

THE DISTRIBUTION AND ABUNDANCE OF THE PARADISE SHELDUCK (*Tadorna variegata*, Gmelin) IN NEW ZEALAND FROM PRE-EUROPEAN TIMES TO THE PRESENT DAY

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Captain James Cook, R.N., on "Resolution" in Dusky Sound, wrote in his diary on 11 May 1773, descriptions of the five species of waterfowl he had encountered in New Zealand. He recorded "the largest are as big as a Muscovy Duck with a very beautiful variegated plumage, both male and female have a large white spot on each wing, the head and neck of the latter is white but all the other features as well as those on the head and neck of the drake are of a dark variegated colour." (Beaglehole, 1959). J. R. Forster (1843), the naturalist with Cook on the voyage, wrote on 7 April 1773, "I always observed them in pairs, from which I believe them to be monogamous. The male makes a rattling noise like a castanet. They are difficult of access. Always found at the mouths of streams and fresh waters."

These were the comments of the first Europeans to document the existence of the Paradise Shelduck *Tadorna variegata*. But it was well known to Polynesian man long before Cook and Forster. It formed part of the diet of the Maori and probably the earlier colonisers as well.

The species is of comparatively recent origin. It is a member of a widely distributed genus, its plumage and general behaviour are similar to those of the Cape Shelduck *T. cana* and the Australian Shelduck *T. tadornoides* and Johnsgard (1965) suggests its evolutionary position is between these two, despite their geographic distribution. Fleming (1962), with reference to a group of species of which the Paradise Shelduck was one, commented, "Using the yardstick of strong sub-speciation in about 15,000 years, I see no need to push their origin further back than the early Pleistocene a million years or so." The 'originals' probably invaded New Zealand at a time when the grazing niche normally occupied by geese was incompletely filled by the now extinct flightless geese, or at a time when these geese were already extinct. The Paradise Shelduck is very goose-like in its feeding behaviour and general ecology, and reflects the availability of that niche not only during the course of its evolution but also to-day.

PRE-EUROPEAN TIMES

The distribution of the species in pre-European times is uncertain but it is not unreasonable to suggest that it was closely associated with lowland short-tussock grasslands and, to a lesser extent, with swamplands. The paucity of this habitat-type prior to Polynesian colonization would suggest that the species was never widespread nor numerically strong but rather had a clumped distribution, being locally plentiful around Lake Grassmere and the Wairau River mouth, for example. Evidence on distribution during Polynesian occupation is derived from semi-fossil bones found in swamps or from Maori

