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Additional notes on the birds and vegetation of the southern Kermadec Islands, 2002 and 2006

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Abstract Twenty five bird species were recorded following 2 brief winter visits to the southern Kermadec Islands during 2002 and 2006. Of these, 15 were seabirds and 10 land or shorebirds. Rapid changes in the dominant vegetation cover occurred between 1988 and 2002. Ferns replaced grass and sedge swards over much of the island, and although this succession was rapid, the distribution of woody species (the presumed historical dominant cover) did not change, most likely due to limited seed sources, Pacific rat (*Rattus exulans*) predation, and competition for space from other species. Possible impacts of these changes on the avifaunal composition of Macauley Island are discussed. Following the presumed eradication of Pacific rats from Macauley Island in 2006, recommendations are made for future vegetation and bird monitoring.

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INTRODUCTION

The Kermadec Islands comprise a chain of widely scattered active and extinct volcanic cones (or remnants of them) emerging from the Kermadec sub-oceanic ridge adjacent to the Tonga trench and Le Havre Trough (Veitch *et al.* 2004; Gaskin 2011). Macauley Island, the largest of the southern group, was visited during the winters of 2002 and 2006 to count and assess the risk to the population of Kermadec red-crowned parakeets (*Cyanoramphus novaezelandiae cyanurus*) by a proposed Pacific rat (*Rattus exulans*) eradication programme (Greene *et al.* 2004). During these visits we also had the opportunity and the means (a vessel equipped with a helicopter) to visit other islands briefly within this group and make notes on the status of the flora and fauna.

This paper records observations of birds made during 2 winter visits in 2002 and 2006. The publication of these winter observations is intended

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to both supplement and update the extensive information presented in Veitch *et al.* (2004) from these rarely visited islands.

METHODS

Only those species recorded on land or at sea immediately adjacent to the islands (Kermadec Island Coastal Marine Area, Gaskin 2011) visited were recorded. Direct sightings and evidence such as calls at night, size of burrows and the presence of corpses and eggs were also used.

We (TCG, RPS & PJD) recorded birds on or around L'Esperance Rock (5 ha) on 20 July 2002, and Curtis and Cheeseman Islands (52 & 7 ha, respectively) on 20-21 July 2002 (Fig. 1) from the sea. Five days were spent on Macauley Island (306 ha) from 21-26 July 2002 (see Fig. 1 for location of campsite) during which a brief landing was made on the lower slopes and top of Haszard Islet (6 ha; Fig. 1). This visit is thought to be the first time anyone has been able to access the top of this small island. Following our departure from Macauley Island and a further brief stop at Curtis Island, 2 of us (TCG & RPS) landed on Cheeseman Island for *c.*40 minutes. A small team of Institute of Geological & Nuclear Sciences (IGNS) scientists was landed on Curtis Island between 21-26 July 2002 and their observations of birds (particularly those of C. de Ronde) have also been incorporated in this account.

During 2006, TCG, PJD, RG & JWB observed birds on Curtis and Cheeseman Island from the sea and from the top of Curtis Island on 28 June. Seven days (28 June-4 July 2006) were spent on Macauley Island (the same campsite was used in 2002; see Fig. 1), followed by 1 day (5 July) on Raoul Island (2938 ha).

Detailed historical summaries of the geology and botanical features of the southern Kermadec Islands can be found in Veitch *et al.* (2004), Greene *et al.* (2004) and Gaskin (2004). Here we summarise recent major changes in vegetation composition and cover for those islands on which we were able to spend significant periods of time.

CHANGES TO VEGETATION

Macauley Island

In 1988, cutty sedge (*Cyperus insularis*)(as *C. ustulatus* in Veitch *et al.* 2004) and the grass (*Microlaena stipoides*) formed dense swards which dominated the island. By 2002 and 2006, these had been largely replaced by tall (up to 2.5 m) dense expanses of fern (*Hypolepis dicksonioides*) which covered about 70% of the island (Greene *et al.* 2004; Barkla *et al.* 2008). Despite these rapid successional changes, recovery of the island's presumed historical dominant woody cover appears slow (Veitch *et al.* 2004; Barkla *et al.* 2008). Since 1988, the distribution of woody species (particularly Kermadec ngaio *Myoporum rapense* subsp. *kermadecense*) remains largely unchanged. Restricted to the northern and western cliffs with a few sizeable outliers, the regeneration of woody species appears to be limited by low seed dispersal, seed predation by Pacific rats (Campbell & Atkinson 2002) and spatial competition from the extremely dense fern and sedge cover (Greene *et al.* 2004; Barkla *et al.* 2008; M. Ambrose, *pers. comm*.).

