993:40–41, 44), an ochred chain-work mourning string from Bathurst Head (Khan 1993:85), a firestick sheath bound with fibre and decorated with red ochre (Khan 2003:14), and two ochred string love charms from Mapoon (Khan 2003:20). Roth (1910:23, 26) also noted that the head-net made by men in the Boulia and Leichardt-Selwyn districts, and the possum-fur fillets with bark fibre ties made in the north-western districts, would be "coated thickly with red ochre grease".

The unusual "button and loop" knot observed in the bodies of QM objects QE10831, QE10836, and QE11284–QE11290 indicates that these bags were worked with pre-made lengths of string, with the open end of the ply secured first before the commencement of looping. Roth (1901:11) noted this type of joining knot was used to fasten waist-belts, describing the action as like a 'button and loop' when the knot passes through the fold, and the button and loop is clearly visible on the drawstring 'handle' of dillybag QE11284 (Figure 24). It is not known if this ply fold knot was used in other places or times, but there is no mention of these joins being used in dillybags by Davidson (1933), Roth (1901, 1910), Khan (1993, 1996, 2003, 2004), or West (2021). Possibly the nine bags with this knot were made by the same person. The random distribution of these joins suggests that lengths of string were pre-made to varying lengths. This may be because the bag could not be made in the usual way due to difficulties in procuring fibre to splice in as needed, or that multiple agents were involved, with one making string, while another constructed the looping, for example. Both possibilities may be indicative of the disruption of traditional lifeways. There was no evidence of this in the archaeological collection.

The range of fibre attributes recorded in the archaeological assemblage mostly have analogues in the historical objects held at QM, excepting ochred string and square-mesh netting. The attributes suggest the archaeological fibre may be fragmented from local dillybags (looped or netted) or fishnets (looped), or fishnets traded from the Princess Charlotte Bay area (netted). Fragments of pubic-aprons may be seen in the core strings with clove hitches, and the overcast string may represent mourning strings (single core string) or dillybag handles (multiple core strings). The many small fragments of string set in curved shapes may be fragments of any of these objects, but their curves generally match the double looping patterns best. It is difficult to suggest the purpose of these smaller fragments, although it remains possible that these curved fragments derived from a single source, such as a striped dillybag, as the QM bags showed up to four visually distinct fibres used in the looping of a single bag. The four fragments of netting had differing sizes of mesh, thus are unlikely to be derived from the same net. However, the small gauge does suggest these nets were for fishing, dillybags, or personal adornment.

The archaeological fibres all appeared to be derived from bast fibre, requiring longer and more involved processing to extract the fibrous inner bark and make it ready for use, often requiring additional steps of soaking, sun drying, and shredding. The variety of fibre types observed within the assemblage was observed to be at least six, but preliminary visual inspection proved difficult to define the boundaries between species. However, the ethnography recorded different plants being used for different — and sometimes specific — purposes, and this demonstrates the procuring of fibre from a range of species across the landscape.

7 Conclusion

These possible source objects (dillybag, fishnet, pubic-apron, and mourning string) suggest a complex relationship between fibrework and daily life. They represent possessions and mobility (dillybags), food procurement (fishnets), personal adornment (pubic-apron), and heartfelt attachment to kin (mourning strings). The collected objects at QM attest to the intricate fibrework practiced by the Aboriginal people of Laura, in the tightly spun string expertly looped into bags both beautiful and functional, expansive and strong nets, and solidly built woomeras. The shell necklaces demonstrate the adaptation of multiple fibre types (European string and cloth) to traditionally made items. Overall, objects from each category analysed at QM were noticeably uniform in their execution, each reflecting honed techniques designed to fulfil their purpose. These were not experimental or rough but constructed according to regional traditions traced by ethnographers and collectors.