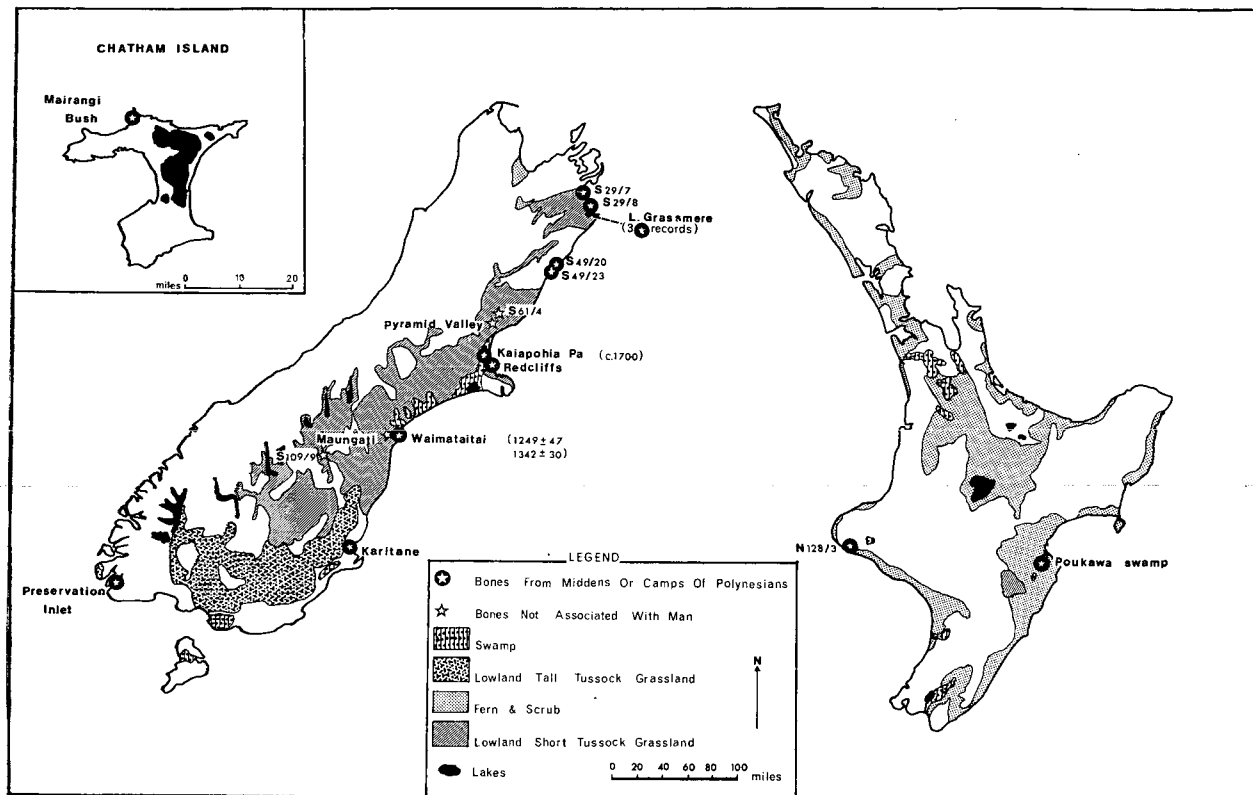


FIGURE 1 — Distribution of semi-fossil remains of Paradise Shelduck in relation to pre-European vegetation. (Vegetation map after Holloway, 1959.) Numbers thus, S109/9, refer to site numbers in the N.Z. Archaeological Association site record files. Additional finds, not shown on map because precise localities are unknown, are: Otatara (S136/2), dated at A.D. 1422 ± 32, 1483 ± 70 and Tai Rua (1407 ± 32, 1447 ± 32, 1465 ± 32) both midden sites in North Otago (Zander, 1967); Te Wairaki Beach, Northland, (recovered from dunes); Te Ana a Moe Cave (midden) and an unspecified dune site, both on Chatham Island.

and Moa-hunter middens. When bones occur in association with Man's activities, one cannot rule out the possibility that birds were carried a considerable distance from their place of origin before being eaten. The distribution of bone-finds is illustrated in Figure 1 together with the distribution of lowlands short-tussock grasslands and swamplands in pre-European New Zealand. (I am indebted to Mr. R. Scarlett, Canterbury Museum, for making available to me his records of Paradise Shelduck remains now lodged in the Canterbury and Otago Museums.) The majority of finds have been in the South Island and their locations agree closely with the suggested habitats. The most interesting finds are three from the Chatham Islands, 500 miles east of the South Island. Paradise Shelduck have never been recorded on the Chathams in European times although B. D. Bell (pers. comm.) reported unconfirmed sightings by local inhabitants of vagrants from time to time. In 1949 Paradise Shelducks straggled to Lord Howe Island, 850 miles north-east of New Zealand (Oliver, 1955). While the Chatham Island bone finds may have been the result of man transporting carcasses from the South Island, the existence of a small local population exterminated by Polynesian man seems more likely. Until 1960, sightings of Paradise Shelduck in Northland were very rare indeed. The specimen recovered from dunes on Te Wairaki Beach may well have been taken there by early Polynesians.

That birds were not exclusively confined to grassland and swampland is emphasized by Cook and Forster encountering them in Fiordland.

Polynesian man may have helped to increase the range and numerical strength of Paradise Shelduck. He is known to have burned large areas of original forest (Holloway, 1959) and to have prevented its re-establishment. In its place, tussock grassland, scrub and fernlands arose and this must have favoured an extension of range. The eastern parts of the South Island, according to Holloway, were very extensively changed by Maori fires, and it was here that the species was most numerous when European colonists arrived. Similarly, land clearance along the east coast of the North Island probably accounted for the distribution recorded by Buller (1868).

EUROPEAN SETTLEMENT TO 1900

Documentation of this period of the species' history is very good and major references in the New Zealand literature are summarized by Oliver (1968).

Buller (1868) provided the first reliable comment on the distribution of the species stating, "It is very common in the South Island and in some parts of the Wellington province but is rarely met with further north." In 1877 Buller documented three sightings of Paradise Shelducks north of Petane (Napier) in the North Island.

Combining all references known to me, I have summarized in Figure 2 the distribution of the Paradise Shelduck from the period of European settlement to 1900. This distribution is probably similar to that of pre-European times — numerically the species became stronger but it is doubtful if its range was extended to any great extent. Throughout the eastern foothills of the Southern Alps and extending down various river valleys, particularly the Clutha and Waitaki onto the lowland plains and into Southland, the bird was