Haszard Islet

On 21 July 2002, the top of this small, very steep islet was accessed for the first time (Greene *et al.* 2004). At least 2 distinct vegetation types were noted during our short visit. The northern end and the cliff edges were dominated by iceplant (*Disphyma australe* subsp. *stricticaule*) with patches of *Parietaria debilis* and native spinach (*Tetragonia tetragonoides*). The remainder of the summit was covered in cutty sedge, scattered clumps of prostrate Kermadec ngaio (<1.5 m height) with any gaps filled by *P. debilis*, native spinach, *Polycarpon tetraphyllum*, *M. stipoides*, *Solanum nodiflorum*, *Sonchus* spp., *Apium p. prostratum* var. *filiforme* and some large *Lepidium oleraceum* (Greene *et al.* 2004). The entire surface was heavily burrowed by a variety of seabirds. No evidence for the presence of Pacific rats was seen and the island appears to have always been free of introduced predators.

Cheeseman Island

The most notable change to the vegetation of this island since the last (and only) recorded landing on this island during 1970, was the almost complete disappearance of cutty sedge from the upper slopes where, along with iceplant, it was formerly dominant (Sykes 1977; Veitch *et al*. 2004). When we visited in 2002, the sedge was almost entirely restricted to the small central valley where it was dominant with the exception of a few scattered plants on the surrounding slopes. The majority of the remaining slopes and rocky area was dominated by a mix of *Parietaria debilis* and iceplant, with the more exposed areas dominated solely by iceplant. In more sheltered areas, interspersed amongst these dominants, were individuals of the fern *Asplenium northlandicum*, *Sonchus* spp., *Cotula australis*, *Lachnagrostris littoralis*, *S. nodiflorum* and a few specimens of *L. oleraceum* (Greene *et al.* 2004). Any areas of friable soil were riddled with numerous petrel burrows. Mammalian predators have never been reported on Cheeseman Island.

CHECKLIST OF BIRDS OF THE SOUTHERN KERMADECS

Bird species recorded on and around the southern Kermadec Islands are listed below following the order and nomenclature of Checklist Committee (OSNZ 2010).

