

# Past distribution and decline of the New Zealand Dotterel (*Charadrius obscurus*) in the South Island of New Zealand

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## ABSTRACT

In the mid-19th century, the southern subspecies of the New Zealand Dotterel (*Charadrius obscurus obscurus*) was widespread in the South Island of New Zealand. It now no longer breeds there and the only recent records are coastal; these are of juvenile and unpaired birds wandering from the small relict population on Stewart Island. Written records and data from museum specimens collected before 1940 are presented, and possible causes of the decline are discussed. The records tend to confirm earlier suggestions that the southern subspecies bred inland. The available evidence suggests that the species had declined in the South Island by the early 1880s. Predation by feral cats (*Felis catus*) and possibly Norway rats (*Rattus norvegicus*), and shooting were the most likely causes. During the period 1880-1900, the decline appears to have become more rapid, coinciding with the introduction and rapid spread of mustelids (*Mustela* spp.) in the mid-late 1880s. The last specimen that may have been a breeding bird was collected in or before 1903. Cats, rats and mustelids were also introduced to the North Island but the Northern New Zealand Dotterel (*C. o. aquilonius*) has survived there; possible reasons for this difference are discussed.

**KEYWORDS:** New Zealand Dotterel, *Charadrius obscurus*, plover, South Island, decline, extirpation, predators

## INTRODUCTION

The New Zealand Dotterel (*Charadrius obscurus*) is an endemic plover numbering about 1400 birds (Dowding & Murphy 1993) and is classified as endangered (Collar *et al.* 1994). Two subspecies have been described (Dowding 1994). The Northern New Zealand Dotterel (*C. o. aquilonius*) breeds on the coast of the northern part of the North Island. The Southern New Zealand Dotterel (*C. o. obscurus*) was once widespread in the South Island, but there are no recent records of breeding there. A population persists on Stewart Island, but this has declined rapidly in the past 40 years (Dowding & Murphy 1993); about 108 birds remained in March 1998 (J.E. Dowding, unpubl. data) and the subspecies is now critically endangered. All modern records of the species in the South Island are coastal and are believed to be of birds (mostly juveniles and unpaired adults) from the Stewart Island population (Barlow 1993, Dowding & Murphy 1993).

Cumming (1991) and Barlow (1993) outlined the early distribution of the species in the South Island, but neither included records of museum specimens. Neither Barlow (1993) nor Dowding (1994) could find any records of coastal breeding

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in the South Island. Cumming (1991) suggested that introduced mammalian predators were the "...most plausible factor in the decline of the NZ dotterel last century".

In this paper, I present further records of the New Zealand Dotterel in the North, South and Stewart Islands, mainly from museum specimens collected before 1940. Based on these specimens and the literature, I examine the timing and possible causes of the decline in the South Island and discuss which introduced mammalian predators are likely to have had an important impact. I also discuss possible reasons for the survival of the species in the North Island when faced with the same predators. Identification of the principal agents of the decline in the South Island may help in management of the species elsewhere or provide useful information if re-introductions to the South Island are contemplated (Dowding 1993).

## DATA SOURCES

### Literature

Wherever possible, published first-hand accounts were used; these were mostly from Transactions & Proceedings of the New Zealand Institute, published diary extracts, or local histories. I also had access to unpublished material of Thomas Potts in the private collection of B. & F. Macmillan. For the sake of completeness, I have included some records from the literature previously cited by Cumming (1991) and Barlow (1993). A number of early accounts use the term 'dotterel' and in many cases it is impossible to be certain whether this refers to the New Zealand Dotterel or the Banded Dotterel (*C. bicinctus*). This is a particular problem with the many localities given in Drummond (1907) and later quoted by Cumming (1991). Some of these records may refer to the New Zealand Dotterel, but because of uncertainty they have been omitted here.

