

GREAT BARRIER ISLAND WILDLIFE SURVEY

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SUMMARY

Sixty-two species of birds (55 land birds, including migratory waders) were recorded in a survey of Great Barrier Island, March—April 1980. In addition, the following land-fauna were found: nine species of lizard, two species of frog, two species of Rhytidid molluscs, and eight species of introduced wild mammals. Included in these totals are the first known records from Great Barrier Island of spotless crane (*Porzana tabuensis plumbea*), Hochstetter's frog (*Leiopelma hochstetteri*), the mollusc *Rhytida greenwoodi*, and a lizard which was possibly *Cyclodina oliveri*. The current status of species not found by this survey but recorded by earlier authors (Bell and Brathwaite 1964, Bell 1976, Harris 1980, Hutton 1868, Powell 1938, Taylor 1976) is discussed.

INTRODUCTION

At the request of the Department of Lands and Survey, Auckland, the Fauna Survey Unit of the New Zealand Wildlife Service surveyed Great Barrier Island, as a contribution to a multi-disciplinary land-use study of the island. The wildlife survey was made from 26 March to 12 April 1980 although the author remained until 15 April 1980. A preliminary report of this survey (Ogle 1980) was prepared for the Department of Lands and Survey, and was also distributed to some other statutory bodies and individuals.

(a) Location and land-form

Great Barrier Island, 28 500 hectares in area, lies across the entrance to the Hauraki Gulf, about 80 km north-east of Auckland and 20 km north of Coromandel Peninsula (Fig. 1). It is topographically very dissected with a strongly indented western coastline and broad sweeping bays on the east. The greatest dimensions of the main island are about 35 km x 20 km, and the highest peak, Hirakimata (Mt. Hobson) is 621 m. Geologically, Great Barrier Island comprises sedimentary rocks overlain by a variety of rhyolitic and andesitic materials, except in the north of the island (Wilson, Moore and Hochstein 1973). The island was connected to the Coromandel and Northland Peninsulas during the late Otiran glacial (20 000-18 000 years b.p.) and separation may have been as recent as 10 000 years b.p. (Stevens 1980).

(b) Climate

The climate of Great Barrier Island is mild; frosts are rare. Annual rainfall at sea level is approximately 1 800 mm, largely in winter

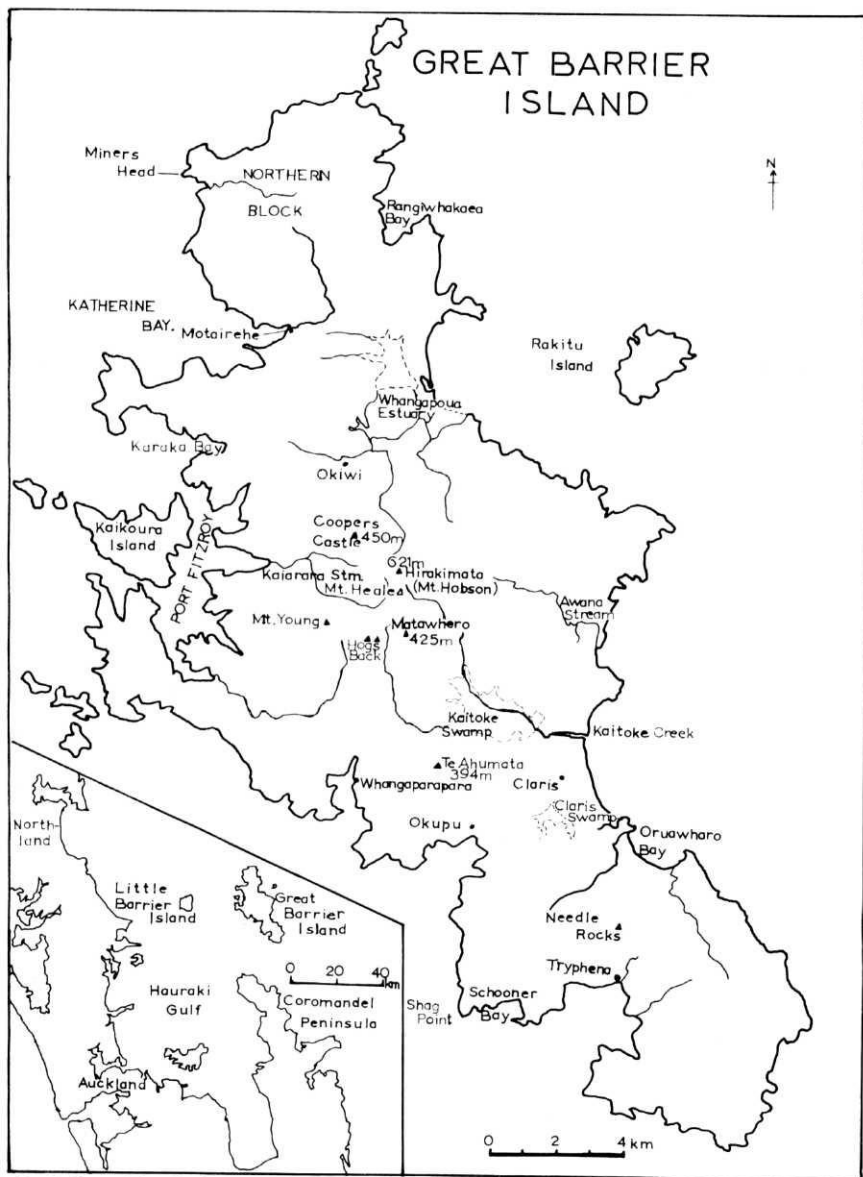


Fig. 1. Great Barrier Island: location and topographic features.

months, while summers are hot and relatively dry (Great Barrier Island Committee of Inquiry 1975).

(c) Vegetation

The present vegetation is a complex mosaic of forest remnants, shrublands, exotic pastures, freshwater wetland communities, and small areas of salt marsh, sand dune associations, and exotic tree plantations. Timber extraction and later farming have been the major causes of reduction in the original forest cover, but shrublands and secondary forest now occur over considerable areas which had been cleared previously. Bell and Brathwaite (1964), and Mason (1951) discussed the vegetation in more detail, and a vegetation map was made in 1980 as a separate contribution to the Department of Lands and Survey's land use study of Great Barrier Island.

(d) Wildlife

Taxonomy in this paper follows that used by the Ornithological Society of New Zealand (1970, 1980) for birds, Hardy (1977) for skinks, Robb (1980) for frogs and geckos and Powell (1979) for molluscs.

The wildlife of Great Barrier Island has already been the subject of numerous reports, some on the results of broad surveys, e.g. Hutton (1868), Bell and Brathwaite (1964), and Bell (1976), and others concerning individual species; Bartle (1967), Imber (1978), MacFadden (1977), and Williams (1976, 1977). All these reported the status of bird species. The presence of other indigenous fauna of special note has been given in taxonomic reviews, for example by Hardy (1977) for lizards and Powell (1938, 1949) for land molluscs.

