

### General

The luxuriant growth of *O. lyallii*, and the large numbers of young plants, with germination even in cracks in the bark of prostrate trunks, have often been noted—for instance by Cockayne (1904) and Dorrien-Smith (1908). Although Cockayne could see no reason why it “should not be the dominant forest of the Southern Islands”, *O. lyallii* has always been considered as fighting a losing battle in the Auckland Islands. To Dorrien-Smith (1908) it was swamped out by rata, “hence its disappearance from the main islands”; to Cockayne (1904) it was perhaps a relic of a former primeval forest, “ousted by a new formation as the conditions changed”; and he also considered “that the tree in question may have been a member of the now vanished and problematical forest of an ancient Antarctic continent” (Cockayne 1907; cf. also 1928: 174).

I suggest that *O. lyallii* is in fact increasing its area on the Auckland Islands, and that the present populations are derived from a relatively recent immigration, probably in the early 19th century, with Ewing I. as the point of entry. From here, it is suggested, the species moved east to points around Ross Harbour, and southwards along the coast (Fig. 5).

The source of *O. lyallii* would probably be the Snares, the only other locality where it is usually recognised as occurring. But when speculating on the history of this species it should be recalled that specimens from Milford Sound (Hooker 1867) and from Stewart Island and the Bluff (Cockayne 1927, 1928) have been considered similar to or identical with *O. lyallii*.

As Moar (1958 a) mentions the difficulty of distinguishing *O. lyallii* pollen from that of the *Pleurophyllums*, particularly *P. hookeri*,

pollen analysis may not be fruitful in elucidating the history of this noble composite in the Auckland Islands.

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## BIRDS AND MAMMALS OF THE SUBANTARCTIC ISLANDS

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If comprehensive limits are allowed for a zone in the New Zealand area designated 'Subantarctic', it would include the outlyers of Stewart I., the Snares and the Chathams in the north, and Macquarie I. in the south. There is, however, a very mixed fauna in the

northern zone with some derivative subantarctic elements only and this is clearly distinguishable from the middle zone which would include Auckland, Campbell, Antipodes and Bounty Is. The southern zone represented by Macquarie is distinguishable again, its



main elements being strongly circumpolar in affinities. For example, Macquarie has three genera of penguins found also in the Indian and Atlantic sectors of the Subantarctic and not otherwise found in the New Zealand Subantarctic as defined above. The sub-species of one of the mollymawks breeding at Macquarie is a circumpolar form and differs from an endemic race breeding at Campbell I. The same is true of the wandering albatrosses\* and the cormorants of these two areas so that Macquarie may be excluded from the more descriptive part of this paper except for some comparisons. For the same reason Foveaux Strait, the Snares and Chatham Is. are not dealt with in detail. This leaves the other four island groups for consideration.

#### BIRDS

Oceanic birds breeding in these groups show remarkable uniformity except for the limits imposed and opportunities provided by varied surface features and vegetation.

Seventeen species of albatrosses and petrels are recorded as breeding at the Auckland Is. About 15 of these also occur at Campbell I. but almost certainly in reduced numbers compared with former abundance. Petrels at Antipodes Is. are practically the same as on Campbell I., but the Bounty Is. have considerably fewer species. There are in fact no strongly endemic races of petrels or penguins at any one of these four groups. The marine cormorants on the other hand have distinguishable endemic races at Aucklands, Campbell and Bounty, while the very few cormorants nesting at Antipodes have never been accurately identified. Petrels are, of course, concerned with the land only for nesting and their density on the breeding areas is affected by many factors. At Antipodes disturbance has never been very severe and birds are undoubtedly denser there than on any other subantarctic island with the exception of the Bounty. At Campbell Is. the ground has been considerably modified and breeding petrels are largely confined to remote and inaccessible outlying stacks. This modification on Campbell I. has produced a more uniform vegetation which may have maintained a high population of the royal albatross. There is no evidence that any oceanic birds have become extinct within historic times as so many evidently have at the Chatham Is.; but one of the two diving petrels at the Auck-

land Islands, the so-called South Georgian diving petrel, which requires specialised conditions for burrowing, appears to be on the verge of extinction.

