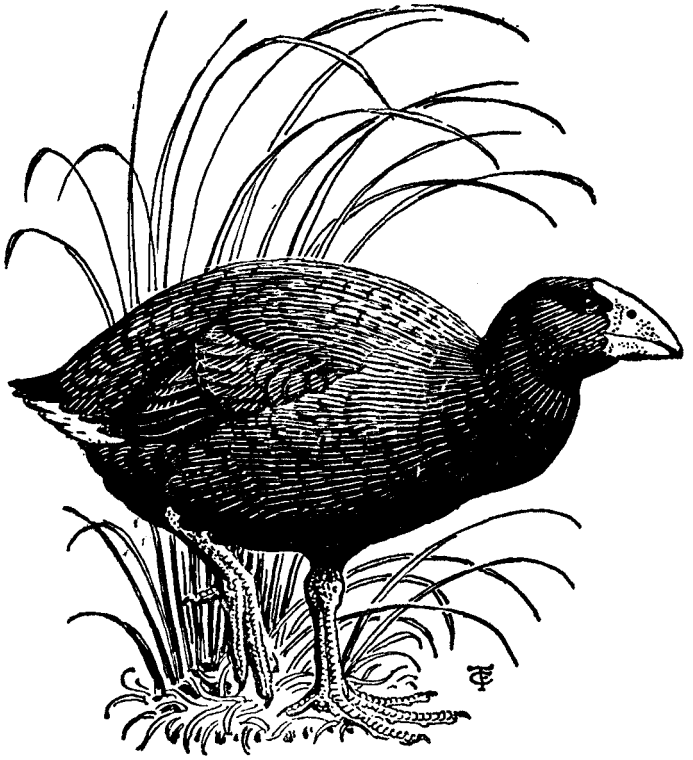
NOTORNIS



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DISTRIBUTION AND NUMBERS OF THE CRESTED GREBE *Podiceps cristatus* IN CANTERBURY

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ABSTRACT

The Crested Grebe is one of New Zealand's rarer breeding birds; it is now confined to the South Island. In Canterbury about 50 pairs were by 1969-70 present as regular breeding birds on 23 lakes; the nesting birds are largely clustered in five groups of lakes: the Lake Sumner group with four pairs; the Lake Pearson group with seven pairs; the Lake Coleridge group with 13 pairs; the Lake Heron group with 12 pairs; and the Lake Alexandrina group with 14 pairs. There has been a decrease of 35 - 40 per cent from some 80 plus pairs nesting on Canterbury lakes 20 - 30 years ago. Most of the breeding pairs are found in lakes above 2,000 feet altitude (up to over 2,600 feet), and with two or three exceptions (small lakes at high altitudes) these lakes do not freeze over in winter and the grebes are resident all year round.

INTRODUCTION

The Crested Grebe *Podiceps cristatus australis* (Gould) is one of our rarer breeding birds, now confined to the South Island. Its distribution and numbers are therefore of general interest, in particular as this lake-dwelling species is decreasing in numbers. It is a native species, immigrated from Australia.

Since my transfer to University of Otago in 1964 and aided by a research grant from the University Grants Committee I have been engaged upon a study of the distribution and ecology of this species in the South Island. This paper is one of a series and deals with the distribution and numbers of Crested Grebes in Canterbury. This district (and former province) is to the north bounded by the Conway River across to Mt. Humboldt, to the south by the Waitaki River across to Lake Ohau and Hopkins River, and to the west by the Southern Alps.

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FIGURE 1 — The characteristic silhouette of a Crested Grebe on the placid waters of Lake Alexandrina.

MATERIAL AND METHODS

Material on distribution and numbers of the Crested Grebe has been collected as and when opportunity permitted during 1964-70. I have personally visited all the major grebe lakes in Canterbury and have in addition received much information from co-operators.

Some 300 questionnaires were mailed to a number of people who were thought to be in possession of grebe observations: ornithologists, field officers of the Wildlife Division and acclimatization societies, national park rangers, university staff, Forest Service personnel, mountaineers, high country farmers, botanists and zoologists in various D.S.I.R. research organizations, and members of natural history societies.

Notices about the study and requests for information were published in ' Notornis ' and ' Forest and Bird ' and in the Newsletter of the Canterbury Mountaineering Club early in 1968.

Much information has also been obtained through interviewing shooters, anglers and back-country farmers living in the grebe areas. The records of Crested Grebes contained in the Ornithological Society of New Zealand Recording Scheme (in the following text abbreviated to O.S.N.Z. Rec. Scheme) were placed at my disposal by the Recording Convener, Mr. A. T. Edgar.

All information collected has been collated and has in some cases been further checked through correspondence, visits or field investigations.

Altitudes and sizes of lakes have been obtained from a number of older and newer maps, and some lake sizes and altitudes have been calculated using the largest scale maps available. Lake sizes for the 14 lakes discussed in Dr. Stout's paper (1969) are based on information supplied by the Lands and Survey Department and have been used in this paper.

DISTRIBUTION AND NUMBERS

The information collected on Crested Grebe distribution in Canterbury is shown in Fig. 2, including both present and past breeding lakes as well as observations outside the breeding range.

The northernmost lake in the Canterbury district is *Lake Tennyson,* altitude 3,619 feet above sea level; it is a high country lake in bleak surroundings with land rising steeply around it except in the southern part. There are hardly any suitable nesting sites for grebes along the shore line, and the lake looks an unlikely Crested Grebe habitat. I saw no grebes when visiting it on 25 January 1970, nor has Mr. L. G. Morris of the N.Z. Forest Service, Hanmer Springs, ever seen any during his several visits to the lake; Mr. Morris has also made enquiries from a local sport-fisherman who has made regular trips to the lake for a number of years without ever having seen any Crested Grebes. While visiting the lake I also talked with two anglers who have fished the lake for a number of years and neither had ever seen or heard of grebes being seen on this lake.

Lake Guyon (1), altitude 2,100 feet, size 190 acres. The only detailed description — and an old one at that — of the life history of the Crested Grebe in New Zealand is " Notes on the habits of *Podiceps cristatus* " by W. T. L. Travers (1870). The following is a brief summary of his main findings: The water of Lake Guyon is warm and " even in severe seasons, has never been frozen over."

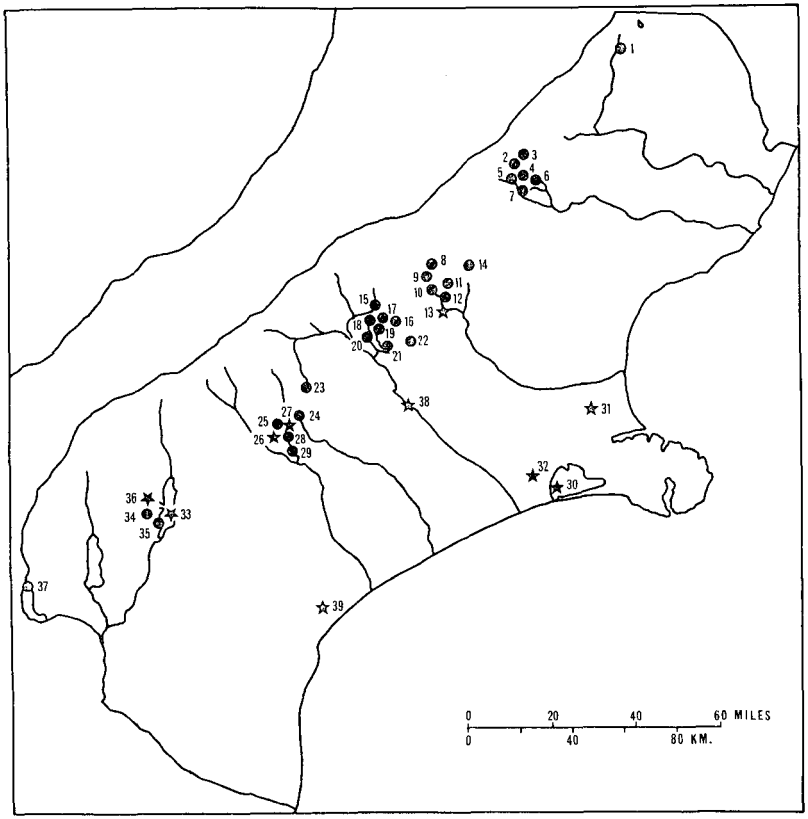

FIGURE 2 — Distribution of Crested Grebes in Canterbury. Numbers refer to numerical order of lake in the accompanying text; circles indicate present and past breeding lakes, stars show occurrence of visiting birds (including possible breeding occurrences).

Grebes are found on it throughout the year. "There are several permanent nests on the borders of the lake, which have been occupied by pairs of birds for many years in succession, from which I am led to infer that, as in the case of some of the *Anatidae,* these birds pair for life. . . . Although the Grebe reluctantly takes to flight, there is no doubt that it flies without any great difficulty, for it is found in situations which it can only reach by rising considerably above the general level of the ground. I have never seen two or more pairs associating together . . . no pair, however, appears to confine itself to any particular station, except when accompanied by young ones." An immature Crested Grebe, collected on Lake Guyon in February 1872 is now in the Dominion Museum (D.M. 1230). There is a specimen (female, with no date, AV 1225) from Lake Guyon in the Canterbury Museum. Only a few recent records are available: a pair was seen in November 1965 (N. Dennison, pers. comm.); a

pair and a single bird were seen in the early summer of 1964-65 and again in the winter of 1965; a single bird was seen early summer of 1969 (G. Roberts, pers. comm.). From being a common breeding bird, occurring in a population of several pairs, only a single pair is left, and only time will show if survival is ensured. Lake Guyon is now the northernmost breeding lake for Crested Grebes in New Zealand, and the population has almost collapsed, with new recruitment — now that the grebes have disappeared from the Rotoroa and Rotoiti Lakes to the north — only possible from the next group of lakes with permanent grebe populations, the Lake Sumner group, some 36 miles to the south as the 'grebe' flies. Some 19 miles almost due west is found another Crested Grebe lake, Lake Daniells, but separating these two lakes (effectively?) is the crest of the Southern Alps; the nearest low altitude crossing would be at Ada Pass, elevation 3,290 feet, and further south Lewis Pass, elevation 2,968 feet. In both cases flying time would be increased appreciably, and New Zealand Crested Grebes are notoriously reluctant and poor fliers.

After the loss of breeding grebes from Nelson-Marlborough during the latter part of last century and the early half of the 1900's, the apparently almost inevitable loss of Lake Guyon as a grebe lake would shift the northern extension of the Crested Grebe range in Canterbury to the Lake Sumner group which, as mentioned next, are now also seriously threatened as grebe lakes.

Lake Sumner (2) at an altitude of 1,725 feet, size approximately 3,520 acres, is now a developing holiday resort with fishing, boating and camping. Crested Grebes formerly were present and nested on this lake. In the Canterbury Museum is found a clutch of two eggs of Crested Grebe collected at Lake Sumner (AV 3435) but without date or further details. It is unlikely, however, that there ever was a large grebe population on this lake as the steep slopes on the one side rise straight out of the lake, while on the other side bush grows to the lake edge; there are no extensive raupo beds, and suitable nesting sites for grebes probably always were limited and are so today. Mr. G. Webb, field officer of the North Canterbury Acclimatisation Society, has visited the lake three times a year over the last four years but has never seen Crested Grebes; he has been informed by Mr. W. Dunnell that he saw a pair in October 1969. During a week-end stay (9-10 December 1967) no grebes were seen on this lake (J. McIlroy, pers. comm.). Mr. J. Stanley of Christchurch has been fishing in the Lake Sumner area for 18 years and considers, when he first went there, that some 12-20 pairs of Crested Grebes nested in Lake Sumner and associated lakes. In recent years he has seen no grebes on Lake Sumner and considers the disappearance due to illegal shooting (he knows of grebes being shot in mistake for shags); disturbance by power boating giving shooters and anglers access to all parts of the lake; and several floods at nesting time, especially in 1957 when Lake Sumner rose 13 feet in 12 hours. The decline in numbers appears to have been gradual and coinciding with increased human activity in the area: holiday campers, anglers, shooters, trampers, boaters. A careful survey of this lake is needed.

Lake Marion (3), altitude 2,200 feet, is a small lake (37 acres) to the north of Lake Sumner and draining into it. A Crested Grebe was seen in December 1967 (J. Stanley, pers. comm.). A deer shooter

in the Hope Valley entering the Kiwi Stream Valley during Easter 1968 reported sighting a Crested Grebe in company with a Blue Duck on this lake (S. C. Sparrow, pers. comm.).

Lake Katrine (4), altitude 1,800 feet, is a small lake (221 acres) connected with Lake Sumner through a channel in a marshy area; Mr. G. Webb of the North Canterbury Acclimatisation Society (pers. comm.) has visited the lake — where there is much boating as well as fishing — three or four times a year over the last four years but never saw or heard of grebes present. The lake is or rather was a good waterfowl area, but the advent of summer visitors, building of baches, use of power boats and launches, and anglers' activities have resulted in the disappearance of not only Crested Grebes but other waterbirds as well, including N.Z. Scaup. Grebes formerly nested on the lake, usually two pairs, but disappeared in the mid-sixties after the rapid increase in boating (Mrs. W. J. McEldowney, Mr. C. A. Nurse, and various anglers I talked to during a visit on 24 January 1970). No Crested Grebes were seen on this lake during a week-end visit, 9-10 December 1967 by J. McIlroy (pers. comm.).

Lake Mason (5), altitude 2,200 feet, size 256 acres, is situated a couple of miles south-west of Lake Katrine and empties into the western end of Lake Sumner. It is partly surrounded by bush, and access is difficult. A Crested Grebe nest with four eggs was found in early November 1951; the nest was situated in a sheltered bay about four feet from the shore (L. G. Morris, pers. comm.); Mr. Morris has re-visited this lake at odd intervals since 1951 but never again saw, nor heard of any one else having seen Crested Grebes there.

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FIGURE 3 — One or two pairs of Crested Grebes nest annually on Lake Sheppard which has several sheltered bays with extensive reed-beds providing suitable nest-sites.

Lake Sheppard (6), altitude 1,916 feet, size 249 acres. A pair of Crested Grebe " at first thought were breeding, but now doubt it " seen late December - early January, 1967-68 (W. C. Clark, pers. comm.). Two grebes were seen in December 1967 (J. Stanley, pers. comm.), and three grebes were seen on the lake on 5 February 1968 (W. E. Hannah, pers. comm.). Mr. G. Webb of North Canterbury Acclimatisation Society (pers. comm.) has visited this lake three to four times a year during the last four years and has always encountered at least one pair of grebes. On 1 and 2 November 1969 Webb saw two pairs, both displaying. A pair seen on 9 February 1969 (W. C. Clark, pers. comm.), and two pairs seen in northern end of lake in November 1969 (N. J. Payne, pers. comm.). A pair with one chick (about a third the size of the parents) seen in the southern bay nearest homestead on 2 January 1970 (Mrs. W. J. McEldowney, pers. comm.). I saw a pair in the northern half of the lake on 24 January 1970; there were no grebes in the southern end, near homestead, where they are most commonly seen but where during my visit two anglers were fishing for trout. Grebes are also occasionally seen on the small Lake Mary, a small pond just to the north of Lake Sheppard and emptying into it, undoubtedly only visitors from Lake Sheppard.

Lake Taylor (7) is a fair-sized lake, of 471 acres, 1,914 feet altitude, and south of Lake Sheppard. No grebes were seen during a week-end stay in December 1967 (J. McIlroy, pers. comm.), but G. Webb (pers. comm.) advises that a pair of Crested Grebes nested during the 1968-69 season and reared two chicks; the nest was at the top end of the lake. On 1 and 2 November 1969 four grebes were seen: one pair in courtship display, and the other two birds together (the young ones of the previous breeding season?). Mr. C. A. Nurse, who has managed Lake Taylor Station for many years, advises (pers. comm.) that he usually sees one or two grebes in the southern end of the lake, mostly near the northern bank covered with bush; in December 1964 he found a grebe nest with three eggs; the nest was attached to beech branches trailing in the water, near the northern shore below Conical Hill. Visiting the lake and watching carefully for grebes on 24 January 1970 I failed to see any.

Lake Sarah (8) is a small lake of 50 acres, altitude 1,970 feet, and just south of Cass. On this small lake one pair of grebes was seen during August-September 1943 (E. F. Stead, N.Z. Bird Notes 1: 66). A Crested Grebe incubating on nest in swamp between Lake Sarah and Cass Rail Station was seen from train about 1945; the large nest was built of raupo and placed in a small area of open water surrounded by raupo swamp (W. J. Harris, pers. comm.). Two pairs were seen on 18 October 1952 (E. W. Dawson, Notornis 6: 86); a pair with three young were seen in May 1963, and a pair was seen in May 1967 (C. J. Burrows, pers. comm.); on 10 November 1967 a pair was seen, and a pair has been seen regularly from time to time over the last 12 years (W. C. Clark, pers. comm.). A pair was seen late November 1969 (D. R. Maindonald, pers. comm.). On 27 January 1970 I saw a grebe fishing in the northern end of the lake; it later swam towards the dense raupo stand and disappeared into it; six minutes later it (or its mate?) came out from the raupo, possibly nest-relief (?).

Lake Grasmere (9) is situated just south of Lake Sarah and has a raupo swamp at its southern end and is at an altitude of 1,912 feet, size 154 acres. Till recently up to three pairs of grebes have nested annually on this lake; on a trip right around the lake on 7 December 1963 a total of seven Crested Grebes was seen; several old nests were found, built on rocks a few feet from the edge of the lake where beech trees border the northern side; one new nest with one egg was seen (W. J. Harris, pers. comm.). A pair was seen in December 1965 (G. Caughley, pers. comm.), and on 11 November 1967; a pair is usually seen on this lake (W. C. Clark, pers. comm.). Three grebes were seen in early January 1968 (G. L. M. Wyles, pers. comm.). Crested Grebe nests have been found several times at this lake; the last nest found contained three hatched eggs and an egg containing an unhatched and apparently abandoned chick; this lake is now a wildlife refuge, and the bush-clad shoreline on the far (north-eastern) side provides good nesting sites; Crested Grebes may survive here for some time to come (D. McLeod, pers. comm.). Four grebes were seen on lake in late November 1969 (D. R. Maindonald, pers. comm.), and I saw a pair diving and feeding not far from the western shore in the northern half of the lake on 27 January 1970.

Lake Pearson (10) is the largest lake in the area (525 acres) and at an altitude of 1,993 feet; it is a long, narrow and time-glass shaped lake with swamps at the northern end. Its nearness to the Arthurs Pass road has resulted in an influx of campers, anglers and boaters over the last few years; several co-operators advise that while formerly one or two pairs nested annually, now only one pair is left and even that may soon disappear; formerly illegal shooting and now boating are given as causes for this. Crested Grebes are often seen on this lake (J. R. Jackson, pers. comm.). A clutch of six eggs was taken at Lake Pearson on 31 December 1931 and is now found in the Canterbury Museum collections (AV 9964). Two Crested Grebes were seen on the lake on 19 January 1948 (G. Guy, N.Z. Bird Notes 3: 89), and a pair performing courtship display was seen on 4 September 1958 (P. Grant, Notornis 8: 197). A pair of grebes was seen on the lake near the Lake Coleridge diversion on 20 January 1959 (A. H. C. Christie, pers. comm.). Four grebes were seen on 25 November 1960 (G. Chance, pers. comm.). One grebe was seen on 31 July 1964 (G. Harrow, pers. comm.), and again a lone bird seen in October 1964 (O. Hughes, pers. comm.). W. J. Harris (pers. comm.) advises: " Perhaps 12 years ago newspapers reported that birds being shot at on Lake Pearson." A pair was seen on 2 December 1967 (A. K. Witty, pers. comm.). A pair nested during the 1967-68 breeding season (D. R. Maindonald, pers. comm.). Mr. G. C. Urquhart (pers. comm.) of Flock Hill reports that a pair has been on the lake for a number of years but while seen in 1967 was not seen in 1968: " Am of the opinion they have been shot." Five grebes were seen on the lake in late November 1969 (D. R. Maindonald, pers. comm.); in spite of careful observations, especially in the northern raupo-fringed bay, I failed to see any grebes when visiting this lake on 27 January 1970.