With this background, much of it published at the time, it is hard to understand the almost complete absence of recognition given to wildlife in the Great Barrier Island Committee of Inquiry's report (1975) on "the island's affairs and future". Bell (1976) stated that before any changes of existing land use were implemented further biological surveys should be carried out, so that such rare and interested biota could be protected. He demonstrated that changes had occurred in the species of birds present on Great Barrier Island within quite short time spans, and he also pointed to deficiencies in knowledge of the status of some birds and most other wildlife.

No short survey could fill all gaps in information, and the team of five members of the Wildlife Service Fauna Survey Unit concentrated on:

1. Up-dating data on distribution and numbers of birds.
2. Locating other indigenous fauna (bats, frogs, lizards, large land molluscs) and recording distribution, numbers and features of their habitats.
3. Identifying and ranking all "habitats of note" (i.e. areas supporting one or more wildlife species of particular interest).

4. Assessing the status of introduced animals and degrees of threat they pose to indigenous wildlife.
5. Identifying other actual or potential threats to the survival of indigenous wildlife.

METHODS

1. Distribution and numbers of fauna

(a) Birds:

A separate bird list was made for each 10 000 m grid square of NZMS 259 topographical map in which a part of the main island occurs. These data were replotted on to 10 000 yard grid squares of NZMS1 maps and were sent to the Ornithological Society of New Zealand (OSNZ) bird mapping scheme. Tape-recorded calls were played in likely areas to find kokako (*Callaeas cinerea wilsoni*), spotless crane, and marsh crane (*Porzana pusilla*). It was proposed initially to include five-minute bird counts on transects of larger forested areas, but this method was abandoned after two days of trials in the State Forest, where a maximum of three birds, and sometimes none, was recorded per five-minute count. The low numbers of forest birds heard or seen may reflect an actual paucity of birds, or a low level of vocal activity so late in the season.

Counts were made of brown teal (*Anas aucklandica chlorotis*) on all roosts, and wading birds on estuaries and beaches. Individual sightings were mapped for other brown teal, parakeets (*Cyanoramphus* spp.), kokako, New Zealand dotterel (*Charadrius obscurus*), Australasian bittern (*Botaurus stellaris poiciloptilus*), fernbird (*Bowdleria punctata*), spotless crane, and banded rail (*Rallus philippensis assimilis*).

(b) Exotic mammals:

In each habitat of note any evidence of predators and browsing animals was recorded. Because each habitat was usually visited only once, no trapping of rodents proved possible, but dead animals and other signs were identified and information was sought from residents.

(c) Bats:

Watches were made for bats at dusk in calm weather.

(d) Lizards:

Eleven species of lizards were known from the island prior to this survey. Knowledge of their habitats elsewhere enabled similar areas to be checked here, with the least possible disturbance. As most areas were visited once only, no systematic live trapping was possible. Photographs were taken of species found, and the animals released. Information was also sought from residents and from R. Rowlands of the New Zealand Herpetological Society (NZHS). Following the land use study, further information on lizards was supplied by J.A. West of the NZHS and J. McCallum.

(e) Frogs:

Although no native frogs (*Leiopelma* spp.) had been reported previously on this island, Great Barrier's geological links with the Coromandel Peninsula (Stevens 1980) suggested that either or both Hochstetter's frog (*L. hochstetteri*) and Archey's frog (*L. archeyi*) could be present. Likely situations were searched. Sightings were recorded of introduced frogs (*Litoria* spp.), although no special searches were made for them.

(f) Terrestrial molluscs:

Searches were made for larger land snails (F. Rhytididae and F. Bulimulidae only).

2. Identification of habitats of note

Standard New Zealand Wildlife Service National Habitat Register cards were filled in for all notable forest remnants, swamps, tidal creeks, and harbours, and the areas were mapped on topographical map NZMS 259 Edition 2 1978. For land-use planning, habitats were rated for their wildlife importance. This information was supplied to the Department of Lands and Survey, is given in Ogle (1980), and is not repeated in this paper.

RESULTS

BIRDS

The far right-hand column of Table 1 shows the 63 species found in the 1980 survey. Of these, about 58 use the main island for at least part of their lives. The status of additional land and shore birds which have been recorded since 1960 is assessed as:

(i) Vagrants (birds which visit occasionally but are not established as a breeding population, nor are they regular migratory visitors): white heron (*Egretta alba*), New Zealand falcon (*Falco novaeseelandiae*), little black shag (*Phalacrocorax sulcirostris*), whimbrel (*Numenius* sp.), white-backed magpie (*Gymnorhina tibicen hypoleuca*), bellbird (*Anthornis melanura*).

(ii) Present, or regular migrants not seen on 1980 survey: Cook's petrel (*Pterodroma cookii*), shining cuckoo (*Chrysococcyx lucidus*), South Island pied oystercatcher (*Haematopus ostralegus finschi*).

(iii) Doubtful: rifleman (*Acanthisitta chloris*), pied tit (*Petroica macrocephala toitoi*), yellow-crowned parakeet (*Cyanoramphus auriceps auriceps*), California quail (*Lophortyx californica*).

Thirty-seven of the species are considered in more detail below.

Northern blue penguin (*Eudyptula minor iredalei*).

Seen at night under Port Fitzroy Guest House wharf and on

Tryphena Beach; swimming to the north of Kaikoura Island and off the southern-most headland of the Great Barrier in daylight; nesting at Cape Barrier; dead birds at several locations. Much suitable breeding habitat exists and this penguin is probably quite common.

Cook's petrel (*Pterodroma cookii cookii*).

Not searched for, as M. Imber of New Zealand Wildlife Service is monitoring the small breeding colony and reports (pers. comm.) that perhaps 20 pairs nest near the track on the lower north-west slopes of Mt. Hobson, outside the black petrel (*Procellaria parkinsoni*) breeding area. Cook's petrel may be a recently established breeding species on the island; its main breeding areas are Little Barrier Island and Codfish Island.

Black petrel (*Procellaria parkinsoni*).

Since breeding black petrels were found at Mt. Hobson in 1960 by Bell and Merton (*in* Bell and Brathwaite 1964) there has been research on this colony and searches of similar sites on surrounding peaks. Current estimates by M. Imber (pers. comm.) are of 1 000 pairs in the area encompassing Mt. Hobson, the upper Kaiarara Stream, north and west of Mt. Matawhero, and the Hog's Back. Small numbers breed on Coopers Castle and Te Ahumata, and possibly on the flanks of Mt. Young. Black petrels now nest mainly on Great Barrier Island, with a small colony on Little Barrier Island.