Among the land birds, there are some interesting differences between the islands. The varied environment of the Auckland Is. can be correlated with a correspondingly varied avifauna. There are two endemic waterfowl, the merganser, extinct, and the flightless duck. In addition there are three self-introduced surface-feeding ducks, including the mallard. There is even one endemic resident shore bird, the Auckland Is. banded dotterel, and a small migrant population of five or six wader species from the northern hemisphere. The two New Zealand birds of prey, the harrier and the falcon, are both present. There have been one or more rails, now probably extinct, and of New Zealand forest birds, one flycatcher, two parakeets, two honeyeaters and the ubiquitous white-eye. Together with the pipit and six European passerines self-introduced from New Zealand we are presented with a reasonably representative land bird fauna. Modifying factors have been comparatively slight. The spread of pigs, feral dogs, cats and probably rats at some stage has rendered the main Auckland Is. unfavourable for the breeding of one or two vulnerable species, notably the snipe, the flightless duck and the red-fronted parrakeet, but there is extensive safe terrain for all these on Adams I. and on several sizeable outlyers around Port Ross. It is a little more difficult to account for the apparent extinction of the merganser. These birds undoubtedly bred in the vicinity of numerous mountain streams in the gullies, depending for food on the local population of *Galaxias* and possibly supplementing it with marine fish close inshore in the fiords and harbours. It was certainly a target for hungry sealers and castaways but still survived at the turn of the century. Since 1904 no trace of the merganser has been found.

Campbell I. lacks the varied vegetation and the more complex terrain of the Aucklands and it is not surprising that the essentially forest species of the Auckland Is. are lacking. Grass-tree (*Dracophyllum*) and tussock offer a restricted habitat and the extensive firing over many years and grazing of stock over

\* Specific names of birds are given in Table 1.



nearly as many have produced conditions in which only wide-ranging flocks of small passerines can flourish. With few exceptions these appear to be the more recent introductions, white-eyes and the six or seven European passerines. There are a few pipits, probably distinguishable as endemic, and a flightless duck also a barely distinguishable derivative of the Auckland Is. bird. The latter are extremely rare and the few records suggests that they have now only one breeding place, the grassy slopes of Dent I. in North West Bay.

At Antipodes Is. there is a small and hardy assortment of land birds. The two parrakeets are strikingly modified by isolation and, as pointed out by Fleming (1952), they probably represent two successive invasions from the parent stock in New Zealand. The Antipodes pipit and the snipe have also marked differences in plumage and in body size from their relatives on the other islands. The self-introduced element within European times is small both in number of species and in the individuals present.

At the Bounty Is., there are relatively few species but an incredible concentration of numbers. On these granite rocks without a vestige of vegetation that would be of any significance to birds, spring, summer and autumn see the arrival of vast shoals of penguins, almost all of one species, the erect-crested penguin, and a large mollymawk, *D. cauta salvini*, one of the several forms of a species whose breeding range embraces Bass Strait, Auckland, Snares, Bounties and Chatham Islands. It is thus strictly not a subantarctic mollymawk. Three other sea birds are common: the sedentary and endemic Bounty Is. shag, the fulmar-billed prion, and a race of the subantarctic tern. There are probably also storm petrels which have escaped notice because they are presumably nocturnal, and few recent investigators have spent a night ashore. A pattern of accommodation is clearly apparent in the breeding locations of the four principal bird species. The shag avoids all competition by nesting on narrow ledges of the precipitous sides of the island, the prion occupies cracks, crevices and holes in the rocks, the mollymawks plant themselves on the top levels of the slabs, boulders and sloping surfaces and the penguins fill in the rest. One noticeable feature of penguin behaviour on the Bounty Is. is the relatively low intensity of alarm

demonstrations and the almost complete absence of predatory skuas. This is clearly related to the effective 'umbrella' cover provided by the waving beaks of the thousands of mollymawks. No doubt there is interspecific adjustment between the mollymawks and the penguins but it is a relatively low premium for insurance against direct predation.

## MAMMALS

### *Marine mammals*

The subantarctic area under consideration is on the migration path of the several species of whalebone whales moving between the tropics and the Antarctic. The northern convergence fringe of the area is also within the distribution range of sperm whales. The smaller toothed whales generally also keep to this latter zone and the only resident breeding whale to record is the southern right whale (*Balaena australis*). Formerly breeding throughout the lower latitudes of the subantarctic zone it has been practically eliminated in most places since about 1850. It is therefore satisfactory to record that at Campbell I. both in Perseverance Harbour and North-West Bay it is a regular winter visitor in fair numbers with a good proportion of cows and newborn calves. This is the only known regular breeding place in this part of the South Pacific. Our area is also the breeding place of two species of eared seals.

