3. Species accounts

3.1 NEW ZEALAND PIED OYSTERCATCHER (TOREA, *Haematopus finschi*)

Introduction

The New Zealand pied oystercatcher (hereafter referred to as 'pied oystercatcher') breeds inland in the South Island (mainly east of the Southern Alps) and on a few riverbeds in the southern North Island (Sagar & Geddes 1999). After breeding, the majority of individuals migrate to the large harbours of the northern North Island, but some birds over-winter in coastal areas of the South Island, particularly between Farewell Spit and Nelson. The number of individuals has increased dramatically since the species was protected in 1940 (Sibson 1966): the estimated total number rose from 49 000 birds in 1970/71 to c. 112 000 by 1994 (Sagar et al. 1999). Assuming that the increase has continued at the same rate, we have estimated a total current national population of at least 130 000 birds. Internationally the species is not considered threatened, and nationally it is also ranked as Not Threatened (Hitchmough & Bull 2004). The species has been reasonably well studied in recent years, with detailed research on dispersal, breeding and survival undertaken by Sagar & Geddes (1999) and Sagar et al. (2000).

Important breeding areas

The majority of individuals breed inland in the South Island (Marchant & Higgins 1993). A wide range of habitat types is used, but breeding sites are typically in braided riverbeds, on farmland, around lakes, or in high-country tussock areas. Since c. 1950, the species appears to have taken advantage of the increase in breeding habitat provided by agricultural land (Sagar et al. 2000). Since the 1980s, a few pairs have also bred in the North Island, in both Hawke's Bay (Twydle & Twydle 1983) and Wairarapa (Onley 1991).

The species is widely dispersed during breeding, making it impractical to list all significant breeding sites or areas; in addition, relatively few counts of breeding populations have been made, even in riverbeds, with the exception of counts made by Maloney (1999) in the Mackenzie Basin and by Hallas (2003) in Marlborough riverbeds. However, the bulk of the population appears to breed in Canterbury, Otago and Southland (Bull et al. 1985; Marchant & Higgins 1993), with smaller numbers also breeding in Marlborough (Hallas 2003).

The species has been recorded breeding in subalpine tundra in Central Otago, on the Old Man, Dunstan, Pisa, and Carrick Ranges (Child 1969), the Rock and Pillar Range (CSN 45/1), and the Lammermoor Range (CSN 48/2). Pied oystercatchers also breed on farmland and pasture near Alexandra (Child 1984), at Wrey's Bush, Southland (CSN 42/4), between Lumsden and Mossburn (CSN 42/2), in the Queenstown and Arrowtown area (Soper & Jardine 1957), at

Manapouri (CSN 48/2), and on the Canterbury Plains (Sagar et al. 2000). Between 1974 and 1981, pied oystercatchers were found in all 14 Canterbury river systems surveyed during the breeding season, with highest numbers in the Waiau, Hurunui, Waimakariri, Rakaia, Ashburton and Waitaki Rivers (O'Donnell & Moore 1983). They were also numerous and breeding in the upper Rangitata River in October 1999 (JED, pers. obs.). Hallas (2003) recorded pied oystercatchers breeding on a number of braided rivers in southern Marlborough, including the Wairau, Awatere, Waima, Clarence, and Kowhai Rivers. They also breed in the Eglinton Valley, Fiordland (JED, pers. obs.), and in the Nelson region (Howard, Upper Buller and Matakitaki Rivers) (CSN 35/4). There are many other known South Island breeding sites, including coastal or near-coastal sites, such as Catlins Lake (CSN 43/4), Wainono Lagoon (Pierce 1980b), Taramakau Estuary, West Coast (CSN 37/3&4), Kowai River mouth (CSN 42/2), and Leithfield Beach, Canterbury (CSN 41/3).

Maloney (1999) compared spring surveys from the 1960s and 1990s in nine braided rivers in the Upper Waitaki Basin. In spite of the dramatic population increase nationally during that time, numbers of pied oystercatchers had declined significantly in the Ahuriri and Cass Rivers, with apparent declines in the Tekapo, Upper and Lower Ohau, Hopkins, and Godley Rivers; numbers in the 1990s were 30%–90% of values recorded in the 1960s.

Breeding in the North Island appears to have begun comparatively recently. Twydle & Twydle (1983) first recorded pied oystercatchers with young at Ngaruroro River, Hawke's Bay, in October 1980, and the first record of successful breeding in the Wairarapa (Tauanui Delta) was in 1990 (Onley 1991).

Important non-breeding sites

Following breeding, pied oystercatchers migrate to coastal areas and gather in large flocks at major bays and estuaries; they are notably absent from rocky coastlines, such as Coromandel Peninsula, the coast south of East Cape, and Fiordland (Baker 1973). The sites that regularly hold 1% or more of the population (1300 birds) are listed in Appendix 1; the top ten of these sites are shown in Table 1. There are many other wintering sites that do not reach the 1% threshold, but are nevertheless used by hundreds of pied oystercatchers; see CSN for examples.

There are clearly two wintering regions of outstanding importance to this species: more than 68% of all pied oystercatchers counted in the OSNZ winter census in 1989 were in the Auckland and South Auckland regions, and 14% were in the Nelson region (Sagar 1990). In June 2003, three large harbours around Auckland (Kaipara, Manukau and Firth of Thames) had 63 500 pied oystercatchers between them, about half of the estimated world population. Within the important Nelson region, there may have been changes in site allegiance in recent decades: numbers of pied oystercatchers at Farewell Spit have increased since 1961, but numbers in Golden Bay and Tasman Bay have decreased over the past decade (Schuckard 2002).

Pied oystercatchers occasionally straggle to outlying islands and to Australia. There are records from Chatham Island (Freeman 1994), the Snares (Miskelly et al. 2001), and Norfolk Island (Hermes et al. 1986); in Australia, they have been recorded in New South Wales and Queensland (Totterman 2000).

TABLE 1. TOP-TEN WINTERING SITES FOR NEW ZEALAND PIED OYSTERCATCHERS (*Haematopus finschi*).

Site rank is based on the maximum figure in the range of counts. Range data are from Sagar et al. (1999), Schuckard (2002) and Appendix 1. A site is designated 'critical' if it regularly holds 30% or more of the total population of this species; sites that also hold more than 100 or more than 1000 Arctic-migrant shorebirds are indicated (+ = yes; – = no).

RANK	SITE	RANGE OF COUNTS	CRITICAL SITE?	ARCTIC MIGRANTS	
				≥ 100	≥ 1000
1	Manukau Harbour	19 467–31 976	–	+	+
2	Kaipara Harbour	8969–21 730	–	+	+
3	Firth of Thames	6274–17 657	–	+	+
4	Farewell Spit	4934–10 883	–	+	+
5	Tasman Bay	808–5982	–	+	+
6	Golden Bay	554–5523	–	+	+
7	Avon-Heathcote Estuary	2126–5000	–	+	+
8	Kawhia Harbour	1200–3803	–	+	+
9	Whangarei Harbour	619–2548 or more	–	+	+
10	Aotea Harbour	694–2007	–	+	+

Based on counts made between 1960 and 1975, c. 20% of the wintering population in the Manukau and Firth of Thames remained there during summer (Veitch 1978). A similar proportion was found at Farewell Spit, where 1600 (23%) of the 7000 wintering birds remained over summer (Schuckard 2002).

Estuaries on the South Island east coast appear to be important during migration. Avon-Heathcote Estuary is clearly an important wintering site, but Crossland (1992, 1993) suggested that many times more pied oystercatchers passed through than were present at any one time, and that 20%–50% of the entire population may use the site during their northward migration.

Movements

Baker (1975) stated that the migration of pied oystercatchers consists of a series of short flights, with stop-overs for feeding and resting, and that the groups of birds migrating were usually small ('typically from two to twenty birds'). However, based on the absence of sightings of their colour-banded birds at stop-over sites, Sagar & Geddes (1999) suggested that the southward migration (at least) was undertaken in one long journey. The proportion of juveniles in northern flocks increases during autumn, suggesting that juveniles either migrate later or more slowly than adults (Marchant & Higgins 1993); colour banding has confirmed that adults and their juveniles migrate independently (Sagar & Geddes 1999).