As for Cook's petrel, our survey did not include active searching for black petrels, but many burrows were seen on Mt. Hobson; a down-covered chick was observed in a shallow burrow beside the track. Nesting habitat is nearly always under forests which have escaped burning, on steep slopes under tree roots and logs. A relatively high breeding success rate and presence of newly-constructed burrows indicate that the population is expanding, in contrast to that on Little

Table 1 (opposite). Summary of bird surveys on Great Barrier Island including seabirds seen from the coast. Vernacular names follow Ornithological Society of New Zealand (1970, 1980). (Adapted and extended from Bell 1976). Key to symbols:

- x specifically identified
- ? uncertain identity
- ! unlikely identity
- + also records of Hutton and Kirk (1868) for Arid Island
- * excluding Hutton's (1868) records which are listed separately here.
- 1 previously reported/not seen by author
- 2 previous unconfirmed record
- 3 identified by later authors
- 4 seen at sea, Great Barrier region
- 5 washed up dead on shore
- 6 on Arid Island only
- 7 probably grey-headed mollymawk see Oliver (1955) p.168.
- 8 reported simply as magpie
- 9 storm wrecked inland

	HUTTON (1868)+	BELL & BRATHWAITE (1964)*	WILDLIFE SERVICE UNPUBL.	REED (1972)	BIRD MAPPING SCHEME (1969-76 BELL (IN BULL 1976) et. al. 1976)	MARCH 1975 (IN BELL 1976)	OCT.-NOV. 1976 (TAYLOR 1976)	WILDLIFE SURVEY, MARCH-APRIL 1980
Northern blue penguin	x	x	x5	-	x	-	-	x
Wandering albatross	x	x4	-	-	-	-	-	x9
Black-browed mollymawk	x	x1	-	-	-	-	-	-
Yellow-nosed mollymawk	77	-	-	-	-	-	-	-
Giant petrel	x	x4	-	-	x4	-	-	-
Cape Pigeon	x	x4	-	-	-	-	-	-
Grey-faced petrel	x	x1,6	-	-	-	-	-	-
White-headed petrel	-	x4	-	-	-	-	-	-
Mottled petrel	-	x2	-	-	-	-	-	-
Cook's petrel	x	7	x	x	x	x	-	-
Fairy prion	x	x1	-	-	-	-	-	-
Black petrel	x	x	x	x	x	x	-	x
Flesh-footed shearwater	-	x1	-	-	x	-	-	x 4, 5
Buller's shearwater	-	x1	x5	-	x	-	-	x 4
Sooty shearwater	-	x5	x5	-	-	-	-	-
Fluttering shearwater	-	x	x5	-	x	-	-	-
Little shearwater	7	-	-	-	-	-	-	-
Grey-backed storm petrel	x4	-	-	-	-	-	-	-
White-faced storm petrel	-	-	x5	-	x4	-	-	-
Black-bellied storm petrel	x	-	-	-	-	-	-	-
Northern diving petrel	x	x	x5	-	-	-	-	-
Australasian gannet	x	x	-	x	x	x	x	x
Black shag	-	x	x	x	x	x	-	x
Pied shag	x	x	x	x	x	x	-	x
Little black shag	-	-	-	-	x	x	x	-
Little shag	-	x	x	x	x	x	x	x
White-faced heron	-	x1	x	x	x	x	x	x
White heron	-	x1	-	-	-	-	-	-
Reef heron	x	x	-	x	x	x	x	x
Australasian bittern	x1	x	x	x	x	x	x	x
Black swan	-	x1	x1	x	x	-	-	x
Paradise shelduck	-	-	x	x	x	x	-	x
Mallard	-	x	x1	x	x	x	x	x
Grey duck	x	x	x	x	x	x	x	x
Brown teal	-	x	x	x	x	x	x	x
Australasian harrier	x	x	x	x	x	x	x	x
New Zealand falcon	x	x	-	-	-	-	-	-
New Zealand quail	x1	-	-	-	-	-	-	-
Brown quail	-	x	x	-	-	-	x	x
Californian quail	-	x1	-	x	-	-	-	-
Pheasant	-	x	x	x	x	x	x	x
Banded rail	-	x	x	x	x	x	x	x
Spotless crane	-	-	-	-	-	-	-	x
North Island Weka	-	x6	x1,6	-	-	-	-	-
Pukeko	-	x	x	x	x	x	x	x
South Island pied oystercatcher	-	x	-	-	-	-	x7	-
Variable oystercatcher	x	x	x	x	x	x	x	x
Least golden plover	-	-	-	x	x	x	x	-
New Zealand dotterel	x	x	x	x	x	x	-	x
Banded dotterel	-	x	x	x	x	x	-	x
New Zealand Shore plover	x	-	-	-	-	-	-	-
Whimbrel	-	x	-	x	x	x	-	x
Bar-tailed godwit	x	x	-	x	x	x	-	x
Pied stilt	-	x	x	x	x	x	x	-
Arctic skua	-	x	x	x	x	x	x	x7
Southern black-backed gull	x	x	x	x	x	x	x	x
Red-billed gull	x	x	x	x	x	x	x	x
Caspian tern	x	x	-	x	x	x	-	x
White-fronted tern	x	x	x	x	x	x	-	x
New Zealand pigeon	x	x	x	x	x	x	x	x
North Island kaka	x	x	x	x	x	x	x	x
Red-crowned parakeet	x	x1	7ap.	7ap.	-	7ap.	-	x
Yellow-crowned parakeet	x	7	-	-	-	-	-	7
Shining cuckoo	x	x	x	x	x	x	-	x
Long-tailed cuckoo	-	x1	-	-	-	-	-	x
Morepork	x	x	x	x	x	x	-	x
New Zealand kingfisher	x	x	x	x	x	x	-	x
Broad-billed roller	-	x1	-	-	-	-	-	-
North Island rifleman	x	x	-	x1	-	-	-	-
Skylark	-	x	x	x	x	x	x	x
Welcome swallow	-	-	-	-	x	x	x	x
New Zealand pipit	x	x	x	x	x	x	x	x
Hedgeparrow	-	x	x	x	x	x	x	x
North Island fernbird	x	x	x	x1	-	-	x1	x
Brown creeper?	-	11,6	-	-	-	-	-	-
Whitehead	-	x6	-	-	-	-	-	-
Grey warbler	-	x	x	x	x	x	x	x
North Island fantail	x	x	-	-	-	-	-	x
Pied tit	-	x2	-	-	-	-	-	-
North Island robin	-	-	-	-	-	-	-	-
Song thrush	-	-	x	x	x	x	x	x
Blackbird	-	-	x	x	x	x	x	x
Silvereye	x1	x	x	x	x	x	x	x
Stitchbird	x	-	-	-	-	-	-	-
Bellbird	x	x6	-	-	-	-	-	-
Tui	-	x	x	x	x	x	x	x
Yellowhammer	-	x	x	x	x	x	x	x
Chaffinch	-	x	x	x	x	x	x	x
Greenfinch	-	x	x	x	x	x	x	x
Goldfinch	-	x	x	x	x	x	x	x
Redpoll	-	x	-	-	-	-	-	x
House sparrow	-	x	x	x	x	x	x	x
Starling	-	x	x	x	x	x	x	x
Indian myna	-	x	x	x	x	x	x	x
North Island saddleback	x	-	-	-	-	-	-	-
North Island kokako	x	x1	x	x1	-	x1	-	x
White-backed magpie	-	x1,8	x1,8	x	x	-	-	-

Barrier Island (Imber 1978).

