

SEABIRD ISLANDS

No. 11/1

Lion Island, New South Wales

Location: 33°33'25"S, 151°19'04"E; in Broken Bay at the mouth of the Hawkesbury River, 480 metres offshore from the northern headland near Pearl Beach on the central coast of New South Wales (NSW).

Status: Nature Reserve administered by the NSW National Parks and Wildlife Service (NPWS), Office of Environment and Heritage. Entry permit required.

Description: Approximately 600 metres long and 280 metres wide at its broader eastern end, Lion Island has an area of ~10.6 hectares, with 8.1 hectares of vegetative cover. The island ascends from 30 metres above sea level at the western end to its highest point, 93 metres above sea level, at the eastern end. This plateau, sloping south to north, has a subtle ridgeline running the length of the island, principally close to the southern cliffs, which commences at about the south-western beach (Penguin Beach). Sandy beaches occur either side of the western point, with the largest, Penguin Beach, lacking a fringing reef. Except for these beaches, the shoreline of the island is rocky, grading from boulders to scree slopes west to east. Lion Island is composed of Hawkesbury Sandstone capping at the eastern end, with underlying strata of the Narrabeen Group being observable elsewhere. Skeletal, sandy soils cover the plateau, reaching a considerable depth in short, narrow gullies and near the level summit. Soil pockets occur throughout the scree slopes and above Penguin Beach.

The principal vegetation is low woodland, largely dominated by Smooth-barked Apple *Angophora costata*, but also by Bangalay

Eucalyptus botryooides on the eastern portion of the island. Tall shrubs, such as Old Man Banksia *Banksia serrata*, Coast Banksia *B. integrifolia* and Native Cherry *Exocarpus cupressiformi*, are scattered among much of the vegetation. Low shrubs form a continuous layer, up to 2 metres high, over most of the island, mostly of *Xanthorrhoea arborea* and *Lomandra longifolia*, but also *Platysace lanceolata*, *Hakea sericea*, *Dodonaea triquetra* and *Acacia ulicifolia*. Other abundant native vegetation on the island includes *Elaeodendron australis*, *Ficus rubiginosa*, *Leptospermum laevigatum*, *Wikstroemia indica*, *Westringia fruticosa*, *Carpobrotus glaucescens* and *Themeda australis*¹.

The most widespread invasive plant species on the northern section of the island is Ground Asparagus *Asparagus aethiopicus*, with moderate infestations of Bitou bush *Chrysanthemoides monilifera rotundata* and Lantana *Lantana camara*¹ also occurring. The western slopes of the island are dominated by Lantana, which forms a thick layer over much of the lower slopes. The eastern section supports Bitou bush, particularly on the north-eastern slope, as well as *A. aethiopicus* and *Acetosa sagittata*. The southern section of the island has relatively low weed densities¹. Other common weeds include *Solanum nigrum*, *Ehrharta erecta* and *Conyza bonariensis*¹.

The litter layer is very deep over the interior of the island, with few herbs being present. In 1973, Benson² reported that the vegetation did not appear to have been burnt for many years and our observations indicate that the island has not been burnt since that time.



Figure 1. Lion Island, New South Wales

Landing: Landing can be made at Penguin Beach at the south-western end of the island in most conditions.

Ornithological History: The ornithological history of Lion Island prior to 1975 is detailed in Lane³. The Australian Bird and Bat Banding Scheme (ABBBS) records indicate that since January 1975, seven banders have visited the island on 199 dates to band birds. Additional research on Little Penguin (*Eudyptula minor*) over the last three decades is summarised below.

In 1990, Taronga Zoo and Sydney Water initiated the Little Penguin Project in response to concerns over the Lion Island population's sustainability. Rogers *et al.*⁴ monitored Little Penguin burrows over four breeding seasons between 1990 and 1994, with Rogers and Knight^{5,6} extending surveys until 1998. At this time, as a part of the Little Penguin Project, beach-count penguin surveys were undertaken in late spring–early summer⁷.

Sergent *et al.*⁸ visited Lion Island four times each year between 1990 and 1992 to collect blood samples from Little Penguins. In September 1991, Palmer (Appendix 6⁷) carried out a radio-telemetry pilot study, attaching transmitters to six penguins trapped on Lion Island. NPWS continued to conduct Little Penguin beach-count surveys over four nights in 2000–2003 and one to two nights in 2004–2008⁹ using previous methodologies⁷. Work has been carried out on the island as part of the Little Penguin threat abatement implemented by NPWS, including extensive bush regeneration and post-regeneration monitoring of penguin behaviour¹. Carlile *et al.*¹⁰ visited Lion Island on 13 occasions between 2004–2005 and 2006–2007, collecting 44 Little Penguin fledglings which were translocated to another penguin colony at Store Beach, North Harbour. Peuker¹¹ collected genetic samples from penguins in November 2005. Vardeh¹² visited over five nights in 2012, seven nights in 2013 and four nights in 2014 to survey penguins.