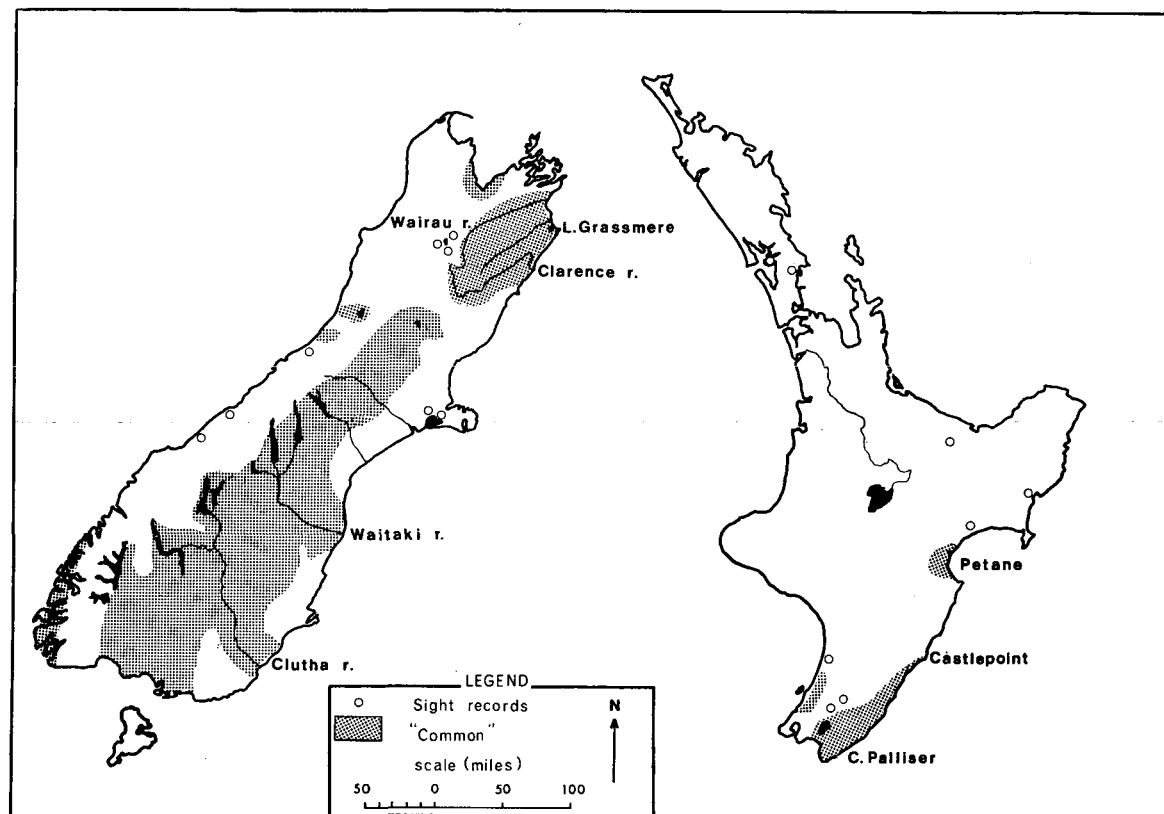


FIGURE 2 — Distribution of Paradise Shelduck, 1840 - 1900.

considered common. The Clarence, Awatere and Wairau Valleys in Marlborough supported large numbers and they were very abundant in the vicinity of Lake Grassmere. Around the coastal regions of Tasman Bay birds were frequently seen. Isolated pairs or small groups were to be found throughout most of the southern fiords while elsewhere on the West Coast (S.I.) distribution was scattered.

In the North Island, there were apparently three areas of local abundance — around the Petane area, in eastern Wairarapa from Cape Palliser to Castlepoint and throughout the sand-dune lake system of the Manawatu. McAllum (1965) has related this distribution to that of forest in 1880.

Land clearance, particularly in the South Island, probably did much to increase the numbers. But throughout the period, the population did not continually expand. In two areas in particular, Marlborough and Wellington, there was, toward the end of the century, a very significant reduction in numbers. Buller (1893) wrote, "This fine duck, formerly so plentiful in the Marlborough district, is becoming scarce, large numbers perishing every season through taking the poisoned grain laid for rabbits. A Marlborough resident informs me that years ago he was a constant attendant when the Maoris hunted the "flappers" or moulting birds when incapable of flight, and that he has known upwards of five thousand to be taken in this manner during a single season. They are now counted only by tens and twenties." Handly (1895) considered drainage and agriculture the reasons for the decline. Likewise, Kirk (1895) commented, "About 15 years ago, the Paradise duck was very common on the east coast of the Wellington district between Cape Palliser and Castlepoint, but at the present time, the traveller may ride the entire distance without seeing a specimen. The eggs and young have suffered from the attacks of rats and wild cats, while stoats and weasels are said to have disposed of the adults, and numbers have been shot for mere sport. The same diminution of numbers has been observed in the South Island where it was always more plentiful than in the North."

Our present knowledge on the effects of poison campaigns and the influence of mammalian predators on waterfowl populations does not allow us to give too much credence to the comments of Buller and Kirk. Over-exploitation seems a more likely reason for the decline.

This decline in Marlborough and Wellington is reflected in the game laws of 1899. The "New Zealand Gazette" (23/3/1899) declared Paradise Shelduck prohibited game in the Wellington district and absolutely protected in the Marlborough and Sounds counties. The shooting fraternity, invariably the last to act in the face of declining game populations, declared the species protected in the North Canterbury Acclimatization district in 1904; presumably it had been gradually declining in that district as well.

Apart from Guthrie-Smith's (1895) comment that the species was becoming rarer in the Petane area, I can find no other comment detailing the status of the Shelduck over the rest of New Zealand at the end of the century.

1900 - 1950

Throughout most of this period there was a gradual extension of the species' range and a rebuilding of the population in areas where a decline had started late in the 1890s. An important feature in promoting the recovery and expansion of the Paradise Shelduck was the chequered history of protection afforded it during the first 20 years — up until the Animals Protection and Game Act 1921 - 22. (Williams — in prep.). In addition, the shooting season was, for the period 1923 - 39, limited to one week and to the South Island only, and land clearance was proceeding rapidly in both Islands.

The range of the species (Figure 3) extended north of latitude 39°S where Buller (1888) noted they rarely occurred. This extension of range was due almost entirely to liberations in the centre of the North Island. J. Cullen in 1915 and 1917 liberated 8 birds (probably from Southland) at Mahuia Prison Camp, four miles from National Park. (T. Shout, pers. comm.). Shortly after liberation, they established themselves on Roto Aira to which 15 more birds (from Southland) were added in 1920 - 21. (Auckland Acclimatization Society Annual Report 1920 - 21). By 1922, a number were to be seen around the headwaters of the Wangaehu River, and later in the decade they became common in the Karioi-Tangiwhai area. A comment in the 1929 Annual Report of the Waimarino Acclimatization Society reads, "Paradise Ducks are often to be seen about Karioi and are apparently also increasing, as as many as seven have been seen together where four years ago, a pair was an unusual sight." In the early 1930s up to 600 birds were counted moulting on a lake at Karioi (T. Shout, pers. comm.). Numbers increased rapidly and the range extended south through the Rangiwaea-Taihape area and west toward Raetihi and the Wanganui Valley. A considerable influx into Hawke's Bay — particularly in the area bounded by the Tukituki and Tutaekuri rivers was recorded in 1936. The Hawke's Bay Acclimatization Society annual report of that year stated, "... thousands were seen on the Inner Harbour Lagoon (Petane area) and on Hawke's Bay rivers." It is very likely that these birds had emigrated from the Rangitikei headwaters. This influx into Hawke's Bay was followed in 1943 - 44 by a substantial invasion into the Wairua-Gisborne district (A. Blackburn, pers. comm.). Twelve were seen on Lake Repongaere in 1943 and 50 more pairs in the upper Hangaroa Valley. A gradual increase in the area from Tolaga Bay in the north to Wairoa in the south followed, despite the species being placed on the game licence in 1948.