Imber (1978) reported that both Cook's and black petrels are subject to predation by cats, mainly on fledglings, and damage is caused to black petrel burrows by dogs. A few rat-eaten eggs have been noted. Predators are not seen as an immediate or major threat to the species, but the situation will continue to be monitored. Imber (1978) suggested that the introduction of the Norway rat (*Rattus norvegicus*) to the island would be a major hazard to the petrels.

Shags (*Phalacrocorax* spp.).

Black (*P. carbo novaehollandiae*), pied (*P. varius varius*) and little (*P. melanoleucos brevirostris*) shags were all seen occasionally at widely separated coastal sites. A colony of at least three nests of pied shags was seen in the north-east bay of Port Fitzroy. Little black shags (*P. sulcirostris*) have been recorded by at least three observers in the past decade (Table 1), and are assumed to be vagrants or seasonal visitors.

White-faced heron (*Ardea novaehollandiae novaehollandiae*).

Further to Bell (1976), this species is now common and widespread in open flat country.

Reef heron (*Egretta sacra sacra*).

Only seen in two parts of the north-east bay of Port Fitzroy. The Ornithological Society of New Zealand (OSNZ) bird distribution atlas (Bull *et al.* 1978) showed this bird in four 10 000 yard squares; Bell and Brathwaite (1964) reported few sightings on each of their visits. Apparently this bird has always been uncommon on the island. Since Hutton's visit (1868), most records included Port Fitzroy as one location for reef heron. While this may reflect a greater frequency and concentration of observers in Port Fitzroy, it may be that optimum conditions exist in few other places.

Australasian bittern (*Botaurus stellaris poiciloptilus*).

Seen or heard at five locations, *viz*; Kaitoke Swamp, Whangapoua Estuary margin, a small swamp just east of Motairehe and in swampy pastures of central Oruawharo Bay and near Okiwi airstrip. While numbers of bittern found on the island appeared similar to those in 1957 and 1960 (Bell and Brathwaite 1964), they were not found in swamps at the northern and southern ends of Oruawharo Bay. It is possible that their distribution is being reduced, perhaps by modification of some habitats.

Paradise shelduck (*Tadorna variegata*).

Seen beside Claris swamp (6 birds), Awana Stream (2), and near Okiwi airstrip (2). First reported on the island in 1972, then 18 birds in 1975 (Bell 1976). While this species has not occupied all the apparently suitable habitat, neither has it increased in the manner suggested by its initial success.

Brown teal (*Anas aucklandica chlorotis*).

Great Barrier Island is the major location for brown teal, an endemic New Zealand duck; possibly more than 90% of all wild brown teal occur here. Once common and widespread in New Zealand, they occur naturally elsewhere only in Northland, in low and declining numbers, and possibly in Fiordland. No sightings of brown teal have been made on Stewart Island since 1971 (M. Williams pers. comm.).

Using the most conservative counts at each site, a total of 658 teal was seen over the 16 days of the 1980 survey. This assumes that birds were not double-counted through moving from one location to the next, ahead of the survey, and for this reason concentrations of habitats occupied by brown teal such as those of Oruawharo Bay - Kaitoke Beach were counted on the same day. These data suggest a relatively stable population since Bell and Brathwaite (1964) estimated "640-700 birds in 1957" and Williams (1976) estimated 702 ± 298 .

Why such numbers of brown teal remain in highly modified habitats when they have all but disappeared from the mainland in similar or even much less modified areas is unknown. Although cats, dogs and ship rats (*Rattus rattus*) are present, the absence of all mustelids, Norway rat, and hedgehogs (*Erinaceus europaeus*) could also prove to be highly significant. Low numbers of both mallard (*Anas platyrhynchos*) and grey duck (*Anas superciliosa*), potential competitors for some resources, might also have some influence in retaining high numbers of brown teal. The total prohibition on waterfowl hunting must also be given some credit, coupled with the protective interest and pride of Great Barrier residents in these birds. This situation, where an endangered species has been protected by the commitment of the total community, must be unique for New Zealand.

Much remains to be learned about brown teal feeding, breeding and other requirements, but there is no doubt that their characteristic communal "roosts" are vital to their success. The largest roosts are on banks of tidal streams, where there is cover from clumps of rushes and sedges, often with low overhanging trees. Adjacent wet pastures appear to be important for nocturnal feeding. The diet of brown teal comprises insects, worms, and other animals which are taken from the surface of wet ground. This means that the ducks are vulnerable to drainage of damp pastures near their roosts, and to pesticides, should these be used on pasture, but the present type of farming appears to be compatible with brown teal survival. Heather (1980) recorded brown teal grazing on mussels on tidal rocks in daylight, north of Kaitoke Creek. The extent and frequency of such feeding are unknown, but Heather (1980) reported eight brown teal as knowing where and when to come to this cluster of rocks, and what to do there.

Nesting habitat was reported by MacFadden (1977) as being mainly in *Carex* clumps on edges of swampy gullies, often at some distance from communal roosts. Local residents reported finding pairs nesting

in steep bush-clad gullies, and our survey found several pairs of brown teal in such sites in the Northern Block of forest.

Brown quail (*Synoicus ypsilophorus*).

Bell (1976) stated that the presence of brown quail, last reported in 1963, required confirmation. One pair was seen on the edge of Kaitoke Swamp by our survey. The poor success of this species and California quail is difficult to explain in view of the abundance of apparently suitable habitat and absence of some of their known mammalian predators.

Banded rail (*Rallus philippensis assimilis*).

The island is a major stronghold for this species in New Zealand. The heads of many tidal bays had banded rail, as did some other swamps. They were seen in daylight occasionally, including a pair with six young beside the Forestry Headquarters at Port Fitzroy, and at night by torch or vehicle lights on public roads and house lawns. As with brown teal, the absence of mustelids and Norway rats might be a factor in the survival of rails on the island.

Spotless crane (*Porzana tabuensis plumbea*).

The only bird species found by our survey which was previously unknown on Great Barrier Island, a success attributable to use of tape-recorded calls in likely habitat. Spotless crane occur more in freshwater swamps than in tidal salt-marshes, and even where they were found in the same wetland as banded rails (e.g. Kaitoke Swamp), the cranes were in the upper freshwater reaches and rails in the lower tidal areas. Fewer suitable habitats exist on the island for cranes than for rails. The upper freshwater parts of the Whangapoua Estuary, now being drained, were almost certainly a major habitat for spotless crane, as they still occur in unmodified pockets of swamp on the north and south fringes of this area. Other islands known to have spotless crane are Three Kings, Poor Knights, and Ponui.

Pukeko (*Porphyrio porphyrio melanotus*).

Seen in the swamp just east of Motairehe but otherwise only on the eastern side of the island, and there more commonly in partly modified wetlands and wet pastures than in densely vegetated wetlands. More than 40 seen in a paddock just north of Awana Stream and east of the main road.

South Island pied oystercatcher (*Haematopus ostralegus finschi*).

The survey was a little early to record the over-wintering of this species. Breeds only in the South Island, but migrates north annually.