Many imported materials were incorporated into traditional material culture, particularly metals which were prized for their durability and ability to maintain a sharp edge. Roth was unconcerned with the incorporation of these new materials despite being concerned about the imminent dilution and loss of culture occurring through contact with non-Aboriginal people, as he regularly distributed goods to Aboriginal communities on his travels. Khan (2008:183) reported 35 objects incorporating new materials were accessioned to the Australia Museum, representing just 3.8% of the collection, suggesting, “[i]t is possible that they were too useful to part with”. Just two objects of European origin were recovered from the excavation of WW — the strip of cloth and a length of wire. This may be interpreted as the occupants having little contact with European people, or the rockshelter receiving only occasional use or even complete abandonment soon after colonisation. It may be that objects incorporating European materials were too useful or rare to be discarded, and were recycled and ultimately removed when people came in to towns and stations. Without extensive dating of the organic assemblage from WW, the temporal span of occupation of the shelter and of fibrework manufacture and discard, is speculative.

This thesis characterises the fibre assemblage excavated from Windmill Way, in SE CYP. Alongside other categories of material, including a substantial macrobotanical collection, faunal bone, shell, wood, and lithics, Windmill Way provides an insight into material culture in the late Holocene. The fibre analysed here represents a small portion of the fibrecraft practices known from ethnography, and this ethnography has aided in the interpretation of the archaeological material.

This characterisation of archaeological fibre from Laura, in combination with fibre objects held at Queensland Museum, provides a window into fibrecraft practice on the Laura and Deighton Rivers which was otherwise neglected by ethnographers. This fibre assemblage is numerically, and possibly volumetrically, larger to any other recovered from an Australian archaeological context. It is therefore significant in its provision of detailed information into the landscape and lifeways of the Aboriginal peoples who occupied Windmill Way rockshelter. These fibre fragments contain multiple plant species in several forms, including fabrics of netting and looping, with some showing traces of ochre and resin. Inferences have been drawn as to the domestic uses of theses fibre objects. While the fragmentary nature of this assemblage means that the final form cannot be ascertained with certainty, how fibre was used in the surrounding regions is known, and principles of similarities must apply. Although the fibre assemblage and museum-held objects show evidence of adaptation and hybridity in the contact era, this study returns a preliminary understanding of traditional fibrecraft practice to the Traditional Owners of Windmill Way. The uses inferred (bags, fishnets, pubic-apron) from ethnography show an adaptive and dynamic population, and demonstrate possible trade, mobility, and ornamentation. They also show detailed knowledge of the environment in the manufacture of fine and strong string from varied plant sources. Perishable items of everyday use are exceedingly rare in the archaeological record due to taphonomic processes rendering this collection an especially valuable and rare glimpse into past lifeways.

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9 Appendix 1: Attributes of fibre

9.1 Bast

Fibre from the inner layer of bark from dicotyledonous plants. Often this is the bark of stems and branches, although the term also applies to the bark of subterranean and aerial roots. Bast fibre is obtained by the removal of the outer and bark and inner core through manual processing or retting, a form of controlled rotting.

Bast fibre is considered a soft fibre as it retains a degree of flexibility following processing and for a considerable length of time afterwards (van Dam and Gorshkova 2003:87).

9.2 Leaf

Fibres from the leaves of monocotyledonous plants. These are grasses and sedges, as well as the epidermis of palm fronds.

Leaf fibre is considered a hard fibre as it retains its shape once dried and becomes tough and brittle to handle (van Dam and Gorshkova 2003:87–88).

9.3 String

String is a composite fibre form comprised of two or more similar fibrous elements twisted around each other. The action of twisting multiple strands into one works to interlock the many, shorter fibrous elements into an infinite length of string, and results in a whole that is stronger than the sum of its parts. Spindles have been used for thousands of years to spin fibre into yarn or string (Barber 1995:35–38), however Aboriginal people only used spindles in the manufacture of animal or human hair string (Roth 1901:7–8, Plate I).

Bush string is the term generally used to describe plant-fibre string manufactured by Indigenous people in Australia. Bush string is generally two-ply and made by the action of knotting two sections of fibre or folding one in half to provide two strands to roll and combining through rolling and twisting the strands together. This is most often done by placing the strands on the thigh and, holding one end in one hand, rolling the strands down the thigh with an open palm to twist the fibres the fibres. The palm is then slid back up the thigh, rolling the two strands together by twisting in the opposite direction (Roth 1901:10, Plate II). The opposing direction of the twists forms an interlocking force by which neither element can easily loosen or unravel. As the string forms, additional fibre is spliced in to lengthen the working strands (Gleba and Harris 2019; Roth 1901:10–11).