Throughout the Manawatu dune lake system, an increase in numbers was noted — perhaps aided by the liberation of twelve Southland birds onto Kapiti Island in 1931 (Wilkinson, 1953). In the Wairarapa, gradual recolonisation occurred — particularly near Lake Wairarapa where, in 1940, up to 300 were seen (O.S.N.Z. Reports & Bulletins 1: 10).

At some time prior to 1936 some Paradise Shelducks were apparently liberated onto Lake Rotomahana and here became locally abundant, although throughout the Rotorua lakes themselves and indeed over most of the Volcanic Plateau north of Taupo, the birds were not common (*Notornis* 3: 44).

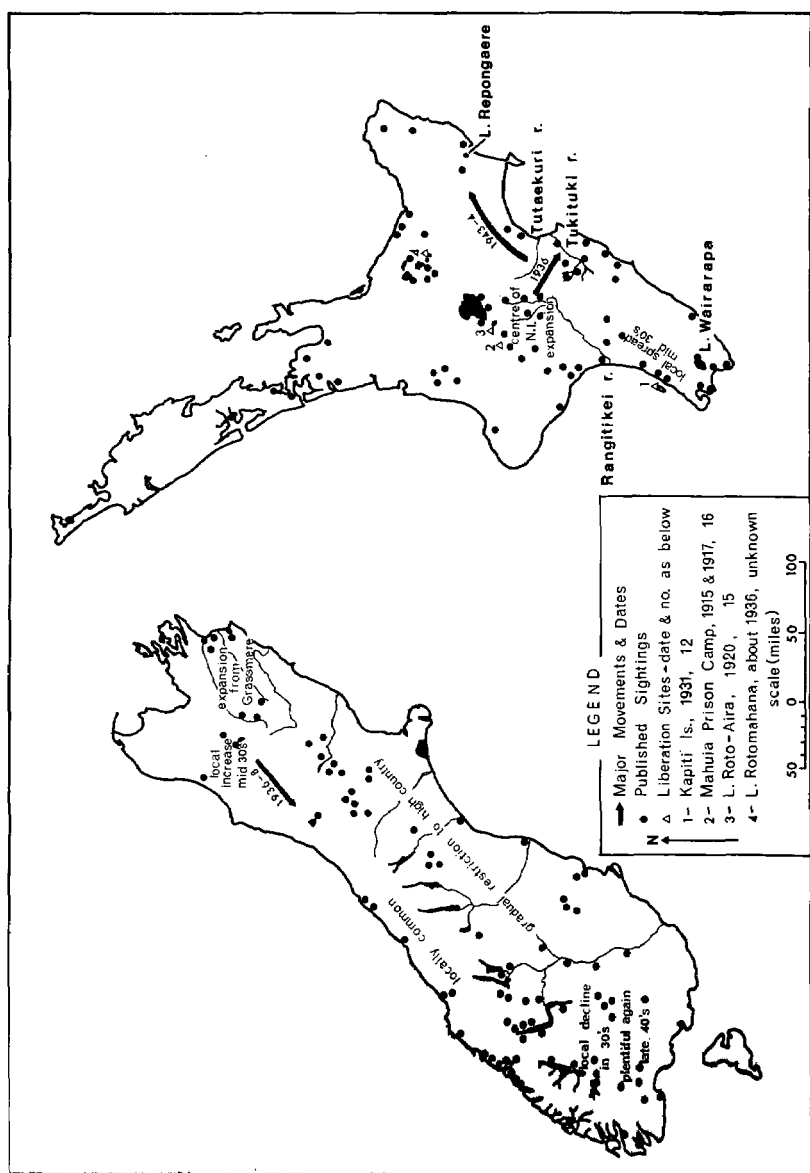


FIGURE 3 — Major population trends and reported distribution of Paradise Shelduck, 1900 - 1950.

Beyond these areas in the North Island only stragglers, pairs or small flocks were recorded e.g. Taranaki, Bay of Plenty, King Country.

In the South Island, despite being returned to the game licence in 1924, local populations, which at the turn of the century were apparently declining, gradually gained numerical strength. The result was that throughout the late 1930s the Shelduck was considerably more numerous over much of South Island than it had been at any stage of its history (including today). But despite the increase, the species' range contracted — disappearing gradually from the lowland areas into the eastern foothills.

In Nelson, little is recorded of the status prior to 1930. But early in this decade, the Nelson Acclimatization Society Reports record a substantial increase in the Murchison area from which birds apparently spread into Buller. Further south along the West Coast there likewise was a gradual increase which, as in other areas, was probably attributable to land clearance. D. Greaney (pers. comm.) noted "in 1940 Paradise ducks were in great numbers in the Haast, Arawhata and other valleys — I had never seen a Paradise duck here before 1914-17." But he added that 1940 was their peak year in these areas, and by 1947 only an odd pair was to be seen.

