APPENDIX

1. Egg weight data

Table A.1: Egg weight (g) data for the Port Lincoln gulls for all years of research (Islands: S=Sibsey, W=Winceby, D=Donington, R=Rabbit, Lo=Louth). 2003 data from Harrison (2003).

Egg Weight Port Lincoln Gulls	**2003**	**2004**	**2005**	**2006**
	(S, W & D)	(S & R)	(S & R)	(R & Lo)
Mean	38.8	39.55	40.49	39.15
Estimated Mean	38.22	39.36	40.47	39.11
Median	39	39.65	40.60	39.10
Mode	40	39	39.10	38.40
Std Dev	4.23	3.77	3.62	3.80
Min-Max	20-55	29-52	29.1-50.5	29.8-52.4
N	487	302	449	615

Table A.2: Egg weight (g) data for the reference gulls for all years of research (C=Coorong, P=Pelican Island (Adelaide), V=Venus Bay, L=Lipson Island). 2003 data from Harrison (2003).

Egg Weight Reference Gulls	**2003**	**2004** Adelaide	**2004** Reference	**2005**	**2006**
	(C)	(P)	(V & L)	(V & L)	(L)
Mean	40	39.67	41.10	41.47	40.19
Estimated Mean	40.36	39.27	41.14	41.03	39.88
Median	41	40.20	41.20	41.60	40.00
Mode	40	40.60	44	42.30	38.60
Std Dev	4.03	4.55	3.67	4.36	3.99
Min-Max	29-50	27.5-47.2	32.5-50	29.9-58.9	32.5-50.2
N	86	173	123	227	107