Northward migration:

According to Marchant & Higgins (1993), breeding adults leave their breeding grounds between late December and early February. Most observations of birds moving north in the North Island are consistent with this timetable. In 1996/97,

Clifford (1997) observed a number of flocks flying north along the Waikato coast. These included:

- Albatross Point—96 birds (in four flocks) on 29 Dec 1996.
- Taharoa—159 birds (in nine flocks of 3–85 birds) on 8 Jan 1997; a flock of seven birds on 23 Jan 1997.

Other sightings on the North Island west coast were of:

- Sugar Loaf Islands, Taranaki—21 birds flying north on 22 Jan 1999 (CSN 47/4).
- Waiongana Estuary—several groups flying north on 3 Jan 1992 (CSN 41/1); 78 birds in seven flocks flying north on 29 Dec 2002 (CSN 02/03, unpubl. report).
- Near Cape Egmont—115 birds flying north in small flocks on 19 Jan and 29 Jan 2001 (CSN 49/2).

Southward migration:

Southward migration begins in late June, and peaks in July and early August (Marchant & Higgins 1993). Records of birds seen flying south include:

- Manukau Harbour—first flights heading south on 21 June 2001 (CSN 49/2).
- Firth of Thames—first departure of 24 birds on 25 June 2004 (K. Woodley, pers. comm.); departure of 30–40 birds on 30 Jun 2003 (K. Woodley, pers. comm.).
- Nelson region—small flocks flying south on 4 July 1994 (Hawkins 1994).
- Hokitika—40 birds on southward migration on 23 July 1990 (CSN 39/3).
- Greymouth—17 birds on southward migration on 26 July 1990 (CSN 39/3).
- Miranda—flocks leaving all afternoon on 31 July 2002, the biggest of which comprised ≥ 130 birds (Riegen 2003).
- Charleston—birds moving south at night on 10 Aug 1986 (CSN 35/4).
- Urenui coast—41 birds flying south on 31 Aug 2002 (CSN 02/03, unpubl. report).

Birds leaving the North Island in June may stage at east-coast South Island sites; Baker (1975) noted that adult numbers began to decline at Avon-Heathcote Estuary in late July as adults moved to the breeding grounds.

Dispersal

A detailed study of annual movement patterns of birds breeding in mid-Canterbury farmland was undertaken by Sagar & Geddes (1999). Birds dispersed 97–834 km from their breeding sites to at least 22 locations (14 in the North Island and 8 in the South Island); there were no apparent links between breeding area and wintering site. Distances travelled by males and females and different age classes were similar. The highest numbers of birds were reported from Whangarei, Kaipara and Manukau Harbours, Firth of Thames, and Avon-Heathcote Estuary, all of which are sites in the top-ten list of wintering sites shown in Table 1. Adults had very high wintering-site fidelity both between and within years, and there was no evidence that juveniles accompanied their parents to wintering sites (Sagar & Geddes 1999).

Overlap with Arctic migrants

The pied oystercatcher overlaps extensively with Arctic-migrant shorebirds in its wintering range. All top-ten wintering sites for the species may have 2000 or more pied oystercatchers, and all have 1000 or more Arctic migrants. Many of the additional sites that do not reach the 1% threshold are used by hundreds of pied oystercatchers, which also overlap considerably with Arctic migrants.

Discussion

There is extensive overlap in range between pied oystercatchers and Arctic migrants. Because of their large numbers, very wide breeding range, and lack of links between breeding and wintering sites, pied oystercatchers are potentially capable of transferring any disease acquired in large North Island harbours to virtually all parts of the South Island.

Following the recent studies by Sagar & Geddes (1999) and Sagar et al. (2000), the ecology of this species on lowland breeding grounds is now reasonably well known, and there are no major gaps in the available information. However, it is not clear why some local breeding populations are declining (e.g. in Mackenzie Basin riverbeds; Maloney 1999), when overall the number of individuals has increased rapidly (Sagar et al. 1999).

3.2 VARIABLE OYSTERCATCHER (TOREA PANGO, *Haematopus unicolor*)

Introduction

The variable oystercatcher is almost entirely coastal in distribution and is found around the North, South and Stewart Islands and their offshore islands. About two-thirds of the national population is found in the North Island, particularly in Northland, Coromandel Peninsula and Bay of Plenty. In the South Island, numbers appear to be concentrated in Fiordland and the Nelson area (Heather & Robertson 1996).

Like the pied oystercatcher, this species has increased dramatically in numbers in recent years. The total population was conservatively estimated at 2000 birds in 1970–1971 by Baker (1973) and at c. 4000 birds by Heather & Robertson (1996). It seems likely that this increase has continued, particularly as many pairs are now benefiting from predator control and other methods of conservation management undertaken for New Zealand dotterels and / or fairy terns (*Sterna nereis*) at sites in Northland, Auckland, Coromandel Peninsula and Bay of Plenty (JED, unpubl. data). Assuming that the increase has continued at a similar rate, the current population would now be c. 4500 birds, even if Baker (1973) underestimated the number of birds by as much as 500 individuals.

The effective population size is unknown, but breeding is delayed until at least 3 years of age (Marchant & Higgins 1993) and sometimes for as long as 7 years (JED, unpubl. data). A relatively high proportion of non-breeding birds would therefore be expected in the national population, particularly at present while it appears to be growing rapidly. Assuming that 500 of the estimated 4500 birds are immature or unpaired adults, the total effective population size would be 4000 individuals or 2000 pairs; on this basis, 20 pairs constitute 1% of the total breeding population.

Internationally this species is not considered threatened. Nationally it is ranked as Not Threatened, with the qualifier RC (Recovering) (Hitchmough & Bull 2004).

Important breeding sites

Variable oystercatchers breed largely on sandy beaches or sand spits, particularly near estuaries, but also on shell banks, rocky shorelines and gravel areas (Marchant & Higgins 1993). Occasionally, pairs will nest on grassed areas (including paddocks or golf courses behind beaches), and on Stewart Island nests are sometimes under tall forest close to the shoreline (JED, pers. obs.).

Identification of breeding sites that are significant at the > 1% level is difficult due to the presence of large flocks containing non-breeding birds at many known breeding sites. In these circumstances, high counts do not necessarily indicate an important breeding site, so that a top-ten list of breeding sites based on total counts is likely to be misleading. Sites that are important to the species during the breeding season (whether for breeding, for flocks of non-breeding birds, or both) are shown in Appendix 2, Table A2.1.

The species is widely dispersed over much of the country's coastline, but the North Island east coast is clearly a breeding stronghold. There are significant numbers of pairs or individuals present in or near many of the major east-coast estuaries in Northland, Auckland, Coromandel Peninsula, and Bay of Plenty; together, sites in these regions constitute 16 (73%) of the 22 significant sites shown in Appendix 2, Table A2.1. On the North Island west coast, the species is scarce south of Auckland (Marchant & Higgins 1993). In the South Island, variable oystercatchers are common in Tasman Bay (Schuckard 2002) and on the rocky coasts of Fiordland and Stewart Island; they are less common on the east coast (Heather & Robertson 1996).

Important non-breeding sites

As noted by Heather & Robertson (1996), breeding and wintering distributions for the variable oystercatcher are similar. The top-ten non-breeding sites for this species are shown in Table 2. Six of the ten sites are on the east coast, north of Auckland. Other sites that pass the 1% threshold of 45 birds are shown in Appendix 2, Table A2.2. Some flocks are now very large. Baker (1973) noted that no flocks exceeded 150 individuals, and as recently as the early 1990s the largest flocks were still typically about that size (Marchant & Higgins 1993); there are now regular reports of flocks of 200–400 birds at certain localities (Table 2), and a flock of 482 birds was reported at Waimea Inlet in October 1999 (Schuckard 2002).

It seems likely that a number of wintering sites used by more than 1% of the total population have not yet been identified. There appear to be large numbers of variable oystercatchers on the Fiordland coast (Heather & Robertson 1996), including a report of 80–100 birds on the shoreline of Preservation Inlet in July 1997 (CSN 48/2). However, apart from a mention of c. 50 birds at Jackson Bay (Marchant & Higgins 1993), there are few records of significant flocks in Fiordland or Westland. The apparent absence of significant winter flocks in Kaipara Harbour is surprising, given a count of 133 birds in November 1996. However, the harbour is large and some parts of it are difficult to access; variable oystercatchers may simply use flock sites that are not covered during surveys.

