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SEABIRD ISLANDS No. 38/1

Big Island, Five Islands Group, New South Wales

Location: 34°29'24"S, 150°55'42"E; 450 metres offshore from Red Point, Port Kembla, 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.

Other Names: Previously Rabbit Island, Perkins Island, and traditionally Booirodoong by the Dharawal custodians.

Description: Big Island is the largest island in the Five Islands Group that also includes Bass, Flinders and Martin Islets, and it comprises two main islets (No. 1 and No. 2)[1] connected by a rocky isthmus that is breached in heavy seas (Figure 1). The total area of Big Island is 19.8 hectares, with 10.7 hectares vegetated. Big Island consists of Permian volcanic rock. The geological sequence is referred to as the Dapto Latite member of the Gerringong Volcanics, Shoalhaven Group[2,3,4]. Relic sand dunes cover sections of the larger islet[4]. Soils derived from latites are highly fertile, although substantial erosion has occurred[5]. The presence of migratory seabirds provides substantial guano that enriches the nutrient status of the surface soils. Bioturbation of the soil profile is actively occurring due to the presence of burrowing seabirds.

No. 1 islet is an irregularly shaped, 11.9 ha (7.7 ha vegetated) islet, with the highest point in the Five Islands Group of 20 m above sea level being near a dissected relic dune in the centre of the island. Cliffs and rocky shorelines cover all but the western approaches, where a small boulder-strewn and sandy beach slopes gently up to the islet's interior. Here, a recently established, elevated platform on concrete piers supports two shipping containers serving as basic research and management accommodation and storage, replacing a previous structure established in 1988 as part of Silver Gull *Chroicocephalus novaehollandiae* research[6]. The broad isthmus (0.4 ha) has a pebble and boulder beach on the north side and deep water access to rock platforms opposite, at the eastern end of No.1. No. 2 islet is more rectangular, on a north-west south-east orientation, with rocky shores leading to cliffs on all sides. Extensive rock platforms cover sixty percent of No. 2, with only three ha of vegetation supported on generally skeletal soil just deep enough to support extensive shearwater burrowing where two basalt dykes cut into the islet's interior from the north-east shore (see Figure 1).

Beyond the rocky shore, the vegetation has become almost totally dominated by introduced grasses, vines and shrubs since the 1976 description[7]. By 2014[8] the 18 extant native plant species were dominated by some of the 35 exotic species. The most notable losses of native species were the *Correa-Westringia* communities previously described by Gibson[7], which were overcome by introduced Kikuyu Grass *Cenchrus clandestinus* that was spreading dramatically in 1976. Whilst the dominant shrubs now are Bitou Bush *Chrysanthemoides monilifera* and Mirror Bush *Coprosma repens*, a restoration project has commenced that will dramatically change the dominant vegetation communities on the island (see below).