Lake Hawdon (11) near Craigieburn is at an altitude of 1,889 feet, size 75 acres, now much visited by anglers. In the early sixties a pair of Crested Grebes nested here but may now have disappeared

(W. J. Harris, pers. comm.). A grebe was seen on lake in December 1967 (J. Stanley, pers. comm.). A pair of grebes was observed on 27 November 1969 when 3,000 4 - 5 inch trout were liberated in the lake (D. R. Maindonald, pers. comm.). I visited this lake on 27 January 1970 and am certain that there were no Crested Grebes present; there were, however, 2 Black Shags.

Lake Marymere (12) is a small lake (56 acres), half a mile south of Lake Hawdon and at an altitude of 2,023 feet. There are no suitable raupo stands or hanging willows suitable for attachment of grebe nests, and the lake is visited by many anglers; there are, however, some matagouri bushes in places along the far shore. In spite of its apparent unsuitability, Crested Grebes appear to have nested here in the past and have also been seen recently. A clutch of two eggs from Lake Marymere was collected on 11 January 1933 by D. Hobbs; it went to the Stead collection and is now in the Canterbury Museum (AV 4293). Mr. H. McAllum (pers. comm.) in November 1962 saw a grebe feeding on this lake. A fisherman, a Mr. Logan (D. R. Maindonald, pers. comm.) found a Crested Grebe nest on 1 November 1969; the nest which contained one egg was constructed of moss and lake weeds and situated about 9 ins. above the water line amongst large rocks at the lake's edge. The bird was observed incubating the one egg, but the nest was subsequently abandoned, the cause believed to be frequent visits and being chased away accidentally by fishermen. Mr. Logan visited Lake Marymere almost every week-end between 1 November and Christmas 1969, but the pair did not build a new nest or try to nest again; the pair, however, remained on the lake and was frequently seen. Probably this pair was seen late November 1969 (D. R. Maindonald, pers. comm.), and again on 28 December 1969 (W. C. Clark, pers. comm.). When I visited the lake on 27 January 1970, the lake was very low (10 feet below normal?), exposing large stony banks. To my surprise I saw a pair of Crested Grebes feeding about 40 yards from the northern shore; these birds were quite tame in their behaviour and took little notice of me.

Vagabonds Inn (13) or Vagabond Tarn is a small barren tarn just over a mile south of Lake Marymere, altitude 2,050 feet. A pair of Crested Grebes was seen on this apparently unsuitable tarn in late November 1969 (D. R. Maindonald, pers. comm.), and were probably accidental visitors during spring looking for suitable nesting waters.

Lake Letitia (14) near Mount White is a small (approximately 60 acres) narrow lake at an altitude of 1,930 feet. A Crested Grebe was seen here on 12 January 1963 (G. Harrow, pers. comm.). A grebe was seen late November 1969 (D. R. Maindonald, pers. comm.), and a pair was seen on 30 December 1969 (W. C. Clark, pers. comm.).

Lake Lilian (15) is a small (40 acres) high country lake two miles west of the meeting point of the Harper and Avoca Rivers, altitude 2,600 feet. A pair of grebes was seen in November 1964 (G. Caughley, pers. comm.). A pair was seen on this lake on 1 November 1969 (D. R. Maindonald, pers. comm.), and again late the same month.

Lake Catherine (16), also known as Lake Monk or Lake Constance, is a small lake (51 acres) at an altitude of 2,050 feet. There is a raupo and willow swamp in the southern end. Crested Grebes have been known to nest on this lake for many years, and usually one pair has been present (M. R. Murchison, pers. comm.). In the early 1950's a grebe nest was found (by Dr. C. J. Burrow's father) and grebes were seen (C. J. Burrow, pers. comm.). A pair was seen on three occasions, December 1966, December 1967 and January 1968, usually near the middle of the lake (J. Wills, pers. comm.). This lake is visited by a few anglers only, and is thus relatively undisturbed for the better part of the year. A pair of grebes was seen in January 1968 (S. C. Sparrow, pers. comm.). A pair with one ¼-grown chick was seen late November 1969 (D. R. Maindonald, pers. comm.). I saw a pair of grebes in the bay half way up the eastern side of lake on 26 January 1970.

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FIGURE 4 — The small Lake Ida freezes over in winter so its one or two breeding pairs must seek nearby open waters (probably Lake Coleridge) during winter.

Lake Ida (17) consists of two small lakes, together covering 24 acres, connected by a stream and surrounded by steep slopes, to the north bush-covered. Its high altitude (2,600 feet) usually results in freezing over in winter when used for ice-skating. In recent years one or two pairs of Crested Grebes have been seen regularly on this lake (M. R. Murchison, pers. comm.). Two grebes seen on 12 January 1963 (W. T. Popplewell, pers. comm.). One grebe seen on 28 October 1966 (G. Chance, pers. comm.), and again one grebe seen on 20 January 1968 (N. Etheridge, pers. comm.). Grebes were seen on this lake November-December 1969 (M. R. Murchison, pers. comm.).

This is one of the very few lakes in New Zealand which regularly freezes over in winter and which has a nesting population of Crested Grebes, which in turn must move (fly) to the nearest ice-free water for the winter; in this case that would be to Lake Selfe less than a mile away. I visited Lake Ida on 26 January 1970 but in spite of careful observation failed to see any grebes. The lake looked forbidding with no suitable nest sites along the shore and the fact that it freezes over in winter makes it even less suitable for grebes.

Lake Selfe (18) is a small (81 acres) long and narrow lake, set between Mt. Ida and Mt. Cotton; its altitude is 1,950 feet and it very seldom freezes over (H. E. M. Hart, pers. comm.). Lake Selfe has a very important place in the discovery and early history of Crested Grebes in New Zealand, as the first recorded observation and identification — although not published at the time — is Pott's (1869: 74) record: "In April, 1865, we first made its acquaintance, on a small lake, now called Lake Selfe." An old specimen, collected at this lake, in May 1899 by W. Shipley is now in the Canterbury Museum (AV 17,570). A clutch of three eggs was collected at the lake by H. Richardson on 8 December 1930; it was part of the Stead collection and is now in the Canterbury Museum (AV 4736). Each year one or two pairs of grebes are now present on the lake (M. R. Murchison, pers. comm.). Mr. H. E. M. Hart, who was the manager of the Lake Coleridge Power Station from 1923-1953, frequently passed Lake Selfe when travelling to the Harper River Diversion and reports (pers. comm.): "During this period a pair of Crested Grebe were usually to be seen on Lake Selfe. Some seasons, one, or rarely two young birds were to be seen with parent birds. No nests seen." Mr. Hugh Wilson (pers. comm.) also reports

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FIGURE 5 — Lake Selfe is a grebe lake of historical interest as the Crested Grebe was first identified and observed here in 1856 by the famed Canterbury naturalist, T. H. Potts.

frequently seeing Crested Grebes at this lake "some years ago. At this stage there were at least four pairs of grebes on the lakes, and since then grebes are nearly always to be seen if you are passing by Lake Selfe toward the Harper Diversion. At times when we were at the lake in January, the birds would perform beautiful courtship displays." Four grebes were seen on 25 December 1961, and again four birds on 28 October 1966 (G. Chance, pers. comm.). Four grebes were seen on 12 December 1964 (P. Crozier, O.S.N.Z. Rec. Scheme). Each year over the period 1964-67 a pair was seen on this lake (M. J. W. Douglas, pers. comm.). In May 1967 an adult grebe was seen (C. J. Burrow, pers. comm.), and usually a pair is seen. Three grebes were seen on 31 December 1967 (W. J. Harris, pers. comm.). Mrs. Marion Lane has advised that Mr. P. G. Ellis of Christchurch has been fishing at this lake each year for the last five years and found one pair nesting each year. During the 1967-68 breeding season, the nest was found and uncovered; it contained four eggs. The nest was found in the same place each year; no young ones were seen. Mrs. Lane also saw a pair on 19 October 1969 and found remnants of an old nest. A pair was seen on lake late November 1969 (D. R. Maindonald, pers. comm.), and I saw a pair in a small sheltered bay with beeches overhanging the water on 26 January 1970; this pair, which was preening and feeding, was seen near the far shore about a quarter of a mile from the top end of the lake. A Crested Grebe was reported found dead (shot) at lake edge over the New Year period 1970 (W. McKillop, pers. comm.).

Lake Evelyn (19) is a long and narrow lake immediately southeast of Lake Selfe; altitude 2,000 feet, size 36 acres. This lake has dense raupo stands along its edge; it appears to be a very suitable grebe habitat, and it does not freeze over in winter. Mrs. Marion Lane (pers. comm.) saw a pair of Crested Grebes on this lake on 19 October 1969. On 26 January 1970 I watched a grebe diving and feeding in the northern half of the lake; later on another grebe appeared from the reeds (nest?) ,and the bird I had so far been watching swam into the reeds (possibly going to the nest).

Lake Coleridge (20) is a large lake (approximately 11,520 acres) at 1,667 feet altitude. At its southern end water is diverted to the Lake Coleridge Hydroelectric Power Station. Although not a very suitable grebe lake, the presence of Crested Grebes here has been known for a long time. Potts (1869: 74) mentions that in 1868 he found a Crested Grebe nest on a pile of flax in the small boat harbour. In Canterbury Museum there are two skins of Crested Grebe from Lake Coleridge, a female taken in November 1907 (AV 372), a male dated 5 January 1917 ,AV 2887), and a clutch of three eggs from the Stead collection (AV 4734), collected on 20 December 1917. Several pairs were present on the lake in May 1944 (E. F. Stead, N.Z. Bird Notes 1: 66). Several pairs now nest annually and there may have been an increase in numbers as a result of less indiscriminate shooting (M. R. Murchison, pers. comm.). Pairs of grebes were observed in November 1962 (S. C. Sparrow, pers. comm.). Crested Grebes were seen feeding in the northern end of the lake during the winter of 1966 (G. Webb, pers. comm.). An adult grebe was seen in May 1967 (C. J. Burrow, pers. comm.). A pair observed in north end of the lake on 23 December 1967 where they have been

noticed for three years but do not seem to multiply; they keep to the shallow weedy parts of the lake (N. Etheridge, pers. comm.). A survey of the lake in late November 1969 showed a total of 11 Crested Grebes present, and the impression was that there was a pair in each of the suitable bays (D. R. Maindonald, pers. comm.). On 26 January 1970 I visited the lake and observed its waters from various vantage points; one was the bay at the end of the Ryton Road, about half way up the lake on the northern shore, but no grebes were seen; another area was the ideal waterfowl bay at the southern end of the lake, near the homestead, where I saw a pair of Crested Grebes swimming and diving. A detailed survey from land all around the lake and from a boat on a calm day is needed to establish more closely the actual number of Crested Grebes in this large body of water. The population is tentatively estimated at six pairs.

Lake Georgina (21) is a small lake (50 acres) next to the Harper Road, a couple of miles north of Lake Coleridge Station; altitude 1,800 feet. Mr. H. E. M. Hart who was Manager of the Lake Coleridge Power Station from 1923-1953 frequently travelled this road and has provided this information: " Very occasionally a pair (of Crested Grebes) was seen on Lake Georgina, and one season a nest was observed on shore of this lake close to the Harper Road, but do not think any young were raised (too much in view of public)." Mr. M. R. Murchison (pers. comm.) of the Lake Coleridge Station advises: " The only lake of any size on this property I have

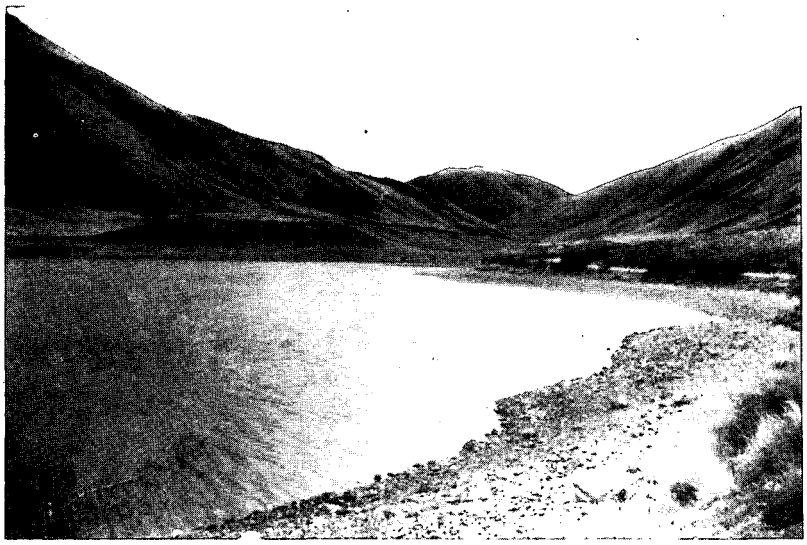

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FIGURE 6 — Lake Georgina photographed at low water-level with exposed stony shores. In such summers grebe nesting is entirely prevented.

not seen permanent Grebe on is Lake Georgina though this could have seasonal use." A pair was seen on 25 December 1961; this pair built a nest in the centre of lake (G. Chance, pers. comm.). A pair was seen on 10 January 1963 (G. Harrow, pers. comm.). A pair of grebes was seen on lake in November-December 1969 (M. R. Murchison, pers. comm.). On 26 January 1970 I saw to my surprise a pair of Crested Grebes on this unsuitable-looking lake; the water level was very low, exposing stony banks, and there were no bushes or trees at the lake edge, nor any raupo stands. At normal water level there are a few matagouris at the lake's edge to which a grebe nest may be anchored. This is one of the smallest lakes I have seen apparently capable of sustaining a pair of Crested Grebes.

Lake Lyndon (22) is a narrow high altitude lake (2,769 feet) without suitable raupo stands and set in tussock-covered hills; size 275 acres. Being next to the main highway to Arthur's Pass it is frequently visited and is used for winter sports as it freezes over most winters. An early record is that of Reischek (1952: 22) who on 20 December 1877 apparently saw Crested Grebes on this lake: " On the west side, at the foot of the Pass, lay a little lake, the Lyndon. Paradise duck, grey duck, little grebe, and other water dwellers were enjoying life on its surface." I have checked the original German text (Reischek, 1924: 43); Reischek uses the name *Steissfusse* which is an alternative (old) German name for the grebes; he precedes this with a descriptive *kleine* (meaning small) in lower case, not a capitalized adjectival part of the specific name. Reischek undoubtedly saw the Crested Grebe (for him to have seen the Dabchick — which is rare in the South Island, in particular east of the Southern Alps — would have been more sensational; Reischek knew both species of grebes as his writings show, and he was undoubtedly also familiar with the Crested Grebe from Europe before his coming to New Zealand). A specimen of Crested Grebe, a female, without date from this lake is in the Canterbury Museum (AV 2890). A pair was seen on the lake in January 1940 (B. J. Marples, pers. comm.). A pair was seen in December 1962, January 1963 and January 1968 (S. C. Sparrow, pers. comm.). Mr. D. R. Maindonald of the North Canterbury Acclimatisation Society has only seen grebes here on very few occasions. Personally I have passed and watched the lake for grebes on a number of occasions, both summer and winter, but have never seen any. I last passed the lake on 26 January 1970 when it was extremely low, exposing wide areas of stony banks. No grebes were seen. On the western side are found a few scattered matagouri bushes — during drought as just described high above the waterline. Ranger G. Webb of the North Canterbury Acclimatisation Society advises me that in summers when the lake is high and full of water, the waterline reaches matagouris and beeches, and he is of the opinion that a pair of grebes nest on the lake in such years when conditions are right.

Lake Heron (23) is a large lake (1,800 acres) east of Mt. Taylor and at an altitude of 2,276 feet. The shape of the lake is very uneven and there are large adjoining swamps and stands of raupo and patches of willows in many places along the lake edge. The lake has been known for its permanent Crested Grebe population for many years.

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FIGURE 7 — Home Bight at the northern end of Lake Heron with a Crested Grebe territory and where a nest was found anchored to trailing willow branches.

Two clutches of grebe eggs in the Canterbury Museum are from this lake, both from Stead's collection, one of three eggs from 17 January 1932 (AV 4737), and one of four eggs from 21 January 1933 (AV 4735). Because of Lake Heron's high altitude and nearness to high mountain ranges, parts of the lake frequently freeze over in winter, and seasonal as well as unseasonal snow-falls occur in the area. Much information has been provided by Mrs. Lane of Ashburton and Mrs. Shona Mulligan of Barford; both frequently visit Lake Heron. They have found that the number of resident grebe pairs varies somewhat, but in the areas visited by them there appear to be five permanent pairs holding territories, one pair in the south-western end of the lake, one pair about half-way up the western shore, two pairs in the northern end, and one (or possibly more) pair at the swamps half-way up the eastern shore. Two grebes were seen on 28 May 1960 (E. W. Crack, Notornis 9: 237). Two pairs seen on 23 November 1960 (G. Chance, pers. comm.). R. Boud (pers. comm.) saw a breeding pair in December 1962; the nest was in a willow growing in the water, about 30 feet from the shore, south-western end of lake. Seven grebes were seen on 10 January 1963 (W. T. Poppelwell, pers. comm.). On 2 November 1963 Mrs. S. Mulligan (pers. comm.) saw five pairs displaying during the day; they were in the southern end of the lake. A pair was observed in May 1965 (E. B. Green, pers. comm.), and a pair seen in August 1966 (M. J. W. Douglas, pers. comm.); a single grebe was seen on 5 June 1966 (G. Harrow, pers. comm.). A pair was seen on 25 July 1967 (S. N. Adams, pers. comm.).

Two grebes seen in Harrison's Bight on 18 November 1967, have been noticed here for last three years; they keep to the shallow weedy parts (N. Etheridge, pers. comm.). Observations in 1968 (Mrs. M. Lane, pers. comm.): One grebe seen on 30 October, four on 1 December, two on 26 December, and four on 29 December; on last mentioned day two pairs were seen displaying in the more secluded upper lake area. The disastrous floods in November 1967 were thought to have affected their numbers. In 1969 the following observations were made: on 20 and 27 April and on 3 May, seven adult grebes and three young were seen (one pair with two young and one pair with one young); on 21 July a total of nine grebes was seen. On 17 May 1969 I visited the lake with Mrs. Mulligan, but in spite of watching for grebes using both binoculars and telescope in the lower and upper ends of the lake as well as from various points along the western side of the lake, only one Crested Grebe was seen, feeding near the middle of the lake and nearer the far shore. I visited Lake Heron again 15-17 January 1970 and covered the lake by car, walking and dinghy (northern end); I located 7 pairs of Crested Grebes: 2 pairs in the south-western corner where a willow-sheltered bay and a tree-framed lagoon at the stream outlet provide shelter and numerous nesting possibilities; the holiday season brings many visitors, and nesting success appears low: a pair another mile up the western shore where there is another bay: a pair in Home Bight at the northernmost end of the lake, where I found a grebe nest with one lukewarm (incubated) egg; the nest was anchored to trailing willow branches in a willow thicket: two pairs further down from Home Bight, one of these pairs had a half-grown still striped young: and finally a pair outside the eastern bay, surprisingly not in the long narrow bay itself although it appeared to be promising grebe nesting habitat. From my talks with Mr. A. T. Urquhart and sons of Lake Heron Station, Mr. and Mrs. J. J. Rouse of Upper Lake Heron Station and a number of anglers and visitors who have visited the lake for a number of years, it appears that the Crested Grebe population has been declining (and fluctuating somewhat) and that formerly some 10-12 pairs nested at the lake.