The alarming decline in Marlborough to which Buller (1893) and Handly (1895) had referred was soon halted. From local concentrations at Lake Grassmere and Wairau Lagoon, the species recolonised the Clarence, Awatere and Wairau valleys. Extensive forest and scrub clearance after World War I probably assisted this expansion but the Shelduck's response to protection in some areas in the 1960s suggests protection from the gun may have been a more influential factor in promoting recovery.

The gradual retreat from the lowlands occurred from Kaikoura south to Otago, but along the base of the Alps, numbers were very high by 1940. The area about Lake Sumner became the species' focal point in North Canterbury during its decline at the turn of the century, and it is undoubtedly from here that recolonization of its former range occurred. About Lake Sumner, Shelducks have always been very plentiful. In the hill country drained by the Rakaia River, the local Acclimatization Society recorded poor years over the period 1927-34. In the Waitaki Valley, the species remained very common in the foothills but became virtually unknown after 1940 in the lower reaches of the river. The 1940 Annual Report of the Waitaki Acclimatization Society commented, "Paradise duck are not any more plentiful down country but have increased in the Otago district." Throughout most of Otago the early decline was halted but the resultant increase was concentrated to hilly country above 1000 feet. The pre-1900 range was effectively halved.

The history of population trends in the Southland-Southern Lakes area is confusing. Information suggests that as late as 1930 Shelducks were decreasing in numbers, particularly in the Te Anau district. But recovery must have been dramatic because by the late 1940s, the bird was described as 'plentiful' throughout Southland and Southern Lakes (Southland Acclimatization Society Reports) and R. R. Sutton (pers. comm.) considered that this was the time when they reached their peak numbers.

Thus the period 1900 - 1950 was one during which the species extended its range very considerably in the North Island — the result of land clearance and liberations; in the South Island, local populations depleted at the turn of the century steadily strengthened to peak levels in the late 1930s although the range tended to be restricted to the more elevated country.

1950 TO THE PRESENT DAY

These twenty years have seen dramatic reductions in populations throughout the South Island and some parts of the North Island. At the same time, liberations in Northland and gradual spread into Waikato and South Auckland have resulted in the species ranging over the entire country. The decline began in the South Island in late 1940s and was apparently caused by increased shooting pressure — a lengthening of the shooting season to four weeks, high bag limits over most of the South Island and a rapid and continuous increase in the number of shooters.

The first region of the South Island to experience the decline was the Canterbury foothills. A survey conducted by the Wildlife Service in 1961 revealed that numbers were very low in the Rakaia and Rangitata catchments about 1955 - 57 — the decline being first observed shortly after World War II. The South Canterbury Acclimatization Society commented in 1956 on the considerable decline in its area (Rangitata) and stated that many of the runholders were of the opinion that protection was necessary. North of the Rakaia to Lake Sumner, the downward trend spread. Today, the numbers in the Upper Hurunui river - Lake Sumner area are considerably lower than formerly. D. Maindonald (pers. comm.) referred to a count of moulting birds on Lake Sumner on 28/12/1957 as being between 4000 - 5000. E. Sharpe and M. Crombie (I.A.D. file 46/62/48) reported 3000 birds here on 20/1/1967; but in contrast to 1957, the entire local population appeared to be concentrated on the lake. According to information gathered from runholders by D. Maindonald in 1968, there has been a slight increase since 1957 in the Waimakariri and Rakaia catchments.

In the Waitaki System, M. Keillor (pers. comm.) wrote, "The Hakataramea Valley, about 40 miles long, used to carry a large population — perhaps thousands of birds less than 30 years ago but today (1968) you can travel the valley and see only the odd pair or two . . ." Run-holders in the Upper Waitaki today consider the species 'common' but "nothing like the numbers of 1930 - 40." Most agree that the decline in this area has been steady and continuous. Throughout Southland, Otago and Southern Lakes, the rapid increase in the late 1940s was apparently followed by an equally rapid decline. By 1962 (R. R. Sutton, pers. comm.) numbers were very low and the species was given protection throughout Southland. Protection from the gun seems to have been enough to reverse the decline. Sutton stated that "the increase was slow at first due to lack of mature breeding stock but has occurred at a much faster rate in the last 2 - 3 years (1967 - 1969). Paradise Ducks are now being recorded in localities where they have not been seen for well in excess of 20 years and the breeding range is also definitely extending." Zander

(1967) considered that the species' range in Southland was generally confined to land between 500-1000 ft. particularly in the Te Anau-Lumsden - Garston area.

A steady decline in numbers whilst a game bird, followed by a gradual recovery during years of protection, is also the history of the species in the Nelson district. Until 1958, the annual reports of the Nelson Acclimatization Society recorded 'good' numbers throughout. But in 1958 they noted fewer than previously. The decline continued until 1966 when the Society decided to protect the species completely throughout Nelson — initially for five years. D. Zumbach (pers. comm.) related details from the Murchison district which are similar to those quoted by Keillor (above) — high numbers in 1957 down to a scattered few in the same locality in 1966-67. The decline in Nelson coincides with that in the adjacent West Coast and Marlborough. There was an "alarming decrease in Paradise Ducks" throughout the West Coast (1965 Annual Report West Coast Acclimatization Society); the following year they were protected here also. Zumbach wrote that "since they have been off the (game) licence, there has been a noticeable increase — but they still have a long way to go to even approach the numbers of 10-12 years ago." A survey of known moulting sites in Nelson and southern Marlborough on 13/1/1969 revealed a total of about 1100 birds.

Reliable evidence on population trends in the past 20 years over much of Otago and West Coast is not available. Zander (1967) recorded that the range in Otago appears confined to hill country between 1000-2000 ft. in the upper Taieri and Ida Valleys, with pockets of concentration near Lake Mahinerangi, Middlemarch and Alexandra-Lauder. Some birds are known to moult on Lake Onslow.