TABLE 2. TOP-TEN WINTERING SITES FOR VARIABLE OYSTERCATCHERS (*Haematopus unicolour*).

Site rank is based on the maximum figure in the range of recent counts. A site is designated 'critical' if it regularly holds 30% or more of the total population of this species; sites that also hold more than 100 or more than 1000 Arctic-migrant shorebirds are indicated (+ = yes; – = no).

RANK	SITE	RANGE OF COUNTS	CRITICAL SITE?	ARCTIC MIGRANTS ≥ 100	ARCTIC MIGRANTS ≥ 1000
1	Tasman Bay	81–380[a]	–	+	+
2	Ohiwa Harbour	170–350	–	+	+
3	Whangarei Harbour	52–315	–	+	+
4	Mangawhai Estuary	147–248	–	+	–
5	Waipu Estuary	140–243	–	+	–
6	Ruakaka Estuary	62–204	–	+	+
7	Wellington Harbour	45–200	–	–	–
8	Matarangi Spit	140–180	–	+	+
9	Parengarenga Harbour	102–176	–	+	+
10	Rangaunu Harbour	65–173	–	+	+

[a] Range of annual counts April–June 1998–2001; combined counts from 5–10 sites (Schuckard 2002).

Movements

Information on movement has been summarised by Marchant & Higgins (1993). Most re-sightings and recoveries of colour-banded birds have been within 60 km of the banding site, with the longest confirmed re-sightings at 125 km. A small number of records of birds moving between the North and South Islands are considered doubtful (Marchant & Higgins 1993).

Several recent small-scale colour-banding studies in different parts of the country all tend to confirm that this species does not normally move large distances. Schweigman (2002; pers. comm.) banded adults and chicks around Dunedin; adults were largely sedentary, but juveniles moved more frequently and further, with the most distant recovery being in Christchurch (c. 310 km). One bird bred c. 30 km from its natal site. Re-sightings from a small sample of birds colour-flagged in Tasman Bay (South Island Wader Study Group, R. Schuckard, pers. comm.) have all been within a few kilometres to date. Adults banded on the North Auckland east coast were nearly all sedentary; two exceptions, where birds moved 21 and 40 km to new breeding sites, followed divorce and death of a mate respectively. Of six chicks colour-banded in the same area and known to be breeding, three have bred at their natal site and three away from it (greatest distance 61 km) (JED, unpubl. data).

Fluctuations in counts at some sites suggest that there may be regular movements of flocks (or of birds between flocks) during the non-breeding season. For example, in 2001–2003 numbers were higher in Whangarei Harbour in March than in June; conversely, counts at Ruakaka in 2001 and 2003 were higher in June. Therefore, it is possible that birds are moving between the two sites either following moult or in response to other factors.

Adult variable oystercatchers may make short-term feeding trips. Colour-banded adults resident at Pakiri River have occasionally been seen feeding at

Whangateau Estuary (10 km away) before returning to Pakiri as the tide rises (JED, unpubl. data). Similar movements have been detected near Dunedin (P. Schweigman, pers. comm.). The frequency and extent of these trips are largely unknown.

Overlap with Arctic migrants

The distribution of the variable oystercatcher overlaps extensively with Arctic migrants, particularly in northern North Island estuaries and in northern parts of the South Island (Table 2). Nine of the top-ten wintering sites for the taxon have more than 100 Arctic migrants, and seven of them have 1000 or more. Variable oystercatchers are widely dispersed and there are at least 26 further wintering sites important to the species at the 1% level (Appendix 2, Table A2.2); there is also significant overlap with Arctic-migrant shorebirds at many of these.

Discussion

There is extensive overlap between non-breeding flocks of variable oystercatchers and Arctic migrants, so that the potential for disease transfer between them is likely to be relatively high. However, adult variable oystercatchers are essentially sedentary and are unlikely to spread disease far. Movement patterns of non-breeders are much less well understood, but the limited evidence available suggests that juveniles and sub-adults are more mobile than adults. However, even juveniles of this species appear unlikely to spread disease widely compared with some of the other taxa considered in this report, notably internal north-south migrants, such as the pied oystercatcher and wrybill.

Following the research undertaken by Baker (1972, 1973, 1975), there has been relatively little work on this species in the past 20 years. In part, this is probably because numbers have increased and the species is not of conservation concern. The three colour-banding studies currently in progress (see 'Movements' above) are all small-scale, localised, and being undertaken on a voluntary basis. Further information is required on movements of juveniles and the composition of flocks; it is possible that some large flocks are composed largely or entirely of non-breeders, similar to the nursery flocks described for the African black oystercatcher (*H. moquini*) (Leseberg 2001).

Some important breeding sites may not have been identified. We have found no breeding-season counts over the 1% level within a single estuary anywhere in the South Island outside the Farewell Spit–Nelson region. This may reflect a lack of data. There may be important sites in Fiordland, which supposedly contains 10% of the population, and there are almost certainly at least 20 pairs in Paterson Inlet, Stewart Island (JED, pers. obs.). Some wintering sites have probably not been identified either. With the notable exception of Kaipara Harbour, these are probably also mainly in the South Island, away from the Nelson region. In the case of Fiordland, it may be that the absence of large tidal estuaries in the region means that the population there remains dispersed year-round. The number of variable oystercatchers is increasing rapidly (Sagar et al. 1999) and thus the significance of any breeding or wintering site could change relatively quickly.

3.3 PIED STILT (POAKA, *Himantopus himantopus leucocephalus*)

Introduction

The stilt *Himantopus himantopus leucocephalus*, known in New Zealand as the pied stilt or poaka, and elsewhere as the black-winged stilt, is found in the Philippines and south through Indonesia to the Bismarck Islands, Australia and New Zealand (Marchant & Higgins 1993). New Zealand pied stilts can be distinguished from Australian birds by a shorter tarsus, longer tail and more variable plumage, caused by introgressive hybridisation with the endemic black stilt *H. novaezealandiae* (Pierce 1984b). Pied stilts are believed to have colonised New Zealand from Australia in two separate invasions, giving rise to our black and pied stilt populations (Pierce 1984b). The present-day pied stilt may have arrived in New Zealand as recently as the 19th century, and the national population is known to have expanded rapidly in both the North and South Islands from about the 1870s until at least early in the 20th century (Pierce 1984a). There is evidence that the occasional pied stilt still crosses the Tasman Sea, although not always in an easterly direction: the plumage and feeding technique of a stilt seen in Tasmania in 1988 suggested that it originated from New Zealand (Fletcher & Fletcher 1989).

The total New Zealand pied stilt population is estimated at c. 30 000 birds (Heather & Robertson 1996). This estimate is based on data collected in the years up to 1994 (Sagar et al. 1999), but there is no reason to suspect that abundance has changed significantly in the past decade (e.g. see Veitch & Habraken 1999; Appendix 3). Pied stilts are a common native bird, and were classified by Hitchmough & Bull (2004) as Not Threatened with the qualifier SO (Secure Overseas).

Important breeding sites

Pied stilts typically breed near shallow water in a wide variety of habitats throughout New Zealand, from the edges of estuaries, wetlands and flooded paddocks in the lowlands, to braided riverbeds far inland in the central South Island (Marchant & Higgins 1993). They usually breed colonially in groups of 3–20 pairs, although colonies of up to 100 pairs can occur (Heather & Robertson 1996). Nest-site selection is dependent on local environmental conditions, especially rainfall (e.g. Barlow 1989; Sutton 1989). Child (1983) noted a marked decline in the number of pied stilts breeding in Central Otago, and suggested that the invasion of local riverbeds by weeds was at least partly to blame.

Identifying important breeding areas from counts is difficult, as pied stilts have a very protracted breeding season: birds that breed in lowland areas may return to their breeding grounds as early as June with the first clutches laid in early July (Marchant & Higgins 1993), while those nesting far inland may not finish breeding until February (Pierce 1983). However, it is clear that pied stilts breed in most parts of New Zealand, although they are rare on Stewart Island and the Chatham Islands, and are absent from Fiordland and subantarctic islands (Heather & Robertson 1996).