Least (Pacific) golden plover (*Pluvialis fulva*).

Twelve seen in Whangapoua Estuary 28 March 1980. They could not be re-located on 12 April 1980 and were presumed to have begun their annual migration to northern Asia or Alaska. The frequency of sightings since 1960 suggests that this estuary is used regularly by a

small party of golden plover, part of several hundred which visit New Zealand annually.

New Zealand dotterel (*Charadrius obscurus*).

Whangapoua Estuary; at least 30 present on both 28 March 1980 and 12 April 1980, all in pale grey eclipse plumage. Two juveniles seen on Kaitoke Beach. Breeding occurs on the Whangapoua sandspit north of the harbour entrance (Brian D. Bell pers. comm.). Heather (1980) reported New Zealand dotterel feeding on mussels on tidal rocks north of Kaitoke Creek.

Banded dotterel (*Charadrius bicinctus bicinctus*).

Whangapoua Estuary: the 50 or more birds exceeds earlier totals for the same area (Bell and Brathwaite 1964), but fewer birds were seen at other sites in 1980 than previously.

Wrybill (*Anarhynchus frontalis*).

Wrybill nest only in some Canterbury and Otago riverbeds. However, in winter most migrate to coastal estuaries from Hauraki Gulf northwards. Fifteen were seen on 28 March 1980 at Whangapoua Estuary.

Eastern bar-tailed godwit (*Limosa lapponica*).

In view of the numbers recorded by earlier observers, our count of 20 godwit on 28 March 1980 was almost certainly influenced by the departure of most for northern hemisphere breeding grounds before this date. These 20 were not seen on 12 April 1980 and it is not known whether any godwit over-winter here. Bell and Brathwaite (1964) quoted a local report of some over-wintering at that time.

Arctic or pomarine skua (*Stercorarius* sp.).

A single bird which could not be positively identified was seen pursuing white-fronted terns over the bay to the west of Kaiarara Stream.

New Zealand pigeon (*Hemiphaga novaeseelandiae*).

Occasional and widespread in larger forests and some smaller remnants of forest. Three seen in a Port Fitzroy garden eating mountain guava (*Psidium* sp.) fruit.

North Island kaka (*Nestor meridionalis septentrionalis*).

Great Barrier Island can be regarded as one of the strongholds for North Island kaka. Kaka were seen throughout, from coasts to the summit of Mt. Hobson, in most forest types, including those with exotic trees, and flying over wetlands and pastures. Total numbers are not easily assessed and may be lower than created by first impressions due to the birds' mobility and conspicuousness. A tree hole-nesting bird with a long (10 week) period from hatching to fledging, kaka may be quite vulnerable to predation. It is possible that absence of mustelids and/or Norway rats permits survival of kaka in numbers now rarely seen on the mainland. The absence of possums (*Trichosurus*

vulpecula), which may be competitors for nesting holes and food, might also contribute to the abundance of kaka. The feeding of kaka on fruit and on insects in rotting wood and under bark has created some problems for forestry and gardening on the island. Shoots of pines (*Pinus* spp.) and *Cupressus macrocarpa* are often damaged, producing multi-leadered trees. Kauri (*Agathis australis*) appear less affected, although kaka were seen feeding on kauri cones.

Red-crowned parakeet (*Cyanoramphus novaeseelandiae*).

Assuming all sightings to be of different birds, 13 parakeets were seen, at seven locations. Of these birds, only the six in forest near Okiwi School could be positively identified as red-crowned, but it is suggested that the seven unidentified parakeets were also red-crowned. These and previous records of parakeets are so scattered in time and location that it is not possible to say whether the species is increasing or even breeding on the island.

Shining cuckoo (*Chrysococcyx lucidus lucidus*).

It is assumed that only the timing of the survey prevented our recording this bird, which migrates from New Zealand in winter.

Long-tailed cuckoo (*Eudynamys taitensis*).

A juvenile bird was sighted on 27 March 1980 over forest north-east of Whangaparapara. This was an unexpected record, both because it is migratory, and from the paucity of previous sightings. Usually it "parasitises" whitehead nests, but in the absence of whiteheads, it is not known whether the cuckoo seen was over-wintering on the island, or whether it had paused here on its migration northwards, or whether it had been raised by some other bird species.

Morepork (*Ninox novaeseelandiae*).

Widespread and locally common. While camping out in forests on consecutive fine nights at 400 m a.s.l. near Mt. Heale, then 20 m a.s.l. near the Kaitoke Swamp, we heard moreporks at both sites, but far more frequently at the latter. They were also common around a camp near Miners Head, but seemed less common around urban areas of Tryphena and Port Fitzroy.

New Zealand kingfisher (*Halcyon sancta vagans*).

The abundance of kingfishers in most areas was remarked upon by each of the survey team; Bell and Merton (*in* Bell and Brathwaite 1964) made a similar observation.

North Island rifleman (*Acanthisitta chloris granti*).

Despite records from 1972 in Bell (1976) and by Harris (1980) the status of the rifleman on the island is still doubtful. It is suggested that Harris (1980) confused rifleman with another species, perhaps grey warbler, which he did not record. Our survey spent perhaps 300-400 man-hours in forests, including camping out at five locations, but the presence of rifleman could not be confirmed.

Welcome swallow (*Hirundo tahitica neoxena*).

First reported in 1973 (Bell 1976), now widely distributed and particularly common over flatter pastures and freshwater wetlands. Seen even at remote points such as the extreme western end of Miners Head.

North Island fernbird (*Bowdleria punctata vealeae*).

Apart from the main North Island, this fernbird is known only on two other islands, two of the Aldermen Islands. A wetland habitat with several vegetation strata seems important; most fernbirds on Great Barrier were found where scattered manuka of one to 2.5 m overtopped tall sedges, which in turn overtopped short sedges and often umbrella fern. Largest populations were throughout Claris Swamp, the upper reaches and fringes of Kaitoke Swamp, and the shrubland/sedge margins of Whangapoua Estuary. For their small size, intact swamps beside the road between Kaitoke Swamp and Claris and in the extreme north-west corner of the freshwater swamp of Whangapoua Estuary also had fair numbers of fernbird.

Low open manuka shrubland/scattered sedges and umbrella fern is common around the track from Mt. Heale to the Kaitoke swamp. Without use of tape-recorded calls, six fernbird were noted here on 14 April 1980, up to at least 300 m a.s.l. It is possible that fernbird may be more widespread in this vegetation type, but it is a seral stage following burning and is thus temporary habitat. *Hakea* species are accelerating the return of this country to tall dense woody vegetation, which is unsuitable for fernbird.

Pied tit (*Petroica macrocephala toitoi*).

As for rifleman, no evidence could be found to support an earlier record of pied tit (1973; *in* Bell 1976). As indicated by Bell and Brathwaite (1964), it is difficult to believe that if the species were present it would not be widespread, as so much apparently suitable habitat exists.

Bellbird (*Anthornis melanura*).