In the North Island, the northward extension of range continued and, aided by liberations in Northland, Paradise Shelduck are now to be encountered throughout.

The Northland liberations (summarised in Figure 4) were mainly of birds trapped in the National Park area (Waimarino Acclimatization Society district) although some were also obtained from Gisborne. Records of these liberations kept by the various Acclimatization Societies involved, are incomplete and many are inconsistent with the number of birds thought to have been supplied.

Within the Whangarei Acclimatization Society's district, an unofficial liberation of 40-60 birds was made in 1959 (R. T. Adams, pers. comm.) and in 1961 or 1962, 24 pairs from Gisborne and Waimarino were released. In January, 1963, the Wildlife Service forwarded 42 birds from Lake Repongaere, and 24 more from the Waimarino district the following month. The 1962-63 Report of the Whangarei Acclimatization Society however did not record the liberation of these 66 birds but commented, "Thanks are again due to the Waimarino Society for two consignments of Paradise Duck, 182 in all." I can find no further record of liberations into the Whangarei area but R. T. Adams (pers. comm.) informed me that about 100 birds were released there in 1969. The Bay of Islands Acclimatization Society liberated 10 birds onto Lake Owhareiti in January 1964 and although approval was given for one hundred more to be released in this area (I.A.D. file 46/2/27), I can find no record that this

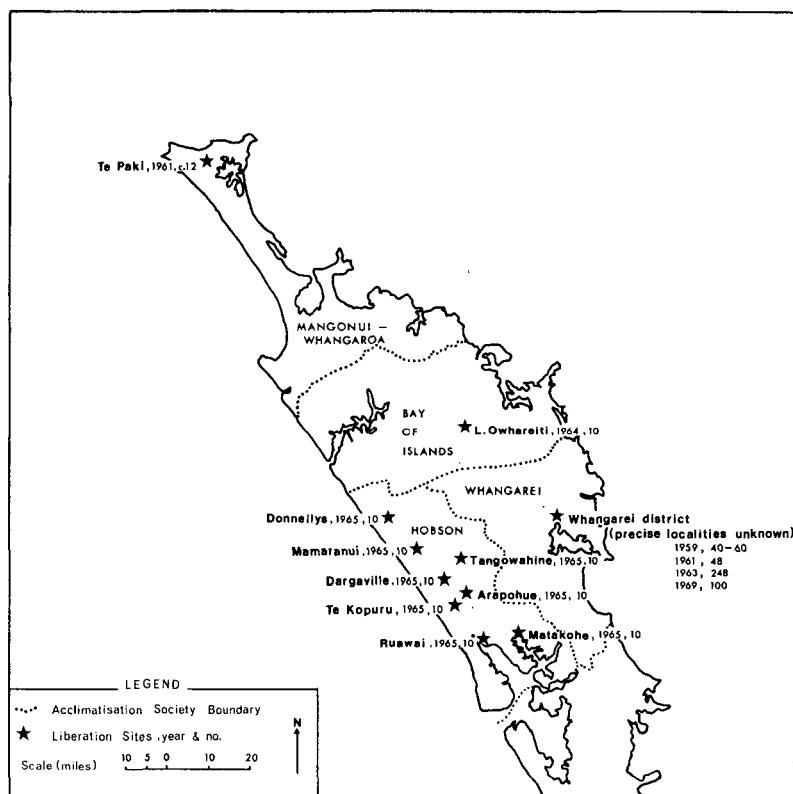


FIGURE 4 — Known liberations of Paradise Shelduck in Northland.

liberation was made. Fifty birds were trapped near Gisborne on 7/1/65 and forwarded to the Hobson Acclimatization Society. The Society reported (22/10/1968, I.A.D. file 46/2/3) that 80 birds were released at eight sites throughout their district in January, 1965, although their 1964-65 annual report states that only 48 birds were liberated. The eight liberation sites are recorded in Figure 4. The only other known liberation involved at least 12 birds on Te Pahi Station in 1961.

At least 506 birds are known to have been released in Northland, but many liberations have gone unrecorded.

Paradise Shelducks have adapted well to this new area and are becoming increasingly common throughout and there have been numerous observations of small flocks and broods. The greatest concentrations at present appear in the Maungatapere - Kara - Hikurangi swamp area (M. Munro, pers. comm.) and further north from Hokianga to Te Pahi (O.S.N.Z. Recording Scheme files). The future of the species in Northland looks bright.

In South Auckland and Waikato recent colonisation has been consolidated. In 1956 the Hamilton sub-society of the Auckland Acclimatization Society reported that Shelducks were frequently to be seen on Lake Karapiro and that they were spreading. McAllum (1965) reported breeding at Lake Wahi and Lake Whangape in 1960-61. They are now recorded breeding in the Whangamarino swamp, Patetonga and Piako river (O.S.N.Z. Recording Scheme file). McAllum suggested that sightings north of latitude 37°30'S. were probably of visitors but that breeding could be expected once "a tradition" for the area had been established. This appears to have happened, for although the species is still relatively uncommon, reports of broods are frequent. Throughout southern Waikato, King Country and the Raglan-Kawhia coastal region the species is regarded as common; and the Raglan area was reported to have had greatly increased numbers in 1955-56 (Auckland Acclimatization Society 1956 Annual Report).

On the Volcanic Plateau, from Taupo north to Bay of Plenty, the species is resident and breeding but in no great numbers, except for local concentrations about Lake Rotomahana and Lake Rerewhakaaitu. They occur usually on most of the other Rotorua lakes and the population throughout the region is slowly increasing.