Breeding concentrations identified by Marchant & Higgins (1993) include:

- Northland (Awanui, Kawakawa, Dargaville and Naumai)
- Auckland (Helensville and Drury)
- North Waikato (Whangamarino)
- Bay of Plenty (on the coast and around Rotorua lakes)
- Hawke's Bay (common on gravel rivers, coastal lagoons and estuaries)
- Manawatu and inland Wairarapa
- Marlborough (rivers such as Wairau and Awatere)
- Canterbury (widespread on coastal lagoons, rivers on the Canterbury Plains, and in the Mackenzie Basin)
- Otago (coastally and inland, e.g. lower and upper Taieri Valley and Manuherikia River)
- Southland (throughout, especially on inland riverbeds)

During a census of Hawke's Bay rivers in October 1986, 220 birds were counted on the Ngaruroro River, 310 on the Tutaekuri River and 482 on the Tukituki River (CSN 35/4). Between 1974 and 1981, the species was found in all 14 Canterbury river systems surveyed during the breeding season, with highest numbers in the Ashburton River, but large populations also in the Waitaki, Ashley, Waiau and Hurunui Rivers (O'Donnell & Moore 1983). Pied stilts were generally absent from the uppermost stretches of the larger rivers (e.g. Rakaia and Waimakariri). Pied stilts were present in all 11 Upper Waitaki Basin rivers surveyed in 1991–1994; densities were highest in the Ahuriri, Tekapo and Lower Ohau Rivers (Maloney et al. 1997).

Important non-breeding sites

In winter, pied stilts are widespread throughout both the North and South Islands. The highest numbers are consistently counted in the Firth of Thames, and Manukau and Kaipara Harbours (Sagar et al. 1999); in June–July 1989, more than half of all pied stilts counted were found in the Auckland and South Auckland regions (Sagar 1990). Sites further south, such as Tasman Bay (Owen & Sell 1985; Schuckard 2002) and Lake Wairarapa (Robertson & Heather 1999), where stilt numbers peak in autumn and winter, are also important local wintering sites.

Sites that normally have 300 pied stilts or more (1% of the total estimated population) in winter are listed in Appendix 3.1; the top-ten non-breeding sites are shown in Table 3.

Veitch (1999) examined monthly count data at three high-tide roosts in the Firth of Thames (the most important pied stilt wintering site nationally; Table 3). Numbers varied erratically, changing by more than 100% from month to month through the year, largely, it was suggested, due to changes in food availability inland (Veitch 1999). The dependence of local stilt abundance and distribution on changing water levels at other non-breeding sites, such as Lake Ellesmere and Lake Wairarapa, has also been observed (O'Donnell 1985; Robertson & Heather 1999).

TABLE 3. TOP-TEN NON-BREEDING SITES FOR PIED STILTS (*Himantopus himantopus leucocephalus*) IN NEW ZEALAND.

Site rank is based on the maximum figure in the range of counts. Range data are from Sagar et al. (1999) or, where that has been exceeded, Appendix 3. A site is designated 'critical' if it regularly holds 30% or more of the total population of this taxon; sites that also hold more than 100 or more than 1000 Arctic-migrant shorebirds are indicated (+ = yes; – = no).

RANK	SITE	RANGE OF COUNTS	CRITICAL SITE?	ARCTIC MIGRANTS	
				≥ 100	≥ 1000
1	Firth of Thames	1975–5234	–	+	+
2	Manukau Harbour	2278–4826	–	+	+
3	Kaipara Harbour	1534–4679	–	+	+
4	Lake Ellesmere	203–2328	–	+	–
5	Whakaki Lagoon	446–2318	–	+	–
6	Lake Wairarapa	573–2000	–	+	–
7	Ahuriri / Westshore	5–1645	–	+	–
8	Parengarenga Harbour	99–1537	–	+	+
9	Tauranga Harbour	141–862	–	+	+
10	Whangarei Harbour	47–816	–	+	+

Coastal wetlands in Canterbury, particularly Lake Ellesmere (O'Donnell 1985), Washdyke Lagoon (Sagar 1976) and Wainono Lagoon (Pierce 1980b), which hold small resident populations of breeding birds, experience a peak in pied stilt numbers in late summer, as birds move from inland breeding grounds to these coastal wetlands before migrating north. Numbers at Mokau Estuary also peak in late summer, although on a much smaller scale than the Canterbury staging sites, with a maximum of 91 stilts observed in February 1999 (B. Hartley, pers. comm.).

Movements

In the late 1980s and early 1990s, OSNZ members colour-banded and monitored pied stilts to study their movements in New Zealand. The study was coordinated by R.J. Pierce, who kindly provided the unpublished information summarised below (Appendix 3.2 contains the full description of regional movements as provided by Pierce).

Pied stilts that breed in northern New Zealand are mainly sedentary or make local seasonal movements, typically of less than 20 km. These birds seldom make long-distance movements; there is, for example, no evidence of these birds moving north to the Aupouri Peninsula harbours (Parengarenga, Houhora and Rangaunu). Birds in central New Zealand show a combination of sedentary behaviour and local and long-distance movements. Sedentary behaviour and local movements are the norm for stilts that breed in coastal lagoons and estuaries, while those breeding further inland, for example on riverbeds or ephemeral wetlands, tend to move out to the same coastal sites. Relatively few of the stilts that breed in central New Zealand migrate to northern New Zealand. In contrast, pied stilts that breed in southern New Zealand are predominantly migratory. Inland birds of mid-Canterbury, the Mackenzie Basin, Central Otago and Southland migrate to northern New Zealand harbours from

Kawhia to Parengarenga. However, some birds in coastal Canterbury, Otago and Southland do reside at coastal lagoons and estuaries year-round. One-year-old pied stilts typically return to their natal breeding grounds, and those at lowland sites normally visit the breeding grounds. At inland sites, first returns are normally at 2 years (R.J. Pierce, pers. comm.).

Overlap with Arctic migrants

Many pied stilts winter at coastal sites frequented by large numbers of Arctic migrants. All of the top-ten sites for pied stilts regularly host 100 or more Arctic migrants, and six receive many thousands of Arctic migrants annually. At the Firth of Thames, which is the most important stilt wintering site, there is clear evidence that there is close contact between pied stilts and Arctic migrants; Arctic migrants use the Miranda Stilt Ponds (a breeding site for several pied stilt pairs, and a feeding and roost site for many hundreds of stilts) as a high-tide roost, and bar-tailed godwits and lesser knots roost alongside pied stilts at other high-tide roosts (near Thames and near Kaiaua) (SJM, pers. obs.).

Discussion

There is clearly extensive overlap (and close contact) between pied stilts and Arctic migrants in New Zealand, with obvious potential for disease transfer between the two groups. The top-ten sites for pied stilts are widely distributed around the country (Northland, Auckland, Bay of Plenty, Hawke's Bay, Wairarapa and Canterbury). Most North Island birds are relatively sedentary and are unlikely to spread disease far, but migratory South Island breeders have the potential to transfer disease from the North Island to the South Island.

Flocks of pied stilts can be highly mobile, and using counts to identify important habitat for the species requires caution. Stilts typically forage in shallow water or saturated mud (Marchant & Higgins 1993) and many hundreds of birds may move to ephemeral wetlands (such as flooded paddocks) after rain, or to tidal estuaries when there is drought inland.

3.4 BLACK STILT (KAKI, *Himantopus novaezelandiae*)

Introduction

The black stilt is one of the world's most threatened shorebird species. It is classified internationally as Critical (BirdLife International 2005) and nationally as Category 1 Nationally Critical, with the qualifiers CD (Conservation Dependent), ST (Stable), HI (Human-Induced) and OL (One Location) (Hitchmough & Bull 2004). In August 2000 there were 48 adult black stilts in the wild, of which 18 or fewer were female (Maloney & Murray 2002). The total population is now restricted to one breeding area, the Upper Waitaki (Mackenzie) Basin, where its continued survival is management-dependent. Most black stilts remain in the wetlands and rivers of the Upper Waitaki Basin year-round, although a small percentage of the population migrates out of the basin after the breeding season (Maloney & Murray 2002).