Maori Lakes (24) are two small lakes about three miles north of the Lake Heron-Erewhon turn-off; the lakes are surrounded by swamp and there is a large swampy area between them; altitude 2,044 feet. Crested Grebes were never seen on these lakes over many years of regular visits (M. Orton, pers. comm.). No grebes seen during several visits in 1969 (Mrs. M. Lane, pers. comm.). I saw no grebes when watching the lower (eastern) lake on 17 May 1969. On 17 January 1970 I again carefully scanned the eastern lake with binoculars from a hill, but no grebes were seen. I then went to the western Maori Lake (size 52 acres) where I saw a pair of Crested Grebes in the western end of the lake, diving and fishing. The pair gradually moved further eastward (which also was away from me); one of the grebes eventually swam and disappeared in the large reed-bed at the southern side of lake (to their nest?). This lake is not readily accessible for man owing to marshy surrounds and large reed-beds, and would appear a lake in which grebes can successfully nest for years to come (if access is not improved).

Lake Clearwater (25), also called Lake Tripp, is a fair-sized lake (488 acres) at 2,188 feet altitude and with a swamp at its western end and scattered willows lining the lake edge. A large camp of anglers' and holiday-makers' cribs brings large numbers of people to the lake, especially during the holiday period, but fortunately motor boats are not allowed on the lake. A pair of Crested Grebes nests annually (M. Orton, pers. comm.). Three grebes were seen on 28 May 1960 (E. W. Crack, Notornis 9: 237). No grebes were seen on 26 December 1967 (J. McIlroy, pers. comm.); no grebes were seen on 20 July and 28 August 1969 (Mrs. M. Lane, pers. comm.), and I saw no grebes during a visit on 17 May 1969. On 15 January 1970 when visiting the lake again, I saw a pair of grebes in the bay with willows at the south-western side of the small island in the middle of the lake towards the northern shore; there was also an adult grebe in the bay at the eastern end of the lake, so possibly two pairs nested at Lake Clearwater during the 1969-70 breeding season.

Lake Camp (26), also called Lake Howard, is a small rain-fed tarn (121 acres), a few hundred yards south of Lake Clearwater and at the same altitude. There is no raupo vegetation around the lake, nor nearby swamp, willows or matagouri bushes along the lake edge which is a stony beach, and it appears an entirely unsuitable grebe lake. Furthermore, it is heavily fished and is also used for water-skiing, and there is a large anglers' camp immediately to the north-west of it as mentioned under Lake Clearwater above. A Crested Grebe was seen on 28 May 1960 (E. W. Crack, Notornis 9: 237), showing that the lake has been and may be used occasionally as a feeding water for grebes from nearby lakes. No grebes were seen on 26 December 1967 (J. McIlroy, pers. comm.), nor on 17 May 1969 when I visited the lake; Mrs. M. Lane (pers. comm.) has not seen any grebes on this lake during various visits, including on 20 July and 28 August 1969. I saw no grebes on 15 January 1970 when again visiting the lake.

Lake Roundabout (27) is a small (32 acres) and shallow lake in gently rolling tussock country, about 600 yards south of the Erewhon Station road and east of Lake Camp; its altitude is 2,159 feet. No grebes were seen on 26 December 1967 (J. McIlroy, pers. comm.). On 15 January 1970 I visited the lake, and while there were a great many waterfowl, no grebes were present. I did hear, however, from anglers that Crested Grebes have been seen feeding on the lake, probably non-breeding birds flying between Lakes Clearwater and Emma.

Lake Emma (28), also called Lake Acland, is a fair-sized lake (384 acres) at 2,151 feet altitude; it is partly surrounded by large swamps, particularly to the west and with reed stands and scattered groups of willows. No grebes have been seen during several visits to the lake over a number of years (M. Orton, pers. comm.). I watched the lake for grebes on 17 May 1969 but failed to see any; as it looked a suitable grebe lake with extensive reed beds and willows, I asked if Mrs. M. Lane of Ashburton could have a closer look which she did: on 20 July and 28 August 1969 she looked carefully for grebes on the lake without, however, seeing any. I visited the

lake on 15 January 1970 and from a vantage point spotted a Crested Grebe fishing and diving in the northern part of the lake; later this bird swam away and eventually settled down on a nest. I walked around the north-western end of the lake and came to within 50 feet of the nest, wading out from a willow tree on the marshy shore; the lake bottom was so soft that I unfortunately could not get to the nest. This nest was quite in the open, an oblong pile of lake-weeds, about 4-5 ins. above water level; the eggs had been covered over with nest material when the bird left, and not till I was several hundred yards away from the nest on my way back, did one of the grebes (the mate had joined in the meantime) return to the nest, uncover the eggs and settle down to incubate.

Lake Denny (29) is a very small lake (approximately 30 acres), about two miles south of Lake Emma and at an altitude of 2,208 feet. While M. Orton (pers. comm.) has never seen Crested Grebes on this lake during several visits over a number of years, N. Etheridge (pers. comm.) reports that he saw a pair of grebes on 9 December 1967 and that he has seen a pair on this lake each year for three years.

Lake Ellesmere (30) is one of New Zealand's largest and best bird lakes, the water area covering approximately 68,800 acres. It is a coastal lagoon, protected from the sea by a narrow gravel spit which is opened up two or three times a year; at such times the water level is lowered, water running into the sea, and salinity increases with incoming tidal water from the sea. Crested Grebes probably nested at this lake in fromer times and maybe till comparatively recently. Stead (1927: 214), writing about the birds of Canterbury, thus stated that while the two New Zealand species of grebes were at one time common on the lakes of Canterbury, the Crested Grebe: " though gone from Lake Ellesmere, may still be seen in pairs on most of the suitable lakes in the back country." Stead seems to have possessed information about former occurrence and breeding of this species on Lake Ellesmere, but I have not been able to find any verification in print or otherwise; it would appear, however, that the lake has been a suitable nesting lake for this grebe. In the Canterbury Museum is a Crested Grebe specimen from Upper Riccarton (31), 14 miles from Lake Ellesmere; this bird, a female (AV 371), was collected on 21 April 1929 and was originally in the Edgar Stead collection. Another specimen in the Canterbury Museum was collected even closer to the lake: a female (AV 1222), collected on 28 August 1922 at Leeston (32), only three miles from the lake. A Crested Grebe was watched on 30 October 1947 in Heathcote Estuary (G. Guy, N.Z.B.N. 2, 154). A more recent observation, showing that Crested Grebes may still occur far outside their present somewhat contracted breeding grounds, is that of Field Officer C. Hughes, North Canterbury Acclimatisation Society, who on several occasions in October 1966 observed two Crested Grebes in the western end of Lake Ellesmere; grebes have not been seen there since (D. R. Maindonald, pers. comm.).

Lake Tekapo (33) is formed in the lower end of a glaciated valley and, through the building of a 115 feet high dam (completed in 1954), the formerly much smaller lake has been lengthened and widened to become a large (20,480 acres) hydroelectric storage dam.

The water is not clear, with much sediment in suspension, being fed by the Godley and many other glaciers. There is hardly any shore-vegetation, such as reed-beds and willow thickets anywhere; most of the artificial lake shore is barren with water levels artificially varied between 2,310 and 2,330 feet above sea level. In spite of diligent search of the lake through binoculars and telescope from vantage points at both southern, central and northern parts of the lake in both summer and winter on a number of visits, I have never seen any Crested Grebes on this lake, neither have local residents and boating people asked. There are no likely nesting places, but grebes from nearby Lakes McGregor and Alexandrina could easily move to central Lake Tekapo for feeding during autumn and winter; the murky glacier-fed water, however, is unsuitable for grebes to fish (see) in, and it is likely that their usual animal food cannot exist there either. The only record I have of Crested Grebes on Lake Tekapo is from Mr. George Chance (pers. comm.) who in January 1961 saw a pair in the small bay at the outlet of the stream from Lake McGregor, obviously a pair from this lake. Mr. Chance also advised that he was told by the late owner of Glenmore Station, that he had on occasion seen grebes on the small tarn near the road between Lake Tekapo and Lake Alexandrina and just under a mile from the north-east corner of Lake Alexandrina.

Lake Alexandrina (34) is a large (1,645 acres), long (4.3 miles) and narrow lake, running north-south, surrounded by tussocky hills and with willows along the shore, bays with reed-beds, a swamp at the northern end and a small island; altitude 2,350 feet. Sheltered bays and parts of the lake freeze over during winter. There are

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FIGURE 8 — Willows along the shore of Lake Alexandrina provide in places anchor-sites for Crested Grebe nests; safer nesting is provided at the small tree-covered island in the northern part of the lake.

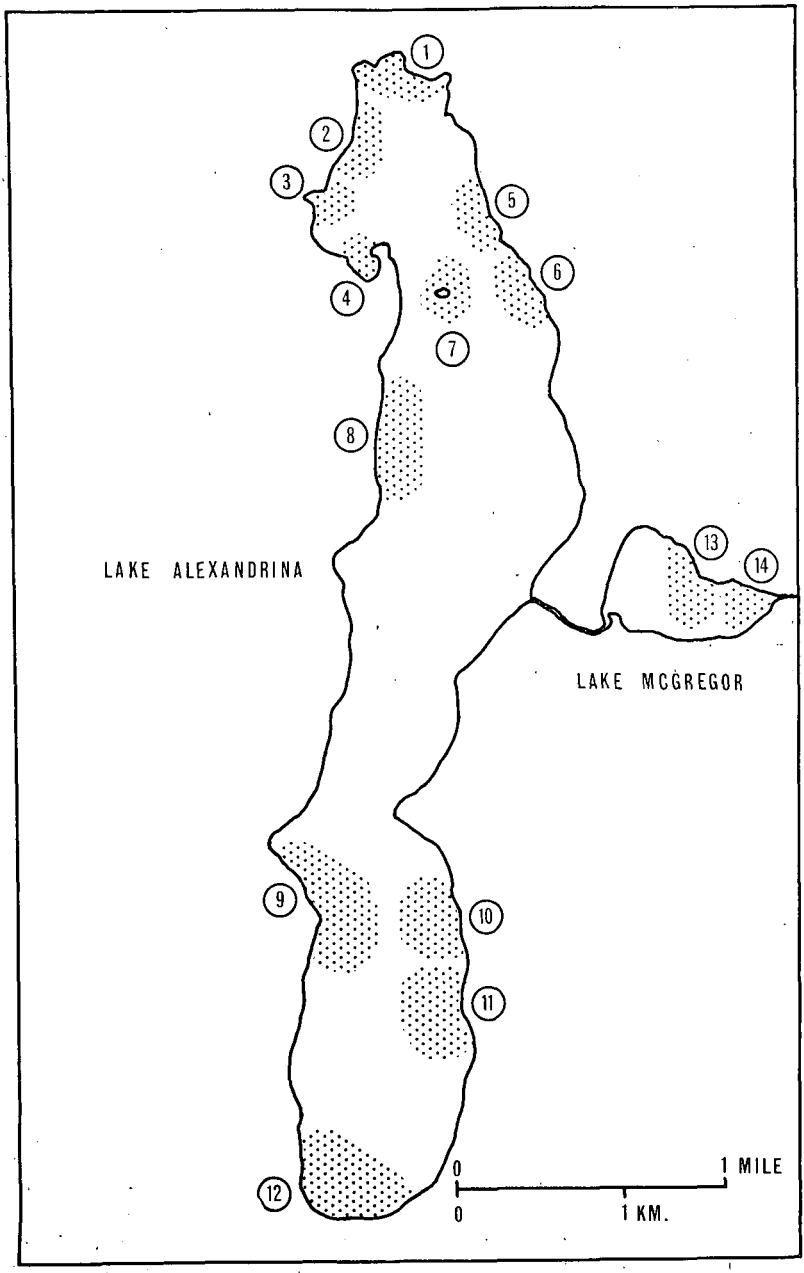

FIGURE 9 — Distribution of 12 pairs on Lake Alexandrina and 2 pairs on Lake McGregor as encountered and mapped on 17 - 18 January, 1970.

anglers' camps with cribs at northern, mid-eastern shore and southern end of the lake, but fortunately no motor boats are allowed. One of the most valuable Crested Grebe lakes in New Zealand and for its size probably still has — although local residents and anglers who have fished here for many years claim a decrease — the largest concentration and breeding population of the species in present-day New Zealand. On 21 November 1960 Mr. George Chance (pers. comm.) saw nine grebes, seven in the northern (Glenmore) end and two at the middle camp; a nest with seven eggs was found at lake on 14 January 1961. A total of 14 grebes was counted on 20 October 1962 (W. T. Poppelwell, pers. comm.). Three pairs seen on 18 October 1966 (A. Wright, pers. comm.). On 25-26 December 1966 M. F. M. Wright (O.S.N.Z. Rec. Scheme) counted a total of 18 Crested Grebes on this lake: one pair in the north-eastern end, five pairs below the middle camp on the eastern side, one pair in the south-eastern part, one pair in the south-western end, and a pair in the Bay of Wales, a mile-and-a-half from the bottom end on the western side. On 5 March 1967 Mrs. H. Oliver (pers. comm.) saw three Crested Grebes near middle camp. I have studied grebes at this lake since 1964 with visits in spring, summer, autumn and winter, and have over this period observed a fairly constant population of some 10 - 12 pairs, mainly present in the upper and lower thirds of the lake; the middle third with the large and ever growing anglers' and holiday camp is less often frequented by grebes. On 17-18 January 1970 I made a careful count and mapping of Crested Grebes on Lakes Alexandrina and McGregor, delineating their approximate territories, and located 12 pairs on Lake Alexandrina: three pairs obviously had nests, one pair had two-quarter-grown young, and one pair had a half-grown young (cf. Fig. 9).

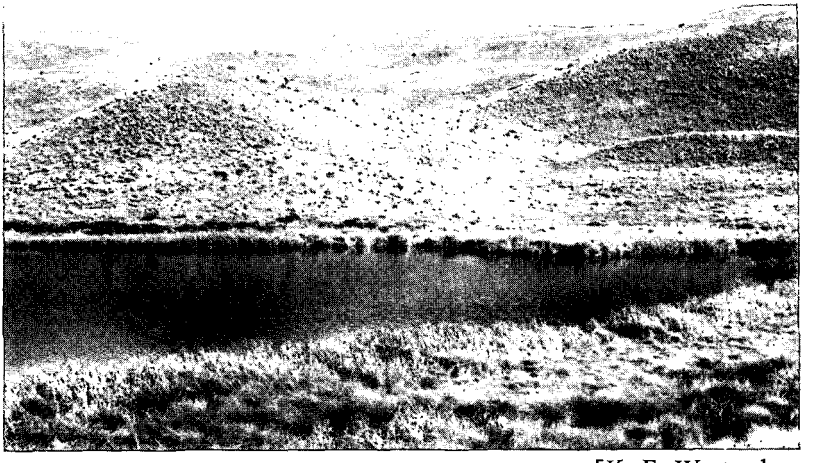

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FIGURE 10 — A sheltered bay, fringed with reed-beds, offers optional nesting sites for Crested Grebes in a bay at Lake Alexandrina; such dense reed-beds are the exception on New Zealand grebe waters.

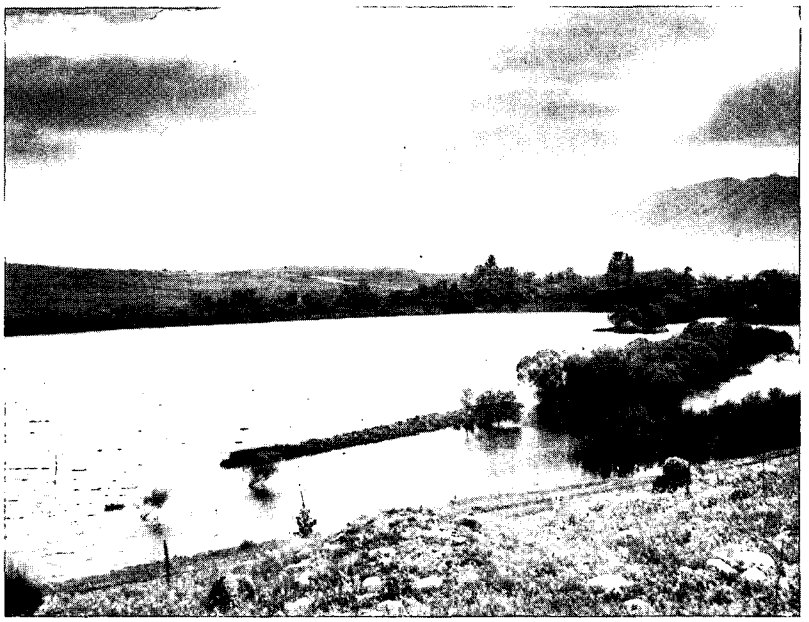

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FIGURE 11 — The eastern end of Lake McGregor during a period of high water levels. Two pairs nested here during the 1969-70 breeding season, in reed-beds and willow thickets.

Lake McGregor (35) is a small lake (102 acres) at the same altitude as Lake Alexandrina and connecting the latter with Lake Tekapo via streams at both ends. Extensive reed beds at the northern shore and willow and reed thickets in the eastern parts provide suitable water fowl nesting areas. On 20 November 1960 Mr. G. Chance (pers. comm.) counted 14 Crested Grebes in this lake and on 21 November 1960 found a nest with 4 eggs; the group of 14 grebes was assembled near the outlet. Over this period 20-27 November 1960 7 pairs were located, holding territory; each pair patrolled a roughly triangular area consisting of a piece of shore-line and a less frequented area of water out towards the centre of the lake. When the 14 birds were holding their " community gathering " one evening, much courtship display, fighting, chasing and defending of territory was seen. On 18 October 1962 a total of 23 Crested Grebes was counted on this lake (W. T. Poppelwell, pers. comm.). On 24 February 1963 five adults: one pair and three single grebes were seen; no young; a total of 12 grebes was observed on 22 November 1965; all were in pairs; one seemed to have a nest which could not be found; no young (H. R. McKenzie, pers. comm.). Over the period 30 October - 2 November 1966 three pairs were located and their territories defined (G. Chance, pers. comm.). A pair and a single grebe were seen on 27 December 1966 (P. M. Sagar, pers. comm.). On 11 January 1967 2 pairs of grebes were seen; courtship display was observed (W. T. Poppelwell, pers. comm.). During my own visits I have observed

two or three pairs; while surveying grebes and mapping territories on 18 January 1970, I observed two pairs, one in the eastern end with two half-grown young, and a second pair more towards centre of lake but also in narrower eastern half. An angler told me that he in early January 1969 (the holiday period when the middle camp has a large population of anglers and their families and other holiday makers) had found a dead Crested Grebe with a .22 bullet in its head, and washed ashore on the lake edge, the result of vandalism. Crested Grebes are fully protected by law.

Hartley Tarn (36) is a small high country tarn a couple of miles north of Lake Alexandrina. Mr. G. G. Murray of Glenmore Station told me that he had seen a pair on this lake in December 1969 when working in the area; when I visited this barren tarn in its forbidding hills on 18 January 1970 I did not see any grebes and as the tarn can easily be covered, I am sure there were no grebes then. Maybe the pair seen had been looking for a suitable nesting habitat as part of the spring exodus to breeding grounds.

Lake Pukaki at 1,588 feet altitude and of a size at present of some 31 sq. miles is a large lake with a hydroelectric power station at its southern end. This lake is fed by the Tasman River which drains the alpine valleys to the west; it is as uninviting and unsuitable as a waterbird area as is Lake Tekapo and mainly for the same reasons; furthermore, present planning envisages a raising of this lake when the future development of the hydroelectric development of the Waitaki River is carried out. I have visited this lake on a number of occasions at different times of the year (the road to the Hermitage skirts the western shore of the lake at its full length) but I have never seen any Crested Grebes on this lake, nor have any of the local people I have talked to ever seen or heard of grebes being seen there. Mr. G. Seymour of Ferintosh Station (pers. comm.) has advised me that he has never seen or heard of Crested Grebes on this lake.

