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SHORT COMMUNICATION



## Terrestrial fauna survey of Slipper Island (Whakahau)

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### ABSTRACT

We describe the history of Slipper Island (Whakahau) off northeastern New Zealand and report on a survey of the terrestrial fauna undertaken in December 2016. Results from this survey are compared with the last comprehensive survey in August 1973. The terrestrial habitat of the island is predominantly farmland and has changed little in extent over the past 50 years. As a result, the avifauna has remained remarkably consistent, although with some species turnover that reflects changes in the wider regional landscape, and some notable native species additions. Pacific rats were abundant across the island, and as a result reptiles are depauperate due to local extinctions. Bell frogs and Argentine ants are both recent arrivals on the island. On the nearby smaller native forested Penguin and Rabbit Islands the avifauna is predominantly native.

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## Introduction

The Slipper Island group (−37.07°S, 175.92°E) lies about 4 km east off the coast of the Coromandel Peninsula, falling within the southeastern boundary of the Hauraki Gulf Maritime Park (Bassett et al. 2016). The island group comprises the main 242 ha Slipper Island (Whakahau), 10.8 ha Penguin Island and 12.2 ha Rabbit Island c. 500 m to the south, and Watchman Rock to the west. Slipper Island is the western remnant of an andesite cone (maximum elevation 142 m) with steep exposed eastern cliffs atop boulder beaches, sloping down to three western beaches (Hayward et al. 1974). The majority of Slipper Island is in private ownership and most of the island, certainly all accessible areas, is in fenced farmland pasture grazed by sheep and cattle, with little vegetation. The generally inaccessible northeastern cliffs comprise rocky tiers of native forest with some wilding pines. Two wetlands occur, in the north and south of the island, respectively, and are being fenced and restored. A lighthouse is located on the eastern point of Slipper Island and two intersecting grass aviation runways located near the northern wetland were built in 1948. The island is rich in archaeology, including historical pā sites and graves from original Māori occupation (Atwell et al. 1975). Penguin and Rabbit Islands are owned by Ngāti Hei and comprise native forest surrounded by cliffs and boulder beaches. During Māori occupation, mutton-birding occurred on all three islands (Douglas and Gubb 1974; Anderson 1997) and tuatara (*Sphenodon punctatus*) were once present (Cree and Butler 1993).

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Slipper Island was in European ownership by the second half of the nineteenth century with the family of Thomas Drifill, at which time an attempted introduction of rabbits (*Oryctolagus cuniculus*) failed (Drifill 2015). Rabbits were probably also introduced to both Penguin and Rabbit Islands (giving the latter its name), where they now apparently only persist on Penguin Island (Hayward and Moore 1974). Slipper Island was purchased by the family of Doug Norman around 1945, and then the family of Abe and Nora Needham in 1969. From 2007 to 2009 10 small lots totalling 7 ha were subdivided around South Bay, ostensibly for Needham family descendants (Gumbley 2001). At this time four small parcels were also set aside as public esplanade reserves and designated in May 2013, although only the 0.57 ha lot at Home Bay is practically accessible, the others being steep and inaccessible. A campsite on private land also exists at the northern end of South Bay. The majority of the island still vested in a single title (217 ha) was owned by shareholders of Slipper Island Resort Ltd, and in September 2015 was sold to Wendy Weimei Wu. Infrastructure on the island consists of farming and accommodation buildings around Home Bay, including lodge style accommodation and four self-contained chalets built in the mid-1990s (a fifth having burnt down), and private dwellings on the subdivided sections around South Bay. Today the island is managed as a working farm and as 'Slipper Island resort'.