Twine, cord, thread, and rope are general terms that reference the thickness of the strands and resulting string, although cord often refers to the roundness of three- or four-ply string. Rope making is often a two- or three-person task, due to the difficulty in handling the thicker strands.

9.4 Ply and Direction of Twist: ssZ, zzS

Ply comes from the French *plier*, meaning 'to bend', because if you take a spun thread and bend it in half it will *bend* as it twists around itself and forms a thread that does not readily fray (Barber 1995:39). Thus, ply refers to the number of strands combined to make string. Draft-spun fibres made with a spindle are not usually plied, however, spliced fibre is always plied (Gleba and Harris 2019:2333). The minimum number is two, and more than four ply is uncommon. The action of rolling the twisted strands together is often called plying.

The direction of twist of the strands is recorded by determining the direction of the initial twist of the strands, and the direction of spin used to combine the strands. A clockwise twist has its fibres slanting from the upper left to lower right, reminiscent of the central angle in the letter S, while an anticlockwise twist resembles a Z. Thus, a two-ply string with the strands initially twisted clockwise, then plied together anticlockwise is marked 'ssZ', with the number of lower-case letters correlating to the number of ply (Emery 1995:11).

9.5 Ply fold

The ply fold occurs in the making of bush string when a single strand of twisted fibre is folded back on itself and allowed or encouraged to twist together (ply together) to form a two-ply string. This fold is held in place by the opposing twist of the two ends of the strand and in turn prevents the ply and strands from untwisting, or fraying. This is the process employed in the making of fringes for pubic-aprons worn by

Indigenous peoples across Australia. Alternate terms include ‘plying’, ‘doubling’, re-plying’, ‘re-doubling’ (Emery 1995:13).

9.6 Knots

9.6.1 Overhand knot

An overhand knot is a suspended knot, wherein the strand from which it is suspended is not engaged in the knot, and the placement of the knot may be moveable on the strand. An overhand knot is formed by crossing a single strand to form a loop, then passing one end around the other and through the loop. The loop may be independent or formed around an object or another strand.

Figure removed due to copyright restriction

Figure 40. Overhand knot (Emery 1995:34).

9.6.2Overhand bend

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An overhand bend is a form of joining two stands. The method follows that of the overhand knot, above, but the two stands are knotted as one. Ashley ranks the overhand bend as more secure than the sheet bend, but still among the weakest of knots.

Figure 41. Overhand bend (Ashley 1944:258).

9.6.3 Sheet bend

The sheet bend or weavers knot is widely used in the manufacture of netting and as such is also known as a netting knot or mesh knot. Emery (1995:38) notes that the subtle difference between a sheet bend and a fishnet knot may not be evident until a knot is loosened so its internal structure is more easily identified. Globally, sheet bends are also known to occur in other contexts or uses, such as rigging ropes, and when used in finer threads the knot is called a weaver's knot (Ashley 1944:262). Weaver's knots are used to join two ends together, traditionally in the weaving loom, but nets are made with a single string. When sheet bends are used in netmaking, the loop from the proceeding row stands in for the 'bend' and the working end of the strand is wound around it.

Figure removed due to copyright restriction

Figure 42. Sheet bend or weavers knot used in netting (Davidson 1933:258).

9.6.4 Clove hitch

A clove hitch is formed by two half hitches around a base string. To form, the strand is looped around the base string, then drawn behind the tail to form a second loop. The end of the strand is crossed on the side closest to the first loop, with each tail emerging from the centre of the knot in *alternate directions*. If both tails emerge from the centre of the knot in the *same direction*, this is known as a cow hitch (Emery 1995:36–37).

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Figure 43. Clove hitch (Emery 1995:36).

9.7 Fabrics

Emery (1995:xvi) distinguishes fabrics from textiles by their Latin root words: *facare*, meaning to build or fabricate; and *texere*, meaning to weave. As such, many fabrics, including woven textiles, are classified. Fabrics may be made from a single element, or from two or more elements. The separate systems of fabrication designate the manner of the interactions between the elements, resulting in defined fabric structures (Emery 1995:xvii).