M. Imber (pers. comm.) reports seeing one juvenile bellbird on 17 March 1977, near the track on the north-west slopes of Mt. Hobson, not far above the highest altitude kauri dam. Bell and Brathwaite (1964) could only confirm its presence on Rakitu (Arid) Island, and no other records of bellbirds on Great Barrier are known since then. It is probable that Imber's sighting was of a vagrant from Rakitu and that bellbirds are not breeding on the main island.

Tui (*Prosthemadera novaeseelandiae*).

Occasional in most forested areas, but not as commonly observed as in some mainland areas. Flowering of nectar-producing plants tend to make tui more conspicuous as they feed, but as few such plants were flowering in late March — April this may have contributed to our impression of reduced numbers.

Myna (*Acridotheres tristis*).

First recorded in 1960 by Bell and Brathwaite, and widespread by 1975 (Bell 1976). Recorded almost throughout the island by our survey, except in the Northern Block of forest; more common in open country. No counts were made.

North Island kokako (*Callaeas cinerea wilsoni*).

Extensive playing of tape-recorded calls of Northland kokako through the Northern Block located two birds only, these being in a valley leading into the south end of Rangiwahakaea Bay. The present condition of this forest suggests that few more kokako could be expected. One was probably heard by J. Halkett (New Zealand Forest Service) in 1979, also in the northern area, and earlier records are summarised by Bell (1976). While it seems that a severe reduction has occurred since "a strong colony" was reported by Bell and Brathwaite (1964), based on Merton's 1963 sightings, this may not be the case as Merton (pers. comm.) saw two only, and heard one, or perhaps two, more birds. Therefore, it seems that only a few kokako have been present in the Northern Block since at least 1955, which suggests that it might not be too late to initiate intensive mammal control in those forests to save kokako on the island. Future surveys in spring or summer, using recorded tapes of the local dialect might reveal more kokako.

EXOTIC MAMMALS

The survey's findings generally supported those of Bell and Brathwaite (1964).

(i) Goat (*Capra hircus*).

Most abundant in Northern Block, up to 14 in one herd. Some signs of goats were in most other areas, but local opinion is that they are becoming scarce in areas south of Claris. Deterioration of forest habitat for birds, lizards, and Hochstetter's frog is attributable chiefly to goats. Removal of ground cover and shrubs have led to erosion, notably on the dissected topography of the Northern Block. Regeneration is largely as epiphytes, especially on tree ferns.

(ii) Wild pig (*Sus scrofa*).

Probably fewer than goats, but signs of wild pigs were found through much of the island, most commonly in the Northern Block. Although some landowners disclaimed knowledge of pigs on their land, pig sign was often found, and it appears that wild pigs may be "farmed" for private use. Compared with goats, wild pig impact is localised but is still regarded as a threat to wildlife. Apart from causing damage to vegetation and soil, pigs are partly carnivorous and brown teal nests, land snails, native frogs, and lizards are possibly at risk.

(iii) Fallow deer (*Cervus dama*).

Present on Kaikoura Island where they are being farmed. It is reported that deer have crossed the channel at least once to the main island, this being about 100 m wide at its narrowest point.

(iv) Cat (*Felis catus*).

Cat droppings were seen throughout the forests. The only recognisable contents in these were from rats. As mentioned earlier, effects of cats on petrel breeding are being monitored, as cats had a serious impact on the same species of petrel on Little Barrier Island.

(v) Rats.

Signs of ship rat (*Rattus rattus*) and kiore (*R. exulans*) were seen throughout, although never at high densities. The only camp where ship rats were troublesome was on the western edge of Kaitoke Swamp (14–15 April 1980). No sign or reliable report was found for Norway rat (*R. norvegicus*).

(vi) Mouse (*Mus musculus*).

Mice were not seen, but were reported near human habitations.

(vii) Mustelids.

Our survey found no evidence of mustelids; local opinion and published reports support this. However, a 1977 Wildlife Service file report on brown teal on Great Barrier Island states "one land-owner reported sighting a ferret (*Mustela putorius furo*) ... his description was convincing". Ferrets are the mustelid most likely to have reached the island as domestic pets, but on its own this report is insufficient evidence of the presence of ferrets.

(viii) Dog (*Canis familiaris*).

Feral or uncontrolled dogs were heard as far north as the valley near Miners Head. One farmer reported sheep deaths from pig-hunters' dogs left in the Northern Block and earlier mention was made of dogs digging into petrel burrows on Mt. Hobson. The effects of dogs on wildlife may not be great at present, but again it is the rare ground-nesting birds which are at risk.

(ix) Rabbit (*Oryctolagus cuniculus*).

Common in open country, especially on sandy soils.

BATS

Neither residents' reports nor our survey added to the records in Bell (1976), where Veitch's 1972 sighting in the Northern Block of forest is the most recently confirmed. The species remains unknown.

LIZARDS

Dick (1981) listed ten lizard species from Great Barrier Island. These

were supported by our survey. In addition, we recorded a skink which was probably *Cyclodina oliveri*, and we accept earlier published records, one collection, and a recent local report of *Hoplodactylus duvauceli*, bringing the total number of lizard species on the island to twelve - seven skinks and five geckos. This represents the greatest variety of lizard species of any island or comparable area of mainland, in New Zealand.

A summary of species is given in Table 2, with notes on distribution and abundance on the island. Some of these notes are expanded below, but it is intentional that this paper does not specify locations for lizards, as lizard conservation in the wild has been disregarded by some collectors in the past. Details of our survey's findings have been

Table 2. The lizards of Great Barrier Island.

NAME	DISTRIBUTION ON ISLAND	ESTIMATED ABUNDANCE
GEKKONIDAE		
<i>Hoplodactylus duvauceli</i>	Not seen 1980. Isolated reports up to about 1975.	Rare, perhaps extinct on island.
<i>H. granulatus</i>	Not seen 1980. Reported near Kaiarara Stream, near Tryphena and further south. In bush and shrubland.	Probably not uncommon.
<i>H. maculatus</i>	Probably the most common and widespread gecko on island. In disturbed and undisturbed sites.	Common.
<i>H. pacificus</i>	Widespread in bush and shrubland.	Common.
<i>Naultinus elegans elegans</i>	Not seen 1980, but reported independently in at least 4 locations in southern half of island, in shrubland.	Uncommon.
SCINCIDAE		
<i>Leiolopisma homalonotum</i>	3 seen. Northern Block and Needle Rocks forests. Others reported (Table 3).	Rare or uncommon.
<i>L. moco</i>	Widespread in open areas, both natural and disturbed sites.	Common.
<i>L. smithi</i>	Widespread on coasts.	Common.
<i>L. suteri</i>	Coastal; in both northern and southern parts of island.	Uncommon.
<i>Cyclodina aenea</i>	Widespread in forest, shrubland and open sites.	Common.
<i>C. sp. (C. oliveri ?)</i>	Northern Block of forest.	Rare.
<i>C. ornata</i>	Widespread in forests.	Common.

supplied to the national lizard and frog inventory, Ecology Division, Department of Scientific and Industrial Research (DSIR), Nelson.