Before our visit, the only published survey of Slipper Island took place in August 1973 by the Auckland University Field Club (Hayward and Moore 1974). Records were published of the ornithology (Douglas and Gubb 1974), herpetology (Townes 1974), botany (Court et al. 1974), geology (Hayward et al. 1974) and archaeology (Atwell et al. 1975). Although the rats on the island were at that time identified as Norway rats (*Rattus norvegicus*), recent reports suggest that only the Pacific rat (*Rattus exulans*) is abundant across the island (R. Chappell pers. comm. 2017). An island-wide ground-based rat control programme was undertaken from 2012 to 2015 in approximately 300 bait stations placed around the coast and through the interior of the island, and around infrastructure, supplemented with bait bags launched from above and below cliffs (W. Baggaley pers. comm. 2017). To avoid stock interference Protecta™ (Bell Laboratories) bait stations were typically mounted about 1 metre off the ground on a wooden stake and a large piece of rope was extended mostly to the ground to enable rodent access. Bait used included brodifacoum blocks and pellets, diphacinone and cholecalciferol. Rat numbers were significantly reduced, but they would have persisted on the steep forested generally inaccessible cliffs. At the time of our visit, rat control was in place around areas of habitation in Home and South Bays and along beaches to protect nesting New Zealand dotterel (*Charadrius obscurus*). Our goal was to undertake a broad rapid faunal assessment of the island in order to make recommendations for future ecological management on the island, particularly pertaining to rat eradication and likely ecological benefits. Most of the islands in the region (e.g. Aldermen and Mercury Islands) are now predator free, and eradicating rats and ecologically restoring Slipper Island would contribute to the interim goals of a Predator Free New Zealand by 2050 (Russell et al. 2015).

## Materials and methods

We visited Slipper Island from 2 to 5 December 2016. All birds and reptiles observed were recorded with annotation of number and habitat. Seabirds were specifically sought around

the northeastern cliffs with habitat searches during the day and listening posts for 90 minutes after dusk for two nights above Crater Bay. Four lines of Victor rat snap-traps were set across the island, each consisting of 10 traps baited with peanut butter in large white corflute tunnels spaced every 50 m along prominent geographical features comprising coastal, cliff top, wetland and pine forest (Figure 1). Traps were set for two nights.



**Figure 1.** Slipper Island with rat trapping lines indicated (dark red lines) and the accessible grey-faced petrel colony where a chick was banded (light blue star). Insert map shows location of Slipper Island in New Zealand (black arrow).

Opportunistic collections of ants were made when they were observed in abundance on features around Home Bay including the wharf, chalets, shore front and old family garden. Ants were also collected on peanut butter lures (i.e. the rat traps) further along the northern coast boulder beach. Kayak excursions were made to Penguin and Rabbit Islands to observe birds. Where species identification was uncertain, photographs (reptiles) and specimens (ants) were provided to experts.

## Results

The extent of island habitats has changed little in the last 50 years (Figures 2 and 3). Forest of any kind is restricted to the steep northeastern cliffs, where it is predominantly native mainly comprising pōhutukawa (*Metrosideros excelsa*) with an understorey of kawakawa (*Macropiper excelsum*), rangiora (*Brachyglottis repanda*), karamū (*Coprosma* spp.), taurepo (*Rhabdothamnus solandri*), hangehange (*Geniostoma ligustrifolium*) and harakeke (*Phormium tenax*).

When walking through pasture after dusk, Pacific rats were easily observed scuttling between grasses. Four traps were set-off without capture and one Pacific rat was caught, yielding 1.3 rats per 100 corrected trap nights. The Pacific rat caught was an adult male weighing 84 g (total length 295 mm, tail length 150 mm; deposited at Auckland Museum).

Birds recorded in December 2016 were compared with those recorded in August 1973 (Table 1). Reptiles and ants recorded in December 2016 were documented following identification by respective taxa experts (Table 2). Half an hour was spent kayaking around each of Penguin and Rabbit Islands where we observed little penguin (*Eudyptula minor*), grey-faced petrel (*Pterodroma macroptera gouldi*) burrows, pied shag (*Phalacrocorax varius*), Australasian harrier (*Circus approximans*), variable oyster catcher (*Haematopus unicolor*), black-backed gull (*Larus dominicanus*), shining cuckoo (*Chrysococcyx lucidus*), grey warbler (*Gerygone igata*), tūi (*Prosthemadera novaeseelandiae*), fantail (*Rhipidura fuliginosa*), chaffinch (*Fringilla coelebs*) and greenfinch (*Carduelis chloris*). The Watchman rock had a large colony of white-fronted tern (*Sterna striata*) with a few black-backed gulls.

