Status of the Endangered Population of Little Penguins *Eudyptula minor* at Manly

Review of five years of monitoring (2002-03 to 2006-07) and the implementation of the Recovery Plan since 2000

Photo: DECC

Prepared by Biodiversity Conservation Section, Metropolitan Branch, on behalf of the Little Penguin Recovery Team

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Department of **Environment & Climate Change** NSW

Acknowledgements

The successful implementation to date of the recovery program for the endangered population of Little Penguins at Manly has been a combined effort of many organisations, groups and individuals. The Department of Environment and Climate Change (DECC) wishes to acknowledge the support and efforts of everyone involved.

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- Threatened Fauna Ecology Unit, DECC
- Biodiversity Conservation Section, DECC
- Manly Environment Centre
- Taronga Zoo
- Manly Council
- NSW Maritime
- DPI Fisheries
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This report was prepared by James Dawson, Biodiversity Conservation Section, DECC.

Summary

Data from the last five seasons of monitoring the Little Penguin population at Manly (2002/03 to 2006/07) shows:

- An average of 54 breeding pairs per season (range 46-64 pairs), with last year the best result to date (64 pairs);
- An average of 106 chicks fledged from the colony annually (range 99-127) with last year the best to date (127 fledglings);
- Breeding success (conservative figure of number of eggs that produce chicks) averages 69% per year (range 59-81%).

The variability of the figures between years reflects the natural variation observed in wild populations from season to season. These figures are high compared with those reported from other Little Penguin colonies in Australia. Other positive measures of the health of the Manly population include:

- The highest recorded proportion of pairs that double-brooded (i.e. laid two clutches of eggs in a season); and
- The highest recorded fledgling to adult mass ratio (103%), indicating that food at the colony is relatively abundant.

In addition to the figures on breeding success other points of interest include:

- Up to11 artificial nest boxes (out of 59 maximum) used for nesting by penguins in a single year;
- Of approximately 350 young birds banded or microchipped at Manly over the past 10 years, only 20 fledglings have returned to the Manly colony, 13 of which have bred;
- Penguins banded at Manly have been recorded at several sites including Bermagui on the NSW Far South Coast and Sydenham Inlet in Victoria;
- Penguins banded at other colonies have turned up at Manly, including several from Phillip Island, 761 km away.

The recovery plan has been comprehensively implemented by all member groups of the Little Penguin Recovery Team. This includes:

- Mapping and annual monitoring of the population;
- Educating the public that lives around the colony on managing threats;
- Erecting signage around the colony to identify it to the community, particularly in relation to responsible dog ownership;
- Continuous suppression of foxes in Sydney Harbour National Park;
- Effective management of recreational boat use in North Sydney Harbour;
- Construction of artificial nest boxes for use by breeding penguins;
- Wide community awareness and education about penguins in Sydney Harbour;
- Cessation of commercial fishing in North Sydney Harbour;
- Declaration of “critical habitat” for the population and effective protection through planning regulation;
- Successful completion and publication of ecological research projects; and
- Successful coordination of the program through a representative recovery team.

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1 Introduction

The Little Penguin *Eudyptula minor* is relatively common in the waters of southern Australia and breeds mainly on offshore islands. The colony in North Sydney Harbour represents a small fraction of the NSW population, but is the only known breeding colony on the mainland in NSW. The Little Penguin population at Manly was listed as endangered on the NSW *Threatened Species Conservation Act* 1995 (TSC Act) in January 1997 and the Recovery Plan for this endangered population was approved in October 2000 (NPWS 2000). Since that time the recovery program has been very active, aided by direction of the Little Penguin Recovery Team. This report has been prepared to review the implementation of the plan, and in particular to summarise and report on the last five years of monitoring data for the colony. The review also aims to identify continuing and emerging issues and priorities for the ongoing implementation of the recovery program.

2 Review of monitoring program 2002-2007

Monitoring of the Little Penguin population at Manly has been undertaken in one form or another since 1996, when landing site counts were organised by the NPWS and Manly Environment Centre. Between then and 2002 a range of different observers used a variety of methods to collect information on the population. After a number of years it became apparent that this data had not been systematically collected and was therefore not comparable, limiting the ability of the recovery program to draw meaningful conclusions on the status of the population from it.