9.7.1 Single-element textile

Single-element textiles are classified as a structure composed from a single strand (element) interworked in a systematic manner to form a cohesive structure. Interworked structures differ from felted fibres, also formed by a single element, by the defined intermediate stages of processing the fibre into a strand. This processing stage(s) results in the systematic ordering of fibres or filaments. Felted fibres, by contrast, require a single stage of processing that may be elaborate, but is technologically singular (Emery 1995:17). Felted fabrics include bark-cloth or tapa and papyrus, and agglomerate fibre fabrics such as paper and woollen felt. Felted fabrics are characterised by the naturally occurring ordering of fibres or random disorder of filaments subsequently manipulated into a planar surface (Emery 1995:22–25). Single-element fabrics, conversely, are constructed in a controlled manner to build the fabric to prescribed dimensions. The pattern of construction may vary from a simple looping technique to a complex system of loops and twists in almost infinite variety (Baker 1985).

9.7.2 Looping

The basis for fabric is the loop, wherein a strand is doubled back on itself to form an opening through which another strand may pass (Emery 1995:31). Fabrics formed by a single strand in the following systems of looping are described as looped fabrics. In looping, each loop is secured in its construction, and if the working end of the strand is pulled, the loop will pull tight and not unravel. This is contrasted to interlooping, of which knitting is a commonly known form. Interlooping is secured only by the construction of the subsequent row of stitches and if the working tail is pulled the whole will unravel (Emery 1995:39). Looping is described as a ‘knotless netting’ (Davidson 1933:259; Emery 1995:46), although this does not imply the form of the stitches or the fabric except to imply a similarity to netting.

9.7.2.1 *Simple looping*

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Figure 44. Simple looping (Davidson 1933:259).

Simple looping was described by Davidson (1933:259) as a "half-hitching technique … coiling without a foundation". It is constructed by a series of single loops worked from an initial base strand then subsequently suspended from the pendant loop of row above, formed by threading the string through the loop from

the front then bringing it forward to cross itself before proceeding to the next loop. Emery (1995:31) describes the form as buttonhole stitch, widely used in sewing and lacemaking, and universally in use as a fabrication and decorative technique.

Simple looping is known across the eastern half of the Australian continent, including far western Queensland and NSW, and across the northern half of NT to the WA border. It is not known in WA, Central Australia or Tasmania. This style is also known in PNG (Davidson 1933:259).

9.7.2.2 *Loop and twist*

This is a variation on simple looping, where the strand, after being drawn through the pendant loop of the preceding row, is drawn once (loop and single twist) or twice (loop and double twist) around itself before proceeding to the next loop (Davidson 1933:262; West 2021:35).

Figure removed due to copyright restriction

Figure 45. Loop and single twist (Davidson 1933:262).

Assuming the construction is occurring from left to right, in loop and single twist, the strand is drawn through the loop above from behind before being wound around itself, while in loop and double twist the strand enters the loop from the front. This ensures that in both cases, the strand exits the twist on top and the twist is uniformly in an S-twist. The effect is an elongated mesh.

9.7.2.3 Double or hourglass looping

Double or hourglass looping is considered the most complex form of knotless netting in Australia (Davidson 1933:264). The basis for construction is the loop and single twist technique, and the initial form is the same (Roth 1901:13). However, as the strand exits the twist, it is drawn back through the loop just finished—the top of the hourglass —from the front, then continues through the back of the pendant loop above before passing through the bottom of the hourglass to complete the twist (Emery 1995:33). This technique has a limited range of distribution on the north-central coast of Queensland and Cape York Peninsula, and in Papua New Guinea (Davidson 1933:264–266).