In spite of introgressive hybridisation between the black stilt and its close relative the pied stilt, allozyme electrophoresis (Greene 1999), analysis of mitochondrial DNA (Chambers & MacAvoy 1999), and behavioural and morphological differences between the two stilts (Pierce 1984b) support the retention of the black stilt as a distinct species. Pierce (1984b) classified the plumage of adult stilts on a scale of A ('pure' pied stilt) to J ('pure' black stilt). In our analysis we include information on dark-plumaged hybrids (nodes F to I) as well as apparent pure black stilts, since these dark hybrids show behavioural similarities to and are managed like black stilts (Saunders et al. 1996; Reed 1998). We also note that some observers who contributed information included in this report may have experienced difficulties differentiating sub-adult black stilts from hybrids, as some sub-adult black stilts retain a small amount of white mottling on the abdomen until 17–20 months of age (Pierce 1984b).

Important breeding sites

The breeding season extends from August to February, with a peak in egg-laying in October (Maloney & Murray 2002). Black stilt chicks fledge when aged 39–55 days (Pierce 1986), and remain in family groups until the end of winter (August–September) (Pierce 1983).

In the late 1950s, one pair of black stilts nested on the Orari Riverbed near Geraldine in lowland South Canterbury (Child 1958). Since the 1960s the breeding range has been largely confined to the Upper Waitaki Basin, with only very occasional reports of adult birds outside that area (Pierce 1984a; Maloney & Murray 2002). Most such reports are of black stilts paired with pied stilts: a pair at the Hakataramea River in 1971 and a pair at Wainono Lagoon in 1979 (Pierce 1984a), and two pairs at Lake Ellesmere in 1986 (O'Donnell 1988).

During surveys undertaken in October–December 1991–1994, black stilts were found breeding in 8 of 11 rivers surveyed in the Mackenzie Basin (Maloney et al. 1997). Because the black stilt population is so small, all eight rivers had at least 1% of the total population. Largest numbers were recorded in the Ahuriri, Tekapo, Tasman and Lower Ohau Rivers (Maloney et al. 1997). Black stilts were breeding in the Upper Ohau and Godley Rivers in the 1960s, but were no longer present in the 1990s (Maloney 1999).

Important non-breeding sites

Each year, about 85%–90% of the total black stilt population winters in the Upper Waitaki Basin (Pierce 1984b; Reed & Murray 1989; Maloney & Murray 2002). These families move to tarns in later summer and autumn once their chicks have fledged, then gather in and around lake deltas in winter (Saunders et al. 1996). The remaining 10%–15% of individuals make an annual migration to post-breeding grounds in coastal Canterbury and northern North Island estuaries (Reed & Murray 1989). The birds use these sites from February until July or August; most then return to the Upper Waitaki Basin in early spring (Maloney & Murray 2002).

Black stilts have been known to winter in North Island estuaries for at least 60 years. Black stilts and dark hybrids appeared in Whangarei as early as December in the 1940s (Anon. 1943). In the 1940s and 1950s, individual birds and small groups of black stilts wintered at Miranda in the Firth of Thames (Sibson & McKenzie 1944; Anon. 1951) and in Manukau Harbour (Anon. 1951). Black stilts have also wintered in Kawhia Harbour for many years: six birds were recorded in May 1954, ten in July 1955, and nine in July 1956 (Anon. 1957).

The number of migrant black stilts received an unexpected boost between 1981 and 1987, when wildlife managers cross-fostered black stilt eggs to pied and hybrid parents in an attempt to increase the black stilt breeding population. Juvenile black stilts cross-fostered to pied or hybrid pairs migrated with their foster parents, and only 1 of the 21 fostered chicks was eventually recruited into the black stilt breeding population (Reed, Murray & Butler 1993). This may account for the significant increase in the number of birds noted wintering in the Firth of Thames and Manukau Harbour between the 1960s and the 1990s (Veitch & Habraken 1999).

In May 1988, Murray & Reed (1988) visited 34 sites between the Ashley River mouth near Christchurch and Whangarei Harbour, searching for black and hybrid stilts. Black stilts and dark hybrids were only found at two sites: South Kaipara Harbour (two pure black stilts and seven dark hybrids, two of which were banded) and Kawhia Harbour (nine dark hybrids, two of which were banded, and one almost pure black stilt juvenile, also banded; Reed & Murray 1989). Kawhia Harbour was also a popular wintering site in other years: black stilts and dark hybrids were found in every OSNZ Kawhia winter census from 1976–2003 (Plant 1987; Cuming 1994; Appendix 4). During the June 1990 census, 16 hybrid / black stilts were found at Kawhia Harbour, including three adult black stilts and four banded juveniles (CSN 38/4). Band sightings of black and dark hybrid stilts from 1985 to 1991 were listed by Reed, Nilsson & Murray (1993).

During the OSNZ national winter shorebird surveys from 1983 to 1994, up to 32 black and hybrid stilts were found at coastal sites, with an average of 15 per year (Sagar et al. 1999); note, however, that the record of 16 black stilts in the upper Manukau Harbour on 18 June 1995 (CSN 43/3) was an error (none were seen; T. Lovegrove, pers. comm.). Most winter sightings were in northern estuaries (Manukau, the Firth of Thames, Kaipara and Kawhia), but one or two birds were regularly seen in Canterbury at Wainono and Washdyke Lagoons. During monthly shorebird counts at Lake Wairarapa over the same period, one to two black stilts were found to be present for about 6 months in 3 years (Robertson &

Heather 1999). The OSNZ 1983–1994 summer counts also recorded a few black stilts at coastal sites near the Mackenzie Basin, especially at Wainono and Washdyke Lagoons and Lake Ellesmere, during November and early December (Sagar et al. 1999).

Records of black stilts outside the Mackenzie Basin since 1990 confirm that stilts have been seen most frequently and in the largest numbers at the Kaipara, Manukau and Kawhia Harbours and at Lake Ellesmere (Table 4; Appendix 4). Black stilts and dark hybrids were also regularly seen in smaller numbers at Tauranga Harbour (Matahui Point) and Mokau Estuary. The monthly breakdown of the records reveals that while nearly all sites had birds recorded in winter, there were also summer records of smaller numbers of birds from many sites, which could refer to sub-adult non-breeding birds. For many sites, November was the only summer month during which birds were recorded, but this may reflect survey effort (OSNZ summer censuses are carried out in November) rather than the true temporal distribution of the birds.

There are now a number of records of juvenile or sub-adult stilts being seen at coastal sites around New Zealand, mostly during the non-breeding season; sites include Kaipara Harbour (CSN 44/2), Kawhia Harbour (CSN 38/4), Lake Ellesmere (Reed 1987), Washdyke Lagoon (CSN 48/2), the mouth of the Rakaia River (CSN 48/2), and Brighton, Otago (CSN 02/03 unpubl. data). It is not clear from published information how widely young birds wander around the country or when they typically return to the breeding grounds. Pierce (1984b) recorded one node-I bird that had been colour-banded as a juvenile on the Cass

TABLE 4. IMPORTANT WINTERING SITES FOR BLACK STILTS (*Himantopus novaezelandiae*).

Site rank is based first on the number of years in which black stilts have been recorded in the past 14 years, and second on maximum number seen (black: B; and hybrid: H) (see Appendix 4). A site is designated 'critical' if it regularly holds 30% or more of the total population of this species; sites that also hold more than 100 or more than 1000 Arctic-migrant shorebirds are indicated (+ = yes; – = no).

RANK	SITE	YEARS SEEN (1990–2004)	MAX. NUMBER		CRITICAL SITE?	ARCTIC MIGRANTS	
			B & H	B		≥ 100	≥ 1000
1	Upper Waitaki Basin	14		48[a]	+	–	–
2	Kawhia Harbour	14	16	7	–	+	+
3	Lake Ellesmere	13	18	7	–	+	–
4	Manukau Harbour	12	7	?	–	+	+
5	Kaipara Harbour	11	7	4	–	+	+
6	Tauranga Harbour	8	6	4	–	+	+
7	Mokau Estuary	7	2	1	–	–	–
8	Ashley Estuary	5	4	1	–	+	–
9	Wainono Lagoon	5	3	1	–	–	–
10	Firth of Thames	5	2	1	–	+	+
11	Motueka Sandspit	4	4	0	–	+	+
12	Washdyke Lagoon	4	2	1	–	–	–
13	Farewell Spit	4	2	0	–	+	+

[a] Maloney & Murray (2002).

River Delta on 8 January 1980 and was subsequently sighted in the Manukau Harbour on 7 October 1981, before returning to the Cass River to breed in the 1982–1983 season. Woolley (1994) also recorded sub-adults in a North Island harbour during the breeding season (two banded sub-adults at Kawhia in November 1993), suggesting that at least part of the non-breeding population spends the summer (as well as winter) in North Island estuaries.