### Museum specimens

New Zealand museums holding specimens of *C. obscurus* are: Auckland Institute & Museum, Auckland (AIM); Museum of New Zealand, Wellington (MoNZ); Canterbury Museum, Christchurch (CanM); Otago Museum, Dunedin (OtaM). Overseas museums with specimens are: American Museum of Natural History, New York (AMNH); Australian Museum, Sydney (AusM); British Museum (Natural History), Tring (BMNH); Carnegie Museum of Natural History, Pittsburgh (CMNH); Field Museum of Natural History, Chicago (FMNH); Florida Museum of Natural History, Gainesville (FloM); Liverpool Museum, Liverpool (LivM); Museum of Comparative Zoology, Cambridge, Mass. (MoCZ); National Museum of Natural History (Smithsonian Institution), Washington D.C. (USNM or NMNH); Naturhistorisches Museum, Wien (NHMW); Specola Museum, University of Florence (SMUF); University Museum of Zoology, Cambridge (UMZC); University of Oslo Zoological Museum, Oslo (UOZM). Fifteen other major collections in Europe, Australia and North America had no holdings of *C. obscurus*.

TABLE 1 - Written records of the New Zealand Dotterel from the South Island before 1940 for which localities are known. Numbers in brackets after locations identify those locations in Figure 1.  $\leq$  before a year indicates a record from that year or earlier.

Location	Date	Evidence of breeding?	Reference
Dusky Sound (1)	April 1773	no	Hoare (1982)
Waikouaiti (2)	c. 1840	no	Oliver (1930)
Woolshed Flat, Upper Rakaia (3)	1856	yes	Potts (1885)
Pateroa, Upper Taieri River (26)	1862	no	Bathgate (1922)
Rakaia River just below gorge (4)	1867	yes	Potts (unpubl. data)
Summit of Dog Range	$\leq$ 1870	yes	Potts (1870)
Browning Pass (5)	$\leq$ 1872	yes	Potts (1872)
Lake Heron (6)	$\leq$ 1872	?	Potts (1872)
Port Cooper (7)	$\leq$ 1872	no	Potts (1872)
Upper Rangitata flats (8)	$\leq$ 1872 (Aug)	?	Potts (1872)
Upper Ashburton River (9)	$\leq$ 1873	yes	Potts (unpubl. data)
Lake Ellesmere (10)	$\leq$ 1883	no	Potts (1883)
Waimakariri flats (11)	$\leq$ 1883	no	Potts (1883)
Bluff Harbour (12)	April 1877	no	Reischek (1924)
Okarito (13)	$\leq$ 1878	no	Hamilton (1878)
Above Makarora Valley (14)	$\leq$ 1881	yes	Baker (1932)
Spencer Ranges (15)	$\leq$ 1882	no	Buller (1882)
Saltwater Creek (16)	$\leq$ 1888 (May)	no	Seebohm (1888)
Riverton (17)	$\leq$ 1888 (Dec)	no	Seebohm (1888)

Many of the specimens have no date and/or location recorded. All specimens are skins or mounts except those marked [B] (=bones) or [E] (=egg). In the 19th century provincial boundaries differed from those of today; the Province of Nelson included present-day Marlborough, Canterbury included Westland, and Otago included Southland, Fiordland and Stewart Island. Provincial boundaries shown in Fig. 1 are from McKerrow (1881).

## RESULTS & DISCUSSION

Written records with South Island localities are shown in Table 1; written records from Stewart Island were given by Dowding & Murphy (1993). Details of museum specimens are listed in Tables 2 and 3 and Appendices A and B. South Island and Stewart Island sites (Tables 1 & 2) are numbered and shown in Fig. 1.

### Past distribution

In the 19th century, the New Zealand Dotterel was clearly widespread in the South Island, both inland and on the coast (Fig. 1, Table 3). There are numerous records from Canterbury (possibly reflecting the greater density of observers and collectors there than in other areas), and most of these birds probably wintered on the east coast (Potts 1872). There are a few records (without precise locations) from the mountains of Nelson and these birds may have wintered at Farewell Spit and possibly elsewhere in Golden Bay, sites where New Zealand Dotterels from Stewart Island are still occasionally seen (Dowding & Murphy 1993).