Lake Ohau (37) is another large (approximately 14,720 acres) high country lake in impressive but barren surroundings; elevation 1,720 feet. I have visited this lake on various occasions but never seen any Crested Grebes, but two grebes were seen in the northern end of lake during the second week of October 1966 (R. Smith, O.S.N.Z. Rec. Scheme). Mr. S. H. Weatherall of Lake Ohau Station advises (pers. comm.) that two pairs of Crested Grebes were permanent residents on the pond at the northern end of the lake from 1954-1959; from 1960-68 there was only one pair left but on 9/10/70 I saw two pairs in full breeding plumage, one pair at the top end and the other off the western shore about half way along.

In addition to the above mentioned lakes where Crested Grebes are or have been found as breeding birds or visitors, there are a few more records of accidental occurrences of grebes in Canterbury. In the Canterbury Museum collections there are two Crested Grebe specimens: a female (AV 1224) shot on a small lake in Rangitata Gorge (38) on 8 May 1917; this bird was with a male when shot, but the male is not now in the Canterbury collection: and a young male (AV 2888), with no date, collected at Temuka (39).

NUMBERS AND POPULATION DENSITY

Accepting the inevitable shortcomings and errors in a field project of this nature and magnitude, the results of this study show that about 50 pairs of Crested Grebes have been found on Canterbury lakes about 1965 - 70.

Nesting takes place every year on 23 waters, namely Lakes Guyon, Sumner, Sheppard, Taylor, Sarah, Grasmere, Pearson, Marymere, Letitia, Lilian, Catherine, Ida, Selfe, Evelyn, Coleridge, Georgina, Heron, Western Maori Lake, Clearwater, Emma, Denny, Alexandrina, and McGregor.

Nesting birds may (occasionally) be present on Lake Hawdon and Vagabonds Inn.

Formerly occupied nesting lakes are Lakes Katherine, Mason, Lyndon, Ohau (where they may possibly still nest some years when conditions are favourable), and Ellesmere.

Crested Grebes occur as visitors on Lakes Marion (possibly nesting?), Camp, Roundabout, Tekapo and Hartley Tarn.

There are no records of Crested Grebes present now or formerly at Lakes Tennyson, Pukaki and Waitaki or in the coastal lagoons, Washdyke and Wainono Lagoons.

Grebe waters in Canterbury vary enormously from small lakes like Lake Ida (24 acres), Lake Denny (30 acres), Lake Evelyn (36 acres), Western Maori Lake (52 acres) and Lake Sarah (50 acres) to such large lakes as Lake Coleridge (11,520 acres), Heron (1,800 acres) and Alexandrina (1,645 acres).

The mean water area per nesting pair for all occupied Canterbury lakes is 430 acres; excluding the two large lakes (Sumner and Coleridge) — for which grebe numbers correspond to a breeding pair per 2,149 acres — the average water area per pair is 150 acres. Comparatively the highest populations are found on the smaller suitable lakes, where the lake margin with nest sites is comparatively larger per unit of water area, and where maximum populations are a pair per 25 - 50 acres compared with a mean of 137 acres per pair in for example the larger Lake Alexandrina; which is, for New Zealand conditions, one of the most densely populated larger grebe lakes. If Lake Ida, which in fact consists of two lakes which usually freeze over in winter so Crested Grebes are summer residents only, is considered somewhat anomalous compared with the usual all-year lake occupancy of New Zealand grebes, indications are that minimum lake size to sustain permanently a pair of breeding grebes (and the offspring eventually leaving to nest elsewhere) in Canterbury is in the order of 40 - 50 acres. The highest verified populations are Mr. George Chance's record of 15 acres per pair on Lake McGregor in 1960; on this same lake Mr. W. T. Poppelwell counted 23 Crested Grebes in October 1962. The number of grebes on Lake McGregor has decreased appreciably but even earlier, numbers fluctuated somewhat from year to year, possibly mainly as a result of fluctuations in lake level (the lake connects Lake Alexandrina and the controlled hydro-lake, Lake Tekapo).

In ideal circumstances and in the best years, Canterbury grebe populations have thus reached maximum populations of up to one nesting pair per 15 acres of water surface. Compared with high densities of this species in Europe, New Zealand populations look poor indeed. In Czechoslovakia, Hanzak (1952: 10) mentions for example the Slavnic Pond which on its 27 acres has as many as 7 pairs of nesting grebes, or approximately one pair per 4 acres. Hanzak also found that smaller lakes, provided they are otherwise suitable, have comparatively higher grebe populations: On lakes exceeding 247 acres (100 ha.) there are 4 pairs per 100 ha. (or 1.6 pair per 100 acres), while on lakes of smaller size there are on the average 10 pairs per 100 ha. (or 4 pairs per 100 acres).

In Britain Simmons (1955: 12) found that Crested Grebe waters must be at least 5 acres in extent " though locally a couple of small pits of some two acres each have been colonized recently (one pair of grebes on each) and young successfully reared there." Harrison and Hollom (1932: 175) during their famous Crested Grebe Inquiry 1931 found that under special conditions even very small lakes may be colonized in southern England, with a pair of grebes per 3.5 acres (Blackpit in Bucks.), 3 acres (Latimer in Bucks.), 3 acres (Lindridge, Warwick) and 4 acres (Island Pool in Worcs.).

Whether comparing maximum or over-all numbers of Crested Grebes on European and New Zealand waters, the much higher population densities in Europe stand out clearly. Higher European grebe densities may partly be a result of more suitable ecological conditions: better food supply, more abundant nesting sites, less violent hydrological situations (less marked changes in lake levels); all of which needs further study. Another difference which has a possible bearing on the pronounced differences in population densities is the fact that New Zealand grebes with rare exceptions are permanent residents on their breeding waters; in this way, feeding opportunities at the most unfavourable part of the yearly cycle, i.e. winter, become the deciding factor in determining populations. In Europe grebes are migratory and thus only occur on their breeding grounds during the spring-summer-autumn period when food production is highest. Hanzak (1955: 35) showed that in Czechoslovakia grebes arrive on their breeding grounds late March and leave again in October, thus spending only some six months on their breeding waters; during the remainder of the year these grebes live in their winter quarters, sustained by other food sources.

POPULATION DECLINE

As will appear from the detailed discussion of individual lake populations of Crested Grebe, the present population on Canterbury lakes is approximately 50 pairs while an enumeration of former population estimates show a population earlier this century in the order of some 80 pairs (minimum). Utilising these figures, the decrease in the grebe population appears to be some 35-40 per cent, a depressing state of affairs when the limited distribution and the current habitat deterioration is considered.

Crested Grebes have disappeared as breeding birds from some lakes, such as Lakes Katrine, Mason, Lyndon, Ellesmere and Ohau, and have decreased in numbers of breeding pairs on other lakes, such as Lakes Guyon, Sumner, Sarah, Grasmere, Pearson, Selfe, Heron and McGregor.

Indications are that the species is decreasing in a north-south direction with populations stronger in the southern sector. The Crested Grebe has in this century disappeared as a breeding bird in Nelson-Marlborough; the northernmost breeding lake, Lake Guyon, which formerly held a good population according to Travers (1870), has now only one pair left; the next group to the south is the Sumner Lake group where a population decline from some 16 to about 6 pairs has taken place over the last 20 - 30 years.

A certain minimum of nesting pairs (not known) is undoubtedly necessary on isolated lakes or associated lake groups in order to ensure breeding, stimulate courtship displays, facilitate exchange of individuals, replacements, prevention of inbreeding due to isolation as well as new recruitment in case of climatically caused disasters.

The string of grebe lake groups down the Canterbury high country slopes appears in danger of disintegration if or when in each cluster of lakes the population reaches below the safe minimum for this particular species.

New Zealand's Crested Grebes are vulnerable; they belong to an ancient and undoubtedly primitive bird order which has shown little ecological plasticity, little adaptability to environmental changes, in particular those caused by man (in which respect, incidentally, our New Zealand birds have proved inferior to Crested Grebes in north-western Europe), and their reproductive rate is extremely low.

Major factors in the decline of Crested Grebes in Canterbury are (not necessarily in the order of importance): illegal shooting (the Crested Grebe has had complete protection by law since 1907); disturbance from nests (by boaters, anglers, holiday makers); power-boating and water-skiing; dislodging nests and frightening birds; naturally occurring floods and associated disruption of nests; fluctuating water-levels (and nest disturbance) as a result of hydro-lake manipulations; eutrophication of lakes and resultant changes in invertebrate and fish populations as well as the murky water hindering or making difficult the under-water hunt for prey; opening up of lakes for holiday activities removing reed-beds, bushes and trees along shore (for nest attachment); tourists and anglers wandering along and fishing from the shore, keeping the grebes from their nests for hours and thus destroying the eggs. The above is a brief outline of some of the main factors responsible for the grebe decline; this subject will be dealt with in more detail in another paper.

DISTRIBUTION AND ALTITUDE

In Canterbury the Crested Grebe now nests in high country lakes only. On five lakes at from 2,275 - 2,600 feet altitude breed 46 per cent of the population, on 16 lakes between 1,900 and 2,200 feet breed 38 per cent, and below 1,900 feet (1,600 - 1,900 feet) altitude are found 16 per cent of the breeding population.

The mean lake level is about 2,202 feet altitude, or approximately at the level of Lake Catherine.

Freezing over of the breeding lakes takes place only at the upper level (2,600 feet), Lakes Ida and Lilian; and Lake Lyndon (2,769 feet), sometimes used as a breeding lake; partial freezing of lakes, in some bays and in some years also take place at 2,350 feet, Lakes Alexandrina and McGregor, while occasional freezing over of some bays takes place at 2,276 feet: Lake Heron.

The Canterbury Crested Grebe lakes lie between 42° and 44° S. latitude. This corresponds to northernmost Spain, central Italy, Bulgaria, and Turkey in the southern part of the European range of the nominate subspecies of this form; where it occurs in these parts, it is also a bird of high country and mountain lakes (cf. Harrison and Hollom, 1932: 103; Wadley, 1951: 63) but also at lower levels (cf. for example Bannerman, 1959: 204), although detailed recent studies are lacking. The whole question of the southern breeding range of the Crested Grebe in Europe in relation to altitudes of breeding lakes and with due consideration to appearance of accidental visitors and migrants is in need of attention.

The relationship between altitude and latitude in terms of climate and thus faunal and floral distribution patterns are of such a nature that it can be converted into a usable sliderule bio-climatic law. This rule, based on work by Humboldt and Chapman (Allee *et al.* 1949: 461), incorporates the facts that temperature increases about 1 degree Fahrenheit for each degree of latitude from either pole towards the equator and that 1 degree Fahrenheit is equivalent to 300 feet altitude in the mountains. Utilising this principle, the Canterbury Crested Grebe range corresponds bio-climatically to sea-level latitudes of approximately 49° - 52° N. latitudes, encompassing southern England Belgium, parts of Germany and Poland, all areas known for good grebe populations.

The comparative nearness of Canterbury grebe populations to the equator is thus offset by altitude, bringing the environmental conditions more into line with conditions prevailing in the main range of the nominate subspecies. Similar situations are found in the distribution of the African subspecies *(Podiceps cristatus infuscatus)* which according to Benson and Irwin (1963: 213) is found discontinuously on high country lakes, and in the eastern asiatic range of the nominate subspecies which breeds, for example, on Tso Kar Lake in Ladakh in the Himalayan Highlands at 14,900 feet altitude (Meinertzhagen, 1927: 617).

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KING SHAGS IN THE MARLBOROUGH SOUNDS

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ABSTRACT

Colonies of the King Shag **Leucocarbo carunculatus carunculatus** (Gmelin, 1789) were visited three times in 1964-65. Numbers are now about the same as when they were discovered in 1773 — two or three hundred birds — although more colonies are known. Since 1773, large fluctuations have probably occurred; heavy collecting by nineteenth century ornithologists, shooting for ladies' muffs around 1900 and, more lately, misguided shooting " to protect fisheries " have all taken a toll.

Details of nests and eggs are given. The species usually breeds once each year, in winter; but sometimes two cycles of breeding have been observed. The times of breeding vary from colony to colony and from year to year.

King Shags are easily disturbed at the breeding colony, possibly because of long persecution. Any further study of the birds themselves should be limited to regular, remote censusing only. Ecological work and banding on less vulnerable subspecies such as **L. c. chalconotus** should be done in the hope that the results will prove valid or helpful for conserving their rarer relatives.

INTRODUCTION

King Shags *Leucocarbo carunculatus carunculatus* (Gmelin 1789) are interesting for three reasons:— Firstly, at latitude 41°S they are the northernmost representatives of the pink-footed, blue-eyed subantarctic shags, which occur in a belt mostly south of latitude 50°S. (However, the closet relatives are both found north of this line: Stewart Island Shags, *L. carunculatus chalconotus,* range as far north as Dunedin at 46°S, and another subspecies, the Chatham Island Shag *L. c. onslowi,* is isolated 500 miles east of Christchurch, at latitude 44°S.)

Secondly, they are confined to a relatively small area, the Marlborough Sounds, close to the convergence of sub-antarctic with subtropical waters which is sometimes associated with Cook Strait.

In sharp contrast with many New Zealand native birds, now rare but formerly plentiful, the King Shags' third distinction is that they have apparently never been known to be numerous or widespread.

As a reconnaissance for a population study, three visits were made to colonies during the winters of 1964 and 1965 (20-27 July 1964, 25 August 1964, and 18-22 May 1965). The information gathered has been combined with information from Internal Affairs Department files in an attempt to provide an up-to-date picture of the status and breeding habits of this rare bird.

PUBLISHED RECORDS

In 1773, J. R. Forster, naturalist on Cook's second voyage, collected the first King Shags from White Rocks outside Queen Charlotte Sound; he estimated the total population at about 160 birds (see Hutton 1878). Later expeditions collected more specimens but added nothing to this information.

Over a hundred years later, White Rocks was still the only known breeding colony, but Buller (1891) stated that there were then only 80 birds; eggs and young were found in both July and

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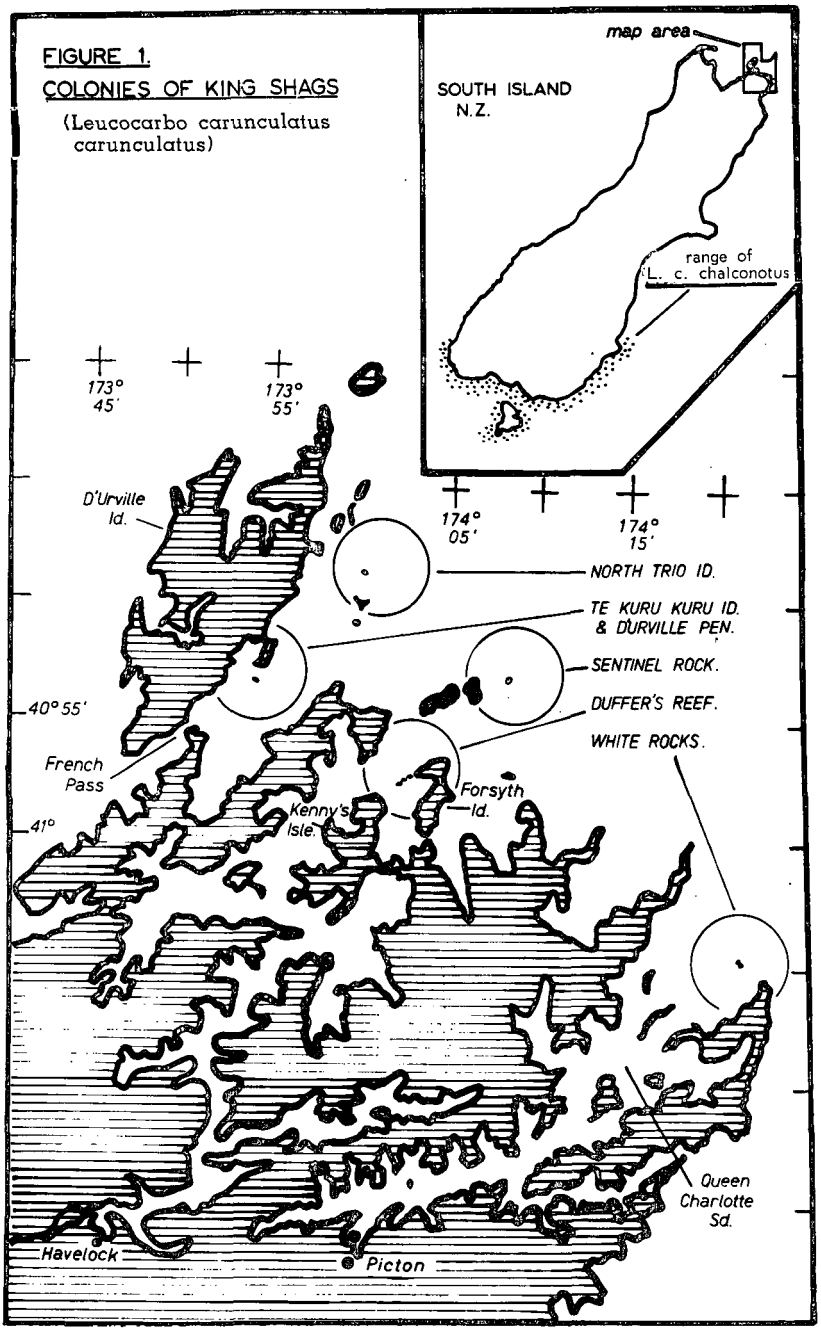
FIGURE 1.
COLONIES OF KING SHAGS
(Leucocarbo carunculatus carunculatus)
map area
SOUTH ISLAND N.Z.
range of L. c. chalconotus
173° 45'
173° 55'
174° 05'
174° 15'
D'Urville Id.
NORTH TRIO ID.
TE KURU KURU ID. & D'URVILLE PEN.
SENTINEL ROCK.
DUFFER'S REEF.
WHITE ROCKS.
40° 55'
41°
French Pass
Kenny's Isle.
Forsyth Id.
Queen Charlotte Sd.
Havelock
Picton

October of that year. Forty years on, Falla (1933) found smaller irregular colonies on other islets nearby, and counted 80 adults on White Rocks in July 1932. He concluded that nesting occurred in midwinter.

By 1948, Falla (unpublished, Internal Affairs Department file) had recorded a new major colony on the North Trio Island as well as a regular roost on Sentinel Rock. However, both White Rocks and North Trio then had only 25 nests each, a small increase compared with that of about 40 nests at White Rocks alone in 1932.

Since that time, the Wildlife Service has kept a watch on the birds; new colonies have been found at Duffer's Reef (a major colony discovered by Dr. Fleming in 1951), Sentinel Rock (1951) and Te Kuru Kuru Island (1960). A temporary colony on D'Urville Peninsula found in 1951 and occupied up to 1959 probably gave rise to the rookery on Te Kuru Kuru Island from 1960-67. Similarly, a favoured roost on Kenny's Isle (a peninsula near Duffer's Reef) may soon follow the history of Sentinel Rock to become another colony. Probably there have always been several colonies, with changes of sites from time to time.

COLONIES VISITED

In 1964-65, visits were made to all five known colonies (see Fig. 1):—

(i) *White Rocks,* where the colony is on the only sloping area, the southern face, of an otherwise vertical, narrow stack 50-60 feet high;

(ii) *Sentinel Rock,* a high razorback in Cook Strait east of Outer Chetwode Island. The colony is on its eastern slope (37-45°), out of reach of high seas and partially protected from wind by taupata scrub *(Coprosma repens);*

(iii) *Duffer's Reef,* a chain of rocks extending west from Forsyth Island at the entrance to Pelorus Sound. King Shags have nested on the three outermost rocks, referred to from the landward side as I, II and III. *I* was the main colony site up to about 1964. The birds nest on a plateau which has a clear area of 55 by 17 feet facing west and beyond the reach of the waves. On *II,* the Shags in 1964 cleared an area of 12 by 13 feet facing north, but did not nest there again. Here there was sheltering scrub to the south and east, and no danger from the sea. Although *III* is a bare, storm-swept rock only a few feet above the sea, it was the only site occupied at Duffer's Reef by 1966, after starting as a colony the year before.