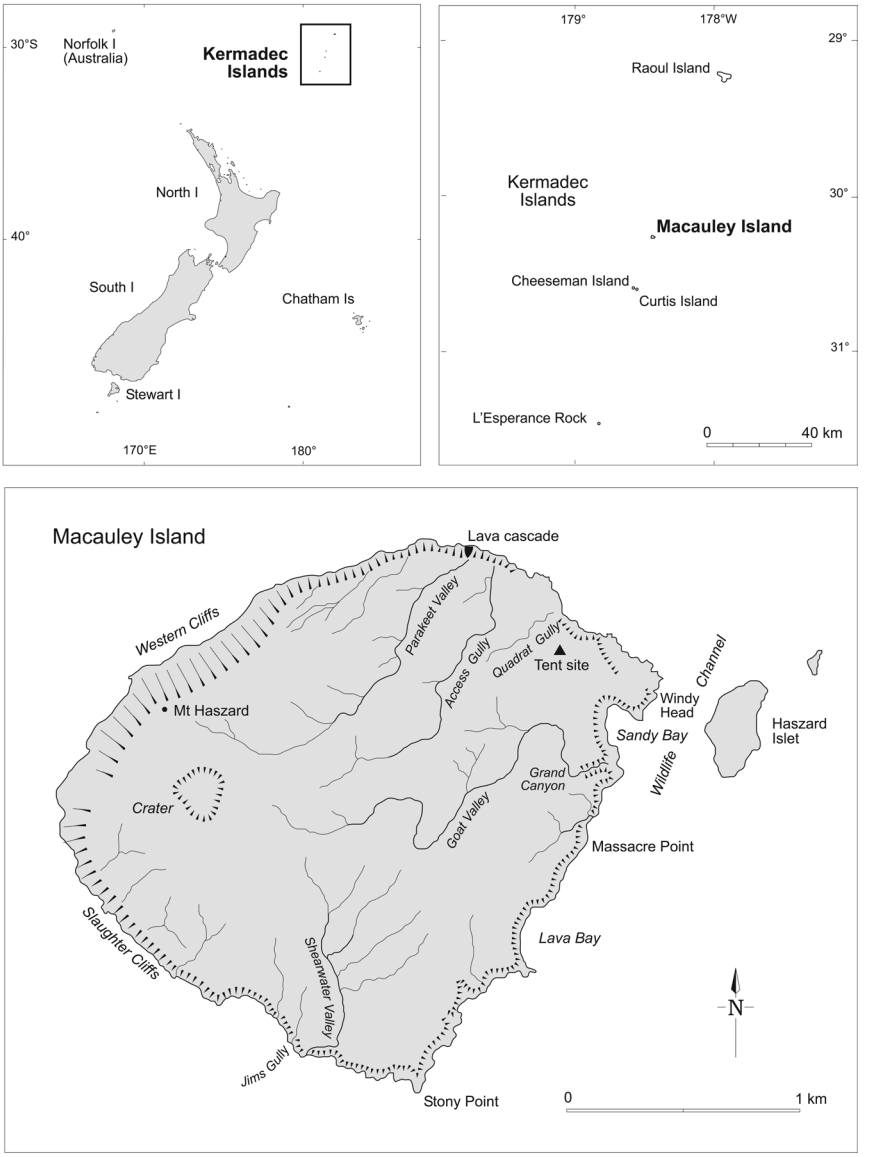

Fig. 1. Location of the Kermadec Islands and important geographic features on Macauley Island, including our campsite, referred to in text.

Northern giant petrel (*Macronectes halli***)**
One was seen from coastal cliffs flying past Macauley Island in July 2006.

Providence petrel (*Pterodroma solandri*)
At least 5 providence petrels were seen with larger numbers of Kermadec petrels (*Pterodroma neglecta*) (see below) between Macauley Island and Cheeseman Island on 26 July 2002. A decision from the Records Appraisal Committee (RAC) on this sighting is currently pending (OSNZ RAC UBR2014/04).

Kermadec petrel (*Pterodroma neglecta*)
One pale-phased bird was seen flying close to L'Esperance Rock on 20 July 2002. One was also seen near Curtis Island on 21 July 2002. Two dark-phased birds were seen on the ground on inaccessible cliffs on the eastern side of Haszard Islet. Photographs were taken of an adult dark-phase bird on an egg in an area of cutty sedge behind the beach on the western side of Haszard Islet (Tennyson *et al.* 2003). On Macauley Island, 6 birds of the 3 colour phases were seen flying over Haszard Islet and around the Sandy Bay cliffs during 21 July and 3 more were seen on 22 July 2002. On 25 July 2002, 3-4 birds seen flying over the cliffs below the summit and at least 1 was between Access Gully and the summit suggesting

that they were nesting and/or prospecting in these areas. One corpse was found on the Western Cliffs. No breeding birds were located (Tennyson *et al.* 2003). One chick, nearly fledged, and probably of the intermediate phase was seen on the surface of Cheeseman Island on 26 July 2002 (Tennyson *et al.* 2003). On 26 July 2002, 20-30 Kermadec petrels of all 3 colour phases were seen between Macauley Island and Cheeseman Island. There was only 1 sighting of 2 birds flying over Macauley Island during the day in 2006.

White-naped petrel (*Pterodroma cervicalis*)
Large numbers of corpses (>50) were encountered in gullies and at the base of cliffs (*e.g.,* in Access Gully and Quadrat Gully) on the eastern side of Macauley Island (Fig. 1) in 2002 and 2006. Healthy populations appear to be breeding in these areas. Several fledglings were seen trying to depart from patches of fern and *Solanum* scrub on Macauley Island and a few adults were observed flying over the island during the day in 2006. No birds were heard calling at night. The loss of the talus slope in Sandy Bay (Greene *et al.* 2004) has resulted in the loss of burrows for *c.*200 nesting pairs that were present in 1988 (Taylor & Tennyson 1988). On Haszard Islet a small number of burrows (<20) of a size used by this species and 1 deserted egg were located that measured 67 x 45 mm and may have been this species or wedge-tailed shearwater. We consider it likely that some of these burrows were of *Pterodroma cervicalis* as medium size white Procellariiform feathers were found in the nest bowls of several nests. No evidence of this species was detected on Cheeseman Island.