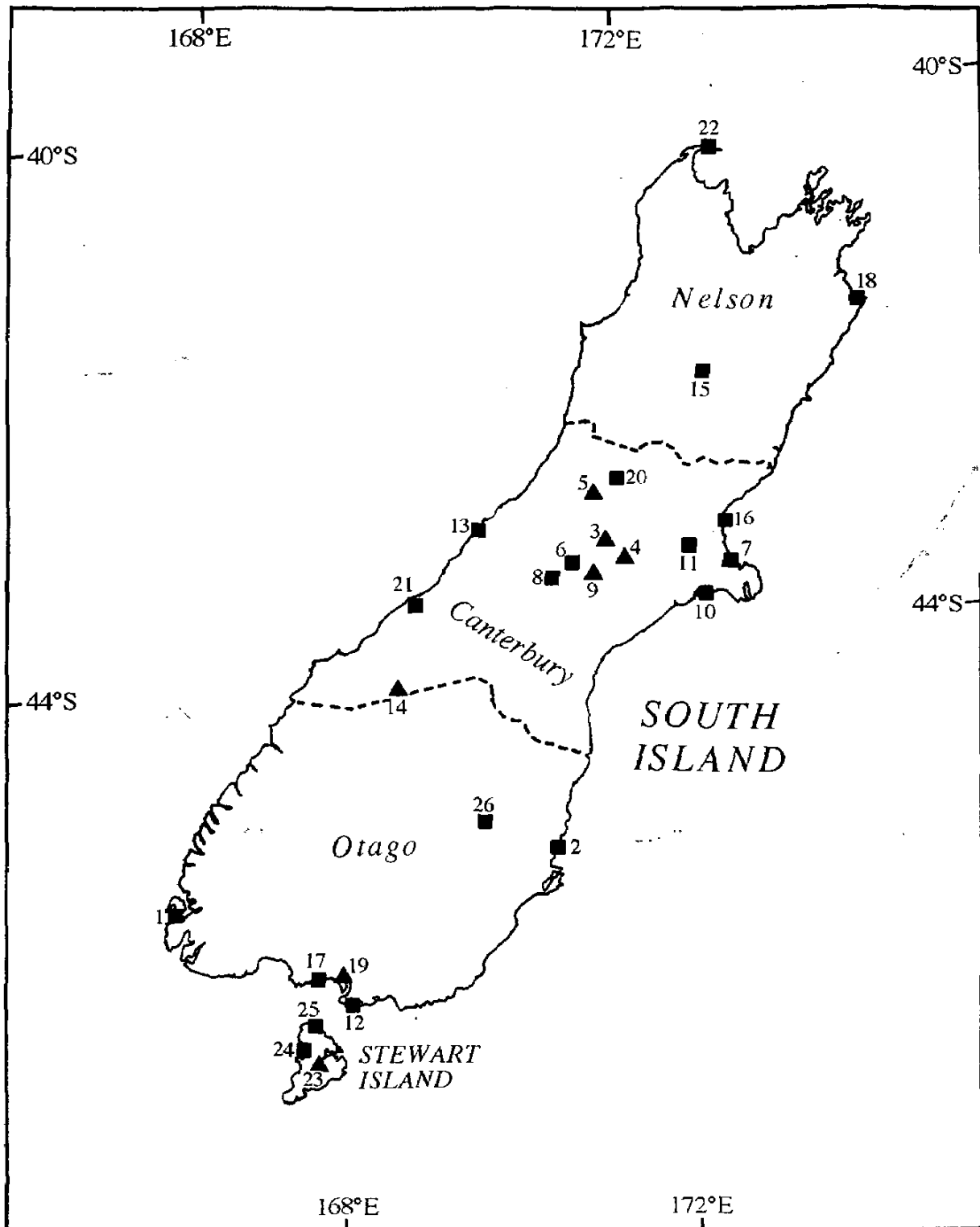


FIGURE 1 - Locations of New Zealand Dotterel records from the South Island and Stewart Island before 1940. Numbers refer to locations listed in Table 1 (written records) and Table 2 (museum specimens); where sites are close together, a single number and symbol may represent two or more sites. Solid triangles show records with evidence of breeding. Provincial boundaries (dashed lines) are from 1881.