Considerable land development is taking place on the Volcanic Plateau and once pasture quality reaches the optimum stage (McAllum, 1965) a steady increase in the area could be expected. In the Tauranga district where the species has not been shot since 1963, numbers are definitely increasing. The increase here is more probably a consolidation of the northerly spread.

In Taranaki, where all grades of pasture occur, Paradise Shelducks are common, with a concentration about Lake Ratapiko. Approximately 250 were recorded here in a post-moulting flock on 26/4/1958 and most of the birds shot in North Taranaki are taken here (B. Quickfall, pers. comm.). Paradise Shelduck in Taranaki, as they probably do in many districts, show a distinct preference for the higher (500-1000 ft.) and more dissected inland farmland — being considerably more common in the head waters of the Waitara river and the Whangamomona area than on the open coastal plain. But from Hawera, south, the hill country reaches closer to the coast, and coastal lakes and lagoons not infrequently support flocks of 600-700. Moulting probably occurs on some of these coastal waterways. Northern and eastern Wanganui are areas into which the Paradise Shelduck has emigrated from National Park. The increase and spread throughout this region is "gradual and continuous" (Wanganui Acclimatization Society 1960 Annual Report); although the Society's 1956 report suggests there was a considerable influx during 1953-56. Southern Wanganui has had a slower build-up and from here along the coast to Cook Strait, the species has at no time been numerous, although it is frequently shot.

During these 20 years, the Tongariro National Park, Hawke's Bay and Gisborne have been the stronghold of the Shelduck in the North Island. In the Waimarino Acclimatization Society district (which includes most of Tongariro National Park), the Society's reports from 1950 to 1960 contain references to the continuing increase

in numbers. But in later years, evidence from banded birds (Williams, in prep.) suggests this expansion has ceased and shooting pressure has reached the maximum which this population can sustain without significantly declining. Nevertheless, the greatest population density in New Zealand is currently to be found in this area.

Within Hawke's Bay there was an apparent recession in the late 1950s. The Hawke's Bay Acclimatization Society recorded numbers in 1956 as "reduced" and in 1959 as "scarce." But the open hill country toward the Ruahine, Wakarara and Kaweka ranges has continued to support numerous Shelducks throughout the 1960s. The species is commonly seen on Ahuriri Lagoon and may moult both here and on Lake Runanga. On the latter numbers of 400-500 have been recorded (W. Gunn, pers. comm.).

The gradual colonization of Poverty Bay, following the 1943-44 invasion, continued during the 1950s. The considerable population expansion, according to A. Blackburn (pers. comm.) coincided with the widespread aerial topdressing (which increased the clover content of pastures) and with the extensive construction of pot-dams for stock on hill country. Pot-dams are now known to provide ideal rearing habitat for ducklings. Blackburn considers peak numbers about Gisborne to have been in 1956-57, and that, until 1962, numbers remained relatively static whilst dispersal northward took place. In March 1962 he observed 200 birds in one flock in the Waikura valley with similar numbers in other northern regions of the East Coast where previously the species was unknown. But since 1962, he considers the Gisborne population to have declined. This belief is substantiated by banding data. Birds in this district are being cropped at a rate which exceeds recruitment. An aerial census of known moulting sites from Whakiki lagoon to Parihaka in January 1969 recorded about 5000 birds. A year later, the count was 3,400.

The remaining area of the North Island to be considered stretches south from Hawke's Bay to Cook Strait and lies east of the Ruahine-Tararua Ranges. The species appears locally abundant at Lake Hatuma but becomes scarcer towards the south, being very rare south of Eketahuna, although small liberations from the Mount Bruce Native Bird Reserve are developing a healthy local population. Scattered individuals and pairs are recorded on ground above 500 ft. along the coast from Castlepoint to Cape Palliser. A variable number (100-150) may be encountered in the vicinity of Lake Wairarapa.

Figure 5 illustrates in general terms only, the status of the species throughout New Zealand at the present time (1969). Population densities are indicated by shading, and terms used to describe density are "abundant," "common" and "rare." The New Zealand zootopographic map has been used as the basis for plotting density distributions. Such a grid method tends to over-simplify but is considered the best method for the data available. Where data for some areas are not available I have used my own judgment in arriving at density values.

Thus, since 1950, Paradise Shelduck numbers in many areas of New Zealand have declined. In some areas, e.g. Southland, West Coast, Waitaki, North Canterbury and Nelson, this decline was