Since the 2002/03 breeding season a single protocol has been followed to ensure the data is standardised and comparable. From 2002/03 until 2004/05 the monitoring was carried out by the Threatened Fauna Ecology Unit of DECC Biodiversity Research and Management Division (Carlile 2003, 2005; Carlile and Wheeler 2004), principally by Nicholas Carlile, Project Officer Seabirds. This data has also now been analysed and written up for publication (Priddel *et al.* submitted). From the 2005/06 breeding season the monitoring has been carried out under contract, using the same methodology, by Dr. Lisa O'Neill (O'Neill 2006, 2007). This report reviews the monitoring data from the past five breeding seasons to provide a summary of the status of the population of Little Penguins at Manly.

2.1 Methodology

Each year the penguin colony was visited at least fortnightly throughout the breeding season, which runs from June to February. During each visit all known nest sites between Manly Point and Cannae Point (Figure 1) were checked for signs of nesting activity. Potential nest sites were examined at least every six weeks. Active nests were located with GPS and marked in the field using permanent tags on rocks. Where active nests were accessible for visual inspection, the number of eggs, chicks and adults was recorded. Where possible, penguins in nests were captured by hand, weighed and marked with either a flipper band (2002/03 and 2003/04) or a passive integrated transponder (PIT tag; 2004/05 onwards). Chicks were marked from 5-6 weeks old, just prior to fledging.

Each year, information recorded on the population included the number of breeding pairs, and numbers of eggs, chicks and fledglings. It must be noted that the figures for

nests, breeding pairs, eggs laid and chicks fledged are known to be conservative, given that the figures do not include all known breeding pairs. For example, the figures do not include results of breeding pairs from Manly Wharf and Oceanworld, or sites where access to private property would invade people's privacy. In addition, some nests remain undetected within the monitored sites due to difficult terrain, difficulty of visual access into potential nest sites and dense vegetation. This is not seen as a limitation of the monitoring program as the program has been designed to be consistent in the sites monitored so that effective comparisons can be made from year to year.

2.2 Results

The results of monitoring the population of Little Penguins at Manly are included in Table 1. Most of the figures show quite a degree of variability from year to year. This reflects the natural variation observed in wild populations of a range of seabirds from season to season (O'Neill 2007; Priddel *et al.* submitted). Each of the parameters is discussed in more detail below.

Table 1: Monitoring summary for Manly Little Penguins (O'Neill 2007)

	2002/03	2003/04	2004/05	2005/06	2006/07	Mean ±S.D.
Total active nests	94	99	79	70	84	85 ± 12
Total breeding pairs	55	49	56	46	64	54 ± 7
Total eggs laid	133	118	138	118	158	133 ± 17
Total chicks fledged	102	100	101	99	127	106 ± 12
Breeding success	70%	74%	61%	81%	59%	69% ± 9
Total banded/chipped	118	96	80	32	51	
Adults	50	26	24	7	19	
Fledglings	68	70	56	25	32	
Ratio of nest box use	11 of 16	9 of 40	9 of 43	7 of 59	8 of 58	

2.2.1 Nest sites

Active nests are defined as any known nest site showing signs of recent activity such as the presence of birds, whitewash (faeces), feathers or nesting material during the breeding season. The number of active nests recorded in the colony has ranged from 70-99. A breakdown of the location of active nests throughout the colony is provided in Table 2. On average slightly more than 50% of nests in any given year have been located around Manly Point, incorporating the Oyama Ave. and Addison Rd. sites. The balance of nest sites occur in Sydney Harbour National Park, including Quarantine Beach, Store Beach and Collins Flat.

Table 2: Number of active nest sites at each locality by year (O'Neill 2007)

	2002-03	2003-04	2004-05	2005-06	2006-07
Quarantine	19	22	16	17	18
Store Beach	-	-	3	2	2
Collins Flat	19	18	17	13	23
Addison Rd	31	27	22	18	20
Oyama Ave	25	32	21	20	21
Total	94	99	79	70	84

2.2.2 Breeding pairs

The number of known breeding pairs of Little Penguins in the Manly colony has ranged from 46-64 in any one year. The lowest and highest figures have been recorded in the last two years respectively (Table 3), illustrating the high level of natural variation within the colony from year to year. While up to three active nests have been recorded at Store Beach in Sydney Harbour National Park only one breeding pair has been active at this site in 2004-05 and 2006-07. Store Beach has been the focus of a translocation trial over the last three years in an attempt to encourage the population to expand into a large area of vacant, high quality nesting habitat. As yet none of the 63 young birds released at this site have been recorded back there (Carlile and Priddel 2007).