However, specimens collected on the Paringa River, Westland (Table 2), and a record of the species at Okarito (Hamilton 1878) suggest that some birds probably bred west of the main divide and wintered on the west coast. This is supported by the observations of Charlie Douglas (Pascoe 1957), who recorded in his monograph on the birds of South Westland that New Zealand Dotterels bred in the mountains and frequented the sea beaches and river flats in winter. The first record of the New Zealand Dotterel was from Dusky Sound in April 1773 (Hoare 1982), but it is interesting to note that the species has apparently not been recorded there or elsewhere on the Fiordland coast since. Reischek spent six months based in Dusky Sound from April 1884; he ranged north to Jackson's Bay, but his list of birds for the area did not include *C. obscurus* (Reischek 1884). The species was also not mentioned in his list of the birds in the Chalky Sound-Dusky Sound area (Reischek 1887).

The information summarised in Fig. 1 supports earlier suggestions that the species bred inland in the South Island (Barlow 1993, Dowding & Murphy 1993, Dowding 1994). However, in some cases locations listed are rivers, and it is not clear where on the river (at the mouth or inland) the specimen was seen or collected. A chick collected on the Oreti River at Wallacetown in 1875 (AMNH 736917, Table 2) was about 9 km inland. Records of birds (even in highly-coloured plumage) on the coast during the breeding season do not necessarily indicate that breeding occurred there; such records could be of unpaired adults or juveniles.

### Timing of the decline

All the written records I have found that give precise localities (Table 1) are from before 1888. The records of Thomas Potts are of particular value; he first recorded the species in 1856 (unpublished diary entry 31 October) and provided much of the surviving information on it from the South Island. He was widely quoted by other authors (e.g. Buller 1888, Hutton & Drummond 1904). In earlier articles, Potts (1870, 1872) gave no indication that the species was declining. In 1883 however, he noted that "...it is quite probable that the [Canterbury] plains...are now entirely forsaken as a breeding place..." (Potts 1883); two years later he recorded that the species "...formerly bred on the Canterbury Plains...for the most part it has retired to the mountains of the back country" (Potts 1885). This apparent contraction of breeding range is the first suggestion of a decline, and its timing (just before mustelids became widespread - see below) is informative. Unfortunately, I have found nothing that Potts wrote on the species after 1885. There are four museum specimens (Table 2) with a precise South Island locality collected between 1890 and 1900; none was collected inland where the subspecies bred - all were from Farewell Spit, a locality at which non-breeding birds of the southern subspecies are still occasionally seen (Dowding & Murphy 1993). There is a specimen at Cambridge (Table 3, UMZC 16/Cha/23/a/2) collected in Canterbury (no precise location), with no collection date but an accession date of 21 October 1903.

TABLE 2 - Museum specimens of the New Zealand Dotterel collected in the South Island and Stewart Island before 1940 for which localities are known. Numbers in brackets after locations identify those locations in Figure 1. ≤ before a year indicates a specimen collected in that year or earlier.

Location	Date	Number of specimens	Museum and catalogue or accession number(s)
Lake Marfell (18)	sub-fossil	1	CanM [B]
Lake Grassmere (18)	sub-fossil	1	CanM [B]
Moabone Pt (7)	sub-fossil	1	CanM [B]
Port Cooper (7)	≤1849	1	BMNH 1849.12.12.1
Port Cooper (7)	Feb 1850	2	LivM EoD <sup>a</sup> 51315, 51505
Port Cooper (7)	Mar 1850	1	LivM HBT <sup>b</sup> 12378
Waimakariri River	Oct 1872	1	BMNH 1896.7.1.331
Riverton (17)	Dec 1874	4	BMNH 1896.7.1.325/6/7; AMNH 736277
Wallacetown (19)	Jan 1875	1	AMNH 736917
New Brighton (7)	Apr 1877	2	NHMW 49.082, 49.095
Okarito (13)	Oct 1877	2	MoNZ DM 1374 [B], 15131 [B]
Arthur's Pass (20)	Sep 1878	1	BMNH 1926.10.10.13
Invercargill (19)	1886	1	MoNZ DM 2362
Paringa River (21)	1887	3	NHMW 1.396, 3.700/1 [all B]
Cape Farewell (22)	summer 1891	2	CanM Av 1781; CMNH 22427
Cape Farewell (22)	winter 1892	1	CanM Av 1783
Cape Farewell (22)	1892	1	CMNH 22428
Table Hill, Stewart I (23)	1895	1	CMNH 22426
Mt Anglem, Stewart I (25)	1896	1	UMZC 16/Cha/23/a/1
Awarua Bay (12)	28-01-1923	1	CanM Av 1782
Mason Bay, Stewart I (24)	04-11-1934	1	AIM B2706