Black-winged petrel (*Pterodroma nigripennis*)
Numerous abandoned eggs, egg-shells and decomposed corpses were observed on the surface of some areas of Macauley Island in 2002 and 2006. A single late chick (deformed) was also seen on 29 June 2006. Only one adult was seen flying over gullies on the western side of island on 30 June 2006. No calls were heard at night. The large number of corpses and burrows of a size made by black-winged petrels suggests that this species is still the dominant summer burrowing seabird on Macauley Island, Cheeseman Island and Haszard Islet.

Wedged-tailed shearwater (*Puffinus pacificus*)
Less than 10 corpses of this summer-breeding shearwater were found. Large burrows surrounded by areas of bare vegetation typical of *Puffinus* shearwaters were only observed within 20–50 m of the cliff edge on the eastern side of Macauley Island in 2002. Higher densities of burrows and corpses were observed on the western side of the island in 2006. On Haszard Islet, burrows surrounded by bare vegetation and containing only dark feathers were found and are thought to be wedge-tailed shearwaters. No direct evidence of breeding birds was detected on Cheeseman Island.

Kermadec little shearwater (*Puffinus assimilis kermadecensis*)
About 20 birds were spotlighted or heard calling at night on Macauley Island in July 2002. None was seen or heard in 2006. The loss of the talus slope in Sandy Bay has resulted in the loss of the 50 burrows used by nesting pairs in 1988 (Taylor & Tennyson 1988). Several burrows of a size used by this species and 1 recently broken freshly laid egg confirm this species is present in very small numbers on top of Haszard Islet.

Little shearwaters were an abundant winter breeding species on Cheeseman Island in 2002. The majority of burrows on this heavily burrowed island appeared to be occupied by this species. At least 20 adults were on eggs at an advanced stage of incubation on 26 July 2002. The surface of Curtis Island was heavily burrowed near the fuel store on top of the island in 2006. Most of these burrows were active and assumed to be occupied by little shearwaters based on the time of year, size of burrows and records from previous visits (Veitch *et al*. 2004).

Kermadec storm petrel (*Pelagodroma albiclunis*)
Three were spotlighted on 3 separate nights on Macauley Island in July 2002. Fifty to 100 small burrows of a diameter suitable for this storm petrel were detected in bare ground on top of Haszard Islet. Although it is possible these burrows were produced by white-bellied storm petrels, subsequent visits have confirmed Kermadec storm petrels breeding on the lower slopes of Haszard Islet (Tennyson 2010; Gaskin 2011) and elsewhere white-bellied storm-petrels are crevice nesters rather than digging their own burrows (RPS, *pers. obs.*).

White-bellied storm petrel (*Fregetta grallaria*)
Five birds were spotlighted and 3 heard making their distinctive high pitched repetitive whistling calls on Macauley Island during July 2002. The discovery of some fresh but fragmentary remains attributed to this species on the cliffs overlooking Sandy Bay on 22 July 2002 confirmed the presence of this species, but given that at other breeding sites the majority fledge in May (Marchant & Higgins 1990), July may have been too late to detect the species in significant numbers.

Red-tailed tropicbird (*Phaethon rubricauda*)
Birds were found on Macauley Island occupying cavities in steep cliffs and on the sides of gullies composed of pumiceous tuff, amongst rock piles and under the dense canopy of regenerating Kermadec ngaio forest particularly in the northwest of island. Some birds were breeding inland but only

where there were bluffs with suitable cavities. No eggs were seen during either 2002 or 2006. One very small downy chick was seen in 2006 and numerous adult birds were observed regularly returning to almost fully grown chicks throughout the day during 2002 and 2006. The most common food items provided to chicks appeared to be flying fish (*Cypselurus lineatus*). We estimated the winter breeding population of this species on Macauley Island to be between 200 and 300 pairs. One chick, near fledging, was found on the cliffs on the eastern side of Haszard Islet in 2002 and at least 3 other potential nest sites were seen. No birds were seen on Curtis, Cheeseman or L'Esperance Islands in 2002 or 2006.