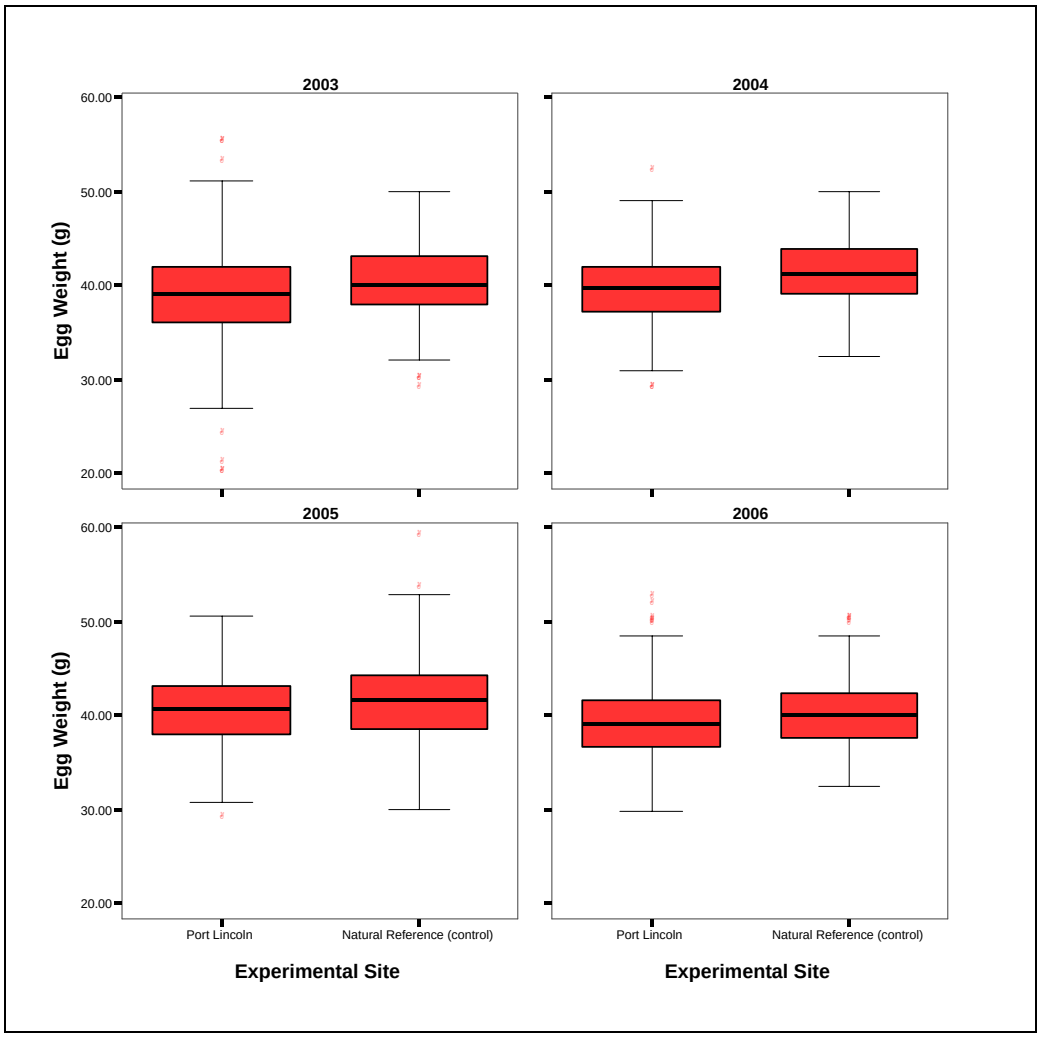

Figure A.1: A comparison of mean egg weight (g) for each site over the four years of data collection (2003 data from Harrison, 2003).

2. Program MARK model outputs for chick survival

Table A.3: Program MARK model outputs for 2004 Port Lincoln chick survival.

Model	AICc	Delta AICc	AICc Weights	Model Likelihood	Num. Par	Deviance
phi(t) p(t)	168.6844	0.0000	0.99944	1.00000	7.0000	0.0557
phi(t) p(.)	183.6651	14.9807	0.00056	0.00060	6.0000	17.2308
phi(.) p(t)	199.0034	30.3190	0.0000	0.00000	8.0000	28.1503
phi(.) p(.)	237.5496	68.8652	0.0000	0.00000	2.0000	79.6038

Table A.4: Program MARK model outputs for 2004 reference chick survival.

Model	AICc	Delta AICc	AICc Weights	Model Likelihood	Num. Par	Deviance
phi(.) p(.)	126.2687	0.0000	0.91107	1.0000	2.0000	71.5366
phi(.) p(t)	131.4719	5.2032	0.06756	0.07420	10.0000	57.3629
phi(t) p(.)	133.8195	7.5508	0.02089	0.02290	10.0000	59.7105
phi(t) p(t)	141.3844	15.1157	0.00048	0.00050	17.0000	45.6965

Table A.5: Program MARK model outputs for 2005 Port Lincoln chick survival.

Model	AICc	Delta AICc	AICc Weights	Model Likelihood	Num. Par	Deviance
phi(t) p(t)	154.7201	0.0000	0.99922	1.00000	9.0000	32.1750
phi(t) p(.)	169.0769	14.3568	0.00076	0.00080	6.0000	53.5583
phi(.) p(t)	176.9420	22.2219	0.00001	0.00000	8.0000	63.6719
phi(.) p(.)	197.2074	42.4873	0.00000	0.00000	2.0000	90.4207

Table A.6: Program MARK model outputs for 2005 reference chick survival.

Model	AICc	Delta AICc	AICc Weights	Model Likelihood	Num. Par	Deviance
phi(t) p(t)	129.8835	0.0000	0.88648	1.00000	8.0000	16.6320
phi(t) p(.)	134.8163	4.9328	0.07525	0.08490	7.0000	31.5837
phi(.) p(.)	136.9422	7.0587	0.02600	0.02930	2.0000	44.9374
phi(.) p(t)	138.4429	8.5594	0.01227	0.01380	7.0000	35.2103

Table A.7: Program MARK model outputs for 2006 Port Lincoln chick survival.

Model	AICc	Delta AICc	AICc Weights	Model Likelihood	Num. Par	Deviance
phi(.) p(t)	388.5645	0.0000	0.59070	1.00000	11.0000	76.6322
phi(t) p(t)	389.3082	0.7437	0.40726	0.68950	15.0000	67.9104
phi(t) p(.)	400.0058	11.4413	0.00194	0.00330	11.0000	88.0735
phi(.) p(.)	405.9957	17.4312	0.00010	0.00020	2.0000	113.6830

Table A.8: Program MARK model outputs for 2006 reference chick survival.

Model	AICc	Delta AICc	AICc Weights	Model Likelihood	Num. Par	Deviance
phi(t) p(t)	31.2479	0.0000	0.62471	1.00000	2.0000	3.9895
phi(t) p(.)	33.5808	2.3329	0.19458	0.31150	3.0000	3.9895
phi(.) p(t)	34.2089	2.9610	0.14214	0.22750	3.0000	4..6176
phi(.) p(.)	36.8172	5.5693	0.03858	0.06180	2.0000	9.5588

3. Reproductive output parameter data for all islands

Table A.9: Silver Gull reproductive output parameters on their breeding islands.