(iv) *North Trio Island,* to the west of the Chetwode Islands. Here the area occupied changes from year to year; in 1964 nests were being built on a pinnacle on the northern end, but in 1965 a new area 25 by 17 feet had been cleared on the steep southern face (Group IV).

(v) *Te Kuru Kuru Island* ("Bushy" or "Stewart" Island) in sight of French Pass township. The position of the colony changed from a steep face looking south-eastwards in 1964 to a low rock about four feet above sea level, on the western side, in 1965.

RESULTS

Nests and Eggs

Nests were about 20 inches wide (range 14-26 inches), up to 17 inches high on the downhill side, with a nest chamber about 11 inches wide and 3 to 4 inches deep (21 measured). Nests were usually about 40 inches apart (range 24 to 91 inches). Although ultimately ruled by pecking distance, distance apart probably varies according to the density of the population and the slope of the site. Two-egg clutches are usual, but because some of the one-egg clutches in Table I may have been incomplete, the numbers of larger clutches should probably have been higher.

TABLE 1: Clutch Size (all records 1949-65)

	One Egg	Two Eggs	Three Eggs	Totals
No. of clutches	59	88	20	167
% of Total Clutches	35.4	52.7	11.9	Mean 1.8 eggs/clutch

Eight eggs were measured; mean length was 65 mm (range 63-67 mm) and mean width 41 mm (range 40-43 mm). Two eggs weighed about 62 gms each.

Breeding Seasons

Although the colonies have been visited many times, there is still not enough information to follow the timing of breeding in any one colony. This is partly because the observations are concentrated in the months May to November, partly because there are few years with more than one observation and partly because many records are incomplete.

From all information available in Internal Affairs Department files, it seems that King Shags usually nest once each year at each colony, but on fairly rare occasions they may nest twice in the same year (6 times in 49 colony/years); whether or not the same birds are involved is unknown. What does seem clear is that a normal breeding cycle takes about five months, and that the bulk of breeding activity occurs between March and December. Breeding normally starts about May, but tends to start two or three months earlier if two cycles are attempted (Table 2).

The onset of breeding varies from colony to colony and from year to year. In some years breeding activity would be seen throughout the year if all the colonies were visited month by month. Among other New Zealand Shags, it is normal for each colony to follow its own timing and for breeding to occur in a diffuse way with generalised peaks of activity, rather than substantially in unison.

Numbers

Again, because records are fragmentary, it is not possible to say accurately how many King Shags there are. In Table 2, the figures for 1951, 1961, 1964 and 1965 are nearest complete: 333 birds seen in 1951, 260 birds estimated in 1961, 245 birds seen in

TABLE 2 — Records of maximum numbers of birds

Colony	1948	1949	1950	1951	1952	1953	1954	1955	1956
White Rocks	- 25 n	-	60 b 40 n	70 b 22 n	-	20 b -	-	-	32 b 25 n
North Trio Id	- 25 n	80 b 33 n	100 b 28 n	95 b 15 n	-	80 b -	75 b 47 n	-	-
Duffer's Reef	(Colony unknown before 1951)			150 b 29 n	-	-	-	-	100 b 80 n
Sentinel Rock		-	-	18 b 4 n	-	-	-	-	-
D'Urville Peninsula	(Colony unknown before 1951)			-	-	-	-	-	-
Te Kuru Kuru Id	(Colony transferred from D'Urville Peninsula in 1960)								
TOTALS:									
Birds	-	80	160	333		100	75		132
Birds estimated	(100)	(66)	(136)	(140)	NO RECORDS	-	(94)	NO RECORDS	(210)
Nests	50	33	68	70		-	47		105

1964 and 192 birds estimated in 1965. For estimates, a nest is assumed to represent a pair of birds. Probably there are about three hundred all told, allowing for non-breeders and others not seen.

Miscellaneous Results

Feeding: Diving times are consistently longer in King Shags than in other species. Although Stonehouse (1967) recorded a maximum of 64 seconds for a Pied Shag *(P. varius)* in deep water, this was an unusual observation and he was able to show that the bird was near the limit of its capabilities; the average length of time under water was 12 seconds. On the other hand, King Shags average 46.5 seconds (6 individuals, 22 dives) and can easily stay under as long at 95 seconds.

They apparently hunt bottom-living fish: birds disturbed at their nests in 1964 regurgitated soles *(Peltorhamphus novaezelandiae)* and sand-eels *(Gonorhynchus gonorhynchus)*. Locally they are blamed for depleting the blue cod *(Parapercis colias)* fishery, but birds illegally shot to stop this are said to have contained only soles. Falla (1933) found small blue cod at the White Rocks colony, and expressed the opinion that they were the main food; he made the point, however, that marine birds scarcely ever deplete their food supply.

Parasites: Two species of ticks, found in nests on North Trio Island and Te Kuru Kuru Island respectively, were identified as *Ixodes eudyptidis* Maskall (previously known from Spotted Shags *Stictocarbo punctatus,* Black Shags *P. carbo,* Black-backed Gulls *Larus dominicanus,* and Little Blue Penguins *Eudyptula minor)* and *Ornithodoros capensis* Newmann (previously known from Spotted Shags — Dumbleton 1961).

and nests (from Table 2) n = nests, b = birds.

1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967
80 b -	90 b -	-	-	36 b 29 n	-	31 b 14 n	80 b 23 n	-	-	-
-	10 b -	- 13 n	- 29 n	- 24 n	21 b 11 n	80 b -	30 b 6 n	37 b 17 n	61 b -	-
60 b -	62 b -	120 b -	-	- 68 n	- 47 n	-	85 b 40 n	97 b 54 n	94 b -	45 b 20 n
-	-	4 b 2 n	-	5 b 4 n	11 b 8 n	-	20 b 12 n	20 b 12 n	21 b 18 n	-
16 b 7 n	22 b 7 n	-	(Colony abandoned after 1959)							
			12 b 6 n	- 5 n	9 b 6 n	-	30 b 10 n	33 b 13 n	-	-
156	184	124	12	41	41	111	245	187	176	45
(14)	(14)	(30)	(70)	(260)	(144)	(28)	(182)	(192)	(36)	(40)
7	7	15	35	130	72	14	91	96	18	20

Some think that infestation of chicks may cause much of the movement of colonies from site to site, as at North Trio Island (B. D. Bell, pers. comm.) but no more evidence of this has been gathered yet.

DISCUSSION

King Shags have been protected since 1924, but, like other Shags throughout New Zealand, they have suffered illegal attacks in the cause of assumed fisheries protection. For a time late last century, commercial shooters shot King Shags for skins to be made into ladies' muffs; previously they had been collected avidly by scientists. Before the chicks hatch, merely a close approach from a sight-seeing launch is enough to cause birds to fly from their nests in alarm. Because the eggs are brooded between the feet and the belly, many are tumbled out of the nest in the hurry to get away, and others are taken by Reb-billed Gulls *Larus novaehollandiae scopulinus* before the Shags come back.

Neglecting previous heavy predation by man, why has the population of King Shags remained small since 1948 ? It appears that there is plenty of food and nesting space, no competition from other species, and no records of diseased or heavily parasitised birds. Possibly, the reason lies within the birds themselves.

King Shags may be struggling against an ecological gradient which we cannot discern at present, perhaps because they are better suited to life further south; here, one would expect them to have evolved adaptations to life at a lower latitude to offset this. Another possibility is that, as a small breeding stock, with little genetic variability, they may have less success in breeding than a larger stock with a larger gene pool. Again, perhaps some colonies are too small

to attain the minimum amount of social stimulation needed for successful breeding; Fraser-Darling's theory is probably tenable this far at least (Fraser-Darling 1938); and small groups of Pied Shags at Lake Pukepuke had less success than larger groups, and their breeding was less well co-ordinated (E. K. Saul, unpublished). Whatever the reason for its rarity, the species seems to be surviving and just replacing the breeding stock; further disturbance by man could upset this balance. But unless man was responsible for keeping numbers low in Forster's time (Maoris may have used the squabs as food, as they did with other species of Shags), this is debatable. For their conservation, it is safest to assume that disturbance will have a bad effect.

Considering their very small numbers, there is no doubt that King Shags are vulnerable as a subspecies; considering their history, there is no doubt that they are also very resilient. We know very little about them, and to conserve them properly we need to know much more. Their extreme timidity is a big difficulty, making observation difficult and conservation perilous while they are being studied. The safest methods would probably be those *not* involving landing and handling, but careful, regular observation from as far away as possible. This is uncomfortable and expensive from small boats, but perhaps easier and cheaper with light aircraft. Although estuarine Shags are not panicked by aerial surveys, we do not know yet how King Shags react to planes overhead; however, if they are not unduly disturbed, all their colonies could be aerially checked and photographed in a single morning. This would yield only gross data; total numbers of birds, nests and fledglings; but perhaps these would be enough to allow calculation of productivity and survival rates for each colony. For reasons of conservation alone, such a programme of regular surveillance would be valuable.

A banding and colour-marking programme planned to get more specific details (such as age at which breeding first occurs, individual faithfulness to nest site and mate, and all the data needed for making proper life tables) would be fraught with the danger of disrupting some colonies even if banding were to be done when the birds are least timid — that is, when adult, and when at least 50% of chicks are hatched, or for birds of the year just before they can fly. Night banding might reduce disturbance, but few operators would be willing to risk injury to find out.

Neither long-range observation nor banding is likely to provide us with many leads about the King Shags' relations with the physical world or other animals. What they eat can only be gauged from regurgitated fish and pellets found around the colonies; taking birds as specimens for stomach analyses, or even forcing birds to disgorge, is indefensible today, although Fairchild's decimation of the colony at White Rocks was recorded with equanimity by Buller in 1891.

To obtain this additional information, the only safe course seems to be to get it at second-hand from studies of the more numerous Stewart Island Shag *L. c. chalconotus*. These studies are much more likely to produce information applicable to King Shags than are any attempts to obtain it from the King Shags themselves. To find out how Stewart Island Shags get their livelihood, how their populations are made up and how they interact with their environment may well

be the best foundation for doing something useful for their scarcer relatives. In their ecology especially, once the important factors are known for Stewart Island Shags, it should be possible to measure the same factors in the King Shags' environment without disturbing the birds.

CONCLUSIONS

(i) For as long as they have been known, King Shags have maintained a small population of about three hundred birds or less. Constant harassing seems to have made them very afraid of man, and no doubt has caused big changes in their numbers in the past. The figures quoted in this paper are tentative and do not permit us to say whether the birds are increasing or decreasing.

(ii) King Shags generally breed once each year, starting in May or June. More information on breeding is needed to explain why numbers remain small in spite of protection. Some of this information could be gathered by regular aerial censuses. Because any further work at colonies, however meticulously planned, would inevitably cause disturbance, studies of ecology, behaviour and population should be undertaken on other subspecies which are less vulnerable. The results of these studies would be either valid for King Shags or at least indicative of lines to be explored for the species.

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NOTES ON THE MIGRATION OF THE WILSON'S STORM PETREL *Oceanites oceanicus* NEAR ENIWETOK ATOLL WESTERN PACIFIC OCEAN[1]

By LAWRENCE N. HUBER[2]

The status of Wilson's Storm Petrels in the Atlantic and Indian Oceans is fairly well known (Roberts, 1940; Bourne, 1960; Bailey, 1968), but our knowledge of them in the Pacific is restricted mainly to along the west coast of South America (Murphy, 1936) and in Australian waters (Serventy, 1952; Oliver, 1955). Recently, Crossin (in preparation) found them to be "extremely widespread and sporadic" in the Central Pacific, but for the most part their status in the remainder of the Pacific is virtually unknown. Amerson (1969) reported none in the Marshall & Gilbert Islands, through 1967, but evidence which will be discussed later, suggests his reportings may have been in error. However, from 7 August 1968 to 30 May 1969, while making an ornithological survey of Eniwetok Atoll (11° 30'N, 162° 15'E) in the Marshall Islands for the Pacific Ocean Biological Survey Program, Smithsonian Institution (POBSP), I collected specimens and data that indicate a northward migration of Wilson's Storm Petrels through that area in April and May.

This species was first recorded in the Eniwetok area on 3 September 1968 with the collection of a lone bird feeding over a garbage slick behind a ship anchored in the lagoon. No other storm petrels were seen. The sea outside the atoll was not systematically checked until 17 April 1969 when another was taken outside the atoll about three miles southwest of Eniwetok Island (code name "Fred"). It was feeding with four other white-rumped storm petrels over a garbage slick dumped from a passing ship. Although I could not secure the remaining birds, their feeding behaviour was characteristic of Wilson's. During the remainder of April and through May, eight more trips were made to the same area. On each visit an oil slick was made with two to three gallons of cooking oil and about ten pounds of ground beef fat. The slicks, in moderately rough seas, attracted storm petrels for up to three hours and appeared to be most productive between 0700 and 1000 hours, and especially from 1700 hours to at least dusk.

Table 1 lists white-rumped storm petrel sightings. Working from an 18 foot skiff in rough seas precluded watching the birds and as the various species with white rumps are similar in appearance, positive identification was made only after the birds were collected. Collections included 63 Wilson's Storm Petrels, 3 Leach's Storm Petrels *Oceanodroma leucorhoa,* and 1 Harcourt's Storm Petrel *O. castro.*

1 Paper No. 41. Pacific Ocean Biological Survey Program, Smithsonian Institution, Washington, D.C. 20560.

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TABLE 1 — Abundance of " white-rumped storm petrels " over artificial oil slicks three miles southwest of Eniwetok Island, Eniwetok Atoll, April and May 1969.

Date	April 17	April 25	May 6	May 8	May 14	May 22	May 27	May 28	May 29
Birds seen	5	9	8	16	13	13	15	14	4
Hours observed	2	4.5	3.5	3	2	5	2	3	2
Birds per hour	2.5	2.0	2.3	5.3	6.5	2.6	7.5	4.7	2.0

Data on the Leach's and Harcourt's Storm Petrels will be included in a forthcoming paper on the avifauna of Eniwetok Atoll (Huber and Bushman, in preparation).

Comparisons of measurements of the Eniwetok Wilson's specimens with those given in Murphy (1963) for the two races of Wilson's, indicate that the Eniwetok specimens are of the larger race, *Oceanites o. exasperatus*, which breeds in the Antarctic Zone rather than the smaller subantarctic *oceanicus* (Table 2). This also agrees with the findings of Falla, Sibson and Turbott (1967: 53-54) for New Zealand specimens and Ozawa (1968) for his Japan specimen.

There was a marked change in sex ratios during the collection period (Table 3). Females were more prevalent than males in the April collections, but in the May samples the ratio reversed and by late May males were predominant.

Examination of the gonads revealed that only 10 of the 25 female specimens had bred. The gonads of these 10 birds were granular, with obvious old ruptured follicles, and their oviducts were loose and convoluted. The ovaries of 10 of the remaining 13 females were smooth in appearance, with all ova minute, and their oviducts were straight and thin. The gonads of the remaining 3 birds were too damaged to determine if they had or had not bred.

The average weight of subcutaneous fat deposits scraped from 45 May specimens was 6.7 grams (range 3.0 - 9.5) and its average percentage of body weight was 19.9 percent (range 8.3 - 22.7). Little subcutaneous fat was found on the September bird.

Their faded and worn upper wing coverts indicate that all April-May specimens were in definitive basic plumage for as Murphy (1918: 118) noted juvenile birds " have fresh, black, unworn quills and body feathers, and gray, white-edged greater coverts, at a time of year when the feathers of old birds show the maximum effects of wear and fading." My examination of known adult and immature specimens in the U.S. National Museum does not confirm the con-

TABLE 2 — Measurements (in mm) of the two recognized races of *Oceanites oceanicus* from Murphy (1936), and from Eniwetok specimens.

	No. of specimens	Wing		No. of specimens	Tail	
		Mean	Range		Mean	Range
O. o. oceanicus	51	137	130-146	51	59	55-63
O. o. exasperatus	30	152	142-159	30	67	59-73
Eniwetok Specimens	49	154	143-162	55	70	65-75

TABLE 3 — Sex ratios of Wilson's Storm Petrels taken offshore, Eniwetok Atoll, April-May 1969.

	April 17-25		May 6-14		May 22-29	
	No.	Percent	No.	Percent	No.	Percent
Males	1	14	17	61	21	75
Females	6	86	11	39	7	25
Total	7	100	28	100	28	100

clusiveness of Murphy's other two characters of immaturity in this species (e.g., *the "conspicuous white edgings on the feathers of the belly, and . . . a whitish spot in the lores"*).

The September specimen had just begun moulting both the contour and flight feathers, and its older plumage was so worn that one can only wonder how the bird could fly.

Only one of the April or May birds, taken on 28 May, had begun a normal remigial moult; another May specimen which had lost many of the feathers of one wing probably had had an encounter with a predator.

There is little doubt that most April and May birds were migrating north. Most had large deposits of subcutaneous fat and only one of the 63 had begun wing moult which normally takes place on the non-breeding grounds. A further indication that there was movement through the area was the change in the sex ratios of the specimens. Since studies of well known northward migrations of this species show that they continue through June, it is reasonable to assume that these west-central Pacific Wilson's follow similar cycles. If this is so, it adds new importance to the growing list of records in Japanese waters (Serventy, 1952; Ozawa, 1968).

Since the area outside the atoll was not systematically surveyed from June through March, it is not known whether significant numbers of these storm petrels were then present. However, since several specimens had very small subcutaneous fat deposits, and one had just begun wing moult, possibly some Wilson's spend their entire non-breeding season in the Eniwetok area. The September specimen, with little subcutaneous fat and with worn plumage and in complete moult, shows that at least one Wilson's was in the area during the previous non-breeding season.

Even though the sea was not surveyed during the non-breeding season, 12 white-rumped storm petrels seen between Makin and Maiana Atolls during a November 1964 POBSP survey in the Marshalls suggest the possible presence of Wilson's. The birds were reported as possible Leach's by Amerson (1969), but the field notes of the survey team, of which I was a member, and the survey report indicate the birds were not Leach's. They were described as having " more white on rump and tail than the similar Leach's," and " the tails were noticeably straight across " or " squarish," unlike the often deeply forked tail of Leach's. The birds were tentatively identified as Harcourt's, mainly because Wilson's were not expected in the area. Since Harcourt's and Wilson's appear identical in the field, the birds may have been Harcourt's or Wilson's or both. Since October and November lie within the expected months for the southward prebreeding migration of the Wilson's (Roberts, 1940; Serventy, 1952; Bourne, 1940), the 12 may have been returning from the north. It is interesting that nearly all the Central Pacific Wilson's specimens were taken in October and November (Crossin, in preparation).

There are three possible explanations for the absence of first year birds in the Eniwetok collection: (1) first year birds leave the nesting area after the adults and the collection period did not last until their arrival in the area; (2) they migrate to a different area; or (3) they migrate by a different route. Since Roberts (1940) states he found no indication that adults and immatures leave the breeding ground separately, the first explanation seems unlikely. However, it cannot be excluded as Roberts did not mark his study birds. It is far more probable however, that first year Pacific birds may spend their first winter in a different area from the adults. Murphy (1936) suggests that first year Atlantic birds tend to migrate not as far north and nearer the coasts. If Pacific first year birds are coastal in migratory habits they would probably pass well to the west of Eniwetok.

Presumably the females which had not bred were 2 to 3 years old for studies on other species of storm petrels indicate that most breed by the time they are four years old (Gross, 1947; Davis, 1957; Allan, 1962).

From the Eniwetok specimens, the sightings during many hours of observations, and the well known regularity of the Wilson's migrations in other parts of the world, it appears that there is a regular northward migration of Wilson's Storm Petrels through the northwestern Marshall Islands in April through at least May. Analysis of moult and subcutaneous fat data taken from specimens indicates that Eniwetok may lie in the non-breeding range of this species.