a = Earl of Derby collection

b = Canon H.B. Tristram collection

Published records from the period 1900-1940 are few and unhelpful. There are almost no first-hand records of the New Zealand Dotterel with precise localities from the South Island during that time. Hutton & Drummond (1904) noted that the species "...has had to beat a retreat before civilisation" (again suggesting a decline), but their work drew heavily on that of Potts and their remark almost certainly paraphrased his comment of 1885. Buller (1905) mentioned the species only briefly, giving evidence of breeding at Table Hill, Stewart Island. Replies to a nationally-circulated questionnaire on introduced and native birds were presented by Drummond (1907) and Fulton (1907) but, as noted above, it is impossible to distinguish reliably between New Zealand Dotterels and Banded Dotterels in their reports. Philpott (1919) recorded that the species was "Seldom seen on the mainland. In Stewart Island it occurs in fair numbers." There is a skin in the Canterbury Museum collected in 1923 at Awarua Bay, Southland (Table 2); this is still a flock site for Stewart Island birds (Dowding & Murphy 1993) and this specimen does not provide evidence of breeding in the South Island at that date. Stead (1927) noted that the New Zealand Dotterel had "...become very scarce in Canterbury." Hope (1927) compared the status of birds in North Canterbury with the position 20-30 years earlier; Banded Dotterels and Wrybills (*Anarhynchus frontalis*) were both recorded as still present but New Zealand Dotterels were not mentioned,

TABLE 3 - Records of New Zealand Dotterels from the South Island before 1940 for which a province only is known (for provincial boundaries, see Fig. 1). ≤ before a year indicates a specimen seen or collected in that year or earlier.

Location	Date	Number of specimens	Reference or museum and catalogue number
Otago	*1851	1	OtaM Av 4990
Nelson	Jun 1873	1	BMNH 1896.7.1.333
Nelson	Jun 1873	1	LivM HBT <sup>a</sup> 8498
Otago	Nov 1874	1	BMNH 1891.10.1.1228
Otago	1874	1	AMNH 736276
Otago	*1881	1	OtaM Av 4514
Province of Nelson	≤1888	1	Seebohm (1888)
Canterbury	1896	1	BMNH 1896.7.1.329
Otago	≤1897	2	BMNH 1897.12.6.21/2
Canterbury	≤1903	1	UMZC 16/Cha/23/a/2

a = Canon H.B. Tristram collection

\* one of these dates may be in error (P. Schweigman, pers. comm.)

suggesting that they were already rare or absent from the area at the turn of the century. The final demise of the species as a breeding bird in the South Island is impossible to document. Some authors appear to have assumed that the species was still present, or were vague. Myers (1923) noted that it was found in the north of the North Island and on Stewart Island and stated "It occurs probably in suitable intervening localities, but might be easily overlooked..."; Oliver (1930) stated that it was "Formerly fairly plentiful throughout, now scarce except in a few localities where it is still common".

With the exception of the 1923 Awarua Bay specimen, I can find no museum specimens collected in the South Island after 1903 and before 1940 (Tables 2 & 3). All specimens with data collected after 1903 are from the North Island (n=25) or Stewart Island (n=1) (Table 2, Appendix B). Together, these observations suggest that the New Zealand Dotterel had declined in the South Island by the early 1880s, but probably underwent a more rapid decline between the mid-1880s and 1900. There are, in fact, no definite or likely records of breeding after about 1890; however, it is likely that the species was overlooked (particularly in the high country) and a small number of pairs probably persisted into the early 20th century.