		Port Lincoln Area						**Reference Sites**					**Adelaide Area**
		Rabbit Island			**Sibsey Island**		**Louth Is**	**Lipson Island**			**Island C**		**Pelican Island**
		2004	*2005*	*2006*	*2004*	*2005*	*2006*	*2004*	*2005*	*2006*	*2004*	*2005*	*2004*
Clutch Size	Mean	2.49	2.37	2.44	2.19	2.25	2.51	2.64	2.3	2.27	1.93	1.72	2.37
	StDev	0.7	0.72	0.57	0.65	0.61	0.57	0.68	0.68	0.64	0.58	0.63	0.67
	Range	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3
	N	51	95	161	83	100	90	25	90	48	30	32	30
Egg Weight (g)	Mean	39.71	40.13	38.97	39.43	40.84	39.5	42.74	42.03	40.19	39.21	39.2	39.67
	StDev	3.47	3.44	3.68	3.97	3.77	3.98	3.08	4.39	3.99	3.39	3.4	4.55
	Range	32-52	29.1-50.5	29.8-51.6	29-49	31.6-49.3	30.4-52.4	35-50	31.6-58.9	32.5-50.2	32.5-45.8	29.9-46.3	27.5-47.2
	N	123	225	391	179	224	224	66	207	107	57	50	71
Egg Volume (cm^3)	Mean	38.1	38.86	38.36	39.25	39.39	38.6	40.26	40.38	39.29	39.84	39.84	38.73
	StDev	3.34	3.29	3.32	3.14	3.29	3.36	2.71	3.87	3.73	3.14	3.01	3.42
	Range	30.4-45.2	29.8-47.5	29.7-50.03	32.1-49	31.7-47.6	29.04-48.5	34.1-47.5	29.6-55.9	29.8-47.01	34.03-46.03	31.3-47.2	31.5-45.3
	N	123	225	392	172	224	224	66	207	107	57	49	71
Hatching Success (%)	Mean	91.98	72.06	79.88	77.34	90.91	80.43	59.03	51.81	59.76	96.3	88.89	-
	StDev	18.12	38.86	34.62	33.98	26.38	33.58	43.95	47.13	41.83	13.34	25.32	-
	Range	33.3-100	0-100	0-100	0-100	0-100	0-100	0-100	0-100	0-100	50-100	0-100	-
	N	27	33	82	25	33	23	24	79	41	27	27	-

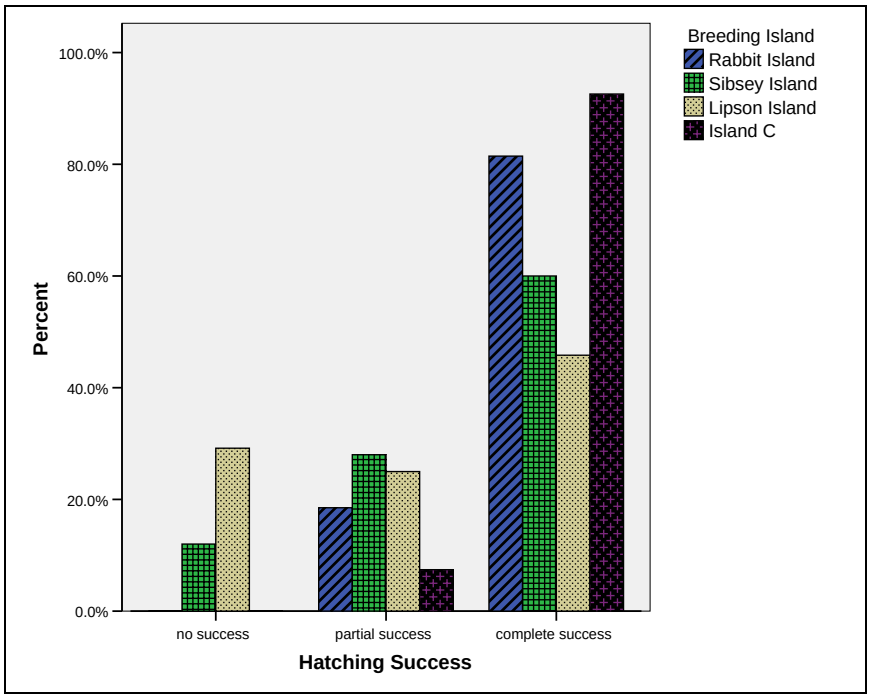

Figure A.2: Percentage of nests with a hatching success in each category for each breeding colony in 2004.