Masked booby (*Sula dactylatra*)
At least 2 pairs of birds were observed on L'Esperance Rock in July 2002. This is the first record of this species on this island (Veitch *et al.* 2004) but it is not known if they were attempting to nest. IGNS volcanologists visiting Curtis Island at the same time reported about 100 occupied nests (C. de Ronde, IGNS, *pers. comm.*). Many of these nests had 1 egg but some were seen with 2 eggs; no chicks were seen. In 2006, small numbers of masked boobies were seen flying around Curtis and Cheeseman Islands. On Curtis Island in 2006, several adult pairs were observed sitting on ground scattered over summit plateau with a small number of immature birds flying about overhead. The number of masked boobies seen on Macauley Island was similar to the number recorded in 1988 (Taylor & Tennyson 1988). Forty-eight nests were noted on the short section of northern coast between our camp and the summit of Mt Haszard (Fig. 1) on 25 July 2002. Of these, 9 had 1 egg, 2 had 2 eggs and 1 had a single newly hatched chick. Any close approach to incubating birds usually resulted in the regurgitation of large flying fish. Five banded birds were seen and 3 were captured. All captured birds had been banded as juveniles on Macauley Island in 1988 (Taylor & Tennyson 1988). Far fewer birds were seen on Macauley Island during 2006 compared to 1988 – presumably due to the earlier timing of our visit. Circumnavigation of the island by helicopter on 4 July 2006 suggested numbers had risen to ~50 individuals prior to our departure. Birds were restricted to areas of bare ground near cliff edges or sparse clumps of *C. insularis* and iceplant (*cf.* earlier observations of breeding birds scattered over the central plateau (*e.g.,* Gaskin 2011). On Macauley Island no sign of nesting was seen and immature birds appeared more common than adults. A small number of masked-boobies were seen flying about Haszard Islet and 11 were observed on the ground at the top of the western cliffs.

Swamp harrier (*Circus approximans*)
Single adults were seen over Curtis and Cheeseman Islands in 2002 and 1-3 harriers were seen each day flying over Macauley Island in 2006. Circumstantial evidence for harriers having killed and fed on parakeets, petrels, shearwaters and Pacific rats on Macauley Island was noted in both 2002 and 2006. A freshly eaten, still warm, grey noddy (*Procelsterna cerulea albivitta*) corpse was found on Cheeseman Island in 2002 – we suspect that it was a swamp harrier victim.

Ruddy turnstone (*Arenaria interpres*)
A flock of 6 birds were seen on 25 July 2002 on the coastal lava platform of Macauley Island near the mouth of Access Gully (Fig. 1).

Pacific golden plover (*Pluvialis fulva*)
Two birds were seen flying north over our campsite on Macauley Island on 22 July 2002.

Brown noddy (*Anous stolidus pileatus*)
Two birds were seen off L'Esperance Rock on 20 July 2002 suggesting that a small population may nest here. Two were seen feeding with grey noddies off Curtis Island (where they are known to breed; Taylor & Tennyson 1988) on the 21 July 2002.

Black noddy (*Anous minutus minutus*)
No birds were seen around any of the southern Kermadec Islands in 2002. Small numbers (<5) were seen flying about Curtis and Cheeseman Islands in 2006. This species appears to be almost completely absent from the Kermadec Islands during the non-breeding season (Veitch *et al.* 2004).

Grey noddy (*Procelsterna cerulea albivitta*)
More than 2000 birds were seen roosting and flying around L'Esperance Rock on 20 July 2002 and the cavernous hole in the centre of the island was white with noddy guano. Large numbers of birds (*c.*1000) were also seen roosting and flying around coast of Curtis and Cheeseman Islands on the same day. On Macauley Island more than 500 birds were seen roosting and flying about the small piece of coast visited in 2002. In 2002, between 100 and 200 birds were noted roosting, prospecting and preparing nest sites in caverns, and on cliff faces in Quadrat Gully and *c.*50 were seen in Access Gully (Fig. 1); none were seen on eggs.

In 2006 far fewer grey noddies were seen flying about Curtis, Cheeseman and Macauley Islands than in 2002. About 10 birds were seen flying around coastal cliffs and over Macauley Island, 20-30 birds were seen sitting on top of or flying about a small rock stack off Stony Point and on 2 July 2006 a flock of *c.*20 were seen in Wildlife Channel. Presumably the species had not yet commenced breeding.

Sooty tern (*Onychoprion fuscatus serratus*)
A single dark-plumaged immature bird was seen off L'Esperance Rock on 20 July 2002. Abandoned eggs were found at 6 sites on Macauley Island in

Table 1. Frequency of plant parts eaten by Kermadec red-crowned parakeets on Macauley Island in July 2002 and July 2006.