Virtually all records of New Zealand Dotterels in the South Island collected by the Ornithological Society since 1940 are coastal and are likely to be of juvenile and unpaired birds wandering from Stewart Island (Barlow 1993, Dowding & Murphy 1993). Possible exceptions are two birds seen near Luggate, Otago in about 1953 (Williams 1963) and a single bird seen in the Matukituki Valley, Otago in October 1969 (Vincent 1972). It is now impossible to decide whether these birds were part of a relict population, or whether they were Stewart Island birds wandering, prospecting or attempting to breed. However, there was an interval of at least 60 years between these sightings and previous definite records of breeding in the South Island, suggesting that the latter explanation is more likely.

### Possible causes of the decline

There was probably some reduction in breeding range as the Canterbury Plains were settled (Potts 1883), but it is clear that the New Zealand Dotterel nested in substantial numbers in many remote localities in the Southern Alps and their foothills (Table 1). Much of this high-altitude habitat is still relatively unmodified physically, and the braided river-beds and plains are still used for nesting by other plovers, notably Banded Dotterels and Wrybills. Therefore, it seems very unlikely that loss of breeding habitat or disturbance during breeding could have been primarily responsible for such a rapid decline.

Predation by a range of mammals introduced in the 18th and 19th centuries has been responsible for the decline and/or extinction of many taxa in New Zealand (Clout & Saunders 1995). Survival and productivity of a number of endemic shorebirds in the South Island are still affected by predation (e.g. Pierce 1986, Rebergen *et al.* 1998) and it seems likely that introduced predators played an important part in the decline of *C. o. obscurus*. It is now impossible to be certain which predator species were primarily responsible, but the timing of the decline and the dates of introduction of various predators provide some insights.

Packs of feral dogs (*Canis familiaris*) were a problem for farmers in the South Island during the mid-19th century. There was general agreement that they were also responsible for declines and local extinctions of the Weka (*Gallirallus australis*), Kakapo (*Strigops habroptilus*) and kiwi (*Apteryx* spp.) (e.g. Lauper 1863, Pascoe 1952). They were common in Canterbury and Otago in the period 1850-1865 (Thomson 1922) but were apparently brought under control by the 1870s (Gillies 1877). Dogs may have taken some New Zealand Dotterel chicks, as they still do in the North Island (Dowding 1993), but the species was still clearly widespread in the South Island after feral dogs had largely disappeared.

Cats (*Felis catus*) were introduced to New Zealand in the late 18th century, but feral cats may not have been common in the South Island until the mid-19th century (Fitzgerald 1990). They were described as "very numerous" in Canterbury by 1860 (Butler 1863). Cats (possibly in conjunction with Norway rats) are believed to have been the main cause of the decline and extirpation of the Shore Plover (*Tbinornis novaeseelandiae*) in the South Island (Davis 1987). They were also reported to have had an impact on many other native species (Thomson 1922) and probably played a part in the decline of New Zealand Dotterels in the South Island. The recent decline of the species on Stewart Island is believed to be due largely to predation by feral cats (Dowding & Murphy 1993).

House mice (*Mus musculus*) spread in the South Island from the 1850s onwards (Murphy & Pickard 1990), but mice are probably too small to represent a serious threat to New Zealand Dotterel eggs, chicks or adults. Ship rats (*Rattus rattus*) became widespread in the South Island after 1890 (Atkinson 1973), but their present distribution is largely in forested habitat, suggesting they would have been rare in sub-alpine and river-bed dotterel nesting areas or coastal flocking sites. Norway rats (*R. norvegicus*) were introduced in the late 18th century but there are few



reliable early records; however, they were clearly widespread and numerous in the South Island by the 1850s (Moors 1990). Norway rats probably had some impact in the South Island, but New Zealand Dotterels survive in the presence of Norway, ship and Polynesian (*R. exulans*) rats on Stewart Island, suggesting that rodents were probably not the major reason for the rapid decline at the end of the 19th century.