I wish to express my appreciation to A. Binion Amerson, Jr., Philip C. Shelton and George E. Watson for their helpful criticism and suggestions. I also wish to thank A. Binion Amerson, Jr., Thomas F. Dana and the many Eniwetok Island personnel who assisted me in the collection of the specimens.

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WILDLIFE SURVEY OF THE MOTUROA ISLANDS

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SUMMARY

Bird species found on the islands of the Moturoa Group are listed and other natural features such as physiography and vegetation briefly described. The presence of other animals is mentioned and the history of the group outlined.

INTRODUCTION

From 7 to 16 September, 1968, two members of the Wildlife Service, Department of Internal Affairs, visited the Moturoa Islands primarily to determine their use by oceanic birds, and broadly to survey them as a habitat for other wildlife. The survey entailed the compilation of a bird list with notes on breeding, a brief botanical survey, and notes on other fauna.

PHYSIOGRAPHY

The Moturoa Group lies north of Cape Karikari at about 34°47'S, 173°22'E. The group comprises four small scrub-covered islands, two scrub-covered stacks partially attached to one island, two partly vegetated but independent stacks, and several smaller bare rocks (Fig. 1).

The main islands, from south to north, are: Whale, 25 acres, rising to 142' a.s.l.; Sugarloaf (also known as Pudding Island), 2-3 acres, 70' a.s.l.; Green, 13 acres, 120' a.s.l.; and Moturoa Island, 20 acres, 130' a.s.l.

All are similar insofar that each is a rocky dome surmounted by a layer of light clays and friable humus. Coastlines, in exposed places, are cliffs and in sheltered areas rocky platforms predominate.

Hillsides on all islands are moderately steep and eroding through petrel burrowing, especially on Moturoa, Green and Sugarloaf Islands. The slopes are divided by ridges and spurs into many differing aspects.

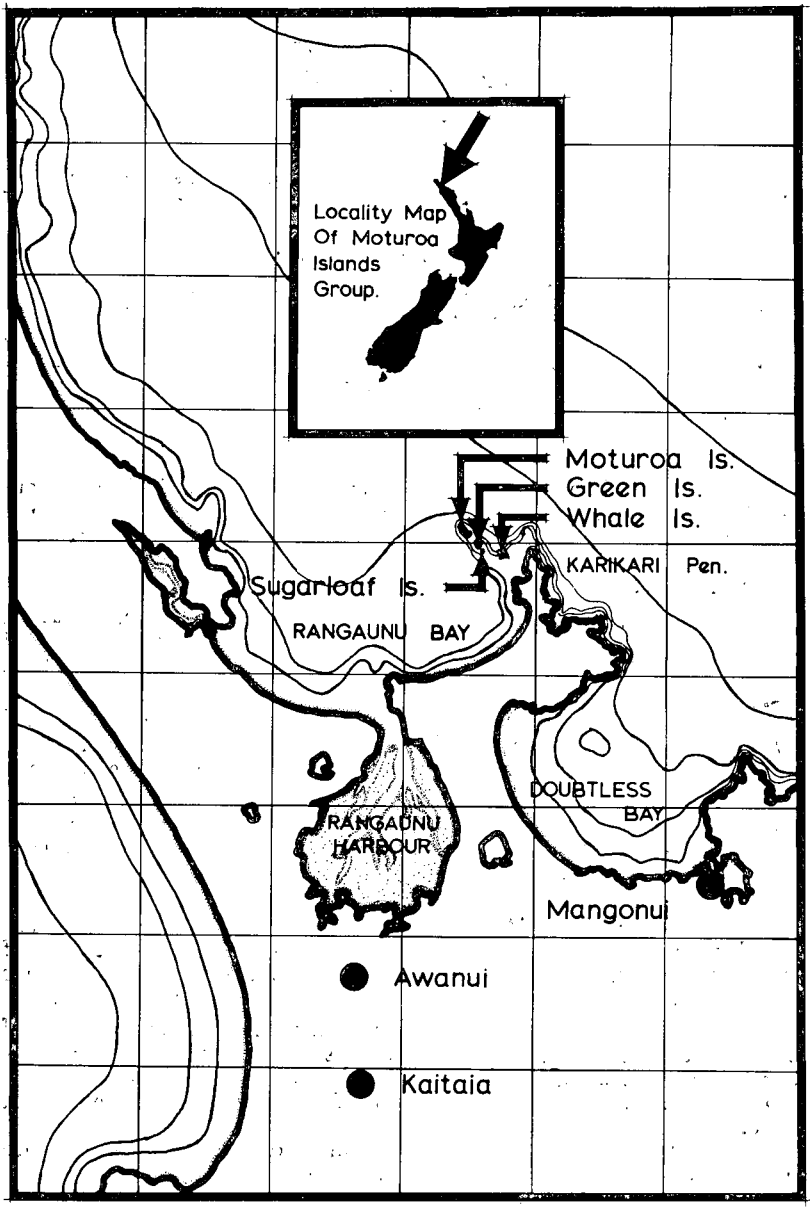
HISTORY

Fortunately, the Moturoa Group lies north of New Zealand's popular boating harbours, and has therefore escaped the attention of frequent visitors. The difficulty in landing on the three outer islands has no doubt helped to preserve them in their near-original state.

They are Maori-owned, and although there is no evidence of permanent occupation, the early owners have left their mark. A portion of Whale Island was, until recently, cultivated and cropped. Pigs were later turned out, the last of these being removed about 1966.

Early Maoris no doubt used the birds for food, and this practice has persisted until recently, as several 'birding' sticks made from fencing wire were found.

Whale Island seems to derive its name from the establishment there of an early whaling station. A large iron pot, as used in the whaling days, still remains. During the early 1900s soil was removed


Locality Map
Of Moturoa
Islands
Group.
Moturoa Is.
Green Is.
Whale Is.
KARIKARI Pen.
Sugarloaf Is.
RANGAUNU BAY
DOUBTLESS
BAY
RANGAUNU
HARBOUR
Mangonui
Awanui
Kaitaia

from the east side of Moturoa Island, and used as fertilizer. Fortunately this operation foundered. Considering all these phases of utilization it is remarkable that neither Polynesian nor European rats reached the islands.

VEGETATION

The plant communities on Moturoa, Green and Sugarloaf Islands are nearly identical and one description will suffice for all three. Whale Island has been modified by several means and, as a consequence, supports a very different vegetation. It appears to have been burnt within recent years and the plant cover is that of early plant succession; grasses, rushes, flax, toitoi, bracken and cabbage trees dominate the hillsides with scattered mingimingi and *Cassinia* on drier slopes. In damper coastal regions are dense thickets of taupata and *Hymenanthera;* and a narrow coastal belt of *Senecio lautus,* ice plant *(Disphyma); Salicornia,* renga lily and *Cotula* almost encircles the island. One medium-sized and two seedling pohutukawas grow on the north side. *Muehlenbeckia* occurs in tangles everywhere, but particularly on spurs. Two semi-attached rock stacks are similarly covered.

The three unmodified islands are almost entirely covered with dense taupata/*Hymenanthera* scrub about 18 inches high around their margins. Height increases to a fairly even canopy of 6 - 8 feet with odd plants emerging to 10 - 12 feet. Although taupata dominates most areas, *Hymenanthera* entangled by *Muehlenbeckia* dominates the spurs. In the occasional clearing *Cyperus,* flax and inkweed are early colonizers. A belt of *Senecio,* renga lily, *Disphyma,* and some *Salicornia* and *Samolus repens* extends around the outer soil margins and on areas of coastal erosion.

On these three islands the soil loss appears to be counterbalanced, at least in part, by the high proportion of leaves knocked from trees, particularly taupata, by incoming birds. Whereas the vegetation of the three outer islands is typical petrel scrub, the plant cover of Whale Island is similar to that of the adjacent mainland; and, as regeneration proceeds, it may be expected to remain similar but with some reinstatement of ' petrel scrub.'

BIRDLIFE

The islands have a very poor resident avifauna, especially of native species, but this is to be expected. The nature of the vegetation limits the variety of land birds, and the rocky shorelines the shore birds. Pelagic birds, although not represented by many species, are an extremely important feature of the islands, particularly of the three unmodified ones.

The following is the list recorded during our visit (see Table I):—

Blue Penguin *Eudyptula minor*

Very numerous on the three unmodified islands where it occurs throughout. Although numbers are not so great on Whale Island, they will no doubt increase as plant regeneration proceeds. Breeding occurs.

TABLE 1 — Distribution of Bird Species Recorded — Moturoa Island Group, 7 - 16 September, 1968

Species	Whale	Sugarloaf	Green	Moturoa	Others - stacks, rocks
Northern Blue Penguin	x b	x b	x b	x b	
Fluttering Shearwater	x b	x b	x b	x b	x o *
N.I.Allied Shearwater	x b	x b	x b	x b	
Grey-faced Petrel	x b	x o	x o	x b	
White-faced Storm Petrel	x o	x o	x o	x o	
Northern Diving Petrel	x b	x b	x b	x b	x o *
Australian Gannet					i
Pied Shag					x
Blue Reef Heron				x	x
Australasian Harrier	x				
Australian Brown Quail	x o			x o	
Northern Oystercatcher	x				
Southern Black-backed Gull	x	x	x	x	x
Red-billed Gull	x	x	x	x	x
Caspian Tern					x
White-fronted Tern					x
Welcome Swallow	x o				
Blackbird				x	
New Zealand Pipit	x				
White-eye	x	x			
Greenfinch			x	x	
Goldfinch			x	x	
House Sparrow		x	x	x	
Starling	x		x	x	

x Recorded

b Breeding confirmed

o Breeding probably occurs

* Burrows on small stacks, probably of breeding colonies

i Since reported but requires confirmation

Fluttering Shearwater *Puffinus gavia*

Extremely abundant on Moturoa, Green and Sugarloaf Islands where burrowing was intense and occupied all soil areas. Numbers were low on Whale Island, except for slightly stronger colonies on the semi-attached stacks. Eggs were seen.

Allied Shearwater *Puffinus assimilis haurakiensis*

This species, although found on all islands, is scarce. Birds were scattered along ridges and spurs. Eggs were found but no young were seen.

Grey-faced Petrel *Pterodroma macroptera gouldi*

Moderate numbers of burrows occur on Whale Island, but only small numbers on the others. The bulk are found in flax and patches of *Cyperus*. [On the not-so-distant Cavalli Islands (Notornis 5: 112), these petrels have suffered heavily from burning and excessive mutton-birding. Ed.]

White-faced Storm Petrel *Pelagodroma marina maoriana*

This species was heard coming ashore onto Whale Island on 9 September — possibly the date of their first arrival. Birds had not been heard or seen on the two previous nights, nor was any evidence of their presence found. [At Mokohinau and the Alderman Islands, hundreds have been found coming ashore much earlier than this. Ed.] Active burrowing occurred on their first night ashore. On Whale Island this species was found on the southern face, where the grass *Stentaphrum secundatum* formed dense mats, and in areas of flax. On the other islands, the birds occupied higher ridges and spurs, usually among thickets of *Hymenanthera* and *Muehlenbeckia*. It is probable that this species is more numerous than observations indicate.

Diving Petrel *Pelecanoides urinatrix*

Burrows are extremely abundant over the three outer islands with fewer on Whale, although the adjacent rocky stacks hold good numbers. This species appears to be breeding in greater abundance on the outer margins of the islands. Eggs were seen.

Gannet *Sula serrator*

Several were seen flying offshore. It has since been reported that this species nests on a semi-bare rock off Cape Karikari, but this requires confirmation. [In mid-January 1971 Gannets were seen resting and alighting on a thickly white-washed rock off the northern end of Tokerau Beach and conveniently viewable from the De Surville memorial. Although three brown immature Gannets were seen in flight near the rock, conclusive evidence of breeding was not obtained. Ed.]

Pied Shag *Phalacrocorax varius*

Nine were counted on a bare rock off Moturoa Island. This species probably does not nest on the islands.

Blue Reef Heron *Egretta sacra*

One was seen frequenting Moturoa Island and nearby rocks.

Harrier *Circus approximans gouldi*

One Harrier was noted passing overhead each day whilst we were on Whale Island.

Australian Brown Quail *Synoicus ypsilophorus*

Five in a small covey were seen on Whale Island and two more on Moturoa Island.

Variable Oystercatcher *Haematopus unicolor reischeki*

One was seen on the shoreline of Whale Island and a pair occasionally flew past the island.

Southern Black-backed Gull *Larus dominicanus*

Small numbers around all islands.

Red-billed Gull *Larus novaehollandiae scopulinus*

Present in small numbers around all islands and rocks.

Caspian Tern *Hydroprogne caspia*

An occasional one was seen flying overhead.

White-fronted Tern *Sterna striata*

Forty-two were seen on a sea-swept rock close to Moturoa Island.

Welcome Swallow *Hirundo neoxena*

Four were observed on Whale Island. One pair was defending an area and attempting to nest in the remains of a hut.

Blackbird *Turdus merula*

One was seen on Moturoa Island.

Pipit *Anthus novaeseelandiae*

Two were seen on Whale Island.

White-eye *Zosterops lateralis*

A small number occurred on Whale and Sugarloaf Islands.

Greenfinch *Chloris chloris*

A few were observed on Green and Moturoa Islands.

Goldfinch *Carduelis carduelis britannica*

Small flocks were seen on Green and Moturoa Islands.

House Sparrow *Passer domesticus*

Two were recorded on Sugarloaf Island, with small numbers on Green and Moturoa Islands.

Starling *Sturnus vulgaris*

A roost containing several hundred was found on the semi-attached stack to the west of Whale Island. Other roosts were found on Green and Moturoa Islands which were used by several thousand birds. On clear evenings Starlings could be seen flying in, always from south-west.

GENERAL

It is possible that the larger species of *Procellariidae,* such as Sooty Shearwater *Puffinus griseus* and Flesh-footed Shearwater *P. carneipes* nest on these islands, but if they do they would probably be in small numbers only. From the large numbers of Penguins, Fluttering Shearwaters and Diving Petrels encountered, particularly on Sugarloaf, Green and Moturoa Islands, this group must rank among the more important for the breeding of these species in northern New Zealand.

No sign of rats was found, and the abundance and variety of skinks and geckos on all islands confirms their absence.

Although Tuataras had been reported from at least one of the islands, none was found, despite what appeared to be favourable habitat and weather.

DISCUSSION

Observations on all four islands show there was a tendency for petrels to occupy particular zones. This was particularly marked in some species. Grey-faced Petrels, although lightly scattered over a wide area of the islands, seemed to have a preference for dense sedge and patches of *Cyperus* and flax. White-faced Storm-petrels and Allied Shearwaters, although occupying the dense vegetation on the upper parts and ridges of the three unmodified islands, are perhaps attracted by dense vegetation rather than topography. This view is supported, in part, by the storm petrels' use of lower slopes in dense grasses on Whale Island.

The two most common species, Diving Petrel and Fluttering Shearwater, are generally common everywhere with a concentration around the marginal herbs and low, but compact, shrubs. However, in dense thickets entangled with *Muehlenbeckia* these species are almost absent, their place being taken by storm petrels and a few Allied Shearwaters.

The areas occupied by Diving Petrels and Fluttering Shearwaters are, in effect, the areas of climax vegetation. The *Coprosma/ Hymenanthera* association is the permanent inner cover and any modification, either natural or artificial, creates conditions whereby flax and *Cyperus* are often early colonisers. Grey-faced Petrels find this vegetation suitable, possibly because they obtain better access to the ground and thus exploit the area and prevent other species from using it. As plant succession proceeds, conditions become less attractive to them and other species begin moving in. The heavy entanglements of *Muehlenbeckia* may prevent larger bird species from using the ground beneath; thus, smaller birds such as White-faced Storm-petrels become the principal occupiers of such zones. The ridges and spurs where this occurs usually have less friable soil; and although soil content is sometimes greater, burrowing opportunities are fewer. As the *Muehlenbeckia* covers areas of high and low soil content it seems that the ability of a smaller bird to penetrate the tangles determines the use of such areas.

ACKNOWLEDGEMENTS

My thanks are due to Dr. G. R. Williams and Mr. D. V. Merton for critically reading the manuscript.

FEMALE BLACKBIRD ATTACKING MIRROR REFLECTION

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Territorial threat display is well known in many species of birds and in Blackbirds *Turdus merula* it is particularly common at the start of the breeding season (Gurr, 1954; Snow, 1958). This note describes unusually intense and prolonged territorial behaviour by a female Blackbird towards its own reflection.

[J. E. C. Flux

Plate I — Four views of female Blackbirds pecking at reflection in chrome headlight rim. Note the tattered tail and the droppings smeared on bumper and grill.

On 20/8/69 at 0905 hrs., in the Ecology Division carpark in Lower Hutt, I noticed a male Blackbird apparently 'attacking' or displaying to its own reflection in the chrome rim of a car headlight. After about two minutes the male was replaced by the female which behaved similarly, and continued to do so intermittently for 26 days until 15 September. The male took no further interest in any of the cars, although it frequently fed on the lawn close to the displaying female.

The right headlight rim of one car was most frequently attacked, although chrome radiator grills, bumpers and hub-caps of this and other cars were also attacked. Usually the female stood on the bumper and pecked at her reflection in the nearest part of the chrome rim, with head arched, wings fluttering and tail repeatedly fanned and cocked (Plate 1). This behaviour was observed on 18 of the 20 days that observations were made. On 21 August, the female spent at least 5 hours displaying or resting on the bumper compared with 2¼ hours on the first day. After several days of this behaviour, which persisted in all weathers with only brief stops to feed or rest, both tail and primaries became very tattered and the car radiator grill and bumper became stained with droppings and scratched. By afternoon she was obviously tired and rested for longer periods between displays. On the next day, however, she began again with renewed vigour. By the second week of September only brief encounters on the cars were noted, the last record being on 15 September. After this both male and female were often seen feeding on the lawn by the carpark taking no notice of the cars.

In New Zealand, Blackbird territories are established from April onwards and nest building begins in late August (Gurr, 1954). Thus these Blackbirds were probably starting to nest when these displays began on 20 August. By 15 September, the female may have been incubating and so less aggressive.

These aggressive displays were more violent and protracted than those described by Snow (1958) and Jackson (1952) in garden habitats in Britain. Although the male Blackbird is usually more aggressive than the female in defence of the territory (Snow, 1958), Jackson (1954) reported that sometimes the female attacks an intruder more directly, without the male's elaborate display. Other reports of display or fighting at reflections in windows or mirrors, include a male Yellowhammer *Emberiza citrinella* in New Zealand (Grant, 1967), Blackbirds in Germany (Niebuhr, 1957) and male Robins *Erithacus rubecula* in Britain (Lack, 1965). Several enquiries have been made in recent years to Ecology Division by members of the public about Blackbirds pecking windows.

I thank my colleagues Dr. P. C. Bull and Dr. B. D. Bell for comment on this note and Dr. J. E. C. Flux for the excellent photographs.

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BIOLOGICAL OBSERVATIONS FROM THE McMURDO SOUND REGION, ANTARCTICA

By B. P. KOHN, V. E. NEALL and C. G. VUCETICH
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During the 1968-69 and 1969-70 Antarctic summer field seasons, Victoria University expedition (VUWAEs 13 and 14) completed a programme of geological investigations in the McMurdo Sound region. A number of observations were made which may be of use to ornithologists investigating these areas in the future.