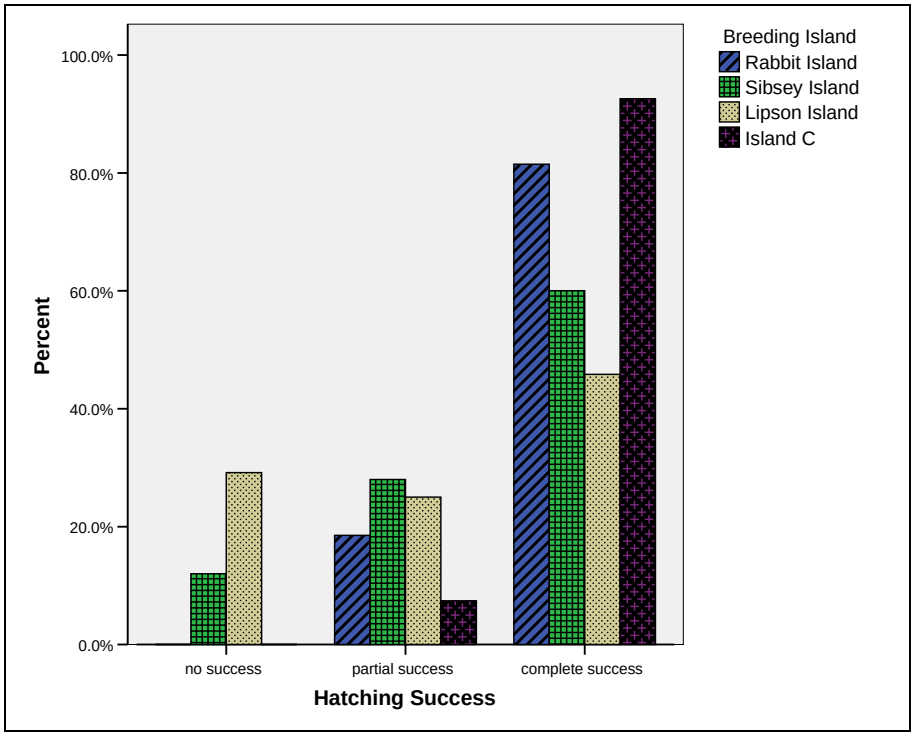

Figure A.3: Percentage of nests with a hatching success in each category for each breeding colony in 2005.

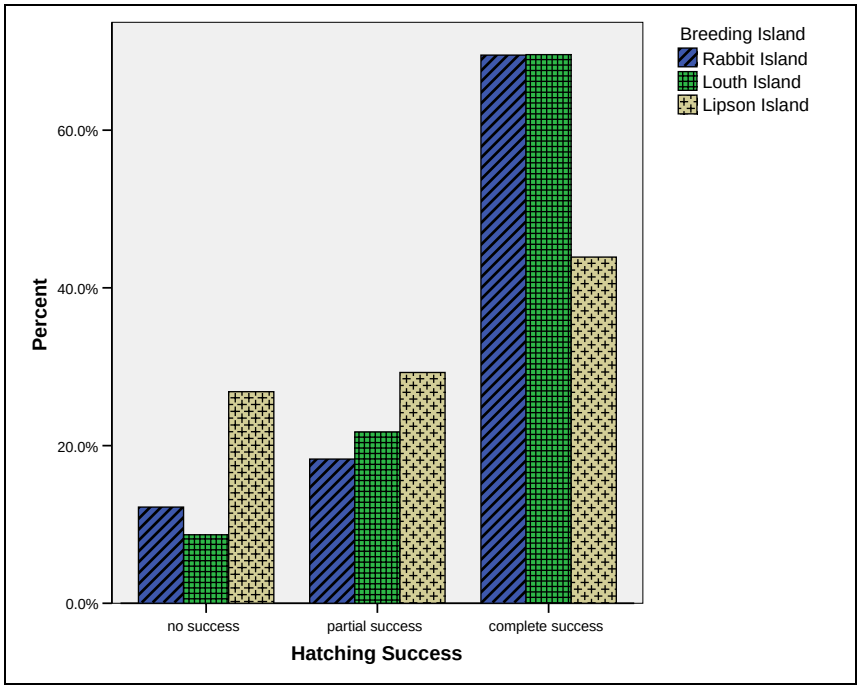

Figure A.4: Percentage of nests with a hatching success in each category for each breeding colony in 2006.