The most important wintering sites for black stilts are shown in Table 4. The sites ranked 1–5 are clearly of major importance to black stilts, whether ranking is based on years seen or maximum numbers. All four of the most significant North Island wintering sites for the taxon have 1000 or more Arctic migrants.

Movements

There is currently little published information about colour-band sightings on the routes taken by birds migrating to and from sites outside the Upper Waitaki Basin. Observations at coastal sites in Canterbury suggest that after leaving the Mackenzie Basin, black stilts regularly pass through four coastal sites in Canterbury: Lake Ellesmere, Wainono Lagoon, Washdyke Lagoon, and the Ashley Estuary (A. Crossland, pers. comm.; Appendix 4). Excluding Lake Ellesmere, there appear to be more recent records from coastal Canterbury sites in June than in other months; however, again this may reflect effort (OSNZ winter wader surveys are undertaken in June).

Regular records from Taranaki estuaries suggest that stilts migrate along the west coast of the North Island: a colour-banded hybrid was seen at Waiongana Estuary in January 1999, a single node-I bird was seen at Mohakatino Estuary in late July 1999, a dark 'smudgy all over' stilt was seen at Mokau Estuary in early October 2001, a colour-banded black stilt was seen at Mokau Estuary in January 2002, and another dark hybrid was seen at Mokau Estuary from late June to early August 2002 (B. Hartley, pers. comm.). There have also been frequent sightings of a single unbanded dark hybrid throughout winter at Mokau, which may be the same bird returning each year (B. Hartley, pers. comm.). It should be noted, however, that few sites are monitored regularly enough to record short stopovers of northward-moving stilts. It is unclear whether recent sightings from the Nelson region, many of which are from the last 4 years, are of staging birds, wintering birds or both. However, one colour-banded bird was seen regularly at Motueka throughout early 2004 (P. Samways, pers. comm.) and was still present in May and June, suggesting that this is a wintering site for some individuals.

A few within-year colour-band sightings have been made of birds at staging and non-breeding sites. Reed (1987) reported a black stilt family group at Lake Ellesmere in late March 1987, and noted that they had left Lake Ellesmere by June of that year. Murray & Reed (1988) noted that a banded node-I hybrid, its black partner and their two nearly pure-black banded juveniles were seen at the Ashley River mouth in February 1988. The hybrid parent and one of the juveniles were later seen at Kawhia Harbour in May 1988. This was the first confirmed record of a juvenile black stilt in the North Island in the 20th century. On 18 August 1988, a colour-banded black stilt was seen at Lyttelton Harbour with 41 pied stilts; all had departed by the following day (Crossland 1988). Crossland (1988) noted that this was almost certainly one of the birds

that had been seen at Kaipara Harbour in May of that year (full details of the band combination were not obtained), and that this party of stilts appeared to be making a brief stop on their southward migration back to the Mackenzie Basin.

Overlap with Arctic migrants

Every year, about 10%–15% of the black stilt population migrates to coastal sites for the non-breeding season (February–July). There they come into contact with large numbers of Arctic migrants in February and March; following this, from April to July, they are in contact with smaller numbers of the sub-adult Arctic migrants that remain in New Zealand for the austral winter. Large numbers of Arctic migrants occur in most of the North Island sites where black stilts winter: of the six top-ten sites in the North Island, five have 1000 or more Arctic migrants (Table 4).

Discussion

Outside the Mackenzie Basin, black and dark-hybrid stilts use many sites frequented by Arctic-migrant shorebirds. The potential for disease transfer between the two groups exists, but because of the very small number of black stilts the risk is probably low. It would appear that more numerous species (pied oystercatcher, banded dotterel and wrybill) are more likely to transfer disease into the Mackenzie Basin from coastal estuaries. However, should any strain that is pathogenic in black stilts be transferred to the basin by any route, the potential threat to this critically endangered species would be very high.

Our survey has identified the important wintering sites for black stilts, but a detailed description of movement patterns away from the breeding grounds using band-sighting data remains to be made. Despite the recommendation of the kaki technical audit that existing information on black stilt movements should be analysed and published by December 1997 (Saunders et al. 1996), sighting information has yet to be analysed and was not available for inclusion in this report. The analysis is, however, in progress (R. Maloney, pers. comm.). Therefore, there is currently little published information on the movements of sub-adult black stilts that leave the Upper Waitaki Basin as juveniles in late summer. Reports of sub-adults in North Island estuaries in October and November suggest that at least some individuals may not return to the Upper Waitaki Basin until they are ready to begin breeding at 2 or 3 years of age. Similarly, although it may be assumed that it is the same members of the population and their offspring that make the annual migrations to coastal sites each year, colour-banding data are required to confirm this. It is also not clear how many of the black stilts and dark hybrids reported from coastal sites in the last 20 years are derived from the cross-fostering trials of the 1980s. Once the colour-banding data have been published, we will have a much clearer picture of the role that sites outside the Upper Waitaki Basin play. However, it is evident that Kawhia Harbour has been a North Island stronghold of black stilts for many decades. It is worth noting that as recently as 14 June 2003 an unbanded, apparently pure black stilt was seen at Kawhia Harbour (OSNZ Waikato 2003), despite the current intensive management of the black stilt population.

3.5 NEW ZEALAND DOTTEREL (TUTURIWHATU PUKUNUI, *Charadrius obscurus*)

The New Zealand dotterel is a large endemic plover with a total population size of c. 1950 individuals (JED, unpubl. data). It is classified internationally as Endangered (BirdLife International 2005). There are two subspecies: the nominate (southern New Zealand dotterel, *C. o. obscurus*), which has a small number of individuals and is largely confined to Stewart Island, and the northern New Zealand dotterel (*C. o. aquilonius*), which is more numerous and is widely distributed in coastal areas of the North Island. Because there are significant morphological and ecological differences between these two subspecies, and they have disjunct breeding and wintering ranges (Dowding 1994), they are considered separately here.

3.5.1 Southern New Zealand dotterel (*C. o. obscurus*)

Introduction

The southern New Zealand dotterel once bred widely in the South Island, but for at least the past 50 (and possibly 100) years breeding has been confined to Stewart Island (Dowding 1999b). The population there reached a minimum of 62 individuals in 1992 (Dowding & Murphy 1993), but has recovered following intensive management, and numbered c. 250 birds in autumn 2005 (P. Dobbins, pers. comm.). It is ranked Category 1 Nationally Critical, with the qualifiers CD (Conservation Dependent), HI (Human Induced) and OL (One Location) (Hitchmough & Bull 2004). On Stewart Island, predation of adult birds (particularly males) by feral cats (*Felis catus*) and possibly rats (*Rattus* spp.) is the major threat to the taxon; predator control at important breeding sites has increased survival (Dowding 1999c).

Important breeding sites

All confirmed breeding records from the South Island were inland (Dowding 1999b). Known breeding locations on Stewart Island are also inland, mainly on subalpine herb-fields and rocky areas. Pairs disperse over many parts of the island to breed; pairs do not normally breed in close proximity to each other (unlike the northern subspecies, which may do so on sand spits or at river mouths), but the population is clumped on favoured hilltops with suitable habitat. Known breeding sites were listed by Dowding & Murphy (1993) and updated by Charteris & Taylor (1997); breeding strongholds have included the ridge west of Mt Anglem, Mt Rakeahua, the northern part of the Tin Range (particularly around Table Hill), and several bare tops in the south of the island around Smiths Lookout. A further survey is planned for the 2004/05 season (P. Dobbins, pers. comm.).

Important non-breeding sites

The important wintering sites for the southern New Zealand dotterel are few and well known. There are three flocks, which together normally hold at least 90% of the total wintering population, with the few remaining birds (mostly juveniles) wandering the coast of the South Island (Dowding & Murphy 1993). Details of the three regular flock sites are shown in Table 5; two of the flock

TABLE 5. WINTERING SITES FOR SOUTHERN NEW ZEALAND DOTTERELS (*Charadrius obscurus obscurus*).

Site rank is based on the maximum figure in the range of recent counts. A site is designated 'critical' if it holds 30% or more of the total population of this species; sites that also hold more than 100 or more than 1000 Arctic-migrant shorebirds are indicated (+ = yes; – = no).