This technique is called “figure-8” looping by West (2021:35), and double interconnected looping by Emery (1995:33), who reserves the name figure 8 looping for a more complex variant. West details the construction of a bag made in figure-8 looping as being started on a basal string held taught between two sticks driven into the ground, or even between the two big toes of the maker (2021:35). The strand is tied to the basal string, leaving a loop of the desired size, and the strand is then looped in a figure-8 or hourglass manner through the bottom loop then through the top and over the basal string, before repeating. At the desired width, the working strand simply loops to the opposite side of the basal string and the pattern is repeated to the end of the row, wherein the strand is taken across the basal string to complete the next row. Looping proceeds in this manner, coiling around until the desired depth is reached (West 2021:36).

Figure removed due to copyright restriction

Figure 46. Double or hourglass looping (Davidson 1933:264).

9.7.3 Netting

Knotted netting in Australia is known across the continent. The technology employed is consistent in all regions of Australia except Tasmania (Davidson 1933:258; Satterthwait 1986:32; Smyth 1878:389–390) and is indistinguishable from the netting made by modern Europeans. Identical netting has been made in most parts of the world dating back to the Neolithic and it continues to be made the same manner today (Davidson 1933:257).

Using a knot known variously as a sheet bend, or weaver's knot, the structure of the knot is fixed and subsequently the gauge of the net is immoveable and the whole cannot be unravelled with the breakage of a single strand, nor distorted with an accidental pull (Emery 1995:34). Netting is manufactured from a single strand of two-ply string (Satterthwait 1986:36) and the regularity of the knots prevents unravelling in the case of breakage.

Figure removed due to copyright restriction

Figure 47. The construction of netting (Roth 1904:Plate XXIII).

9.7.3.1 Game nets

The gauge of the mesh, the space between knots, is usually dictated by the dimensions of a netting needle, often a stick or length of reed, or through use of another standardised measure, such as the maker's fingers or feet (Satterthwait 1986:36). Gauge is specific to the purpose of the net, therefore nets employed in the hunting of dugong are constructed with large meshes of 30 cm or more from strong rope up to 9 mm thick, while nets for capturing birds are lighter and thinner, with mesh around 5 cm made with string as thin as one mm. Kangaroo nets had mesh spanning up to 21 cm square. Nets are recorded up to 91 m in length (Beveridge 1889:76; Satterthwait 1986:36–39).

9.7.3.2 Fishing nets

Fishing nets were often treated with ochre and grease or tanned with bark, while hunting nets were sometimes smoked (Angas 1947:100 in Satterthwait 1986:36). Purse nets were conical or bag-like in shape. Depending on size, bag nets were held by one or more people, or tied to poles driven into the earth or riverbed, while additional hunters drove the prey toward the net. When used as terrestrial traps, bag nets had the additional technology of a drawstring at the opening; sticks propped open the mouth of the net and when an animal ran into it, its struggles collapsed the opening and drew the string tight to ensnare the creature (Satterthwait 1986:38).

9.7.3.3 String bag

A “chain-of-mesh” comprised of netting normally two loops wide is often used to start the base of a string dillybag in western Cape York Peninsula (West 2021:31–33). In its initiation, the strand is looped around a stick and knotted. The strand then engages with the loop to form two sheet bends, regularly spaced. The loop is removed from the stick and flipped so that the tail end of the strand is returned to its starting side, and the operation is repeated with two sheet bends in the pendant loops formed by the knots in the preceding row. The length of the chain determines the width of the bag and when the desired length has been reached the entire piece is turned sideways and the chosen looping form worked into the sides of the mesh (West 2021:32).

9.8 Multi-element fabrics

9.8.1 Twining

Twining is a technique of weaving often used in baskets of varying rigidity but can also be used to create soft fabrics. Rigidity is determined by the qualities of the fibre used, with narrow fibres resulting in a dense, closed weave and flexible basket, and larger, tougher fibres forming an open weave and stiffer basket (Roth 1901:12). When twining, a set of warp fibres (upright spokes radially arranged in basketry) are woven with a set of weft fibres. Less commonly, warp fibres may be twined around weft fibres, or both may be twined around each other (Emery 1995:196). The weft fibres are usually two but may be multiples of two, and occasionally odd numbers. The weft fibres are woven through the warp in the same direction simultaneously, crossing or spiralling in the space between the warp to encompass the warp fibres with each twist (Roth 1901:14–15). The twining may form a Z or S twist, or alternate direction for decorative effect, and may 'float' across more than one warp fibre (Emery 1995:196–197, 199). The twining fibres usually cross with a half turn, causing each to alternate on the front surface of the work. However, a full turn may be taken, returning the same warp fibre to the front with each pass (Emery 1995:200).