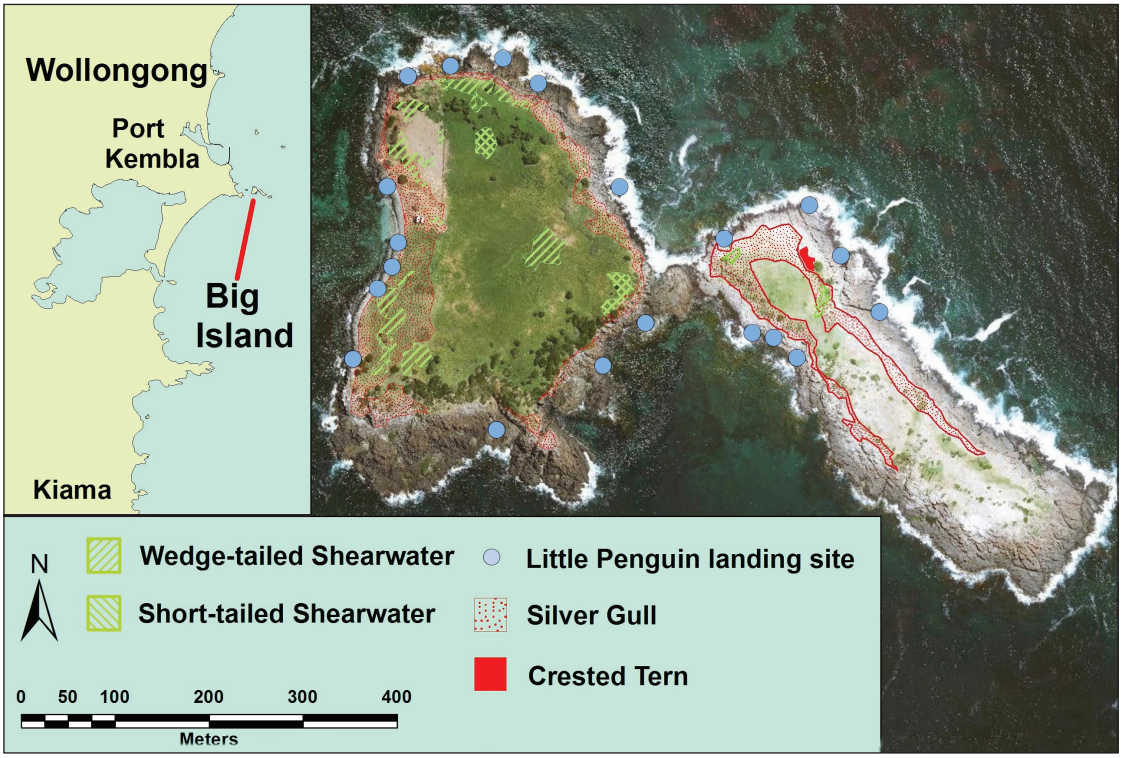

Figure 1. *Big Island, Five Islands Group, New South Wales*

Landing: Landings onto No. 1 islet beach at the western end are practical in most conditions. Alternatively, landing is possible at the isthmus between No. 1 and 2 onto the pebble beach on the north side or, for the transfer of equipment and personnel, directly onto rocks on the south side.

Ornithological History: Gibson[7] detailed ornithological visits to Big Island up until 1976. However, the first mention of seabirds here was after a visit in 1848, when a search for 'conys' on Rabbit Island (Big Island) only found 'sooty petrels'[8] (probably Wedge-tailed shearwaters *Ardenna pacifica*). The Southern Ocean Seabird Study Association (SOSSA) maintained active banding programs on the island from 1976 until 2010 (Australian Bird and Bat Banding Scheme, ABBBS, submitted data). Gibson[7] reported on Silver Gull numbers from visits to the island in 1956/57. Between 1988 and 1991, NPWS Silver Gull studies involved weekly visits from July to January annually[6]. Little Penguins *Eudyptula minor* were sampled for parasites on Big Island on 30 August 2012[10] and Silver Gull nestlings were swabbed for bacterial loads in October 2012[11].

This report of the re-survey of Big Island includes the monitoring of Silver Gulls and other colonial nesting species by Carlile and others during day visits on 5 September 1995, 3 September 1998, 26 August 2002, 28 August 2003, 24 August 2005, 30 August 2012 and 8 September 2014. From 19–23 September 2014, a team of eight experienced ornithologists visited Big Island to survey nesting seabirds. On 13 October 2014, Little Penguin and Silver Gull nesting success was assessed. On 1 December 2014, Little Penguin nesting success was assessed and surface-breeding shorebirds documented. From 2–4 January and 27–28 April 2015, shearwater distribution, burrow occupancy and breeding success were assessed.

Breeding Seabirds and Status

Pelagodroma marina White-faced Storm-Petrel – Previously found amongst tussocks (*Lomandra longifolia* and *Poa* sp.) and Pigface *Carpobrotus glaucescens*; burrows interspersed with those of Wedge-tailed Shearwater *Ardenna pacifica.* Present on both No.1[7] and No.2 (ABBBS data). Not known to breed on the island since the 1970's[7], with the last banding in 1962[12]. In October 2014, a maximum of six storm-petrels at any one time were in the air above an area known as the largest breeding area for the species in 1962[7] from 20:30 until 21:30 on several nights, alighting for short periods on the mats of grass. In December 2014, the shaded, and therefore grass-free, areas beneath nearby bushes were examined for indications of burrowing, but none were found. It appears that White-faced Storm-petrels are attempting to recolonise the island but may be restricted by the lack of suitable habitat.