Table 3: Number of breeding pairs at each locality by year. (O'Neill 2007)

	2002-03	2003-04	2004-05	2005-06	2006-07
Quarantine	14	9	10	8	11
Store Beach	-	-	1	0	1
Collins Flat	8	12	14	10	18
Addison Rd	17	13	16	13	16
Oyama Ave	16	15	15	15	18
Total	55	49	56	46	64

2.2.3 Eggs

The number of eggs laid in each location within the colony has been highly variable from year to year, in line with the number of breeding pairs, ranging from 118-158 (Table 1). The figures shown are likely to be an underestimate, as they include only observable eggs plus a count back of chicks from inaccessible nests. Approximately 50% of all nest sites within the breeding localities are accessible. Any eggs laid in inaccessible nests that subsequently fail to hatch are not included in the figures.

Where a second clutch of eggs is laid in the same nest following the hatching and rearing of a first clutch this is known as 'double-brooding'. The Manly colony has a very high level of double-brooding with an average of 28% of pairs nesting for a second time over the last five years, well above the proportion of double brooding observed in other Australian colonies. This figure indicates that there is a relatively high level of food available to the colony as the degree of double brooding has been considered a good indicator of food availability (Stahel and Gales 1987; Priddel *et al.* submitted).

Two day old chicks in nest. Photo: DECC

2.2.4 Fledglings

Penguin chicks that are at least six weeks old and weigh more than 600 grams when last observed are counted as fledglings. The number of fledglings produced has been remarkably consistent over the last five years of monitoring, with the exception of last year in which a marked increase in fledglings was recorded (Table 4). The reasons for this variation, which is only partly explained by the variability observed in the figures for breeding pairs, are discussed in the breeding success section below.

Between 2002-03 and 2004-05 the weights of adults and chicks prior to fledging were recorded. On average, chicks were slightly heavier than adults at fledging (103%), suggesting again that there was an abundance of food available to the colony in and around Sydney Harbour (Priddel *et al* submitted). This figure is higher than that recorded for other Australian colonies and increases the chances of survival for fledglings in their first year at sea (Reilly and Cullen 1982; Priddel *et al*. submitted).

Table 4: Number of fledglings at each locality by year (O'Neill 2007)

	2002-03	2003-04	2004-05	2005-06	2006-07
Quarantine	22	16	19	15	25
Store Beach	-	-	1	0	1
Collins Flat	18	16	18	24	32
Addison Rd	29	32	30	31	40
Oyama Ave	33	36	33	29	29
Total	102	100	101	99	127

2.2.5 Breeding success

Breeding success is calculated as the percentage of eggs that produce fledglings. This figure is calculated each year from a subset of all nests recorded in that year for which the number and fate of eggs can be determined from the beginning of incubation to fledging or prior loss. For example, in 2006/07 only 33 of 84 active nests met these criteria and were used to calculate breeding success. Figures calculated for breeding success over the last five years range from 59-81% with a five year average of 69% (Table 1).

It is interesting to note that the relationship between breeding success and other parameters is not necessarily closely aligned. For example, the 2005/06 season produced the lowest number of fledglings recorded (99) but the highest breeding success (81%), while the 2006/07 season produced the highest numbers of fledglings (127) and the lowest breeding success (59%) to date. An explanation for this is that in years when there are high numbers of breeding pairs in the colony it is likely that there are a higher number of young or inexperienced breeders, and it is common among seabirds for pairings of such birds to produce fewer successful fledglings, leading to a lower figure for breeding success. In contrast, years with fewer breeding pairs may involve less young birds, leading to a higher breeding success rate. Thus, the results reflect the natural variation expected in wild populations from year to year.