Hedgehogs (*Erinaceus europaeus*) were first imported to New Zealand in 1870, but were probably not present in large numbers in the South Island until the turn of the century. Even today, they are rare or absent from many of the inland breeding sites used by New Zealand Dotterels in the 19th century (Brockie 1990). Hedgehogs are known predators of shorebird eggs (Dowding 1997, Sanders 1997) but are not thought to prey on large chicks, juveniles or adults. Therefore, hedgehogs were probably not an important factor in the decline of *C. o. obscurus* in the South Island.

Three species of mustelid were introduced to New Zealand in the 1880s in an attempt to control rabbits (*Oryctolagus cuniculus*). Ferrets (*Mustela furo*) were released in large numbers from 1882 (Lavers & Clapperton 1990) and stoats (*M. erminea*) and weasels (*M. nivalis*) from 1884 (King 1990). They spread rapidly to all parts of the South Island. As early as 1889, Jonathon Brough wrote to W.L. Buller, blaming mustelids for the decline of birds in the Nelson area (Newport 1962). They had reached Resolution Island by 1900 (Hill & Hill 1987) and there followed numerous reports from many parts of the country blaming them for the decline of native birds (e.g. Buller 1905, Drummond 1907, Myers 1923). Mustelids continue to prey on shorebirds in the South Island, e.g. ferrets take Black Stilt (*Himantopus novaehollandiae*) eggs and probably chicks (Pierce 1986), and ferrets and stoats take Banded Dotterel eggs (Sanders 1997). In the North Island, stoats can have a dramatic local impact on Northern New Zealand Dotterels (Dowding & Murphy 1996).

Huge numbers of shorebirds were shot for food and sport by 19th century settlers. Many species were naive and easily shot - "...so tame that it was slaughter, rather than sport, to shoot them..." (Heaphy 1879); "In some favoured spots, the slaughter was terrible" (Hutton & Drummond 1904). The New Zealand Dotterel was among those hunted and eaten. Earl collected the species at Waikouaiti about 1840 (Oliver 1930) and noted that they "...are very fat at that time [September], and of exquisite flavour..." (Gray 1874). Potts (1883) described the species as an "excellent game bird" and noted that birds feeding at Port Cooper [Lyttelton Harbour] in January were "...especially interesting to the sportsman, as they afford good shooting". In a diary entry on 24 June 1865, he recorded that three of his sons went shooting at Governors Bay "...and brought home a string of redbills, dotterels and sandpipers". In 1881, the eggs were described as "a great delicacy" (Baker 1932). With much of the South Island population concentrated in large flocks at favoured estuaries, shooting of birds in autumn and winter probably reduced numbers of New Zealand Dotterels quite rapidly. The decline of the South Island Pied Oystercatcher (*Haematopus ostralegus finschi*) was attributed to shooting;

its recovery came after the passing of legislation prohibiting shooting of shorebirds in 1940 (Sibson 1966, Baker 1973).

I have traced relatively few museum specimens known or thought to have been collected in the South Island before 1903 ( $n=36$ , Tables 2 & 3 and Appendix A). Some specimens have undoubtedly been lost or were not traced, and others now lacking data probably originated in the South Island. However, there is no evidence to suggest that large-scale collecting was an important factor in the decline.

### CONCLUSIONS

A century later, it is difficult to be certain of the reasons for the disappearance of the Southern New Zealand Dotterel as a breeding bird from the South Island. The available records suggest, however, that shooting at coastal winter flocks and predation by a range of introduced mammals on the inland breeding grounds were the most important factors in the decline. Before the 1880s, the decline was probably caused largely by predation by feral cats (and possibly Norway rats) and by shooting. Whether these agents would eventually have caused extirpation of the subspecies in the South Island is not clear, but the decline appears to have accelerated after the introduction of mustelids in the mid-1880s. The fact that the subspecies has survived on Stewart Island in the absence of mustelids is consistent with the suggestion that they played a major role, at least in the final stages.