Ardenna pacifica Wedge-tailed Shearwater – This species nests on the plateaus and some slopes in loose colonies and sometimes singly; burrows are occasionally interspersed with those of the Short-tailed Shearwater *Ardenna tenuirostris* and Little Penguin. Population size was estimated by counting burrows within a series of 12 random transects 20 m long x 4 m wide in open habitat. Three of these transects were in an area recently sprayed with glyphosate as part of habitat restoration, the area being delineated by the brown colouring of vegetative cover in Figure 1. Additionally, three smaller transects (20 x 2 m) were within stands of Mirror Bush. At the time of the survey, adult birds were incubating eggs. All shearwater burrows within each transect were counted and searched; if they were occupied, the occupant was either extracted or it sometimes vocalised, providing positive identification. Burrows that were too long to determine occupation were classified as "indeterminable" and assumed to have the same occupancy rate and species occupancy ratio as shorter burrows. Six of the transects had the burrow locations marked with coloured identification tags for later assessment of breeding success and productivity of the two shearwater species.

In January 2015, the perimeter of all shearwater breeding habitat (identified by the presence of burrows) was mapped using a hand-held GPS (0.6 ha open habitat, 0.7 ha bush complexes). We surveyed approximately nine percent of the combined area of occupation on the two islets using 16 transects containing 222 burrows, of which 97 were occupied, 115 empty and 10 indeterminable. The 13 transects in open habitat had a burrow density of 0.18/m^2. The density of burrows within transects in the sprayed area (0.24/m^2) was fifty percent greater than the density of burrows in similar habitat on the top of the plateau in unsprayed areas (0.16/m^2). The three transects under extensive Mirror Bush complexes had a burrow density of 0.29/m^2. Occupancy rate of all checked burrows was 40 percent, and of those with birds present, 96 percent were Wedge-tailed Shearwaters. From seven transects, 55 burrows known to contain incubating Wedge-tailed Shearwaters were marked for estimates of breeding success and productivity. In April 2015, 52 of the marked burrows were relocated, with three being 'unrecoverable' within weed regrowth. Fifty percent of active burrows produced chicks, with an estimated productivity of 465 fledglings/ha. The number of successful nests as a proportion of total burrows in the seven transects was 28 percent. Productivity on Big Island was well below that estimated for Montague Island in the same season[13], where breeding productivity in areas dominated by native Spiny-headed Mat-rush was 700 fledglings/ha. Percentage of successful burrows (n = 128) as a proportion of total burrows (n = 383) in the Montague Island study area was similar (33%) to that on Big Island, however. Based on the mean burrow density in all transects, we estimate the total number (± s.e.) of shearwater burrows on both islets combined to be 2585 ± 309, with 96 percent (2482 ± 296) of them being attributed to the Wedge-tailed Shearwater, giving a population estimate of 1080 ± 155 breeding pairs. The number of burrows currently estimated to exist is more than double the estimate in 1940s[14] of "over 1000 burrows".

Ardenna grisea Sooty Shearwater – A single bird was banded on Big Island in 1997. No continuing presence of this species was found during the recent diurnal surveys and nocturnal spotlight and listening surveys.

Ardenna tenuirostris Short-tailed Shearwater – This species nests in two discrete areas on No. 1 islet at the top of slopes on the north and east of the islet in mixed colonies with Wedge-tailed Shearwaters and Little Penguins; occasional burrows are found elsewhere on No. 1. Four percent of identified shearwaters present in the colonies were Short-tailed Shearwaters, but numbers were too few to meaningfully estimate breeding success or productivity. With four percent (103 ± 12) of the burrows attributed to Short-tailed Shearwaters, the population appears unchanged since the 1970s[7], based on burrow numbers. The current approximate population estimate is 50 ± 40 breeding pairs.