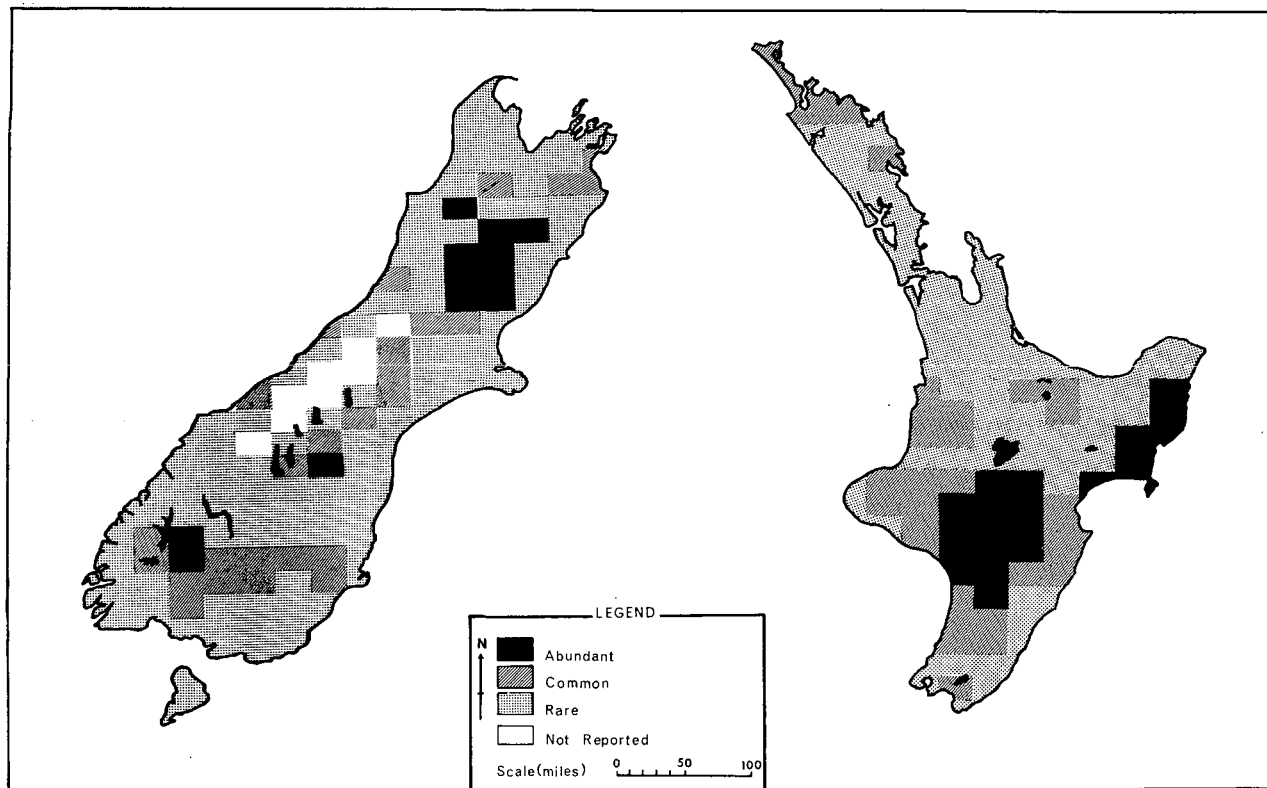


FIGURE 5 — Comparative abundance of Paradise Shelduck, based on reports over the period 1965 - 1969.

sufficiently severe to warrant removal from the game licence for varying periods. In at least Nelson and Southland, protection has been sufficient to halt and even reverse this decline. Similar reductions in numbers are becoming apparent in its more populous areas of the North Island. But liberations and natural northward spread have distributed the species throughout the country.

CONCLUSION

This study has revealed that population trends of Paradise Shelduck are strongly related to the pressures of exploitation. Twice since European colonization, the species has suffered substantial declines throughout its range and only a lengthy period during which exploitation was either prohibited or severely limited by law was sufficient to reverse the decline. The present situation is remarkably similar to that which existed at the end of the 19th century, and if the Paradise Shelduck is to continue as an important game-bird, the first step in management is to reduce the current rate of exploitation.

There is no suggestion that the species is in danger of being exploited to extinction throughout its range, although this is possible locally. Banding data (unpublished) show that Paradise Shelducks are, in two areas of the North Island, being shot at a rate equivalent to Mallard *Anas platyrhynchos* and Grey Duck *A. superciliosa*, yet the Shelduck's potential for replacing breeding stock is about one-third that of these Anatids.

The Paradise Shelduck is well adapted to the open farmland of New Zealand. It has the potential to become and remain a common species throughout this habitat. The only barrier to this is over-exploitation.

SUMMARY

The existence of the Paradise Shelduck was first documented by Cook and Forster on Cook's 2nd voyage to New Zealand in 1773. It was however well known to Polynesian man in New Zealand and formed part of his diet. The ancestral shelduck invaded New Zealand no earlier than the early Pleistocene and its existence here was probably assured by the incompletely exploited "goose" niche. Its distribution and abundance in pre-Polynesian times were limited by the scarcity of favourable grassland habitat. Extensive burning by the Maoris increased the available habitat and the numerical strength and range of shelduck presumably increased. The distribution of semi-fossil bones is closely correlated with the distribution of lowland short-tussock grassland and swampland in Maori times. Remains have been recovered from the Chatham Islands where the species does not exist today. In the early years of European colonization, Paradise Shelducks were common throughout the South Island but in the North Island were rarely encountered beyond the eastern portion of Wellington Province south of latitude 39°S. A considerable decline occurred toward the end of the 19th century, and was considered by some authorities to be the direct result of over-exploitation, accidental poisoning and the introduction of predatory ground mammals. A chequered history of protection between 1900-1920 and very limited shooting in only the South Island from 1923-1939 enabled the species

to reverse this decline and by 1935 to exist throughout most of the South Island in numbers greater than those recorded at any time in its recent history. In the North Island, liberations in the Tongariro National Park district in 1915, 1917 and 1920 provided the nucleus for considerable expansion into Wanganui, Hawke's Bay (in 1936) and Wairoa-Gisborne (in 1943-44). Since 1950, there have been dramatic reductions in Paradise Shelduck populations throughout the South Island and some parts of the North Island. At the same time, liberations in Northland and the gradual northerly spread into Waikato and South Auckland have resulted in the species now ranging over the entire country. The decline is considered the result of increased shooting pressure. In areas where protection from the gun has been afforded, the decline is being reversed.

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