RANK	SITE	RANGE OF COUNTS	CRITICAL SITE?	ARCTIC MIGRANTS ≥ 100	ARCTIC MIGRANTS ≥ 1000
1	Paterson Inlet / Mason Bay	105–120	+	+	–
2	Awarua Bay, Southland	46–59	+ / –[a]	+	–
3	Cooks Arm, Port Pegasus	14–24	–	–	–

[a] Normally holds 25%–29% of the population; reached 31% in 2003 (DOC, Stewart Island).

sites are on Stewart Island and the third is at Awarua Bay on the south coast of the South Island. Individual counts for these flocks over the past 4 years are given in Appendix 5.1, Table A5.1.1 (the population has grown rapidly since 1995 and earlier counts are not representative of the current situation).

Records from South Island sites other than Awarua Bay since 1985 are shown in Appendix 5.1, Table A5.1.2, and discussed under 'Movements' below.

Movements

Movement patterns of the southern New Zealand dotterel are reasonably well understood (Dowding & Murphy 1993). Birds leave the hill-top breeding grounds, typically in January, and join one of the three post-breeding flocks, remaining there until August. The largest of these flocks is highly mobile, feeding on the Freshwater Flats, roosting at Mason Bay by day and roosting at The Neck, Paterson Inlet, at night (Dowding & Murphy 1993). Occasionally, small numbers of wandering juveniles are found roosting at The Neck by day (JED, unpubl. data), but the majority of the population moves in a predictable fashion. Adults are normally highly faithful to their flock sites. Dowding & Murphy (1993) detected no movement of any banded adult between flocks, but a single exception has since been noted: a recently divorced female (possibly attempting to find a new mate) moved between the Cooks Arm and Mason Bay flocks in April 1999 (Dowding 1999c).

There are no obvious links between breeding and wintering sites, e.g. birds from the largest breeding site on Table Hill winter at all three flocks, and several cases are known of the two members of a pair wintering at different flocks (Dowding & Murphy 1993). During the breeding season, there are some local movements: juveniles and unpaired birds have been detected moving between breeding areas, and off-duty adults breeding at Table Hill and Mt Rakeahua feed on the Freshwater Flats, Paterson Inlet (JED, unpubl. data).

Juvenile New Zealand dotterels of both subspecies wander more widely than adults (Dowding & Murphy 1993; Dowding 2001a). A small number of juvenile southern New Zealand dotterels (and the occasional adult) are seen almost annually around the coast of the South Island as far north as Farewell Spit. Sightings since 1985 are shown in Appendix 5.1, Table A5.1.2. The records

from New River (Invercargill) Estuary and Oreti Beach are not surprising, as both are close to Awarua Bay (and just as close to Stewart Island as Awarua Bay is). Most birds at these sites were present for short periods (up to several days) (Barlow 1993). There are many more records from the South Island east coast than from the west coast, but this may simply reflect the smaller number of estuaries and the lower number of observers on the west coast. Colour-banded birds from Stewart Island have so far been seen at Westhaven Inlet, Farewell Spit, Motueka, Wairau Lagoons and Ashley Estuary (Dowding & Murphy 1993; JED, unpubl. data). Dowding & Murphy (1993) noted that none of the many northern New Zealand dotterels that were colour-banded in the North Island had ever been seen at Farewell Spit (or elsewhere in the South Island), suggesting that most or all South Island records were of the southern subspecies wandering from Stewart Island. To date, there are no records to contradict this suggestion.

Age at first breeding for southern New Zealand dotterels is normally 2 or 3 years (JED, unpubl. data). Records of birds at Farewell Spit and Motueka Sandspit in November (CSN 37/3&4) may suggest that not all first-year birds return to Stewart Island in spring.

Overlap with Arctic migrants

In spite of its relative isolation, small size and small breeding range, most of the southern New Zealand dotterel population is in annual contact with Arctic migrants. The Paterson Inlet and Awarua Bay flocks combined typically hold 85%–90% of the southern New Zealand dotterel population, and both are in contact with moderate numbers of Arctic migrants: there are commonly 200–400 bar-tailed godwits in Paterson Inlet (Dowding 1999a) and there is a count from Awarua Bay of 632 godwits on 6 February 1998 (CSN 48/2). The small flock at Port Pegasus is probably rarely (if ever) in contact with Arctic migrants (JED, pers. obs.). The small numbers of birds wandering the South Island are commonly seen at estuaries that hold moderate or large numbers of Arctic migrants (notably Farewell Spit; Appendix 5.1, Table A5.1.2).

Discussion

With the exception of a few birds wandering along the South Island coast, this taxon has a limited and predictable range, encompassing Stewart Island and a few nearby sites on the Southland coast. Many southern New Zealand dotterels are in annual contact with Arctic-migrant shorebirds, and there is therefore potential for disease transfer. Since other coastal birds on Stewart Island, e.g. variable oystercatcher, yellow-eyed penguin (*Megadyptes antipodes*) and even kiwi (*Apteryx australis*), are also in contact with Arctic-migrant shorebirds, they could be infected by them directly just as easily as via southern New Zealand dotterels. Southern New Zealand dotterels do also have the potential to carry disease to their hill-top breeding grounds, where non-coastal species could be infected; however, since individuals are thinly spread during the breeding season, this risk is considered relatively slight.

The total southern New Zealand dotterel population is small and closely monitored, and there are relatively few major gaps in information about movement patterns and wintering sites. The current breeding range is

reasonably well known, but will require periodic updating as the population responds to management. Given the apparent sensitivity of this taxon to mustelids and cats, the breeding range seems likely to remain confined to Stewart Island in the short term, and successful re-colonisation of former breeding areas in the South Island seems very unlikely (Dowding 1999b). Whether the number of post-breeding flocks will increase as the population grows is unknown. A flock of 20 birds was seen at Doughboy Bay in April 2003, but it is not clear whether this was part of the Mason Bay flock on a short-term feeding trip.

The recent sharp increase in population size since intensive management began in 1995 indicates that productivity has been high in recent years; an increase in the number of sightings of juvenile southern New Zealand dotterel wandering the South Island coastline might have been expected as a result, but does not seem to have occurred (Appendix 5.1, Table A5.1.1).

Numbers of southern New Zealand dotterel are still low, and Paterson Inlet (where the Mason Bay flock feeds and roosts at night) is critical habitat for the taxon, with close to two-thirds of the entire population found there in autumn and winter (Dowding 1999a). Awarua Bay, Southland, is also close to critical status, with the 30% threshold having been exceeded for the first time in autumn 2003.

3.5.2 Northern New Zealand dotterel (*C. o. aquilonius*)

Introduction

Northern New Zealand dotterels are widely and thinly spread around the coast of the North Island, mainly north of a line between Taranaki and northern Hawke's Bay. In the southern part of that range, the taxon is relatively uncommon. There are few pairs remaining on the west coast, south of Port Waikato; on the east coast, there has been recent colonisation of the area between East Cape and Portland Island (Foreman 1991), but the population in this area is still small. In recent years, numbers have declined in all parts of the North Island west coast (Far North, Northland, Auckland and Waikato), and more than 80% of the total population is now found on the east coast between North Cape and East Cape (Dowding & Davis 2004).

In a national census undertaken in October 2004, the total population numbered c. 1700 birds. The total effective population is estimated at c. 1400 individuals (700 pairs) (JED, unpubl. data). Nationally, the taxon is ranked Category 3 Nationally Vulnerable, with the qualifiers CD (Conservation Dependent) and ST (Stable) (Hitchmough & Bull 2004).

Important breeding sites

Favoured breeding habitat includes sandy beaches (particularly at stream or river mouths), sand spits at the mouths of estuaries, and shell banks and sandbars in harbours (Heather & Robertson 1996). However, northern New Zealand dotterels also use a range of other substrates, notably in urban areas; these include grass (golf courses, margins of airport runways, motorway verges and lawns) and bare earth or shingle (construction sites, spoil heaps and

quarries). They are generally absent or scarce on long stretches of rocky coastline.