Figure removed due to copyright restriction

Figure 48. An example of twining a bag or basket base (Roth, W.E. 1901:Plate XVI.

Twining is a technique known from all regions across northern Australia from the Kimberley to the central Queensland coast, as well as sporadic locations in SA, NSW and Victoria, and is the primary weave employed in Tasmania (Davidson 1933:274–5).

9.8.2 Simple looping on a foundation

A variation of simple looping where all rows of stitches are formed on a separate foundation element. As in simple looping, the fabric is begun on a base strand, however subsequent rows also capture a separate strand when stitched around the pendant loop above. A further variation is the incorporation of single or multiple twists, as in the loop and twist technique. The material chosen for the foundation produces a varied effect according to its inherent properties of flexibility and stoutness (Emery 1995:53–54).

This is effectively an inversion of the coiling technique described above. A version of coiling is known from Queensland and the Torres Strait (Davidson 1933:285).

Figure removed due to copyright restriction

Figure 13. Simple looping on a foundation (Emery 1995:53).

9.9 Composite fibre objects

9.9.1 Bag

A bag is a container that is made for carrying. It is generally distinct from a basket in that it is softer and collapsible, being made from more pliable materials. Bags are often comprised of single-element textile and can be transversely banded by interchanging string made from differently coloured plant fibre, whether different species or dyed (West 2021:35).

According to West (2021:35, 38), bags are often made from the bottom up, with the rim and handles added last. Handles often are made by bunching together a number of strands of string of the same gauge used in the body of the bag. Sometimes this bunch is wrapped with another string. Roth (1901:12), however, reasons that, “from a constructive point of view, they are all woven on one or another of identical lines. Inflexible baskets formed of withes are found exactly reproduced in flexible bags of fibre twine.”

9.9.2 Basket

A basket is generally defined as a container that is made from stiff materials that will hold its shape when empty. Baskets are usually made from two or more elements woven, coiled, or twined together. The stoutness of the material determines the openness of the weave.

9.9.3 Fillets/necklaces

A number of necklaces were made and worn across CYP. Necklaces of grass bugle beads were strung on plant-fibre twine in large numbers and worn wound around the neck or doubled and tied around the neck with separate strings (Roth 1910:33–34). Strings of pearlescent shell beads were manufactured by saltwater peoples from the Gulf of Carpentaria, Princess Charlotte Bay, and the Great Barrier Reef islands, and widely traded inland (1910:27–28). The shells were shaped into rectangles on the east coast and ovals on the west and lower Gulf coasts, drilled with one or two holes and joined by twining two lengths of string. They were worn as a fillet by men, and a necklace by men and women. In northern CYP, necklaces made of plant-fibre string strung with a variety of pierced shells were also widely traded. Some shells were shaped into squares, while smaller shells were pierced. Certain species were worn by women in mourning, while others were only by children (1910:32–33). Pendants formed from a variety of materials, such as shark vertebra, shell, and beeswax shapes on twine loops, were worn by men and women across northern QLD (1910:34).

Roth (1910:27–36) reported that necklaces may be worn for a number of reasons, from decorative to symbolic. Examples of the latter from CYP include a strand of shell beads or a pendant of nautilus, melo, or pearl-shell worn by women when in mourning, particularly for children (Roth 1910:32, 35). In this case the necklace may also be worn between the shoulder and the opposite armpit (c.f. mourning strings, below).

9.9.4 Mourning band/string

In certain areas, a form of necklace is worn from the shoulder to the opposite armpit as a symbolic indication of grief, but this form adornment is not exclusively indicative of mourning, nor is it the only form of mourning adornment (Hale and Tindale 1936:95; Roth 1910:35–36). The string may be lengths of chainwork, or overcast string, or hold pendants made from the deceased’s hair (1936:94–96).