Species	Food type	Foraging frequency	
		2002	2006
Bidens pilosa	Flowers	Common	Common
	Seeds	Common	Common
Cyperus insularis	Leaves	Some	Common
Disphyma australe subsp. *stricticaule*	Leaves	Common	Common
Ipomea cairica	Leaves	Some	Few
*Lepidium oleraceum**	Leaves	Rare	-
	Flowers	Rare	-
Cotula australis	Flowers	Common	Common
Myoporum rapense subsp. *kermadecense*	Flowers	Rare	Some
	Fruit (on ground)	Rare	Common
Oxalis corniculata	Seeds	Rare	Rare
Polycarpon tetraphyllum	Seeds	Common	Common
Pseudognaphalium luteoalbum	Flower buds	Rare	-
Scaevola gracilis	Leaves/leaf buds	Common	Common
	Flowers	Rare	Some
Sicyos mawhai	Flowers/buds	Some	Some
Solanum nodiflorum	Flowers	Some	Common
	Fruit	Some	Common

*A few observation were made on Hazard Islet in 2002

July 2002 and a single desiccated corpse was found above Access Gully. On Curtis Island the IGNS party reported large numbers of corpses within the crater area. Six desiccated sooty tern corpses and several eggs were located on the northern point of Cheeseman Island on 26 July 2002. A significant colony has been reported on Cheeseman Island during the summer months (Veitch *et al.* 2004). There was no evidence of sooty terns on Macauley Island in 2006.

Kermadec parakeet (*Cyanoramphus novaezelandiae cyanurus*)
Kermadec parakeets were common on Macauley Island (*c.*3,500 individuals in 2006) and were by far the most common terrestrial species observed in 2002 and 2006. Flocks of 20-30 birds were commonly seen flying over the island with some, particularly those flying about over patches of salt burnt *Solanum nodiflorum* scrub in 2006, comprising more than 100 individuals. Large groups were also seen foraging on low-growing vegetation particularly along the cliff edges, under areas of regenerating Kermadec ngaio forest, isolated large Kermadec ngaio trees, a single large Kermadec poplar (*Homalanthus polyandrus*) (Barkla *et al.* 2008), patches of *Scaevola gracilis* and *Ipomea cairica* and extensive patches of salt burnt *Solanum* scrub. Several birds were seen in pockets of vegetation (*e.g.*, *Calystegia soldanella*, native spinach *Tetragonia tetragonoides*) on the coastal fringe and cliffs. Parakeets were also common on the top of Haszard Islet. We did not see this species on either Curtis or Cheeseman Islands.

A list of plant species, and the frequency of plant parts consumed by parakeets is summarised in Table 1. A combination of flowers, seeds, fruit and leaf material from a variety of 13 plant species was consumed. The diet of parakeets was very similar in 2002 and 2006 with differences simply reflecting changes in seasonal phenology and continued changes in the vegetation community. Parakeets were never seen eating any part of the fern *H. dicksonioides* despite its abundance over much of the island.

New Zealand kingfisher (*Todiramphus sanctus vagans*)
Two were seen on the coast between Access Gully and Windy Point on Macauley Island in 2006. This appears to be only the second record for the island (Veitch *et al.* 2004). Kingfishers have not been seen elsewhere in the southern Kermadec group.

Welcome swallow (*Hirundo neoxena*)
About 8-10 swallows were present on Macauley Island in both 2002 and 2006. Swallows were frequently seen near our camp but were most

commonly observed above the Western Cliffs below the summit ridge (Fig.1). In 2002, on Macauley Island, smaller swallows with shorter squarer tails (*c.*3 for which we had good views) were also seen on Macauley Island. These birds had grey underparts and little (if any) spotting on the uppersides of the rectrices. We believe that these were Pacific swallows (*Hirundo tahitica*) – a species previously unrecorded from New Zealand – but could not confirm this without better observations. Small numbers of swallows were also seen in 2002 flying about Curtis and Cheeseman Islands – 8 of which appeared to be flocking with starlings. At least some of these birds were welcome swallows as they had long tails, whitish under-parts and the upper tail was liberally spotted.