## Discussion

Although our visit to Slipper Island was brief, it provides a point of comparison for change on the island since the last documented survey from 1973. A comparable survey of change over a similar length of time (1968–2013) also exists for the vegetation of a small rock stack off the southeastern coast of Slipper Island (Clarkson et al. 2014), while the sparse native vegetation of the main Slipper Island was typical of coastal northern offshore islands (Campbell and Atkinson 2002). Otherwise, the terrestrial environment of Slipper Island is overwhelmingly dominated by pasture, the extent of which has changed very little over the course of the last 50 years, although some changes over time in vegetation composition within pasture and forest habitats are likely (B. Clarkson pers. comm. 2017). As a result of this, the avifauna has changed very little, compared with other northern offshore islands where major restoration interventions have occurred such as predator eradication and replanting (Graham et al. 2013; Ismar et al. 2014). Most of the changes to the avifauna of Slipper Island are due to wider changes in the regional landscape (Robertson et al. 2007)



**Figure 2.** 1959 aerial photo of Slipper Island group from the northeast by Whites Aviation (Photo from JM Stewart Collection).



**Figure 3.** 2012 aerial photo of Slipper Island group from the southwest, Penguin Island in foreground, Aldermen in background (Photo from NZ Herald).

and mirror those from records on the western Coromandel Peninsula over a similar time period of 45 years (C. Miskelly pers. comm. 2017). Recent additions to the avifauna of the island include seven native species, which have apparently self-colonised: paradise shelduck (*Tadorna variegata*), brown teal (*Anas chlorotis*), New Zealand dotterel, spur-winged plover (*Vanellus miles*), shining cuckoo, bellbird (*Anthornis melanura*) and tūi; in addition to the introduction of chickens as an eighth species (the hen having died not long after introduction). Shining cuckoo were not recorded on Slipper Island during the August 1973 survey (before their seasonal return to New Zealand) but had been recorded previously in the group (Douglas and Gubb 1974). Meanwhile, excluding previous uncommon records, three native species have apparently been lost: pied stilt (*Himantopus himantopus*), red-crowned parakeet (*Cyanoramphus novaezelandiae*) and silvereye (*Zosterops lateralis*); and the introduced myna (*Acridotheres tristis*) as a fourth species. Red-crowned parakeets are today generally much less common where substantial predator control is not undertaken, and are also close to disappearing from other islands where rats persist, such as Great Barrier Island (Ogle 1981). Pied stilts may also have been subjected to predation (Stanes 2011). Overall the avian species richness of the island has apparently increased.

Some species have also substantially changed their distribution on Slipper Island. Kingfisher (*Todiramphus sanctus*), welcome swallow (*Hirundo neoxena*) and greenfinch were all more abundant. Pied shags may have declined on the island, with fewer observed during our trip, although there is likely to be high variation in population estimates. In contrast, red-billed gulls (*Larus novaehollandiae*) have established a substantial colony on the island, and a similarly large colony with about 50 birds was observed at the end of the new rocky breakwater at Tairua marina. The existence of these red-billed gull colonies is significant given the recently reported national decline of the species (Frost and Taylor 2016). Although we did not spend time ashore on Penguin and Rabbit Islands, their avifauna was predominantly native, reflecting the relatively unmodified native forested state of both islands. Seabird burrows were observed on both islands, and multiple seabird species have historically been harvested from all three islands in the group (Anderson 1997). Our survey also documented the presumably recent arrival of other introduced species on Slipper Island, including bell frogs (*Litoria aurea*) and Argentine ants (*Linepithema humile*). These species have also recently invaded nearby Great Mercury Island (JCR pers. obs. 2016). They can be a human nuisance and disrupt ecological networks, but may potentially be targets for eradication if at the early stages of invasion.

The presence of Pacific rats only is rare on New Zealand islands today (Taylor 1975), but previous records of Norway rats may have indicated an incursion at that time (Hayward and Moore 1974). Although Pacific rats were easily observed in abundance at night in the farmland, they proved difficult to capture in standard Victor snap-traps. Our low trapping rate may be due in part to the large white corflute tunnels we used as covers, but also may reflect a strong neophobia in the species (Adams et al. 2011) that we were not able to overcome with only two nights of trapping. The previous ground-based bait station eradication attempt of Pacific rats from Slipper Island most likely failed due to incomplete coverage of the island, particularly the forested coastal cliffs where rats were observed regularly, although premature cessation of baiting may also have played a role (Holmes et al. 2015).