Eudyptula minor Little Penguin– This species nests on the slopes and immediately inland from 13 penguin landing sites on No. 1 islet and seven landing sites on No. 2, in rock overhangs, soil scrapes under thick shrubs, grass or soil-covered burrows. In September 2014, we attempted to count all penguins that came ashore. Counts began at dusk and continued until no further penguins arrived during two consecutive 15-min periods (until approximately 20:30). Counts were conducted on two nights at each identified landing site on both No. 1 and No. 2. An average of 231 penguins landed per night (No. 1 islet 164 ± 11, No. 2 islet 67 ± 9). During the day, we examined 42 occupied nests on No. 1 (those containing at least one adult, egg or chick) to estimate the proportion of breeding adults ashore. Thirty active nests contained a single incubating adult (71%), six had an adult brooding a chick or chicks (14%) and two contained just well-developed chicks (5%). Three further nests contained either an adult yet to breed or eggs (later incubated) (10%). These nests were considered to have visitation rates resembling those of nests with brooding adults and were lumped together with them. From the ratio of nests with one adult incubating, one adult brooding chicks (including unattended eggs or a waiting adult) and unattended chicks, combined with known breeding behaviour (three-day incubation shifts meaning 1/3 of incubating adults returning every night, nightly change-overs of brooding adults [15], and both parents generally returning nightly to feed offspring[16]), we estimate that each landing bird 'represented' 2.4 active nests. From work carried out elsewhere[17], breeding pairs account for sixty-five percent of active nests in a colony, allowing an adjusted nesting population to be calculated as approximately 355 ± 21 pairs. This is one third of the previous estimate of 1000 pairs in 1962[7], but probably similar to Keast's 1940[14] estimate of a 'few hundred pairs'. Breeding success (nests with eggs producing near-fledged birds) was calculated for 22 of the active nests where nest contents could be monitored throughout the season. From 36 eggs that were laid, 16 fledglings were produced, equating to a breeding success of 44 percent. This is lower than breeding success recorded for the nearby monitored population at North Harbour, Sydney over the same period (58%), but success at North Harbour was considered well below that normally expected[17] and may indicate a poor year for raising penguin young within the region.

Thalasseus bergii Crested Tern — A discrete population nests on the north side of No. 2 annually, but the location varies. We carried out a direct count of incubating adults in October 2012 and estimated 200 breeding pairs, and again in September 2014 with an estimated 360 breeding pairs. Similar numbers were reported by Gibson[7] during his survey period (1949–1976) indicating that, whilst the breeding numbers vary, the species is well established on Big Island.

Chroicocephalus novaehollandiae Silver Gull — This species has previously dominated the Big Island landscape during their annual July-February breeding period, nesting on all available habitat not covered in heavy shrubs or near significant Australian Pelican *Pelecanus conspicillatus* colonies. Estimates of breeding pairs were made in 1991, 1995, 1998, 2002, 2003 and 2007 at the peak egg-laying period[6], partly by walking transects in an area used in surveys in earlier studies[6]. The total nesting population was estimated from the density of nesting within these transects relative to the island's' total vegetated area. In 2012, the population here had contracted significantly, so that

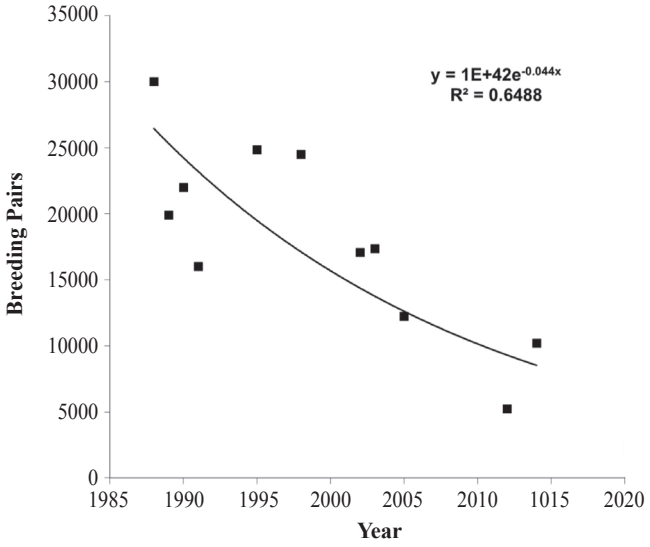

Figure 2. *The estimated numbers of breeding pairs of Silver Gulls on Big Island from the 1980s to 2015.*