Eurasian blackbird (*Turdus merula*)
Small numbers of blackbirds were seen and heard on Macauley Island. In 2002, alarm calls were heard in Access Gully, a female blackbird was seen at the head of Grand Canyon and a male bird was seen flying between Sandy Bay and Grand Canyon (Fig. 1). Fewer blackbirds were noted during our 2006 visit to Macauley Island with only 1 bird heard calling from regenerating Kermadec ngaio on the Western Cliffs below the summit ridge; another unidentified *Turdus* was seen flying past our camp site.

Song thrush (*Turdus philomelos*)
Song thrushes were rarely seen on Macauley Island. One bird was seen on the beach between Access Gully and Quadrat Gully and another single bird seen in a small copse of Kermadec ngaio inland from the western cliffs near Jim's Gully in 2002 (Fig. 1).

Common starling (*Sturnus vulgaris*)
Small numbers of starlings were scattered over Macauley Island during 2002 and 2006, particularly in association with cliffs, bluffs, gullies and coastal areas. In 2006, a flock of 30+ starlings was seen near our camp but most birds were observed in flocks of 5-7 birds. Although starlings were furtive, very mobile and easily disturbed, we suspect the total population on Macauley Island could be as large as 100 birds. A flock of 12 birds was seen above Haszard Islet in 2002 but it is not known whether they were resident or visiting from Macauley Island. Two starlings were also seen in 2002 flying around L'Esperance Rock and a flock of 12 birds was seen with 8 swallows flying around Cheeseman Island.

New Zealand pipit (*Anthus novaeseelandiae*)
One pipit was seen flying between camp and Windy Point on Macauley Island in 2006. This is the first confirmed record for this species in the Kermadec Islands since 1944 (Veitch *et al.* 2004).

DISCUSSION

A total of 25 bird species was recorded, or evidence of their presence noted, on or immediately around the southern Kermadec Islands during our winter visits in 2002 and 2006. Fifteen of these species were seabirds and 10 were land or shorebirds. Of the land birds only 5 were considered indigenous, with the Kermadec parakeet the only indigenous terrestrial species resident in the southern Kermadec Islands (Taylor 1985; Veitch *et al.* 2004). A number of vagrants were also noted, including providence petrels, kingfishers and a pipit. Brown noddies were reported for the first time since the species was found nesting on Curtis Island in 1989. On Haszard Islet we discovered probable burrows of white-naped petrels and Kermadec storm petrels. Notable absentees included silvereyes and any representatives from the finch family, several of which have been recorded on previous visits to the southern Kermadec Islands (Veitch *et al.* 2004).

The relatively young age and volcanic nature of the islands has been suggested as a significant driver of the low diversity of terrestrial invertebrates and flora, with associated consequences for the diversity of the terrestrial avifauna (Veitch *et al.* 2004). The lack of surface water on these islands and the potential for associated periodic food shortages has also been cited as a further impediment to colonisation by many terrestrial bird species. These factors have also been suggested as likely major drivers for the dramatic population fluctuations observed for Kermadec parakeets on Macauley Island (Taylor 1985; Tennyson *et al.* 1989; Greene *et al.* 2004; Veitch *et al.* 2004). In contrast, seabirds represent a significantly larger and more diverse component of the avifauna. The Kermadec Islands are the only known breeding locations for at least 11 taxa in the New Zealand region (Veitch *et al.* 2004) with some species, such as black-winged petrels on Macauley Island, being exceptionally abundant, having reached populations in excess of 2-3 million pairs (Veitch *et al.* 2004). Other taxa, such as Kermadec storm petrels, appear much rarer with the small, historically rat-free Haszard Islet only recently confirmed as a breeding site for this species in 2006 (Tennyson 2010).

Macauley Island is the only island within the southern group to have been subjected to significant human induced habitat modification. The introduction of Pacific rats, pigs (*Sus scrofa*; not recorded after 1836), goats (*Capra hircus*; Straubel 1954) and regular fires in the 19th century (Oliver 1910) directly affected the avifauna through predation, habitat loss and indirectly by effectively reducing the accessible flora to a sward of *M. stipoides* by 1966 (Sykes 1969). Following the eradication of goats in 1970 changes in vegetation composition and cover were dramatic and by 2006 had culminated in the dominance of the fern *H. dicksonioides* over about

70% of the interior surface area of the island (Greene *et al.* 2004, Barkla *et al.* 2008).