**Table 1.** Comparison of birds observed on Slipper Island in December 2016 to August 1973. Nomenclature follows the checklist of the birds of New Zealand (Gill et al. 2010).

Species	December 2016 survey	August 1973 (taken from Douglas and Gubb 1974)
<i>Gallus gallus domesticus</i> (domestic chicken)	One white rooster in the old family garden at Home Bay was introduced by the new owner.	
<i>Phasianus colchicus</i> (pheasant)	A few heard across the island and one sighted near farm buildings.	Two seen.
<i>Tadorna variegata</i> (paradise shelduck/pūtangitangi)	Common across farmland especially the northern wetland and breeding.	
<i>Anas chlorotis</i> (brown teal/pāteke)	One pair in lake by poplars and breeding recorded (B. Brakenridge pers. comm. 2016).	
<i>Eudyptula minor</i> (little penguin/kororā)	One observed off the coast of Home Bay.	One bird with two eggs and seven found dead at Home Bay.
<i>Macronectes giganteus</i> (giant petrel)		Two seen off Home Bay.
<i>Pterodroma macroptera gouldi</i> (grey-faced petrel/ōi)	Common in burrows among vegetated northeastern cliffs. Some burrows contained chicks and one was banded E225525. A few birds on the ground responded to calls after dusk.	Found breeding with 5–15 burrows per 100 m <sup>2</sup> .
<i>Puffinus assimilis</i> (little shearwater)	About 10 heard around the northeastern cliffs in flight after dusk.	None seen or heard.
<i>Morus serrator</i> (Australasian gannet/tākapu)	Regularly observed off the coast.	Seen fishing around coast.
<i>Phalacrocorax varius</i> (pied shag/kāruhiruhi)	Breeding colonies with 18 birds resident identified along the coastal point north of Stingray Bay. Common around the coast.	Colony with 23 nests including five nestlings and 48 birds located south of Home Bay.
<i>Ardea modesta</i> (white heron)		One recorded in July 1973 by resident farmer.
<i>Egretta novaehollandiae</i> (white-faced heron/matuku-moana)	One observed on the lawns in front of the chalets at Home Bay.	Two seen in paddocks near northern swamp.
<i>Egretta sacra</i> (reef heron)		Two separate sightings.
<i>Circus approximans</i> (Australasian harrier/kāhu)	A few birds observed on the island, probably two pairs.	Two sighted.
<i>Porphyrio melanotus</i> (pūkeko)	Common across the island particularly around wetlands.	Abundant in southern swamp with 19 observed on one occasion.
<i>Haematopus unicolor</i> (variable oystercatcher/tōrea)	A few pairs observed along beaches.	Three seen in South Bay.
<i>Himantopus himantopus</i> (pied stilt)		Common in northern swamp and wet pastures with 12 seen on one occasion.
<i>Charadrius obscurus</i> (New Zealand dotterel/tūturiwhatu)	Common along beaches and breeding.	
<i>Vanellus miles</i> (spur-winged plover)	A number of pairs common and vocal across the farmland.	
<i>Larus dominicanus</i> (black-backed gull/karoro)	Occasionally observed around the island.	Seen in small numbers offshore.
<i>Larus novaehollandiae</i> (red-billed gull/tarapunga)	A substantial colony of about 100 birds was located north of Home Bay in front of the chalets.	Seen in small numbers offshore.
<i>Sterna striata</i> (white-fronted tern/tara)	A few observed roosting on the coast alongside red-billed gulls.	Sighted offshore towards Shoe Island.
<i>Columba livia</i> (rock pigeon)		One flying overhead.
<i>Nestor meridionalis</i> (kākā/kākā)	Pair observed flying over the island, they are common on nearby Great Mercury Island (JCR pers. obs. 2016).	
<i>Cyanoramphus novaeseelandiae</i> (red-crowned parakeet/kākāriki)		Two observed.
<i>Chrysococcyx lucidus</i> (shining cuckoo/pīpiwharauoa)	Common across the island.	