The first camp site during the 1969-70 summer was at Cape Barne, an ice-free cape about 30 kms north of Scott Base. From 18/12/69 to 25/12/69, about a dozen pairs of skua *Catharacta maccormicki* were nesting in the seaward valley behind and to the north of the cape. As far as could be determined only one egg had been laid at this skuary prior to our departure. The expedition then visited Cape Bird, Cape Crozier and the west side of McMurdo Sound. On 17th December, two of the party walked from Lake Vanda to the Labyrinth. They found two mummified Adelie Penguins *Pygoscelis adeliae* in the Labyrinth, 66 kms inland, at an altitude of 1000 m (see Fig. 1). Barwick and Balham (1967) have already

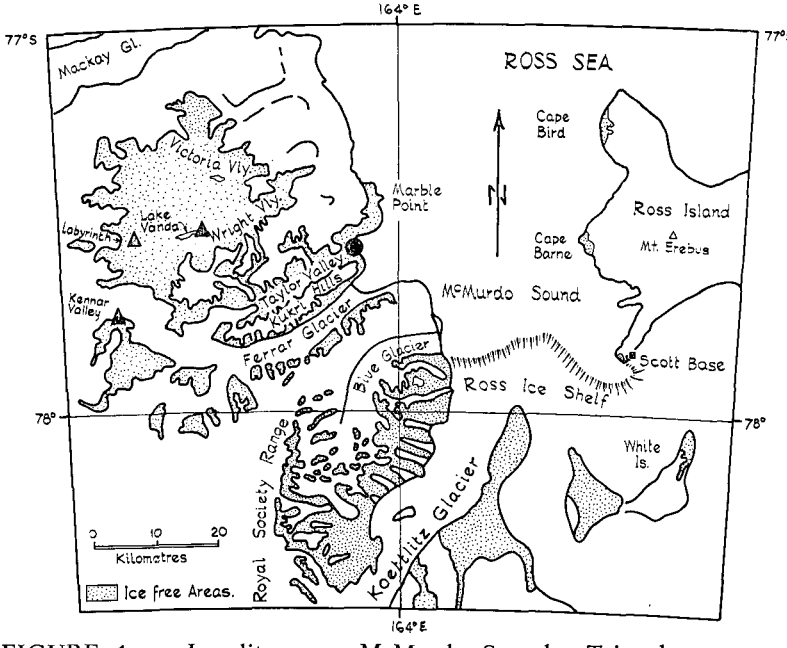

FIGURE 1 — Locality map, McMurdo Sound. Triangles represent Adelie Penguin localities; circle indicates mummified Emperor Penguin.

plotted the distribution of mummified penguins and crabeater seals found in the Dry Valleys, up to 1960. They record two Adelie Penguin remains, one in the South Fork of the Wright Valley, 63 kms inland (and C 14 dated as 560 years old) and one at the foot of the Lower Wright Glacier, 16 kms inland. Mr. Kohn reports that an Adelie Penguin was found by Victoria's 1968-69 expedition in Kennar Dry Valley, a dry valley on the southern side of the Upper Taylor Glacier at a height of 1550 m (see Fig. 2). The shortest distance to the coast is 80 kms via the Taylor Valley. This is the furthest point inland that we know of Adelie Penguins. On previous visits to the area, an additional 3 Adelie Penguins were found by the authors at the eastern end of Lake Vanda.

FIGURE 2 — Adelie Penguin remains in Kennar Valley, 80 kms inland from McMurdo Sound. Length from beak to hind leg — 0.5 metres.

From 18th to 31st December 1969, two of the party studied soils and raised marine deposits at the mouth of the Lower Taylor Valley. In the westernmost corner of New Harbour, 1 km from the coast, on hummocky moraine near sea level, a decapitated skeleton of an Emperor Penguin *Aptenodytes forsteri* was discovered. The headless skeleton is about 1 m long. Except for the scaly feet which are still attached to the bones, most of the tissue has disappeared. This is the first record we know of an Emperor Penguin being found in the Dry Valleys. What is probaly its head was found about 1.5 kms away. Decapitated Adelie Penguin carcasses were also seen at the larger rookeries on Ross Island, and the decapitation was probably caused by skua gulls. A recently dead Adelie Penguin and numerous penguin footprints below high water mark at the mouth

of the Taylor Valley show that penguins do live on the western side of the Sound, although it is open water for only a few weeks of the year.

McCraw (1967) reported that " not more than a dozen patches of moss, ... were seen " in the Taylor Dry Valley. Between 40 and 50 mats of mosses were observed in the Lower Taylor Valley. They were found along meltwater streams draining towards the coast, and under stones at altitudes greater than about 270 m. Most were located in the extremely wet environment alongside the principal flow of waters and in sites of snow patches. The distribution of the mosses is directly controlled by available water. McCraw (1967) also noted " skua gulls . . . . bathing in ponds in the valley, but no nests were found." During our stay from 18/12/69 to 31/12/69 about 10 pairs of skua were observed, nesting along the northern and western sides of New Harbour, at the mouth of Taylor Valley. Most pairs were guarding 2 eggs per nest, and the egg shell colours ranged from grey to olive green, with irregular brown spots. Whilst passing one bird guarding a nest on 22/12/69, a chick was heard chirping and later was seen emerging from one of the eggs. This was the only chick noted at this skuary during our stay.

We thank Dr. R. W. Balham for informative comments whilst preparing this paper.

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SHORT NOTE

WELCOME SWALLOWS AT CHATHAM ISLANDS

While waiting at the Te Hapupu Airstrip, Chatham Islands, on 11/6/70, my attention was drawn by a local farmer to what he described as strange birds that had arrived in the vicinity. The birds were Welcome Swallows and several counts revealed that there were ten birds in the flock.

In discussion with Mr. D. Reid, Resident Commissioner, Chatham Islands, I was informed that the birds had arrived at the Airstrip some three weeks previously and had been identified locally as " Bull Finches." Mr. Reid had written to the Wildlife Service endeavouring to describe the birds for identification. The Wildlife Service provided the following information.

" On May 12, a group of half a dozen strange birds were seen at Hapupu by several people, including D. Reid and L. Smylie. A description was sent to B. D. Bell who identified the birds as Welcome Swallows. A letter received subsequent to F. Hollay's visit reported that a good dozen had been seen at times and that they were observed feeding on midges.

More recently a report from fishermen at Pitt Island records that a Swallow was seen on that Island in December 1970."

— F. G. HOLLAY

BIRD OBSERVATIONS — MACQUARIE ISLAND 1967

By WILLIAM MERILEES

While the author was stationed at Macquarie Island (54° South, 159° East) a number of interesting observations were made of the bird fauna. Previous accounts of the bird fauna of this subantarctic island have been presented by Falla (1937), Gwynn (1953), Law and Burstall (1956), Keith and Hines (1957), and Warham (1969).

BLUE PETREL *Halobaena caerulea:*

Field Notes: 9/11/67: Langdon Point; "Found two skulls today, possibly Blue Petrel in Skua Regurgitations."*
28/11/67: Langdon Point; "Blue Petrel remains numerous in and around dry peaty tussocks. (I) could not locate any active burrows or nests though an extensive search was made."

Law and Burstall (p. 21), reported this species under the title "species once native, but now extinct, or almost so," while Keith and Hines (p. 52) found them to be "very numerous at night" during September and October. Dirt in their feathers and enlarged ovaries led them to suspect breeding but this was not confirmed.

The area in question where these remains were located is near the small rectangular tarn about one hundred yards south west of the prominent rock face which drops down to the coastal terrace at Langdon Point.

The remains of many Blue Petrels were found in the regurgitations of the Skua *Catharacta skua lonnbergi,* particularly those found around the nest of the pair nesting near the tarn. These contained heads and feet primarily. Pectoral girdles with the wings still attached were found under the nearby tussocks *(Poa foliosa).* The greatest number being eleven at one location.

How these birds met their death is not certain as either cats (liberated by the early sealers) or Skuas could be the primary cause after which either the heads and legs could have been eaten by the skuas or the picked carcasses could have been pulled into the tussocks for a final cleaning by the cats.

Time did not permit a thorough search except for the area immediately surrounding the small tarn. However, from the number of mutilated corpses found (at least 47) in this area I would suspect a sizable population must be breeding somewhere in the vicinity.

Falla (p. 120), reports egg laying in progress early in November at Kerguelen Island which is close to the time when the remains of the Blue Petrel were very numerous at Macquarie Island.

* Identification confirmed by Allan McEvey, Curator of Birds, National Museum, Melbourne, and Keith Hindwood, Honorary Curator, Australian Museum, Sydney.

GREY DUCK *Anas superciliosa:*

Field Notes: 28/11/67: " A family with at least six ducklings, two hundred yards North of Boiler Rocks making their way across the feather bed; just hatched."

Included here as this hatching date seems very early for Macquarie Island. Falla (p. 269) reports eggs being found in January by Hamilton in 1912 (?) and ducklings on the 28th. In the following year ducklings were noted on the 4th of February.

MALLARD *Anas platyrhynchos:*

Field Notes: Langdon Bay, " A pair flushed from small stream."
29/7/67: Langdon Bay, " Again flushed a pair of Mallards from small stream."
18/11/67: " Mallard Drake and Duck flushed — Langdon Bay."

The Mallard was first reported at Macquarie Island in 1949, (Gwynn p. 151) and other observations have been made from 1965 to the present. These observations indicate the species may now be resident, but as yet there is no evidence that they have bred.

EUROPEAN STARLING *Sturnus vulgaris:*

Field Notes: (selected): 17/5/67: " Green Gorge Roost; first birds arrived at 2.45 p.m. Total counted arriving 1377."
18/5/67: " Green Gorge Roost — roosting started at 3.00 p.m. Total in Roost 1378."
6/6/67 to 11/7/67: " Many flocks encountered on Plateau in flocks up to 75 individuals."
18/11/67: " Starlings in and around all rock stacks from Bauer Bay to the Base. At ' Catch me ' one pair had cheeping young in nest. Around the Isthmus they are constantly foraging around Camp and Radio Beaches."
28/11/67: Langdon Point; " First family seen wheeling around today — six birds; four juveniles."

The Starling is well established on Macquarie Island with nests commonly found in rock fissures and crevices in the pillow lavas wherever these occur. Normally the species forages on the plateau and coastal terraces in small flocks but during the breeding season pairs are frequently encountered scavenging along the beaches.

In the late afternoon the species gathers to roost, often in the rocks immediately out from the beach in front of the Green Gorge Hut. They also roost in the crevices of the cliffs south of the Hut. Birds arrive at the Green Gorge Roost from the west and after a short " pre-roosting flight " alight and appear to seek out cavities between and around the heads of the Tussock Grass *Poa foliosa.*

During the non-breeding season the species appears more common towards the middle and southern end of the Island and very few individuals are seen near the Base. No birds were collected to determine what they were feeding on but they appeared to favour areas of the sub-glacial herbfield formation (Taylor, 1955), where *Festuca erecta* is dominant. At this time, February to October, the seeds of this species are being shed.

SPECIMENS TAKEN

SOOTY SHEARWATER *Puffinus griseus* — One specimen ♀, taken 12/12/67 on the Isthmus.

Deposited in the National Museum of Victoria, Melbourne, Victoria, Australia. Number B 9352.

COMMON DIVING PETREL *Pelecanoides urinatrix* — One specimen ♂, found dead 14/5/67 by John Reid.

Deposited in the Museum of the Zoology Department, University of British Columbia, Vancouver, B.C., Canada. Number 13407.

DOMINICAN GULL *Larus dominicanus* — 37 specimens.

7 deposited as skeletons in the National Museum of Victoria, Melbourne, Victoria, Australia. Numbers B 9314 to B 9320.

26 deposited as skins in the National Museum of Victoria, Melbourne, Victoria, Australia. Numbers B 9321 to B 9346.

4 deposited as skins in the Tasmanian Museum and Art Gallery, Hobart, Tasmania, Australia.

WEKA *Gallirallus australis* — Two specimens, both ♂, collected on the Isthmus, 6/5/67.

Deposited in the Museum of the Zoology Department, University of British Columbia, Vancouver, B.C., Canada. Numbers 13408 and 13409.

SONG THRUSH *Turdus philomelos* — One specimen, ♀, collected 30/8/67 by John Evans on the Isthmus. Deposited in the National Museum of Victoria, Melbourne, Victoria, Australia. Number B 9351.

GOLDFINCH *Carduelis carduelis* — One specimen collected 5/5/67, on the Isthmus.

Deposited in the Tasmanian Museum and Art Gallery, Hobart, Tasmania, Australia.

ACKNOWLEDGEMENTS

The author wishes to thank Mr. Allan McEvey, Curator of Birds, National Museum of Victoria, and Mr. Keith Hindwood, Honorary Curator, Australian Museum, Sydney, for confirming the identification of the Blue Petrel, and Dr. Rudi Drent, Zoology Department, University of British Columbia, Vancouver, Canada, for critically reading this manuscript.

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A SIGHTING OF BAIRD'S SANDPIPER IN NEW ZEALAND

By H. R. McKENZIE, Mrs. MAXINE E. McKENZIE
Mrs. BARBARA J. BURCH, Miss SUSAN M. FOGARTY

The 1969-1970 summer was notable for the number of vagrant arctic waders recognised. An unusual influx of Curlew Sandpipers *Calidris ferruginea* (Notornis 17, 291-296) may have brought with it several other species commonly breeding in Siberia or northwest America. Of the vagrants there have been two tentative records of Dunlin *Calidris alpina,* one at Karaka and one at Puketutu, Manukau Harbour, the latter a bird with patches of black remaining on the belly; a record of two White-rumped Sandpipers *Calidris fuscicollis* at Karaka (Notornis 17. 236-237); and again at Karaka a solitary bird taken to be a Baird's Sandpiper *Calidris bairdi.* A second record for New Zealand was of two Great Knots *Calidris tenuirostris* at Miranda, Firth of Thames (Notornis 17, 299).

On 28/3/70, M.E.McK., B.J.B., S.M.F. and H.R.McK. were making a routine check of shore-birds at Kidd's Shellbank, Karaka, Manukau Harbour, when a strange sandpiper was found and carefully studied at leisure for over two hours. It was first noticed by H.R.McK. when scanning a loose assemblage of Turnstones, Red-necked Stints and New Zealand and Banded Dotterels on the short growth of the semi-marine flat just behind the beach. Too small for Sharp-tailed, *Calidris acuminata,* one of which was present so that comparisons could be made, it was the size of a White-rumped Sandpiper. It left the paddock before it could be studied and reappeared on the tideflat among several species of scattered waders, right in front of the other three watchers at about twenty yards. M.E.McK. drew attention to it as a stranger and with B.J.B. and S.M.F. carefully listed important details.

The short, dark, straight, rather thin bill was the shape of a Sharp-tailed Sandpiper's but smaller. The crown was sparingly streaked dark and there was a definite but not prominent eye-stripe. The neck all round and sides and front of breast were strongly buff-brown, the lower breast, belly and under tail white. A striking scaly pattern, not striped, on the back was particularly noted and described by the ladies as beautiful. This was amply confirmed when a skin was later examined in the Auckland War Memorial Museum. The two inch long "scaly" area had small rounded feathers with distinct white edgings, the centres being a dark or chocolate brown. The sides of the breast were brown and a peculiar line between the brown and the lower area of white ran from the lower breast to the upper flank. This field note was later explained by study of the skin and of illustrations which showed that the white under surface runs up into the brown breast in a definite bay. This is well illustrated by Peterson, Robbins and Godfrey.

After differing opinions were considered on the spot, the legs were described as indefinitely yellowish brown, a little yellowish upper and the rest brown, one observer mentioning slate. In the

literature mentioned below the colour is given as " blackish or dark slate " (Witherby); " blackish " (Peterson); " legs and feet very dark " (Stout *et al.*). The study skin in the Auckland War Memorial Museum has dark red-brown legs, which, if they had the same colour in life, would look very dark at even a short distance. The vagaries of the light make leg colour notoriously difficult to ascertain. The difference in this case from the usual description could well have been caused by the westering sun making reflections from the shiny mud surface just uncovered by the falling tide.

Feeding was by pecking and the bird moved actively. It was fully tolerated by the other waders nearby. As to be expected from the published accounts it was particularly tame.

We returned to the car, from which the bird was to be well seen at about sixty yards with the aid of a large telescope. B.J.B. had at hand a copy of " Birds of North America: A Guide to Field Identification." From this book Baird's, seen on migration by H.R.McK. in May 1969 by the Mississippi River, U.S.A., was quickly selected. Because the rump and upper tail pattern needed closer observation, B.J.B. and S.M.F. went out onto the flat to put the bird up, keeping between it and the sun. It allowed their approach to thirteen yards and made several short flights, giving excellent views of the rump and upper tail pattern each time. The broad blackish band all down the middle of the rump and tail and the dark across the end of the tail, the lighter brown on each side of the dark band and the rather small area of white on the sides of the upper tail tallied with the illustration in the book. These features were fully and clearly noted and the two observers were pleased to be able to examine without hurrying this important feature.

In size the nearest to it of the straight-billed sandpipers is the White-rumped *Calidris fuscicollis,* which is eliminated by having a white rump. The Least and Semi-palmated, which have a somewhat similar rump and tail pattern, are definitely too small. All with down-curved bills are ruled out. The buffiness of the fore-parts of Baird's, with white under, is not shared by any other and the tail pattern, described above, and so well verified by two of the observers, who were assiduously concentrating on it, is firm evidence.

Since Baird's Sandpiper breeds in north eastern Siberia, north-west Alaska and northern Canada, it could easily be caught up with the regular migrants and the strays above-mentioned and come to New Zealand. Its main migratory fly-way is along the Mississippi Valley, but it uses other routes as well. Stragglers have occurred in England and Scotland, one in South Africa, one in the Falkland Islands and one has been collected in Tasmania.

Bird photographers D. A. Urquhart and N. Douglas came the next day to try to record it and the Sharp-tailed Sandpiper but they had gone, possibly having set out on the long journey to their breeding grounds.

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[When the original account of the discovery of this small sandpiper was submitted to the Rare Birds Committee, some misgivings were felt about the identification, mainly because the legs were described as "indefinitely yellowish brown." However, since either this or another Baird's Sandpiper has now been found, studied and photographed in the Firth of Thames, the Convener of the Rare Birds Committee is of the opinion that this claim to the first sighting of Baird's Sandpiper in New Zealand should be published. — Ed.]

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SHORT NOTE

WHITE NELLY ASHORE ALIVE IN HAURAKI GULF

On 8/8/70 a White Nelly *Macronectes giganteus* was found ashore at Orere Pt., Clevedon, by Mr. and Mrs. H. Volk of Manurewa. It appeared to be hungry and somewhat exhausted. Some bread was accepted, but strangely enough, mussel was refused. The bird was then taken to Mr. T. A. Jenkins, taxidermist, was reported to me and identified. A plan to revive the bird with a view to liberation was decided upon. T.A.J. made a pen for it on his lawn and cared for it till August 25. Mr. Volk met all expenses; the Rosses of Kawakawa Bay provided fish offal; my wife and I kept up a supply of seawater for drinking. Codliver oil was used. Improvement was rapid and the Nelly began climbing the wire-netting of its pen and trying to escape.

An added interest was that the bird carried a band reading "5033461 British Museum S.W.7." This was not removed. But a report to the British Museum was answered by the B.T.O. to the effect that the banding had been done at Signey Island in the South Orkneys on 5/3/70 when it was still non-flying. Thus when it came ashore it was only five months out of the nest.

The plumage was not entirely white. There were scattered spots of black and a few two-inch black feathers except on head and tail. The webs of the feet had pale spots. The bill was light tan white. Measurements in m.m. were:— Bill 100; wing 520; tarsus 100; tail c. 200; mid-toe 145.

Arrangements to release the bird well out to sea were made with the very helpful officers of M.V. Pukeko at Onehunga. This was done at 0010 hours on August 26 about 36 miles north of New Plymouth. The wind was light, S.W., 3 knots and the sea was slight with a low swell. The Nelly slowly came out of its carton and wandered around for a few minutes before flying about fifty yards and settling quietly on the sea. Further observation was impossible because of the darkness.

Sibson (Notornis 16, 46) has shown that white Nellies rarely come as far north as the Auckland coast and Capt. John Jenkins tells me that during his many voyages in New Zealand waters he has not yet seen a white specimen among the hundreds, even thousands, of brown Nellies which have followed his ships.