We visited Lion Island on 17–21 September 2015 to estimate the breeding population of Little Penguins, and again on 16–17 January 2016 to survey Wedge-tailed Shearwaters *Ardenna pacifica* and search for other breeding seabirds previously recorded on Lion Island.

Breeding Seabirds and Status

Ardenna pacifica Wedge-tailed Shearwater – nests in rock overhangs at the top and base of cliffs, as well as amongst rocks in the scree slopes on the island's south-eastern side. Directly adjacent to the cliff tops, an area of tall heath contains several depressions that were probably formerly burrow entrances, but are now collapsed and infilled. In January 2016, the breeding population was estimated by direct counts of birds responding to 'war-whoops'¹³ and other vocal imitations from within cavities showing some level of occupation (excavation and excreta at the entrance). Eleven active burrows were located, with nine being at the cliff base and in surrounding scree. The overall population was estimated as between 10–20 pairs. The 1970s' estimate of 300 breeding pairs³ was only based on the discovery of nine active burrows during a brief search in 1974; the area searched was below the cliffs and similar to that in which burrows were still active during our survey. It is likely that the numbers derived from the 1950s and 1960s studies¹⁴ had declined to their current levels by the 1970s, and may now be stable.

Ardenna grisea Sooty Shearwater – Lane³ documented breeding sites near the island's summit that we found no longer contain burrows. The area below the cliffs was also a known breeding site, but thorough searches and listening for vocalisations on five nights (four in September 2015 and one in January 2016) failed to detect the species.

Ardenna tenuirostris Short-tailed Shearwater – The location of the unconfirmed breeding record³ of this species, a single burrow, was in the cliff-base scree thoroughly searched during our survey. We found no evidence for the species' continued presence, suggesting that it is unlikely to still be nesting on Lion Island.

Eudyptula minor Little Penguin – Breeding on Lion Island is primarily under rock overhangs in excavated cavities, but occasionally also in soil burrows beneath rock outcrops under thick vegetation. Nests were mostly limited to just above the shoreline close to landing sites. Some activity was evident on both sides of the saddle in the interior of the island's western end, suggesting breeding at higher elevations. The birds landing at Penguin Beach nest up to 30 metres above sea level on the slopes leading to the summit. In September 2015, the entire coastline of the island was searched and eleven rock landing sites were identified from the trails of excrement present. Penguins landing at each of these rocky sites (see Figure) and the two beaches were counted over two nights from dusk until no further penguins arrived within a 15-min period (approx. 20:30 hr). We estimated an average (\pm s. e.) of 78 ± 4 penguins landing on the island nightly (on average, 38% of the sample landing at Penguin Beach). Over several days during the same period, a thorough search within the more accessible areas above the beaches found 38 active nests (32% with a single adult incubating eggs, 32% with adults brooding chicks and 36% with 1–2 chicks only). A further 27 nests were empty, but had substantial amounts of downy feathers and fresh guano, suggesting that young had recently fledged (65 active nest sites in total) and indicating an earlier start to the season than in recent years^{15, 16}. From the relative numbers of nests with one adult incubating, one adult brooding chicks and unattended chicks, combined with known breeding behaviour (three-day incubation shifts translating into 1/3 of incubating adults returning every night, nightly change-overs of adults brooding¹⁷ and most parents returning nightly to feed offspring¹⁸), we estimate that each landing bird 'represented' 1.46 nests. Finally, from work carried out colony-wide in Sydney Harbour¹⁹, we know that only sixty-five percent of active burrows have eggs laid in them. This would suggest that thirty-five percent of penguins arriving were either prospecting or pre-breeding birds. This gives a breeding population (based on active nests found during the survey) of 74 pairs, which represented only 58% of accessible nests that showed signs of breeding for the season. If the ratio of accessible, active nests to those where breeding was completed is applied across the island, it suggests that the Little Penguin population on Lion Island was closer to 128 ± 7 pairs. This is less than half the 300 pairs estimated by Lane³, who reported that a survey carried out over two seasons (1958–1959) found 80 active nest sites within the more accessible parts of the island, which were thought to account for approximately 25% of the island's breeding areas. However, if we use the comparison of direct counting of accessible nests as a measure of decline, our estimate of 65 active nests compared to Lane's³ 80 in the 1950s represents an approximately 27% decline. In the intervening years, two population estimates have been made at Penguin

Beach using capture/recapture techniques. Cunningham *et al.*⁷ sampled over five nights during a similar period to that of our survey (21 Sept to 6 Oct 1992), estimating the population of Little Penguins to be 86 pairs (95%CI 80–95 pairs). Vardeh¹² estimated that approximately 26 pairs were utilising the beach, but this sampling probably occurred after peak breeding (mostly between mid-October and mid-November). Comparing our current late-September estimate for the Penguin Beach area of 42 pairs (38% of our total sample) with the 1992 estimate suggests that the population on the island may have declined by as much as 50% in the last two decades.