(Continued)



**Table 1.** Continued.

Species	December 2016 survey	August 1973 (taken from Douglas and Gubb 1974)
<i>Todiramphus sanctus</i> (kingfisher/kōtare)	Abundant across the island.	Seen in small numbers around the coast.
<i>Gerygone igata</i> (grey warbler/riroriro)	Common across forested areas where breeding.	Abundant in scrub and bush.
<i>Anthornis melanura</i> (bellbird/korimako)	Uncommon across forested areas mainly around the tops.	
<i>Prosthemadera novaeseelandiae</i> (tūi)	Uncommon across forested areas mainly but also in pōhutukawa plantings around the chalets.	
<i>Gymnorhina tibicen</i> (Australian magpie)	A few pairs in farmland breeding.	Occasionally seen by farmers.
<i>Rhipidura fuliginosa</i> (fantail/piwakawaka)	Common across forested areas.	Abundant.
<i>Alauda arvensis</i> (skylark)	Common across farmland on the island.	Most abundant land bird.
<i>Zosterops lateralis</i> (silveryeye)		Flocks of up to 19 seen in scrub and bush.
<i>Hirundo neoxena</i> (welcome swallow)	Abundant across the island and breeding.	One seen.
<i>Turdus merula</i> (blackbird/manu pango)	Uncommon around Home Bay and forested areas.	In small numbers.
<i>Turdus philomelos</i> (song thrush)	Common around Home Bay buildings.	In small numbers in scrub and bush.
<i>Sturnus vulgaris</i> (starling)	Abundant across farmland and breeding.	Abundant with flocks of up to 400.
<i>Acridotheres tristis</i> (Indian myna)		Seven seen around farm buildings.
<i>Passer domesticus</i> (house sparrow)	Abundant around Home Bay buildings, nesting in phoenix palms ( <i>Phoenix canariensis</i> ).	Common around farm buildings.
<i>Fringilla coelebs</i> (chaffinch)	A few heard but not observed around the southern wetland.	Small flocks seen.
<i>Carduelis chloris</i> (greenfinch)	Common across the island.	One seen.
<i>Carduelis carduelis</i> (goldfinch)		One seen.
<i>Emberiza citrinella</i> (yellowhammer)	Uncommon.	Present around swamps with 18 seen on one occasion.

**Table 2.** Reptiles and ants observed on Slipper Island in December 2016 survey.

Reptiles		Ants	
<i>Litoria aurea</i> (bell frog)	Although we did not observe any bell frogs, they are heard in the wetlands and were identified from a photograph provided by the farm managers.	<i>Linepithema humile</i> (Argentine ants)	Only searched for around Home Bay (wharf, old garden, boulder beach front) where they were abundant and a human nuisance.
<i>Oligosoma aeneum</i> (copper skink)	A second skink species was occasionally found throughout the pasture grasses across all altitudes of the island, most likely copper skink from a photograph provided by the farm managers.	<i>Nylanderia</i> sp. (parrot ant)	Abundant along the northern boulder beach coast and other rat trap lines where they were found on peanut butter lures.
<i>Oligosoma smithi</i> (shore skink)	Observed on the boulder beach in front of the chalets.	<i>Pheidole rugosula</i> (big headed ant)	Abundant along the northern boulder beach coast and other rat trap lines where they were found on peanut butter lures.
		<i>Technomyrmex</i> sp. (white-footed ants)	Abundant in chalet where they were a human nuisance.

Slipper Island today is very similar in size, habitat and ecology to Tiritiri Matangi Island before the eradication of Pacific rats during ecological restoration (Moller and Craig 1987; Veitch 2002; Galbraith and Cooper 2013). Slipper Island would be a good candidate for rat

eradication if Penguin and Rabbit Islands were included in a single meta-population eradication unit (Robertson and Gemmell 2004), although the genetic linkages among the three islands remain unquantified. Like other islands lying east of the Coromandel Peninsula (Townsend et al. 2016), Slipper Island would be a good candidate for reptile reintroductions following rat eradication, given that it is currently depauperate in reptile species that would have historically been present, including tuatara (Cree and Butler 1993).

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