the previous method was unacceptable statistically as 60% of transects had no nesting. Four (2012) and 10 (2014) randomly-placed 50 metre transects, 2.5 m wide, were established across nesting areas. During this study period, nesting density/m^2 varied from 0.23 nests/m^2 in 1995 to a low of 0.03 nests/m^2 in 2012. The total number of nesting pairs declined exponentially throughout the study period ($r^2 = 0.65$) when compared to earlier estimates (1988-90[6]) (see Figure 2). The population estimated in 1962[7] was similar to that reported from the late 1990s to early 2000s. A nesting success of 73 percent was determined from 16 nests found with one or more chicks (size class 3 or higher[6]) on 14 October 2014 out of 22 sites marked on 19 September 2014 that contained adults incubating eggs. The estimated nesting success was much higher than the 6.5 to 7.6 percent reported by Smith and Carlile over the three seasons 1988-91[6], possibly due to later marking of the initial sample, but more likely to a lower gull population leading to lower levels of food competition and increasing the survival of chicks[6].

Pelecanus conspicillatus Australian Pelican — A small breeding population became established at the eastern end of No. 2 plateau in 1983[1]; in September 1991 it had 108 birds, comprising approximately 20 nesting pairs and 35 crèche-young. In September 1998, over 650 adults and juveniles were counted. In late August 2003, 30 adults were nesting on No. 1 islet and 200 on No. 2. By late August 2005, No. 1 had 135 adults and No. 2 had 446 adults incubating eggs or feeding young up to 60 days old. By late August 2012 this population had contracted to just No. 2 islet, with only 280 adults noted. This species had not previously been known to breed on Big Island[7] or any other offshore island in NSW up to the mid-1970s.

Threskiornis molucca Australian White Ibis — This species commenced breeding on Big Island in the 1990s. The population expansion here was aided by the spread of Mirror Bush thickets to their current extent of 0.7 ha. Estimates in August 2005 were that No. 1 supported 190 nests and No. 2 had 45 nests with young up to two weeks old. In early September 2012, No. 1 had 170 adults at the site with 61 eggs and 106 chicks ranging in age from two weeks to just fledged. On No. 2, there were 52

adults, 37 eggs and 12 chicks. By September 2014, No. 1 had 1576 adults at the site, with 266 eggs and 33 chicks and No. 2 had 113 adults with 259 eggs and 31 chicks, with the young ranging from freshly hatched to two weeks old. This species had not previously been known to breed on Big Island[7] or any other offshore island in NSW up to the mid-1990s.

Platalea regia Royal Spoonbill — Likely attracted to the island as a nesting site due to White Ibis colonies, this species was first noted breeding in October 2012 when there were four nests containing eight eggs and 13 adults on No. 2 islet. In October 2014, 12 adults were observed in bushes on No. 1, but no nests were recorded at that time.

Factors Affecting Status

The presence of 'prospecting' White-faced Storm-Petrels is encouraging, suggesting that the species has not abandoned attempts to breed at its former stronghold. There is potential habitat over significant portions of the island that could be made available to this species by sympathetic regeneration of native vegetation. The installation of artificial habitat to encourage recolonisation is currently being considered.

On No. 1 islet, the two shearwater species have responded differently to an increase in habitat disturbance from weed invasion starting in the 1970s, but the habitat use on No. 2 islet appears unchanged[7]. Wedge-tailed Shearwater breeding on No. 1 has become fragmented, but has exploited the grass-free areas that currently persist under exotic shrubs. Short-tailed Shearwater breeding continues to be limited, and is in open habitat. Areas known for breeding of Short-tailed Shearwaters on the island's lower south side in the 1980s are now dominated by tall shrubs and the birds are currently absent from them (HB & NC *pers. obs.*). Removal of exotic tall shrubs as part of on-going regeneration efforts (see below) will need to be 'staged' so as not to disadvantage the Wedge-tailed Shearwater breeding population as the island recovers. The higher number of burrows found in the recently sprayed area when compared to similar unsprayed areas indicates that shearwaters are likely to respond favourably to habitat that is liberated from exotic vegetation.