2.2.6 Banding and microchipping records

The first banding of penguins from the Manly colony as part of the recovery program was done in 1997. Since that time 639 penguins have been marked, 476 with metal flipper bands and 163 with microchips (Table 1). Of the total of 374 fledglings that have been banded at Manly, only 20 (5.3%) have returned to the colony, and of those only 13 have been recorded breeding. While this overall number of returns is low it must be noted that Little Penguins exhibit low site fidelity and disperse over considerable distances (Reilly and Cullen 1982). It has taken up to six years for returning birds to be detected in the colony and a large proportion of banded chicks are younger than that. For birds banded at least 5 years ago the rate of returns is up to 15% and up to 11% have bred (Priddel *et al.* submitted). These figures compare favourably with other Australian colonies. For example only 1.1% of 3500 fledglings banded at Phillip Island over 11 years have returned to breed (Reilly and Cullen 1981).

All birds marked since the 2004/05 breeding season have been marked with microchips due to concerns that birds banded with metal flipper bands could have reduced survival compared with microchipped birds. This change in marking techniques will have an increasing impact on the results of penguin monitoring. This is most likely to be through a reduction in the detection of known adults within the colony, which often cannot be reached when nesting in deep rock cavities (O'Neill 2007).

Adult Little Penguin being scanned for a microchip as part of monitoring program. Photo: DECC.

2.2.7 Nest boxes

Nest boxes have been installed at several of the breeding sites within the colony of Little Penguins at Manly to augment the available natural nest burrows. At most sites there appears to be no shortage of natural nest holes and penguins utilise them more commonly than nest boxes, although nest boxes are used to some extent at most of the sites they have been installed (Table 1). Breeding success from nests in boxes is comparable with that from natural nest sites. The majority of nest boxes (31) are located at Store Beach, having been installed as part of the translocation trial from 2003-04 to 2005-06. Fledgling birds were housed in these nest boxes for 24 hours prior to release to the wild, however none of these boxes have yet been used for breeding by wild birds.

3 Recovery Plan review

The Recovery Plan for the endangered population of Little Penguins at Manly was approved by the Minister for the Environment, Mr Bob Debus, in October 2000. The plan laid out the strategy required to maintain and enhance the population to a position of security in nature and have it de-listed from the schedules of the TSC Act. The plan contains seven specific objectives for achieving the major objective including:

- To determine the current status of the population and the extent of available habitat;
- To identify and ameliorate impacts of current threats;
- To maintain the population at current levels and increase the limits of potential habitat;
- To continue community education, awareness and involvement;
- To ensure the protection of the Little Penguin population at Manly and its habitat in the long term;
- To support and coordinate research into the ecology of the population; and
- To re-assess recovery program priorities

This final objective is the responsibility of the Little Penguin Recovery Team, a non-statutory body including representatives of a variety of groups with either land management responsibility (e.g. NSW Maritime, Manly Council, NPWS, DPI Fisheries) or an active interest in the welfare or management of Little Penguins (e.g. Taronga Zoo, Manly Environment Centre). As the timetable for implementation of the recovery plan spans five years, a review of the implementation and performance of the actions of the plan is overdue. It is anticipated that the findings of this review will be used to set the directions and priorities for the ongoing recovery program, as well as providing the basis for a new recovery plan for the population that will supplant the existing one, should it be deemed out of date.

3.1 Review of recovery actions

The Little Penguin Recovery Plan contains 18 actions to meet the above objectives. The Little Penguin Recovery Team collectively reviewed the status and past implementation of the actions at a recovery team meeting held on 3 July 2007. The progress, results and ongoing priority of each action was assessed. The details of this review are included in the Table 5 below.

Table 5: Review of implementation of Recovery Actions

Action No.	Description	Progress and results	Status	Priority
11.3.1	The NPWS will monitor the penguin population and identify potential habitat in the area.	Section 2 of this report reviews in detail the results of the monitoring program. Monitoring has been consistently undertaken in a rigorous manner since 2002. Potential habitat has been identified in the critical habitat nomination (2002), although no monitoring has been done to see if this habitat is being utilised. Recommend that an annual survey of potential habitat (particularly at Dobroyd Point) be undertaken during the breeding season and this information included in the annual monitoring report.	Ongoing	High
12.3.1	Establish a mortality register.	Taronga Zoo has established a register of all birds brought to the zoo dead or alive and details of identification and fate. Anyone finding a dead penguin is encouraged to take them to the zoo for post-mortem and examination for presence of a microchip. Details of any dead penguins from the Manly colony that are presented to the zoo are to be included in the annual monitoring report.	Ongoing	Medium
12.3.2	Educate and provide advice to the community on vegetation management, boating, fishing and owners of domestic animals about responsible activities around nesting habitat.	The declaration of critical habitat for the population in September 2002 provided clear new regulations in relation to activities considered threats to the population. The regulation made specific reference to prohibited activities within the critical habitat area, including no companion animals, no anchoring or mooring of boats within 50 metres of the shore in critical habitat, no fishing between sunset and sunrise during the breeding season, no tampering or damaging nest boxes and a distance restriction of five metres from any penguin on land. These regulations have been well publicised in the Manly area and extensive signage has been installed (see action 12.3.3 below and example of signage in Appendix 1). DECC continues to publicise these regulations and educate the community through the efforts of volunteers community penguin wardens. DECC continues to provide advice on vegetation management at the colony, particularly at the breeding sites on Manly Point, including licensing gardening activities in critical habitat.	Ongoing	High