The fur seal (*Arctocephalus forsteri*), once destructively exploited, has been under close protection for 20 years and in this time for reasons not ascertained it has increased its range and probably its total number, especially along the coasts of the South Island of New Zealand. There has also been a re-establishment of a small number at Macquarie I. since 1948 (Gwynn 1953). There is no evidence that the numbers have increased substantially in the central subantarctic zone with which we are concerned here and many of the traditional 'rookeries' of the sealing days are still vacant. In spite of this there is a widely distributed and healthy breeding population. Its greatest density is at the Bounty Is., with several hundreds at Campbell and a lesser number along the south and west coast of the Auckland Is. The status of the Southern fur seal at Macquarie is of the order of only a few breeding females, but the status at Antipodes is unknown, except that a few stragglers have been noticed along the coasts.



TABLE 1. Species list of birds breeding or probably breeding on Auckland Is., Campbell I., Antipodes Is. and Bounty Is.

Species List	Auckland Is.	Campbell I.	Antipodes Is.	Bounty Is.
Yellow-eyed penguin ( <i>Megadyptes antipodes</i> )	+	+		
Rockhopper penguin ( <i>Eudyptes chrysocome</i> )	+	+	+	
Erect-crested penguin ( <i>Eudyptes sclateri</i> )	+	+	+	+
Wandering albatross ( <i>Diomedea exulans</i> )	+	+	+	
Royal albatross ( <i>Diomedea epomophora</i> )	+	+		
Shy mollymawk ( <i>Diomedea cauta cauta</i> )	+			
Grey-backed mollyhawk ( <i>D. cauta salvini</i> )				+
Grey-headed mollymawk ( <i>Diomedea chrysostoma</i> )		+	?	
Black-browed mollymawk ( <i>Diomedea melanophrys</i> )		+	+	
Light-mantled sooty albatross ( <i>Phoebastria palpebrata</i> )	+	+	+	
Giant petrel ( <i>Macronectes giganteus</i> )	+	+	+	
Cape pigeon ( <i>Daption capensis</i> )	+	+	+	+
Antarctic prion ( <i>Pachyptila desolata</i> )	+	?		
Fulmar-billed prion ( <i>Pachyptila crassirostris</i> )				+
Fairy prion ( <i>Pachyptila turtur</i> )			+	
Sooty shearwater ( <i>Puffinus griseus</i> )	+	+	+	
Subantarctic allied shearwater ( <i>Puffinus assimilis elegans</i> )	+		+	
White-chinned petrel ( <i>Procellaria aequinoctialis</i> )	+	+	+	
Grey petrel ( <i>Procellaria cinerea</i> )		+	+	
White-headed petrel ( <i>Pterodroma lessoni</i> )	+	?	+	
Grey-backed storm petrel ( <i>Garrodia nereis</i> )	+	+	+	
Black-bellied storm petrel ( <i>Fregetta tropica</i> )	+	?	+	
White-faced storm petrel ( <i>Pelagodroma marina</i> )	+			
Subantarctic diving petrel ( <i>Pelecanoides exsul</i> )	+	+	+	
South Georgian diving petrel ( <i>P. georgicus</i> subsp.)	+			
Auckland I. shag ( <i>Phalacrocorax colensoi</i> )	+			
Campbell I. shag ( <i>Phalacrocorax campbelli</i> )		+		
Bounty I. shag ( <i>Phalacrocorax ranfuryli</i> )			?	+
Flightless duck ( <i>Anas aucklandica</i> )	+	+		
Grey duck ( <i>Anas superciliosa</i> )	+	+		
Mallard ( <i>Anas platyrhynchos</i> )	+			
Shoveller ( <i>Anas variegata</i> )	+			
Auckland I. merganser ( <i>Mergus australis</i> )	Extinct?			
Harrier ( <i>Circus gouldi</i> )	+	+		
N.Z. falcon ( <i>Falco novaezealandiae</i> )	+			
Auckland I. rail ( <i>Rallus muelleri</i> )	Extinct?			
Auckland I. banded dotterel ( <i>Charadrius biconotus</i> subsp.)	+			
Auckland I. snipe ( <i>Coenocorypha aucklandica</i> )	+			
Antipodes snipe ( <i>C. a. meinertzhageni</i> )			+	
Brown skua ( <i>Catharacta lonnbergi</i> )	+	+	+	+
Southern black-backed gull ( <i>Larus dominicanus</i> )	+	+	+	+
Red-billed gull ( <i>Larus scopulinus</i> subsp.)	+	+		
Antarctic tern ( <i>Sterna vittata</i> )	+	+	+	+
White-fronted tern ( <i>Sterna striata</i> )	+	+		
Red-fronted parrakeet ( <i>Cyanorhamphus novaezealandiae</i> )	+			
Yellow-fronted parrakeet ( <i>C. auriceps</i> )	+			
Reischek's parrakeet ( <i>C. hochstetteri</i> )			+	
Antipodes parrakeet ( <i>C. unicolor</i> )			+	
Auckland I. tit ( <i>Petroica macrocephala marrineri</i> )	+			
Song thrush ( <i>Turdus ericetorum</i> )	+	+		
Blackbird ( <i>Turdus merula</i> )	+	+	+	
Pipit ( <i>Anthus novaezealandiae</i> )	+	+		
Bellbird ( <i>Anthornis melanura</i> )	+			
Tui ( <i>Prosthemadera novaezealandiae</i> )	+	+		
White-eye ( <i>Zosterops lateralis</i> )	+	+		
Lesser redpoll ( <i>Acanthis cabaret</i> )	+	+		
Chaffinch ( <i>Fringilla coelebs</i> )	+	+		
House sparrow ( <i>Passer domesticus</i> )	+	+		
Goldfinch ( <i>Carduelis carduelis</i> )	+	+	?	
Yellowhammer ( <i>Emberiza citrinella</i> )		?		
Hedge sparrow ( <i>Prunella modularis</i> )	+	+		
Skylark ( <i>Alauda arvensis</i> )	+	?		
Starling ( <i>Sturnus vulgaris</i> )	+	+	+	
TOTAL BREEDING SPECIES	52	38	26	8