Little Penguins seem to have responded to the degradation of habitat by becoming more widespread, but less concentrated, avoiding much of the open habitat in favour of areas of tall shrubs or areas where rocky habitat affords alcoves and cavities for breeding. As with Wedge-tailed Shearwaters, the removal of tall exotic shrubs over rocky areas during restoration will need to be carefully managed so that either mature *Lomandra longifolia*-dominated areas or artificial habitat[18] are provided as alternative nesting sites for this species in the short to medium-term. The breeding success of this species on Big Island may need further intensive monitoring to ensure that they are not suffering from threatening processes not discovered in this brief survey.

Whilst Crested Tern nesting appears little changed on Big Island from their variable breeding population up to the 1970s, the Silver Gull population has both increased and then dramatically shrunk in that time. Whilst recent observations of them feeding at the local waste transfer station (NC *in litt.*) appear similar to reports of their efforts here in the early 1990s[19], the number of dead birds noted on the island during the breeding season indicates that they may be suffering the effects of disease that they are known to carry[11]. Further intensive studies are warranted here to determine if the disease has spread to other species. Changes in the dominant cover of exotic grass during restoration may concentrate the breeding populations into more open habitat, but should not of itself lead to further declines in breeding.

Australian Pelicans, White Ibis and Yellow Spoonbills are recent arrivals on Big Island. The pelicans appear to favour the skeletal soil areas of No. 2 and so will not be impacted by any restoration of the native vegetation cover. The ibis and spoonbills are shrub/tree nesters and will likely suffer breeding population declines in the long-term on Big Island as the restoration proceeds.

Swamp Harriers *Circus approximans,* White-bellied Sea-Eagles *Haliaeetus leucogaster* and Peregrine Falcons *Falco peregrinus* were observed feeding on the islands, targeting predominantly Silver Gulls, although the remains of depredated Wedge-tailed Shearwaters were also common. The remains of Silver Gulls were found under the canopy of several Mirror Bushes where a Barn Owl *Tyto javanica* was flushed on two occasions in October 2014.

Big Island is close to popular beaches, and despite signage prohibiting landing, members of the public access the island from the western beach. Indiscriminate walking on fragile areas on No. 1's plateau has the potential to severely damage shearwater burrows and generally disturb colonial nesting birds.

Kikuyu Grass and exotic vines have been degrading the environment and leading to entanglement of Wedge-tailed Shearwaters and Little Penguins, so management of these weeds commenced in 2014[8]. Without control, these invasive species would continue to dominate the landscape, excluding the White-faced Storm-petrel and further reducing the nesting habitat for shearwaters and penguins, while providing habitat for future expansion of the opportunistic White Ibis.

Other Seabirds Recorded

Thalasseus striata	White-fronted Tern
Haematopus fuliginosus	Sooty Oystercatcher (breeding)
Phalacrocorax carbo	Great Cormorant
Phalacrocorax sulcirostris	Little Black Cormorant
Phalacrocorax varius	Pied Cormorant
Microcarbo melanoleucos	Little Pied Cormorant
Egretta sacra	Eastern Reef Egret
Egretta novaehollandiae	White-faced Heron

Other Vertebrates Recorded

The Eastern Water Skink *Eulamprus tympanum,* previously identified by Gibson[7], was common and the Three-toed Skink *Saiphos equalis* was also found here. Previous records[1] of the Garden Skink *Lampropholis guichenoti* and Weasel Skink *Saproscinus musteline* were not corroborated. The European Rabbit *Oryctolagus cuniculus,* present during the last island survey period[7], appeared to have died out. Australian Fur Seals *Arctocephalus pusillus* regularly hauled out on the eastern tip of No. 2 or on the isthmus, but were more commonly found on Martin Islet to the east of Big Island.