Action No.	Description	Progress and results	Status	Priority
12.3.3	Erect appropriate signs to protect the colony.	Signage specified in the recovery plan for Manly Peace Park has been installed by Manly Council. In addition, signage to designate critical habitat has been placed at all access points around the declared area and foreshore access points. Buoy markers have also been installed on the aquatic boundary.	Ongoing	Medium
12.3.4	Educate the community regarding responsible pet ownership and enforce to Companion Animals Act.	DECC Harbour North Area and Manly Council have undertaken community education, signage and enforcement activities in the area since 2000. An additional area between Manly Wharf and Oceanworld has been designated by Council as an on-leash exercise area in response to the continued presence of nesting penguins. As stated above, signage to designate critical habitat has been placed at all access points around the declared area and foreshore access points.	Ongoing	High
12.3.5	Undertake pest management in Sydney Harbour National Park.	DECC has implemented a comprehensive fox control program at North Head as part of the NSW Threat Abatement Plan for Predation by the Red Fox. Ongoing monitoring of the effectiveness of this program shows that the control program has eliminated the threat of foxes to the population. The control program will continue to ensure that any incursions of foxes onto North Head are quickly removed.	Ongoing	High
12.3.6	Include the colony in planning for marine pollution management.	Penguins at Manly have been incorporated into the relevant planning frameworks for pollution spills in the Sydney Harbour. Evidence of effective implementation of these plans around the population was seen in the deployment of booms and other actions undertaken in response to incidents in the harbour such as the Manly ferry accident at Manly Wharf in September 2005.	Complete	High
12.3.7	Enforce the North Sydney Harbour Waterways regulations.	NSW Maritime regularly patrols the critical habitat zone and enforces the regulations around critical habitat at Manly. Similarly DECC staff also patrol and enforce the regulations. The presence of volunteer wardens at beaches in Sydney Harbour National Park will also raise awareness of the need and reasons for the restrictions.	Ongoing	Medium

Action No.	Description	Progress and results	Status	Priority
12.3.8	Monitor fish stocks in Sydney Harbour and surrounds.	To date little data on the status of fish stocks of bait fish of importance to penguins in Sydney Harbour has been forwarded to the recovery team from DPI Fisheries, and regular data would be useful. However, the penguins at Manly do not appear to be limited by food availability given observed high levels of reproductive success and good condition of chicks at fledging.	Ongoing	Low
13.3.1	Manage habitat important to the population (nest boxes).	Management of habitat on all tenures is ongoing, with the critical habitat regulations providing clear guidance to private residents and public authorities alike. Nest box installation has been completed and no additional boxes are required. Ongoing maintenance of nest boxes will occur but nest boxes will not be replaced as they disintegrate. A review of placement of nest boxes may be undertaken.	Ongoing	Medium
13.3.2	Investigate options for landscaping existing burrows to increase predator protection.	The enforcement of the critical habitat regulations, including exclusion of dogs, and the ongoing, comprehensive and successful fox control program means that landscaping and regeneration actions are not required. Shelter requirements for nesting penguins will be managed through the retention of existing vegetation and the implementation of Action 12.3.2.	Complete	Low
14.3.1	Educate the wider community about penguins in Sydney Harbour.	This has been a very successful aspect of the program to date and is ongoing. There have been numerous media articles and promotional events about the Manly Penguins since the adoption of the recovery plan. Currently, there are many active initiatives including the Taronga Zoo schools education program and Penguin Expo, the programs and the launch of the penguin wardens program in October 2007	Ongoing	Medium
14.3.2	NPWS will continue to invite residents to participate in penguin landing counts.	Penguin landing counts are no longer carried out as part of the monitoring program. The current monitoring program provides more information than landing counts can. Additionally, landing counts require larger numbers of people to be in the colony at night, a time when disturbance can be a significant factor.	Complete	Low