As these two islands were traditionally the scene of the largest slaughter in the decade 1810 to 1820 and tradition further states that the seals of these two islands had a superior fur and were known as the 'Upland Seal', it can be assumed that another species was involved, possibly one of the circumpolar species or subspecies of *A. gazella*. One of the latter, a stray bull, has in fact been recorded at Macquarie Island within the last few years (Csordas 1958). Evidence in support of such a hypothesis is now rather difficult to obtain. One would expect to find plentiful bones but in fact a terrain of coastal rocks backed by peat beds which are not at all ancient is a poor preservative. Dry sand deposits and consolidated dunes are rare except in Port Ross, Auckland Is., and no useful range of seal bones of any age has been found apart from a collection made some time ago by the Australian Expedition at Macquarie I., but not yet studied. The subantarctic area would not be suitable for conducting biological work with fur seals as they are so much more plentiful and accessible elsewhere, and it is sufficient here to record that the subantarctic is apparently not greatly affected by the factors which are stimulating a spectacular increase elsewhere.

The southern sealion (*Otaria hookeri*), on the other hand, no longer breeds outside the area, and its peak population and probable dispersal centre is at Auckland Is. only. The following summary of the breeding cycle is somewhat out of balance with the main theme of the paper but may be justified as dealing with a characteristic and dominant marine mammal of the area. The observations on which it is based were made between December 1942 and February 1944, with additional summer observations in 1954 and 1962-63.

There is a dual pattern of reproductive behaviour. On Sandy Bay beach, Enderby I., about 1000 animals may be found between October and February. Their breeding cycle commences with the arrival of about a dozen prime bulls, which take up territories along the strand. For a week or two they engage in sporadic skirmishing with mature but slightly younger bulls contesting the actual territory. In November, the cows appear quite suddenly, most of them coming from the sea but a surprising number wandering down from forest lairs inland. During the formation of harem groups of from 10-40 cows around each of the 'Beach-master' bulls, there is increased competition from young bulls, whose number builds up to about 200 by the time the harem groups are established. The first pups in these beach rookeries are born in December within a period of a few days. In all about

350 cows produce one pup each. This is the peak period of fighting among the competing bulls. The small outlying groups of cows may be headed off by the intruders or may make their own attempts to escape towards the water where they are rapidly surrounded. The harem bull is thus fully occupied in endeavouring to maintain the unit structure of his group. Luckily the pups are possessed of boundless energy and between feeds they move smartly out of the turmoil and play at a safe distance. In spite of this there is some mortality through accident or neglect and by February the number of pups is about half the total born. The exhausted harem bulls have by this time lost interest and moved off to sea and their fragmented harems are to be found in smaller groups with which young bulls are associated. There is a final dispersal of the cows upon which any surviving pups are still dependent in about March. There is a very wide dispersal inland of groups of pups throughout the winter until the end of July or early August when they go to sea. Thus there are sealions to be found ashore throughout the year.