Banding

Data for all banding records commencing June 1955:

Pelagodroma marina – 198 adults, 42 nestlings, with 1 recovery of an unsuccessful fledgling at the banding place.

Ardenna pacifica – 4166 adults, 1633 nestlings and 1571 individuals of unknown age, with 484 recoveries of banded birds on the island. 87 recovered at sea off Wollongong and 33 recoveries along the NSW coast. Five recoveries were from burrows on nearby Flinders Island, Five Islands Group (n = 30), from Muttonbird Island off Coffs Harbour (n = 1) 509 km north and Tollgate Islands (n = 6) 153 km south. Two recovered in the Philippines, 6221 and 5679 km distant. 15 recoveries on Big Island of birds banded elsewhere: Flinders Island (n = 2); Muttonbird Island (n = 7); North Stradbroke Island, Northwest Island and Heron Island, Queensland (n = 4); Norfolk Island, South Pacific and Serrurier Island, Western Australia.

Ardenna grisea – one bird of unknown age banded here in 1997.

Ardenna tenuirostris – 270 adults and 16 nestlings, with 24 recoveries: 22 km to the north, one 178 km to the south and 22 were at the banding site. Two recoveries of birds banded elsewhere, nestlings from Great Dog Island, Bass Strait, 683 km south and from Flinders Island, 3.5 km north.

Eudyptula minor – 125 adults, 2059 nestlings and 184 of unknown age, with 494 recoveries on the island. 105 recoveries in NSW up to 329 km north at Manning Point and south to Merimbula. Nine recoveries were as breeding birds on Lion Island, 108 km to the north and two were on nearby Flinders Island in the Five Islands Group. Eight recoveries on Big Island were birds originally banded at Lion Island (n = 4) and Bowne Island, ACT (n = 4). Thirty-six recoveries outside of NSW; 29 in Victoria, including 13 at Phillip Island and London Bridge (potentially breeding birds). Two recoveries on Big Island of birds originally banded at Phillip Island and one from Rabbit Island off Wilsons Promontory, 629 km south of Big Island. In South Australia, one recovery at West Island, Victor Harbour, 1132 km from Big Island, and four birds recovered on Big Island originally banded on Troubridge Island, Edithburgh, 1197 km from Big Island, and one from West Island, Victor Harbour. Six in Tasmania to as far south as 886 km, at Great Oyster Bay, and one retrapped on Big Island originally banded at East Cove, Deal Island, Kent Group 628 km south as a breeding adult.

Thalasseus bergii – 844 adults and 3622 nestlings, with 28 recoveries on the island and 191 away from Big Island. The furthest recoveries were near Urangan Pier, Queensland, 1034 km north, and Kettering, Tasmania, 1013 km south. Three recoveries of birds breeding were made on Moon Island 170 km north. Seven recoveries on Big Island came from two external locations: six were originally banded on Montague Island, 207 km to the south as either adults (n = 4) or nestlings (n = 2) and one banded as a nestling on Lake Tabourie, 116 km to the south.

Chroicocephalus novaehollandiae – 1033 adults and 18465 nestlings, with 804 recoveries away from the banding site. The most distant recoveries were near Maroochydore on the Sunshine Coast, Queensland, 896 km north, Hobart Tip in Tasmania, 986 km south and Moonta Bay in South Australia, 1238 km west. 277 recoveries at the banding site. One breeding adult was retrapped 42 days later on Spectacle Island in Fredrick Henry Bay, Tasmania, 976 km south. Six nestlings were re-trapped on other islands, three on Moon Island, 170 km north, two on an island in Lake George, 154 km south-west and one on Spectacle Island in Fredrick Henry Bay, Tasmania. Two recoveries on Big Island of birds banded as nestlings on Moon Island.

Pelecanus conspicillatus – 180 nestlings banded, with four recoveries at the place of banding being unsuccessful fledglings. Nine were recovered up to 321 km north at Taree or 42 km south near Nowra in NSW.

Threskiornis molucca – 59 nestlings banded in 2004, with two individuals recovered 10 and 115 km north, respectively.

Haematopus fuliginosus – A single nestling was banded in 2000.

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