Hoplodactylus duvauceli.

One specimen from Great Barrier Island is in the Ecology Division, DSIR, collection lodged at the National Museum, Wellington. Its reference card states that it was collected by B.J. Gill at Okupu on the road, 14 January 1971. A published report of *H. duvauceli* on the island is in Bell (1976), while the coarse-scale map showing national distribution of the species in Robb (1980) shows Great Barrier Island as part of the species' range. A further specimen is held in the MacGregor Museum, Department of Zoology, University of Auckland. The locality given is Great Barrier Island (however, this may include the smaller off-shore surrounding islets). An informed local resident reported one live specimen near Whangaparapara, in about 1975. Dick (1981) makes no mention of *H. duvauceli*.

H. granulatus.

Not found, although one of our survey team, P.J. Miller, saw this gecko in 1972 in forest near the Kaiarara Stream. Also reported by Dick (1981), R. Rowlands (pers. comm.), and an informed local resident, all these sightings being near and to the south-east of Tryphena.

Naultinus elegans elegans.

Not found, although actively searched for. Reported by residents in the Motairehe area (Dick 1981), and reported during our survey by three other local residents in at least four locations in the southern third of the island.

Leiolopisma homalonotum.

It is generally believed that this skink is one of the rarest in New Zealand (e.g. Robb 1980, Ogle 1980, Dick 1981). Hardy (1977) discussed the possible confusion regarding the type locality of this species (Flat Island, Mokohinau group); all subsequent collections and sightings are from Great Barrier Island. Specimens examined by Hardy (1977) were cited mostly without dates of collection and included some raised in captivity. Table 3 lists all known collections and sightings of wild specimens from Great Barrier with dates where these are known.

The records of Dick (1981) tend to link the areas of primarily northern and southern distribution of the species on the island, and give the impression that *L. homalonotum* may be more common than was thought previously. M. Vickers, who accompanied Dick on his survey, has indicated (pers. comm.) that the records of *L. homalonotum* in fig. 1b of Dick (1981) are all tentative. No specimens were captured, and Vickers regarded that seen in the Kaiarara Stream area as the only reliable record. Some other locations in Dick (1981) were based on local reports.

Table 3. Collections and sightings of *Leiopisma homalonotum* on Great Barrier Island.

Date	Locality	Particulars
1900 - 1920	Tryphena	Unconfirmed report of one specimen by locals.
1910 - 1920	Whangaparapara	Unconfirmed report of one specimen by locals.
1950's	Okiwi	Cat reported to kill all individuals from a patch of bush.
16 October 1972	Okiwi	AIM. Rep. 31.2
18 March 1974	Karaka Bay	ED. S1508 (male).
1974	Nimaru Bay (Katherine Bay)	Alive in captivity in Wellington (female).
1976	Great Barrier Island	Died in captivity (juvenile).
31 August 1978	Tryphena	Alive in captivity in Auckland (female).
August 1978	Tryphena	One dead female on road.
August 1979	Whangaparapara	One live female.
March-April 1980	Needle Rocks Scenic Reserve	One juvenile captured and released (Ogle 1980).
March-April 1980	Northern Block (north of Katherine Bay)	Two juveniles captured, photographed, and released (Ogle 1980).

2 further specimens, CM Rep. 320 and BM NH. RR. 1946.8.17.44, are of unknown collection date and locality.

The three specimens found by our survey were in similar habitat within forest, and were in apparently similar situations to specimens reported by Dick (1981). Not included in Table 3 are recent findings by members of the New Zealand Herpetological Society who searched a number of comparable sites in December 1979 — January 1980 and in one area made 21 sightings, representing an estimated 17 different individuals of *L. homalonotum* (J.A. West pers. comm.). The scattered distribution of *L. homalonotum* in the north, west, and south of the island suggests that the paucity of early records resulted from lack of knowledge concerning the species' habitat rather than actual rarity. Nevertheless, until more is known of the size and distribution of populations, this skink must continue to be regarded as rare and endangered.

L. suteri

Found to be locally common at two locations on the western coast of the Northern Block. Rare on the coast south of Tryphena (R. Rowlands, pers. comm.), and rare in Katherine Bay (Dick 1981).

Cyclodina sp. (*C. oliveri*?).

Two juvenile skins, which P.J. Miller considered were possibly *C.*

oliveri, were found among stones on the steep forested bank of a stream on the west coast of the Northern Block. These skinks had a black throat and a 'teardrop' below the eye on the upper jaw. They were smaller and darker than *L. homalonotum* juveniles, and lacked the latter species' chevrons or orangy markings on the back. Unfortunately, the specimen which was captured for identification was mistakenly released with other forest-dwelling lizards, into the forest tract from which it was taken. *C. oliveri* has not been recorded from Great Barrier Island previously, although it is known from a number of islands to the east of Northland and Coromandel, including Little Barrier Island.

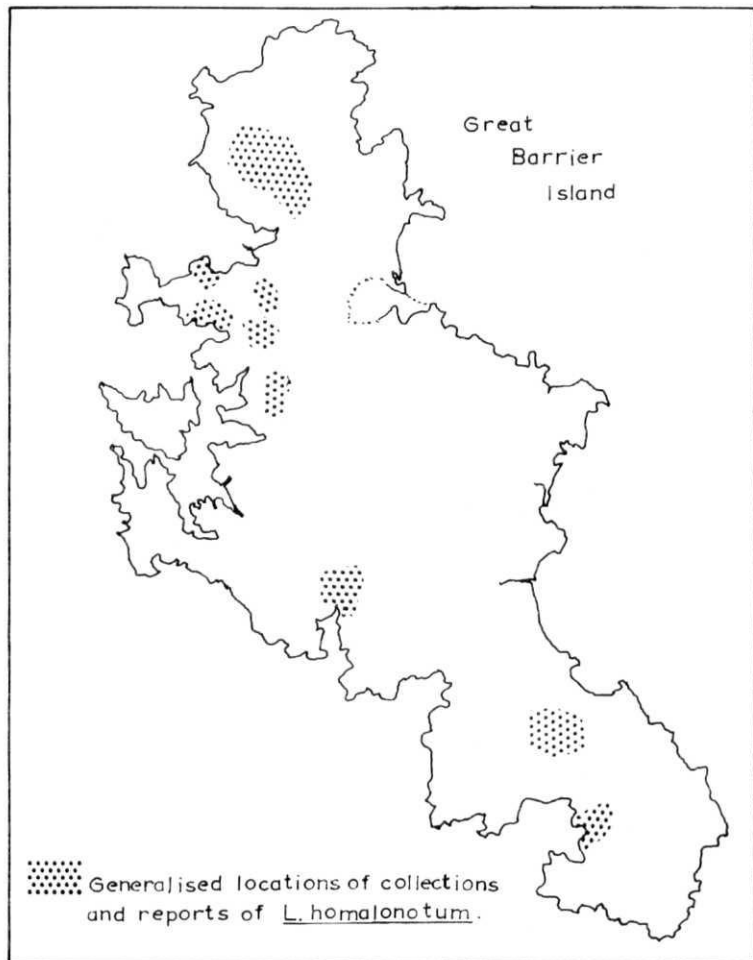


Fig. 2. Generalised distribution of *Leiopisma homalonotum*.