There is a secondary breeding pattern, namely the association of sub-mature bulls with cows which from their size appear fairly old. These pairs are almost completely solitary and widely dispersed, many of them a mile or two inland. They have a high proportion of early births about October and of premature births even earlier. Another marked feature of these associations is the neglect of the solitary pups which often slowly die of starvation. Somewhat intermediate between the two extremes are the small harem groups on the islets and shores around Carnley Harbour, several east coast headlands and on Dundas Reef, from which some pups survive. The few breeding records of sealions on Campbell I. can be included in this pattern. Dispersal of stray males can be further afield and they appear regularly at Macquarie I. to the southward and to Snares and Stewart I. northward.

Features of sealion biology not yet worked out include particularly the age groups of breeding cows in the different patterns of reproductive behaviour.

Of the earless seals, sea leopards (*Hydrurga leptonyx*) regularly, and crabeaters (*Lobodon carcinophagus*) less regularly, come ashore at any or all of the islands but no breeding is reported. Elephant seals (*Mirounga leonina*), whose breeding population has built up over the period 1918-1948 to a high peak at Macquarie I. (Carrick & Ingham 1960) have over the same period increased at a less spectacular rate and in smaller numbers at Campbell I. In still smaller numbers they breed at Antipodes Is. and are regular visitors to the Snares and Auckland Is. where breeding is presumed on Dundas Reef.

#### *Introduced land mammals*

There are very restricted habitats for land mammals in the Subantarctic. The history of introductions has included species intended for the food of castaways, later introductions in an



attempt to graze stock, and the usual accidental escape of rats and mice together with the cats and dogs taken for company by sealers and settlers. The general picture is one of failure to establish or decline in all the ungulates unless the stock is kept up by new introductions and farming practice.

*Sheep* were introduced and pastoral activity commenced on Campbell and Auckland Is. in 1895. On the latter where land clearance proved difficult, flocks of up to 2000 eventually disappeared altogether after being abandoned. At Campbell I., where they were maintained until 1931, they have declined from an estimated 4000 to about 2000 in 1941 and down to about 1000 in 1962, with no sign of any change in the general trend (Wilson and Orwin 1964). A few dozen sheep released on Antipodes Is. 80 years ago did not appear to survive and were reported in dwindling numbers only during the first 10 years after liberation.

*Cattle herds* left when pastoral attempts were abandoned have remained constant at the low level of about 15-20 beasts on Campbell I. and some 60 or 70 on Enderby I.

*Goats*, originally liberated in small numbers at Auckland, Campbell and Antipodes Is., have survived only at Auckland Is., where they are now restricted in distribution and low in numbers at the northern end of the main island only. A small herd on Ocean I. in Port Ross was exterminated in 1941 and replaced by sheep for the use of the wartime coast watchers. These sheep were finally killed out in 1945.

*Wild pigs* have flourished on the main island of the Auckland group and have been responsible for some modification of the ground and of the faunal balance. Although introduced also on Adams I. they failed to establish and at Enderby I. also died or were killed out a good many years ago. On the main island they spread very slowly from their original point of introduction at the north end in 1807 and did not reach Carnley Harbour for more than 50 years. They are now, however, widespread at all levels from the vegetation line to the sea coast where they regularly spend periods rooting amongst stranded kelp.

*Feral cats* are widespread on Auckland I. proper and are present also at Campbell I.

*Feral dogs* have been reported at intervals on Campbell I. and Auckland Is., but not in recent years.

The *brown rat* (*Rattus norvegicus*) is abundant at Campbell I. There are former records also of numbers of rats, species not identified, at the Auckland Is. At the present time there appear to be no rats there, the suitable terrain being fully occupied by mice.

The *mouse* which is abundant at all levels on the main island of the Auckland Is. appears to be the ordinary house mouse (*Mus domesticus*), although its habits are those usually associated with field mice. There were mice also in the depot building at Antipodes I. in 1950.

There are *rabbits* (*Oryctolagus cuniculus*) on Rose and Enderby Is. of the Auckland group, and their history and general biology have been studied recently (Bull 1960).

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