Factors Affecting Status

The impacts on shearwater breeding habitat noted by Lane³ in the 1970s included loss of soil (and therefore burrows) to ocean storm erosion at the base of cliffs and blocking of access to habitat on the island's summit by invasion of the weed Lantana. The native vegetation on the island's summit has since recovered and it is likely that more soil has accumulated under the southeast cliffs where rock-fall previously obscured quality breeding habitat. Given this habitat recovery, we would expect to see the shearwater population grow as the island's capacity to support breeding birds increases. However, the population does not appear to be expanding. Population growth has been seen in the last few decades both north of Lion Island on Broughton²⁰ and Little Broughton Islands²¹ and to the south on Big Island²². As Lion Island is in enclosed waters and not often in the foraging areas of shearwaters, it is likely that without active management shearwaters will remain in low numbers here into the foreseeable future. However, given that the habitat has improved, shearwaters could be attracted to the site by broadcasting their calls at night from an installed seabird sound attraction system²³.

Little Penguins have declined on Lion Island since the late 1950s. However, despite the considerable amount of weed establishment above the beaches, there are still substantial numbers of breeding pairs there. Removal of Lantana and subsequent restoration of native vegetation would alter the amount of vegetative cover, which could temporarily reduce the number of available nesting sites. Weed removal and vegetation rehabilitation should therefore be carried out progressively to minimise any negative impact. The installation of appropriate artificial nesting habitat to complement weed removal²⁴ may assist in retaining breeding pairs at these locations.

Lion Island, together with Snapper Island on the Clyde River²⁵, are the only two penguin breeding sites in NSW in enclosed waters. The presence of House Mice *Mus musculus* here is not unexpected, given the island's proximity to the mainland and accessibility to humans. It is unlikely that mice are directly impacting either species of seabird breeding here, but they may be affecting the native flora and invertebrate fauna.

Other Seabirds Recorded

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|---------------------------------|--|
| <i>Halobaena caerulea</i> | Blue Petrel (remains) ³ |
| <i>Puffinus gavia</i> | Fluttering Shearwater (remains) ³ |
| <i>Pelecanus conspicillatus</i> | Australian Pelican |
| <i>Anhinga novaehollandiae</i> | Australasian Darter |
| <i>Microcarbo melanoleucos</i> | Little Pied Cormorant |
| <i>Phalacrocorax carbo</i> | Great Cormorant |

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|--|------------------------|
| <i>Phalacrocorax sulcirostris</i> | Little Black Cormorant |
| <i>Egretta novaehollandiae</i> | White-faced Heron |
| <i>Haematopus fuliginosus</i> | Sooty Oystercatcher |
| <i>Chroicocephalus novaehollandiae</i> | Silver Gull |

Other Vertebrates Recorded

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|---------------------------------|--|
| <i>Hydromys chrysogaster</i> | Water-rat ³ (confirmed this survey) |
| <i>Mus musculus</i> | House Mouse ³ (confirmed this survey) |
| <i>Rattus rattus</i> | Black Rat ¹⁴ (historic record, not reported since 1968) |
| <i>Ctenotus taeniolatus</i> | Coppertail Skink ²⁶ (confirmed this survey) |
| <i>Eulamprus quoyii</i> | Eastern Water Skink ²⁶ (confirmed this survey) |
| <i>Saiphos equalis</i> | Three-toed Skink ²⁶ |
| <i>Saproscincus mustelinus</i> | Weasel Skink (this survey only) |
| <i>Intellagama lesueurii</i> | Eastern Water Dragon ²⁶ (confirmed this survey) |
| <i>Varanus varius</i> | Lace Monitor ²⁶ |
| <i>Dendrelaphis punctulatus</i> | Green Tree-snake (this survey only) |
| <i>Cacophis squamulosus</i> | Golden-crowned Snake (this survey only) |

Banding

Data for all banding records (first banding occurred on 20 October 1956):

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|-----------------------------|--|
| <i>Ardenna pacifica</i> | – 282 adults, 29 nestlings and 24 individuals of unknown age. Eight recoveries, all within 100 km of banding site, one being recovered dead 7 years after banding. |
| <i>Ardenna grisea</i> | – 7 adults, 4 nestlings and 6 individuals of unknown age. Three recoveries, one found dead off Rumoi city, Japan, one found dead at Moruya Heads, NSW and one recovered alive at the banding site 7 years after being banded. |
| <i>Ardenna tenuirostris</i> | – Two adults in 1973 and 1974, with no recoveries. |
| <i>Eudyptula minor</i> | – 2054 adults, 37 juveniles, 253 nestlings and 1021 individuals of unknown age. 3367 recoveries: 3246 of these recoveries were at the banding site, with an additional 28 birds being recovered within 10 km of Lion Island. For the remaining 105 recovered birds, recoveries extended as far south as Granite Island, SA and as far north as Grafton, NSW, with the latter |

individual recording the greatest elapsed time (11 years 9 months) between banding and recovery. Twenty-five Little Penguins banded elsewhere (mostly in NSW) have been recovered at Lion Island. This number includes interstate bandings at Troubridge Island, SA and one from Three Hummock Island, Tasmania.

Chroicocephalus novaehollandiae – 1 bird banded as a nestling on Big Island off Five Islands, NSW was recovered on Lion Island 107 days later.

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