FROGS

Two species were found, the New Zealand endemic Hochstetter's frog, *Leiopelma hochstetteri*, and a species of Australian tree frog, *Litoria raniformis*.

Leiopelma hochstetteri.

Twenty specimens were found, all close to streams in five catchments of the Northern Block of forest. Their discovery was particularly significant as they represent the first finding of an island population of this species. In view of the isolation of Great Barrier from the North Island these frogs could be expected to differ from their nearest North Island relatives.

Two specimens were collected for specific confirmation by Dr Ben D. Bell, Victoria University of Wellington, and one of these was used for electrophoretic studies. No significant differences were found between this specimen and mainland *L. hochstetteri* (Ben D. Bell pers. comm.). The species is known currently from scattered locations from just south of Whangarei, to the Waitakere, Hunua, Rangitoto and Coromandel Ranges, and parts of East Cape. On Great Barrier, its habitat is being modified by deterioration of the forest surrounding the streams, a situation induced by goats, wild pigs and wandering farm stock. The understorey of forest of valley sides often comprises only rangiora (*Brachyglottis repanda*) and *Coprosma rhamnoides*. The steep sides of many valleys are now composed of fine angular sandstone gravel which moves as scree under the forest. Large slips in heads of some valleys produce clay silt which, with the stone fragments, fill the stream beds and make them unsuitable for *L. hochstetteri*.

Litoria raniformis.

Two specimens were found in wet sand-dune hollows of Kaitoke Beach, and another on the edge of Kaitoke Swamp. Also reported near Okiwi (Ben D. Bell pers. comm.).

TERRESTRIAL MOLLUSCS

(i) F. Rhytididae

Rhytida greenwoodi.

Empty shells were found at several sites in the Northern Block of forest and one was collected for the National Museum, Wellington. One live animal was found, and returned to its habitat, in the valley running south from Rangiwahakaea Bay.

This appeared to be the first record from the island of the species, otherwise known from Auckland to Marlborough (Parkinson 1979). Hayward (1981) records it from Rakitu (Arid) Island, 2.5 km from Great Barrier.

Schizoglossa novoseelandica.

A number of specimens were found under logs and rocks in forest, but only in Needle Rocks Scenic Reserve. One was found with eggs. J. McCallum (pers. comm.) reported that *Schizoglossa* is widespread on Great Barrier. The species was first collected on Great Barrier Island by C. Osborne in 1924, apparently in the Needle Rocks area, and was described by Powell (1949) as an endemic Great Barrier subspecies, *S. novoseelandica barrierensis*. Parkinson (1979) did not support its separation at subspecific level.

(ii) F. Bulimulidae

Placostylus hongii.

No live or dead specimens were found, nor any reports of recent sightings. Powell (1938) listed three Great Barrier Island localities where living specimens had been known in 1913 (an old pa site midway round Tryphena Bay), 1924 (Maori Bay), and 1938 (headland at north end of Schooner Bay). The identity of "Maori Bay" could not be determined, nor the precise identity of the headland at Schooner Bay. Hills and much of the coast were surveyed from Schooner Bay to Shag Point and northwards.

Powell (1938) was of the opinion that *P. hongii* was introduced to the island, either intentionally or accidentally by Maoris, since all three occurrences were on or adjacent to old Maori pa sites.

DISCUSSION

Great Barrier Island has been subject to the local extinction of six bird species since Hutton's visit (1868), including whitehead (*Mohoua albicilla*), North Island robin (*Petroica australis longipes*), stitchbird (*Notiomystis cincta*), North Island saddleback (*Philesturnus carunculatus rufusater*), New Zealand quail (*Coturnix novaezelandiae*), New Zealand shore plover (*Thinornis novaeseelandiae*) and probably yellow-crowned parakeet, pied tit, rifleman, and, as breeding species, bellbird and perhaps some seabirds.

Of the 50 or so indigenous birds breeding, or probably breeding, on the main island of Great Barrier at some time since 1868, 24 are endemic species to New Zealand, and of these endemics, 9 (38%) are now extinct on the island. This compares with 19% of endemic birds which are endangered or have become extinct in European times over the whole of New Zealand (Mills and Williams 1978).

Atkinson (1978) reported that the greatest effects of ship rats are on tree-nesting birds, particularly on small forest passerines, while Norway rats (not known on Great Barrier Island) have their greatest effects on ground-nesting birds. Kiore affect both groups of birds, but their effects generally extend to fewer species than either of the European rats.

It is suggested here that extinction of so many smaller forest birds on the island was caused by the combined effects of kiore and ship rat, at least in part. The fact that some larger forest birds (kingfisher, morepork, kaka, pigeon, tui and kokako) and rarer ground-nesting birds (brown teal, banded rail and two species of petrels) remain - which would be more vulnerable to Norway rat and mustelids than to ship rat and kiore - supports the view that kiore and ship rat could have played an important part in the demise of the smaller birds.

Habitat loss has probably played some part in loss of species from Great Barrier Island, but some nationally rare or declining animal species remain on the island in good numbers in highly modified habitat, most notably brown teal, kaka, banded rail, and the skink, *Leiopisma moco*.

Mustelids and rats are also known predators of lizards. Whitaker (1978) demonstrated the effects of kiore on lizards on off-shore islands, but did not include Great Barrier. However, extrapolation from his graph (p.77) of number of species against island area suggests that Great Barrier might have eight lizard species in the presence of rats, or 11 in the absence of rats. While admittedly Great Barrier's much greater area makes such a prediction from Whitaker's graph statistically doubtful, it is interesting that Great Barrier probably had 12 species, at least until recently. However, Whitaker pointed out that on a rat-free island, any given lizard species is almost never "rare".

On Great Barrier at least three and perhaps five lizard species might be rare, and it appears that in the continued presence of rats, the island will soon achieve the "predicted" total of eight species. In biogeographic terms, it is probable that this reflects a trend for larger areas to have a slower "relaxation period" of species loss after habitat conditions deteriorate (i.e. after rats arrived, in this case).

The probable effects of rats on the large gecko, *Hoplodactylus duvauceli* are shown by its confinement to seven rat-free islands in Cook Strait, although it remains with kiore alone on some islands north of Great Barrier Island (Whitaker 1978).

The abundance of natural predators of lizards, such as morepork and kingfisher, must have some impact on the lizard populations, and it is guessed that some species are more at risk than others. Rats, cats, human collectors and habitat loss and disturbance tend to act selectively on certain species.

Little is known concerning predation of Hochstetter's frog. Habitat deterioration appears to be the main factor limiting the range and numbers of this species.

Larger land snails are extremely vulnerable to rats and wild pigs (Ogle 1979), and the apparent rarity of *Rhytida greenwoodi* and possible extinction of *Placostylus hongii* may be due to these predators.

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