Action No.	Description	Progress and results	Status	Priority
15.3.1	Informed environmental planning decisions are made.	The critical habitat declaration has clarified the issues around environmental impact assessment in relation to penguins. In particular, any development or activity proposed in critical habitat will require a species impact statement to be carried out prior to consent or approval. Ongoing liaison and training with Council planning staff is required to ensure that all staff are aware of the implications of the critical habitat declaration. Any new recovery plan should make reference to critical habitat regulations and consequences in relation to environmental impact assessment.	Ongoing	Medium
15.3.2	NSW Fisheries to consider impacts of commercial fishing when developing management plans.	Commercial fishing has been stopped in Sydney Harbour, so this action is no longer relevant.	Complete	Low
15.3.3	Investigate feasibility of declaring critical habitat.	Critical habitat for Little Penguins at Manly was declared in September 2002 and updated in June 2003 following amendment to the *Threatened Species Conservation Regulation* 2002. Further reviews of the extent and regulations may be required should the population recover and expand its current nesting distribution.	Complete	Medium
16.3.1	NPWS to coordinate and facilitate research on interactions with other colonies and foraging ecology.	Research on links between the Manly population and other populations has been undertaken through the comprehensive banding and microchipping done as part of the ongoing monitoring. This has shown that penguins from the Manly population have travelled as far as Victoria, and that penguins from as far afield as Phillip Island (761km away) have turned up to breed in the Manly population. This information is soon to be published in a refereed scientific journal (Priddel *et al.* submitted). The diet of Little Penguins is well known and understanding of the foraging ecology of the Manly Penguins is not considered to be a high priority given the high levels of reproductive success and good condition of chicks that fledge from the population.	Complete	Low

Action No.	Description	Progress and results	Status	Priority
17.3.1	Convene recovery team to review priorities.	The recovery team has been meeting annually since the approval of the recovery plan. While this has been successful, the team should consider meeting twice per year, with an annual review of priorities. Representation on the recovery team needs to be continuously reviewed to ensure it is representative of those groups with responsibilities in relation to Little Penguins. Issues such as the translocation of penguin fledglings to Store Beach have been trialled as part of the recovery program (Carlile and Priddel 2007) at the request of the recovery team.	Ongoing	Medium

4 References

Carlile, N. (2003). Sydney Harbour Little Penguin Project – monitoring report March 2003. Unpublished report, NSW National Parks and Wildlife Service, Hurstville.

Carlile, N. (2005). Sydney Harbour Little Penguin Project – monitoring report March 2005. Unpublished report, NSW National Parks and Wildlife Service, Hurstville.

Carlile, N., and Priddel, D. (2007). Translocation of Little Penguins *Eudyptula minor* from wild and captive bred populations to Store Beach, Sydney Harbour National Park, 2004/05 to 2006/07. Unpublished report, NSW Department of Environment and Climate Change, Hurstville.

Carlile, N. and Wheeler, R. (2004). Sydney Harbour Little Penguin Project – monitoring report March 2004. Unpublished report, NSW National Parks and Wildlife Service, Hurstville.

Priddel, D., Carlile, N., and Wheeler, R. (submitted). Population size, breeding success and provenance of a mainland colony of Little Penguins (*Eudyptula minor*) in Sydney, Australia. *EMU*.

NPWS (2000). Endangered Population of Little Penguins *Eudyptula minor* at Manly, Recovery Plan. NSW National Parks and Wildlife Service, Hurstville.

O'Neill, L. (2006). Manly Little Penguin Project – monitoring report March 2006. Unpublished report prepared for the Biodiversity Conservation Section, Metro, and the Little Penguin Recovery Team.