4. Calculations for proportion of tuna feed in Silver Gull diet

Assumptions

In the calculation of the proportion of tuna feed in the diet of Port Lincoln Silver Gulls the following assumptions were used:

- Estimates were based on the largest number of gulls observed, which was 27,000 nests or 54,000 gulls in 2005.
- Fledging success (chick output per nest) was taken as 1.25 chicks per nest (Chapter 4) = 33,750 (1.25*27,000)
- The population was thus estimated as a total of 87,750 gulls (54,000 adults + 33,750 chicks)
- The numbers of immature birds could not be estimated so they are excluded from the calculation
- Adult Silver Gull consume about 60g of food per day (Kotega, 1991)
- Juvenile Silver Gulls (chicks up to fledging) consume about 12g of food a

day (chick regurgitations average weight was 2g (Harrison 2003; 2005) and chicks were fed every 90 minutes (Smith, 1995)).

- 240 days of tuna feeding (conventionally tuna, are farmed or fed for a maximum of 180 days or six months, however, as some companies may catch fish as early as December, whilst others may catch in February, not all companies are feeding for the same period of time and hence tuna feed is available to birds from as early as January to possibly the end of September each year (270 days). However, very few pontoons contain tuna in September and hence this month was excluded from the calculations, though seabirds would still be scavenging a small amount of food. Therefore the calculations were based on the assumption that feed was readily available for 8 months or 240 days.

Calculations assuming 100% of tuna feed in diet (for calculating a maximum value as a comparison)

(33750*12g) + (54000* 60g)) *240 = **787.32 tonnes** of tuna feed consumed by Silver Gulls per annum.

Calculation of the proportion of tuna feed consumed from dietary analysis

The dietary analysis (raw data) suggested that 14 out of 49 (28%) of the diet samples contained tuna feed. Thus assuming about 28% of the population (87,750) tuna feed gives 24,570 (15230 adults, 9340 chicks) gulls that annually consume (15230*60g) + (9340*12g) *240 = **246.21 tonnes** of tuna feed.

Observations on tuna farms

Observations of the percentage of baitfish scavenged from the tuna farms suggest that an average of 1.3% is taken by Silver Gulls. If the industry uses ~60,000 tonnes of baitfish per season, 1.3% works out to be about **570 tonnes** of tuna feed scavenged by Silver Gulls per annum. However, the average abundance of 285 Silver Gulls (Chapter 3) at pontoons suggested this was slightly lower at **534 tonnes** (285*130 pontoons=37,050 gulls: 37,050*60*240 days=534 tonnes).

570 (tuna farm feed loss estimation)/ 787 (if 100% of population consumed tuna feed) = 72%.

534 (seabird abundance estimation)/787 (if 100% of population consumed tuna feed) = 68%.

5. Egg oiling data for individual islands

Table A.10: A comparison of hatching success for the three treatments on the two islands used in the trial.

Hatching Success (%) per nest	**Rabbit Island**			**Louth Island**		
	Control	**T1**	**T2**	**Control**	**T1**	**T2**
Mean	88.5	0	0	80.4	0	0
St Dev	32.6	0	0	33.6	0	0
N	26	46	30	23	44	22

Table A.11: A comparison of the fate of oiled eggs for each treatment on each island.

Fate of Nests for Each Treatment per Island		**Rabbit Island**		**Louth Island**	
		T1 N=44	T2 N=30	T1 N=39	T2 N=22
Predated	Mean	34%	47%	28%	32%
	N	15	14	11	7
Missing (not hatched)	Mean	66%	50%	62%	54%
	N	29	15	24	12
Abandoned	Mean	0%	3%	10%	14%
	N	0	1	4	3

Table A.12: A comparison of re-laying rate expressed as % of nests with gulls with treated nests that relayed on each island

Relaying Rate (%) per nest	**Rabbit Island**		**Louth Island**	
	T1	**T2**	**T1**	**T2**
Mean	2.27	3.33	2.56	18.18
N	(1) 44	(1) 30	(1) 39	(4) 22

Source: http://www.puna.net.nz