— H. R. McKENZIE

LETTERS

Sir,

In the June issue of Notornis Drs. Falla and Fleming and Mr. Kinsky gave reasons why they believe that the bird figured on page 223 of the previous volume is a Royal Penguin and not a Macaroni as stated in the accompanying article.

The identification was not based on a consideration of minor character differences such as Falla *et al.* state to exist between Macaronis and dark-faced Royals, but on the scarcity of the latter as noted during 15 months residence on Macquarie Island during which many thousands of Royals were handled. No precise data on the proportions of black-faced birds to non black-faced ones were collected during my stay but I would suspect that the proportion is nearer to 1 in 100,000 than to 1 in 10,000 birds. The probability of such a bird from Macquarie turning up on the Snares is correspondingly low and as the available data on the animal in question fit a Heard Island Macaroni just as well as they do a black-faced Royal, the bird was considered to be a member of the typical sub-species.

The penguin was described by my fellow author B. R. Keeley (the paper was not written solely by John Warham as Falla *et al.* indicate) and the identification based on his description and measurements and on Mr. Cameron's photographs.

May I examine the characters set out by my critics point by point ?

(a) " The white patch on the upper tail coverts, common in Royals and rarely, if ever, found in Macaronis." If true, this would be a most convenient diagnostic feature but reference to Figure 89 in one of Falla's papers (BANZARE Rep., Ser. B, Birds, 1937) shows that at Heard Island breeding Macaronis have white upper tail coverts. These are shown even more clearly on Plate 49 of " The Birds of Heard Island " (Downes, Ealey, Gwynne and Young, ANARE, Rep., B. 1959. See also the description in " Oceanic Birds of South America " Murphy, 1936, p. 432). Thus it seems that at the nearest breeding station to New Zealand for Macaronis, if not elsewhere, breeders have white rumps just as most breeding Royals do. Some of the latter, however, lack this character (see e.g. Fig. 103 in Falla, *loc. cit.*), yearlings especially (pers. obs.).

(b) " the much larger area of naked skin at the gape in Royals." The Snares Island bird shows this feature well but comparison with photographs of Macaronis is again instructive. Take Plate I in " Penguin Marking at Heard Island " by Downes and Gwynne (ANARE Interim Rep., 8, 1955). This shows a pair of Macaronis. Both birds have large and prominent bare areas at their gapes, much more pronounced than that in Kinsky's " Macaroni " at Campbell Island but much the same as in his " Royals " from the same place (Notornis, 17 (4), Pl. XXXIII and XXXIV). My own photographs of live Royals show that this is a variable character in these birds. In fledglings the bare area is hardly visible, in yearlings well developed but it appears to be most pronounced in breeding males and less so in females. It is often very similar in extent to that shown in Downes and Gwynne's plate. Thus the assertion that its size in the Snares Island bird supports its identification as a Royal, needs substantiation, in my view.

(c) " the top heavy bill." The Snares bird certainly had a large bill hence our suggestion that it was a male. The size is accentuated in the photograph by the rather high viewpoint. Judging from the meagre published data, e.g. in Murphy *(loc. cit.)* Macaronis do appear on average to have smaller bills than Royals and I have referred to this elsewhere (Warham, in press) but the ranges of the variation in live birds overlap. The bill length of the Snares bird lies within the range given by Downes and Gwynne for a very small

FIGURE 1 — Dark-faced Royal Penguin, Macquarie Island.

sample of Macaronis. Furthermore, if the Snares bird is compared with their figure the bill is seen to have much the same size and proportions as the male of that particular pair.

(d) " the apparently jet black throat." In the photograph of the Snares Island bird the cheeks and throat are in shadow, but these were very dark, if not " jet black." Kinsky (*loc. cit.* p. 229) states that apart from the normal pale cheeked birds some Royals have either silver grey or jet black cheeks, chins and throats whereas Macaroni Penguins can be separated by their grey black cheeks, chins and throats. The accompanying photograph shows a male *Royal* with grey black cheeks, chin and throat. It bred at Macquarie Island in company with a normal pale-cheeked partner. Note that the condition of the cheeks and throat agrees nicely with Kinsky's " Macaroni " from Campbell Island.

My photograph shows a typical dark-faced Royal and I can recall only one that was darker than this. It is figured by Stonehouse (Penguins, 1968, p. 34). At that island there seemed to be a complete gradation from white cheeked to dark cheeked birds, not a clear separation into distinct types as Kinsky states. That there is some variation too with Macaronis is obvious from Downes and Gwynnes' photographs and also from statements in " The Birds of Heard Island " where it is noted (p. 56) that birds with grey cheeks were not uncommon " though this is not the usual impression among breeding birds." The " rare occurrence of white-faced birds among the otherwise uniformly black-faced Macaronis at Heard Island " is also recorded. Thus I remain unconvinced as to these alleged differences between typical Macaronis and black-faced Royals and cannot agree that the dark condition of the throat of the Snares Island bird aids its determination as a Royal.

Mr. P. D. Shaughnessy, who worked on the distribution of the various face-colour varieties of Royal Penguins at Macquarie Island, confirms (in *litt.*) that face, cheek and throat colour form a continuum between those with wholly white faces, cheeks and throats and those with wholly black faces, cheeks and throats. A Royal with a face as dark as that of the Snares Island bird would be very rare. Furthermore, he found a much higher frequency of dark-faced females than males and on this basis thinks the Snares Island bird unlikely to have been a Royal.

Indeed all the characters brought up by Falla *et al* seem at best equivocal. I certainlly agree with Kinsky's determination of his Campbell Island birds judging by his photographs, not because of their possession of any special characters but because of the rarity of black-faced birds at Macquarie and of white-faced ones at Heard Island.

This discussion is given added piquancy by the appearance in 1970 of yet another dark-cheeked *chrysolophus* on the Snares. This time it was a rather small-billed bird, probably a female and with a well developed crest. We have still not seen any light-cheeked birds. Only Kodachromes of this new arrival are available, unsuitable for reproduction, but I am circulating copies of these to my critics with a copy of this letter and shall be interested in their comments.

Analyses of data from large samples of live *Eudyptes* of four species (or sub-species) now being undertaken indicate that although there are significant differences between some populations in things like bill size and colouration there is not only a considerable overlap but long tails to the distribution curves. It is thus necessary to have statistically adequate samples measured under similar conditions to evaluate the differences. Also like must be compared with like, e.g. female yearlings with female yearlings and male breeders with male breeders. This range of variation makes the identification of strays of unknown provenance all the more difficult.

I have no doubt that using adequate samples some real differences will be found in mensural and other characters between Royals and Macaronis and if Falla, Fleming and Kinsky could publish data on, say, bill dimensions in breeding birds for these two sub-species it would certainly give us something more positive on which to work.

— JOHN WARHAM

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Sir,

As Mr. Warham has kindly given us a preview of his comments and illustrations and invited further comment, we accept the obligation to offer them. Not having seen the bird, as apparently one Mr. B. R. Keeley did, we realise that we and Mr. Warham have to base our discussions mainly on the unsure ground of interpreting photographs and the still more contentious one of weighing up probabilities. Our challenge to an identification based on an assumption (i.e. that the probability of a black-faced Royal Penguin turning up at Snares was low because the proportion of them occurring at Macquarie Island is very low) was perhaps equally subjective in its reliance on a combination of criteria of plumage and structural characters, each admitted to be variable to the point where they could overlap. Mr. Warham considers them to be "equivocal," and we would agree if they had to be applied separately. We relied on weighing up a combination of them, with some dependence on size factors as far as the data permitted. Readers may be left with the impression that there are no safe criteria for distinguishing Macaronis from dark-cheeked Royals and vice-versa, and this may well be the case for a few convergent specimens. However, we think it can be done and agree completely with Mr. Warham that the material used must be comparable in respect to age, sex, and stage of the annual cycle. To re-assess the criteria that have been suggested we turn to Mr. Warham's lettered points:

(a) "The white patch on the upper tail coverts." Here we capitulate. His point is well made, and we agree that this factor can be ruled out for identification purposes.

(b) "Larger area of naked skin at the gape." Agreeing that this feature is pronounced in both Royals and Macaronis in comparison with other crested penguins, and that its extent is determined by age and sex, we would yet observe that it commonly extends in old male Royals almost to the point of disfigurement, curving up

as a warty strip round the base of the latericorn of the bill into the narial groove. This seems to show, if the highlights are not playing up again, in the figure of the 1969 Snares bird. It also shows in the print of a white-cheeked Royal accompanying Warham's letter, though it may be lost in half-tone reproduction. By contrast in female Royals and in Macaronis the upper extension usually ceases to be conspicuous about half-way up the latericorn just above the gape.

The citation of Downes and Gwynn (1955, Pl. 1) shows it adequately for average Macaronis at Heard Island. However, as a difference it is only a matter of degree and not by itself a safe criterion of distinction.

(c) " The top-heavy bill." Agreed that comparative size is an objective factor that can be used when careful measurements or actual specimens are available, and noting that Mr. Keeley recorded bill and flipper length of the 1969 Snares bird as 65.5 and 196mm respectively, we come to Mr. Warham's further comments. To dismiss as " meagre " the data with which several authors have recorded the size range that may be expected in Macaronis does less than justice to what there is. The cited summary by Murphy (1936) presented a random size range, including Gain's 1914 figures, of 9 males and 10 females from 3 localities. The maximum male culmen length in this series is 64.2 (average 60.3). Since then there have been further data, based on adult breeders, from Heard Island, in papers already cited by Warham. Rand (1954) also records a breeding male from Marion Island with culmen 60. Downes and Gwynn (1955) in live measurements of seven mated pairs at Heard Island certainly have one male at 66, no doubt the basis of Warham's conclusions that the Snares Island bird is " within the range " of Macaronis, but the range of their male series is 57 - 66 and the average 61.2. One of us (Falla, 1937), in an earlier study of Heard Island Macaronis collected and recorded breeding males with culmen 62 and 63. An opportunity to examine Royals at Macquarie Island on the same date in the following year prompted a comparison in which were recorded dimensions of a random series of skins which included 10 males with culmen range 64 - 73 (average 66.5 for Royals). Another difference disclosed by the measurements was in length of flipper which was longer by 13mm (average) in Royals than in Macaronis. The actual dimensions given (e.g. pp. 96 and 100) are useless by modern standard flipper measuring technique, but the same method was used for both. A re-measurement of a small series in the Dominion Museum shows Royal flippers 20mm longer. The general postulate of size differences was re-examined and confirmed by Jouanin and Prevost (1953), the work including an examination on their behalf by Dr. Jean Dorst of the considerable series of Macaronis and Royals in the British Museum. All in all it seems unsafe to conclude that a penguin with culmen length of 65.5 is probably a Macaroni.

(d) " The apparently jet black throat." Here again we are back on subjective ground unless specimens are used, and are aware of the pitfalls of light and shadow in photographs. We gather from the quotation from Mr. P. D. Shaughnessy that a Royal with a face as dark as that of the Snares bird in question would be very rare.

This we find confusing in view of the fact that black-faced birds from Macquarie Island available as specimens in several collections (Auckland Museum and some in Australia) are all blacker than any Macaroni specimen known to us.

If there is a continuum at Macquarie Island from white face to black face Royals there must be some birds identical, in facial pattern at least, with what we consider the norm for Macaronis. This has always been a subject for speculation among ornithologists visiting Macquarie Island, for in addition to any genetic trend in the local breeders there must be an occasional genuine Macaroni stray like those which reach Cape Hallett, the Ballenys, and Campbell Island. (One such Macquarie Island stray is No. 8963. Dominion Museum). Not surprisingly most of us have indulged in a change of opinion several times, including apparently Mr. Warham for he now presents as "a typical dark-faced Royal" the identical bird which he had earlier figured (*Animals* Vol. 3, No. 2, 17 December 1963), as a Macaroni.

Finally a comment on the Snares bird of January 1970 of which Mr. Warham sent us Kodachromes. It looks like a female black-faced Royal and we gather that he has so diagnosed it. As it happens to show its under-flipper pattern, may we venture a suggestion which would not have been relevant in the case of the photo of the first bird, namely that this character is sometimes useful, when it can be seen.

The 'Field Guide to the Birds of New Zealand' hopefully offered (p. 25) a diagram of flipper patterns. In that shown for the Royal the dark anterior border band peters out to white, or at least has a break in the dark strip before it reaches the extremity. This is the condition shown in the 1970 Snares Kodachrome and also in Warham's bird figured in Stonehouse (1968, p. 34). By contrast most Macaronis seem to have a much stronger dark anterior band; in fact Rand's figure (1955, p. 63) shows it as unbroken in Macaronis at Marion Island, and the several group photographs by Rankin (1951, figs. 96, 98, 99) show some flipper patterns with a predominantly dark leading edge, as in several skins examined in the Dominion Museum. One male in Rankin's fig. 97 is certainly nearer to Royal pattern, so it is again a difference of degree, but diagnostic in the great majority of specimens. In brief our view is that with all the characters that may be convergent or overlapping open to question, the apparently long flipper, and a bill much nearer the Royal than the Macaroni average, must make any firm determination of the 1969 Snares bird as a Macaroni unacceptable.

— R. A. FALLA
C. A. FLEMING
F. C. KINSKY

REFERENCES (other than those already cited by Warham)

JOUANIN, C., and PREVOST, J., 1953: Captures de Manchots Inattendus en Terre Adelie et Considerations Systematiques sur **Eudyptes chrysolophus schlegeli** Finsch. L'OISEAU et R.F.O., 5, 23, 281-287.

RAND, R. W., 1955: The Penguins of Marion island. The Ostrich, 26, 2, 57-69.

RANKIN, N., 1951: **Antarctic Isle.** Collins. 383 pp., 137 pls.

REVIEW

Review of *"Sounds of New Zealand Birds, Volume One,"* a disc by Les McPherson.

For two reasons it was a great pleasure to review this disc of New Zealand birds: first, it is of excellent quality; and second, it was prepared by an amateur relatively new to the field. New Zealand needs more recordists; amateurs have contributed much in many sciences, and the advent of Mr. McPherson (an O.S.N.Z. member) will provide some needed augmentation to work now being done by the Wildlife Branch and less than a handful of others.

The disc is 45 rpm extended play and covers ten species. An Uher 4000L recorder, operating at 7½ inches per second tape speed, was used in conjunction with an AKG D200E microphone on Agfa PE65 and EMI 99/9 tapes, and in a twenty-inch parabolic reflector on some of the recordings.

To be severely critical, there is a bit of wind noise against the microphone in House Sparrow and Starling cuts (the first two), but this is minor and does not distract. The Song Thrush is well done with no over-recording, an easy fault with loud-volume, high-frequency songs (which he may find harder to avoid when he gets to the Robin and Hedge Sparrow on 7½ speed). The Stewart Island Weka is characteristic; and the South Island Saddleback I had never heard before. The latter was recorded in heavy rain which is quite audible, but the second half of the cut has less rain and a different vocalization which, to me, seems distinct from North Island Saddleback tapes I have heard. The Red-billed Gull again is typical; and the Shy Mollymawk, too, with the latter containing water noises about the boat where the bird was recorded, but this is not objectionable. The two Oystercatcher species are well done, as is the Sooty Shearwater in and out of its burrow.

The South Island Saddleback and Shy Mollymawk will not be found in many New Zealand collections.

Mr. McPherson has set up his proprietorship, "McPherson Natural History Unit," at P.O. Box 21083, Edgeware, Christchurch, the only place where the disc presently is available. Its price is $1.40, indeed a reasonable charge.

My experience since 1958 in recording birds indicated it was easier for me to earn a living in another field and donate my tapes. So I hope Mr. McPherson will be as successful financially as he has been electronically; or at least that his receipts will materially reduce his equipment and travel costs. The Uher is a high-quality, high-priced machine. So is the microphone. The cost of recording equipment in New Zealand certainly is the greatest factor limiting the use of this valuable ornithological tool outside government departments where the high duty does not have to be paid. Tape, too, is two to three times the cost charged at retail in countries of manufacture, which unfortunately encourages most amateur Kiwi recordists to use the slow speeds of 3¾ and 1⅞ inches per second to save tape at the expense of fidelity.

Mr. McPherson deserves the encouragement of ornithologists for his initial effort, plus their hope that he will go on and add more, particularly of as-yet-unrecorded species. When one remembers that Johannes Andersen, back in 1912, recorded over 70 Tui vocalizations

on musical score pads, with the aid of a pitchpipe, four decades before tape recorders, it is clear how much work still remains to be done on the common species.

An understanding interpretation by trained behaviorists is another need. New Zealand, like other island communities well away from continental land masses, has an avifauna more specialized morphologically and behaviorally than the continents. This provides exceptional opportunities for study not available on the continents and certainly in need of more systematic and trained pursuit from the behaviour standpoint where the tape recordist, with careful documentation, can help the behaviorist.

As tape recording grows in New Zealand, it would be well to have the tapes, now spread around various government departments and private homes, located in one central library, documented, filed and catalogued in taxonomical order, with ready playback available for students and for revision and updating of field guides.

— Wm. V. WARD

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NOTICE

ROYAL AUSTRALIAN ORNITHOLOGISTS' UNION 1971 CONGRESS

The R.A.O.U. will be holding its 1971 Congress in Auckland from October 30 to November 2. The venue will be the Auckland War Memorial Museum. The programme for the Congress will be as follows:

SATURDAY, OCTOBER 30 —
Afternoon: Scientific papers.
Evening: Cocktails and official opening, including President's address.

SUNDAY, OCTOBER 31 —
Morning and Afternoon: Scientific papers.
Evening: Films.

MONDAY, NOVEMBER 1 —
Field outing on Hauraki Gulf.

TUESDAY, NOVEMBER 2 —
Morning and Afternoon: Scientific papers.

The Congress will be open to all interested persons on the payment of the registration fee of $10 which covers all. This must be paid before July 31. Scientific papers will be accepted from non-members of the R.A.O.U. on the understanding that members' papers will have to have preference and that the Organising Committee will retain the right to accept or decline any paper. Intention to present a paper must be sent to B. D. Bell, C/o Wildlife Service, with a short abstract for inclusion in the Congress programme, not later than July 31.

Congress registration is to be paid to Miss Hutson, 90 Korokoro Road, Petone, New Zealand.

B. D. BELL
for New Zealand Organising Committee
R.A.O.U. Congress

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O.S.N.Z. Library Catalogue, 70 pp., 50c.

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Kermadecs Expedition, 1964, by A. T. Edgar. Reprints at 45c.

From all bookshops:

A Field Guide to the Birds of New Zealand, by R. A. Falla, R. B. Sibson and E. G. Turbott. $4.50.

From B. D. Heather, 10 Jocelyn Cres., Pinehaven, Silverstream:

A Biology of Birds, by B. D. Heather. $1.33 post free.

From B. A. Ellis, 44 Braithwaite Street, Wellington 5:

Field Guide to the Waders, by Condon and McGill. Price 65c.

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Contributions should be type-written, double- or treble-spaced, with a wide margin, on one side of the paper only. They should be addressed to the Editor, and are accepted on condition that sole publication is being offered in the first instance to "Notornis." They should be concise, avoid repetition of facts already published, and should take full account of previous literature on the subject matter. The use of an appendix is recommended in certain cases where details and tables are preferably transferred out of the text. Long contributions should be provided with a brief summary at the start.

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References: If listed, these should be in the form of the following examples:

1. Atkinson, I. A. E., 1964: Feeding stations and food of the North Island Saddleback in August. Notornis 11, 2, 93-97.

2. Buller, W. L., 1888: A History of the Birds of New Zealand (2nd ed.) 2 vols., the author, London.

The references should be serially numbered, and in the text, should be shown thus: Atkinson 1964 (1), and Buller 1888 (2). If references are cited in the text, the following shortened form may be used: Atkinson 1964, Notornis 11, 2: 93-97.

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