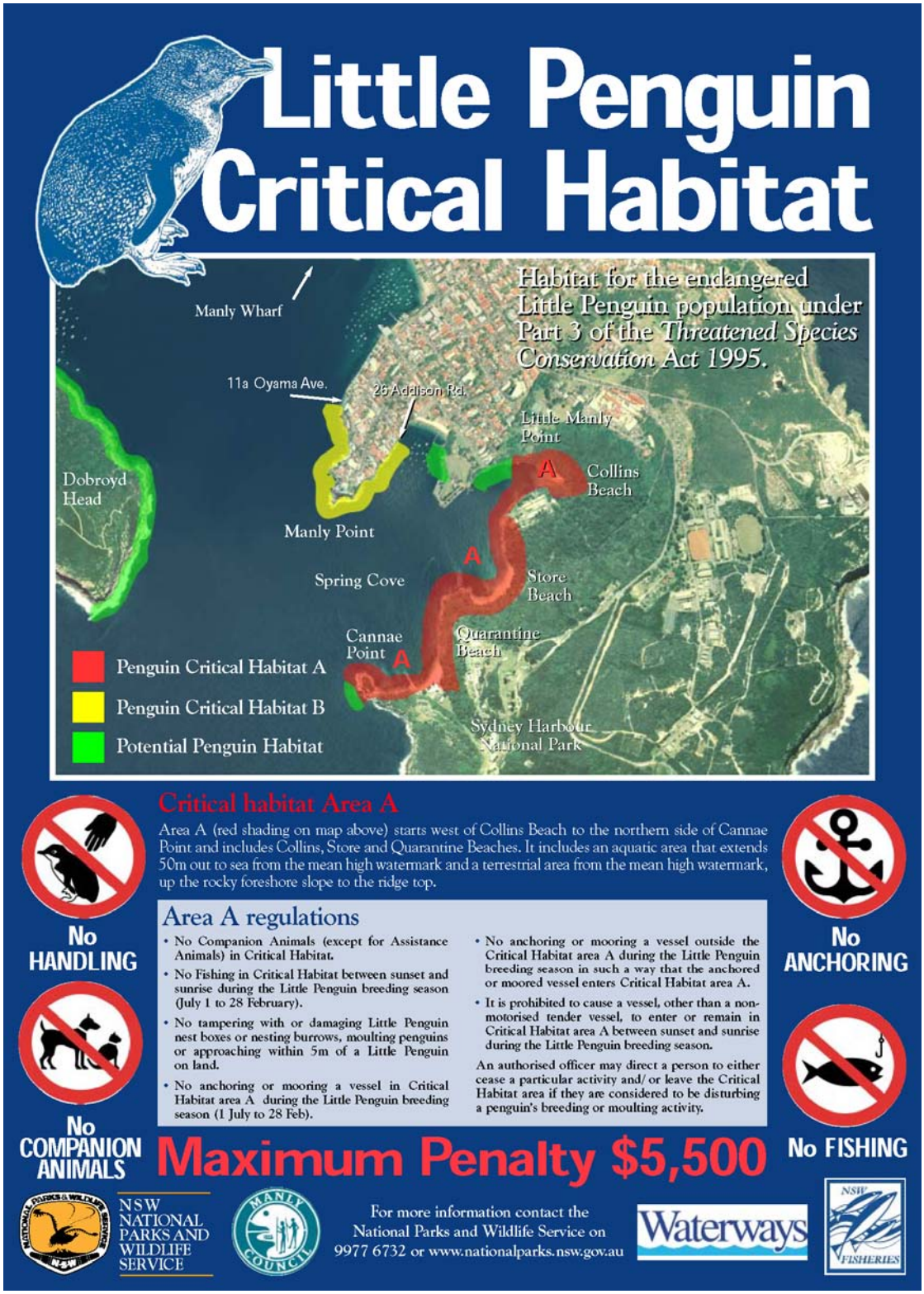
O'Neill, L. (2007). Manly Little Penguin Project – monitoring report July 2007. Unpublished report prepared for the Biodiversity Conservation Section, Metro, and the Little Penguin Recovery Team.

Reilly, P. N., and Cullen, J. M. (1981). The Little Penguin *Eudyptula minor* in Victoria, II: breeding. *Emu* **81**, 1-19.

Reilly, P. N., and Cullen, J. M. (1982). The Little Penguin *Eudyptula minor* in Victoria, III: dispersal of chicks and survival after banding. *Emu* **82**, 137-142.

Stahel, C., and Gales, R. (1987). `Little Penguin. Fairy Penguins in Australia.' (NSW University Press: Kensington.)

Appendix 1: Example of the Little Penguin critical habitat sign installed at all access points around the declared area.

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