Kermadec parakeet numbers have declined markedly from reported maximum estimates of 17,000-20,000 birds in 1988 (Veitch *et al.* 2004) to 3,500 birds in 2006. Although periodic drought appears to be capable of rapidly reducing parakeet abundance, it seems likely that the rapid spread of *H. dicksonioides* has also played a significant role. No parakeets were observed foraging in areas of fern during either of our visits and very few were ever seen in these patches. It is doubtful that *H. dicksonioides* produces much of food value for parakeets (or other land bird species), particularly when compared to the large number of seed heads produced by the formerly more extensive grasses and sedges. Despite these changes, considerable habitat suitable for parakeets is likely to persist. In fact, parakeet numbers will probably increase as a result of the removal of Pacific rats in 2006 and the projected floral regeneration, particularly the spread of more woody vegetation such as Kermadec ngaio (Campbell & Atkinson 2002).

Although the vast seabird populations inhabiting Macauley Island suggest that the impact of Pacific rats on the dominant species has been minor, the current restricted distribution of smaller species (particularly Kermadec little shearwater, Kermadec storm petrel, white-bellied storm petrel and noddies) on the southern Kermadec Islands implies significant impacts on their breeding success. Eradication of Pacific rats from Macauley Island in 2006 and the proximity of historically rat-free islands close to Macauley Island (*e.g.,* Haszard, Curtis and Cheeseman Islands) should help ensure the long-term security of these smaller seabirds.

Goats were eradicated from Macauley Island in 1970, and since then there have been marked increases in the numbers of white-naped petrels, black-winged petrels, wedge-tailed shearwaters and sooty terns (Veitch *et al.* 2004). Between 1970 and 1988, the most noticeable change in vegetation was a marked increase in cutty sedge (*Cyperus insularis*); this had a negative effect on black-winged petrels by causing significant cuts to their webs when they climbed through or over it. A thick sward of *H. dicksonioides* fern up to 3 m high has increased hugely in extent since 1988, but appears to have had little impact on the burrow densities and numbers of white-naped and black-winged petrels (RPS, *pers. obs*.). The effect of the growth of this species on the burrow density and corpse numbers of wedge-tailed shearwaters breeding on Macauley Island between 1988 and 2002 requires clarification by survey during the breeding season. The impact of ferns was however demonstrably marked for masked boobies. All masked boobies seen in 2002 and 2006 were restricted to the coastal cliff margin, presumably having been forced from previous observed sites in the centre of the island by the increasing height and density of the vegetation. Although other surface nesting seabirds were not present on Macauley Island during our visits, it seems likely that the available nesting areas for species such as sooty terns has decreased markedly along with the area covered by smaller grasses and sedges which have either retreated to cliff edges or disappeared. In 2006, white-naped petrel fledglings were seen struggling to escape dense areas of fern, and in 2002, three corpses of red-tailed tropic bird fledglings were found in areas of fern – this suggests that the fern may be having widespread impacts on birds.

Since its discovery in 2002, *Achyranthes velutina* (de Lange *et al.* 2004 as *Achyranthes aspera*; a plant regarded as indigenous) has continued to spread on the northern and Western Cliffs of Macauley Island and by 2006 had begun colonising Windy Point (Greene *et al.* 2004; Barkla *et al.* 2008). It is possible that continued spread and increased surface coverage by this species in these or similar sites will begin to impact on the availability of breeding sites of the relatively small numbers of Kermadec petrels and masked boobies as well as other surface nesting birds on Macauley Island (Tennyson *et al.* 2003; Veitch *et al.* 2004; Greene *et al.* 2004).

The 2 winter visits to the southern Kermadec Islands in 2002 and 2006 provide the most recent assessment of the avifauna of this isolated island archipelago. In particular, we hope the visits to Macauley Island will provide a useful baseline against which the impact of the eradication of Pacific rats in 2006 can be measured. Although regular future monitoring of Macauley Island will be limited by its isolation and inaccessibility, future visitors should, in view of previous significant conservation investment, be encouraged to: (1) confirm the absence of rats, (2) use robust survey methods to assess the status of land birds generally and the Kermadec parakeet population in particular, (3) accurately assess burrow density and seabird numbers, and (4) continue to monitor the dynamic and rapidly changing vegetation communities that are continuing to evolve following the removal of goats in 1970 and Pacific rats in 2006.

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