Why New Zealand Dotterels in the South Island died out, whereas the northern subspecies survived when faced with the same introduced predators, is not clear. It has been noted that the New Zealand Dabchick (*Poliocephalus rufopectus*) also suffered a sharp decline in the South Island in the second half of the 19th century and later became extinct there (Heather 1988), but has survived in the North Island. There may be differences in behaviour between the subspecies of New Zealand Dotterel that affect their susceptibility to predation. In general, birds on Stewart Island (particularly juveniles) are more naive and easily caught than North Island birds (Dowding, pers. obs.) and this may reflect a greater vulnerability to predation. Pierce (1986) demonstrated that differences in behaviour of the closely-related Pied Stilt (*Himantopus b. leucocephalus*) and Black Stilt resulted in marked differences in predation rates. Survival of adult and juvenile New Zealand Dotterels on Stewart Island (where cats and rats are present) is currently much lower than in the North Island, where cats, rats and other predators (including mustelids) occur (Dowding 1997). This is consistent with a greater inherent susceptibility of *C. o. obscurus* to predation, but habitat factors may also be involved. For example, the open beaches free of vegetation favoured by the northern subspecies for breeding (Cumming 1991) may allow for earlier detection of ground-based predators.

Given the likely causes of decline in the South Island, there seems little likelihood of successful re-colonisation or re-introductions of the Southern New Zealand Dotterel to the South Island until widespread control of mustelids and feral cats can be achieved.

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Appendix A - Museum specimens of the New Zealand Dotterel with South Island locality but no date

Locality	Number	Museum and specimens
Christchurch	3	MoCZ (labelled 'J. Haast') <sup>a</sup>
Waimakariri River	1	CanM Av 1788
Canterbury	2	CanM Av 1791/2
Nelson	1	MoNZ DM 2327
Otago	1	MoNZ DM 21794

a = Julius Haast, geologist, collector, and Director of the Canterbury Museum. He was active in the South Island during the period 1860-1880 (Andrews 1986), indicating that these are 19th century specimens.

Appendix B - Museum specimens of the New Zealand Dotterel with known localities and dates collected in the North Island before 1940. ≤ before a year indicates a specimen collected in that year or earlier.

Locality	Number of specimens	Date	Museum and catalogue or registration numbers
Orakei Bay	4	1877	AusM A.1933/4; AIM B2701/3
Orakei Bay	1	1878	AIM B2704
Mangere	3	1878	AIM B2702; AMNH 736283; SMUF
Whangarei Heads	1	1878	SMUF
Manukau Harbour	1	1879	FMNH 426372
Manukau Harbour	11	1882	AusM O.955; AMNH 736281/4, NHMW 49.078/9, 49.081, 49.088/9, 49.091/2, 49.095
Manukau Harbour	1	1883	FloM UF9653
Manukau Harbour	1	1884	USNM 109164
Manukau Harbour	8	1885	AIM B2697/8, B2700; USNM 109165; FMNH 67211, 400138/9, 408003
Manukau Harbour	3	1885	NHMW 3.702/3/4 [all B]
Manukau Harbour	1	≤1885	SMUF
Manukau Harbour	8	1886	NHMW 49.080, 49.083/4/5/6/7, 49.090, 49.093
Orakei Bay	1	1892	AMNH 818658
Kaipara Beach	3	1914	AMNH 736272/3/4
Kaipara Beach	1	1915	AMNH 736275
Whangateau Harbour	6	1922	CanM Av 2419/20, Av 2478; MoNZ DM 2363/4/5
Porirua	1	1925	AMNH 215243
Spirits Bay	1	1929	MoNZ DM 2366
Port Waikato	1	1930	AIM B1132 [E]
Muriwai Beach	1	1931	AIM B3934
Muriwai Beach	1	1932	AIM B3933
Spirits Bay	1	1932	AIM B226 [B]
Parengarenga	1	1934	AIM B2707
Pakiri	1	1936	CanM Av 2480
Muriwai	5	1937	AusM O.37236/7/8/9; MoNZ DM 18370
Manukau Harbour	1	1937	MoNZ DM 18371
Pakiri	1	1938	AIM B1135