The breeding-season distribution of northern New Zealand dotterels is well known from national censuses carried out in 1989, 1996 and 2004. Members of this subspecies breed at a large number of sites, but in October 1996 were concentrated in Northland (48% of the population) and in the Auckland / South Auckland region (23%). A further 12% were on the Coromandel Peninsula and 9% in the Bay of Plenty (JED, unpubl. data). The number of pairs now breeding on the Waikato coast is small and declining, and there is a real risk that breeding sites will be lost unless management is undertaken very soon. Northern New Zealand dotterels breed on a number of offshore islands (see list in Marchant & Higgins 1993), but because suitable habitat is usually limited, these populations tend to be small. There is, however, a population of 55–60 birds on Great Barrier Island (JED, unpubl. data).

A list of sites that regularly hold 1% of either the effective or total population (six or more pairs, or 15 or more adult birds) during the breeding season is shown in Appendix 5.2, Table A5.2.1. It should be noted that northern New Zealand dotterels are often thinly spread along long stretches of beach (e.g. parts of the Northland west coast and Great Exhibition Bay), so that defining sites is inevitably subjective. In addition, some records are of pairs and others are of total birds (the latter often including non-breeders), making comparisons between sites difficult. Breeding sites for this subspecies are therefore not ranked.

The draft recovery plan (Dowding & Davis 2004) identifies 'key' breeding sites as those holding ten pairs or more. A list of the most important breeding sites is shown in Table 6; this includes sites that definitely or probably hold ten pairs and / or 30 birds or more within a limited area during the breeding season.

TABLE 6. KEY BREEDING SITES FOR NORTHERN NEW ZEALAND DOTTERELS (*Charadrius obscurus aquilonius*).

A site is designated 'critical' if it regularly holds 30% or more of the total population of this taxon; sites that also hold more than 100 or more than 1000 Arctic-migrant shorebirds are indicated (+ = yes; – = no).

SITE	RANGE OF RECENT COUNTS		CRITICAL	ARCTIC MIGRANTS	
	PAIRS	TOTAL BIRDS	SITE?	≥ 100	≥ 1000
Kokota Spit / Parengarenga Harbour	16	25–39	–	+	+
Waipu Estuary	14–16		–	+	–
Mangawhai	30–35		–	+	–
Omaha Spit / Whangateau Estuary	8–10	22–28	–	+	–
South Kaipara Head	c. 12	27–38	–	+	+
Whangapoua Beach, Great Barrier Island	8–11		–	–	–
Waikawau Bay	10–11		–	–	–
Opoutere	13–17		–	+	–
Matakana Island[a]	31–41		–	+[b]	+[b]

[a] At least three or four separate breeding areas managed as a unit.

[b] Numbers of Arctic migrants in Tauranga Harbour, not necessarily on Matakana Island.

Other sites shown in Appendix 5.2, Table A5.2.1 may qualify for 'key' status, but either recent data are lacking (e.g. Waikuku / Whareana), or they cover a large area (e.g. Bay of Islands). Together, the nine sites listed in Table 6 currently hold at least 150 pairs, or 25% of the total effective population.

Important non-breeding sites

Northern New Zealand dotterels rarely undertake large-scale post-breeding movements, and flock sites are numerous and widely spread around the North Island coastline. Flocks are typically at or near tidal estuaries, and contain the breeding birds from a limited stretch of nearby coastline and a variable number of local and wandering juveniles (Dowding & Chamberlin 1991). Most flock sites that regularly hold 15 or more birds (the 1% level) are known from national censuses undertaken in March 1990 and 1997; later information comes from annual monitoring (part of the New Zealand dotterel recovery programme), and from records in CSN. The top-ten wintering sites for northern New Zealand dotterel are shown in Table 7, and the list of all sites containing 1% or more of the total population is presented in Appendix 5.2, Table A5.2.2.

The draft recovery plan (Dowding & Davis 2004) identifies 'key' flocking or feeding sites as those regularly holding 30 birds or more outside the breeding season. All of the top-ten wintering sites are, therefore, key sites.

As noted by Sagar et al. (1999), the winter wader counts conducted by OSNZ (in June) do not provide comprehensive coverage of the wintering sites used by either subspecies of New Zealand dotterel. Flocks of the northern subspecies peak in numbers in February–March, and the first birds return to their breeding sites from late April; in addition, some birds remain on breeding territories year-round or visit small flocks that are not covered during the national counts (Dowding & Chamberlin 1991).

TABLE 7. TOP-TEN WINTERING SITES FOR NORTHERN NEW ZEALAND DOTTERELS (*Charadrius obscurus aquilonius*).

Site rank is based on the maximum figure in the range of counts. Range data are from Sagar et al. (1999) or Appendix 5.2. A site is designated 'critical' if it regularly holds 30% or more of the total population of this taxon; sites that also hold more than 100 or more than 1000 Arctic-migrant shorebirds are indicated (+ = yes; – = no).

RANK	SITE	RANGE OF COUNTS	CRITICAL SITE?	ARCTIC MIGRANTS	
				≥ 100	≥ 1000
1	Mangawhai Estuary	112–150	–	+	–
2	Mid-south Kaipara Harbour	93–140	–	+	+
3	Tauranga Harbour	16–119	–	+	+
4	Matarangi Spit	68–104	–	+	+
5	Ohiwa Harbour	62–99	–	+	+
6	Kokota Spit / Parengarenga	19–96	–	+	+
7	Omaha Spit	52–83	–	+	–
8	Whangarei Harbour	27–78	–	+	+
9	Maketu / Pukehina	18–65	–	+	–
10	Rangaunu Harbour	13–64	–	+	+

Movements

Movement patterns of northern New Zealand dotterels are reasonably well known. Annual movements of adults between flocking and breeding sites were described by Dowding & Chamberlin (1991) for a study area on the North Auckland east coast; band sightings since that time have confirmed that the same pattern occurs on other stretches of coastline in Auckland, Coromandel Peninsula, Bay of Plenty and on Great Barrier Island (JED, unpubl. data). Adults typically move to post-breeding flocks in January (later if rearing late broods), and flock numbers peak between February and early April. In most cases, adults move less than 50 km between breeding and flocking sites and usually much less than this; in some cases, the flock site is also a breeding site, so that some birds do not move at all. The return to breeding sites is protracted, with the first birds leaving the flock in late April, while others may remain until July. As long as both members of a pair survive, annual movements of breeding adults are highly predictable (Dowding & Chamberlin 1991). Movement between flocks or breeding sites by adult birds is detected occasionally and is almost always a result of mate loss or divorce (Dowding & Chamberlin 1991; unpubl. data).

As a result of an extended colour-banding study, there is a considerable amount of information available on dispersal of juvenile northern New Zealand dotterels (Dowding 2001a). Dowding (2001a) showed that, in contrast to breeding adults, juveniles are highly mobile and may travel long distances in the c. 18 months between fledging and the normal onset of breeding. Natal dispersal distance (the distance between natal site and the site of first breeding) averaged 31 km; 18% of birds bred at their natal site (often after extensive pre-breeding movements), and nearly all birds (93%) bred within 70 km of their natal site (Dowding 2001a).

Dowding (2001a) also showed that there are currently two regional populations of northern New Zealand dotterel, with little or no gene-flow between them: one consists of birds in Northland and Auckland, the other of birds on Coromandel Peninsula and Bay of Plenty (including Great Barrier Island). Although a small number of sub-adults did move between these areas during pre-breeding movements, there was no natal dispersal detected between them and no breeding dispersal by adults between them (Dowding 2001a). It is not clear whether any other isolated populations exist; if they do, they are likely to be in the Far North or on the west coast.

Overlap with Arctic migrants

There is extensive spatial overlap between northern New Zealand dotterels and Arctic migrants. There is considerable overlap during September–December at sites where northern New Zealand dotterels breed, feed and roost in estuaries frequented by Arctic migrants. The proportion of the total northern New Zealand dotterel population in contact with Arctic migrants increases from January to April, when post-breeding flocks of this subspecies are typically found at many of the larger estuaries that hold big flocks of bar-tailed godwits and lesser knots. All of the top-ten wintering sites for the taxon have more than 100 Arctic migrants, and seven sites have over 1000.

Discussion

Habitat networks currently used by this taxon have been largely identified, and movement patterns of adults and juveniles (which differ) are both reasonably well known. There is significant overlap in range between northern New Zealand dotterels and Arctic migrants; thus, there is the potential for disease transfer between them. Adult northern New Zealand dotterels generally move short distances between wintering and breeding sites and would not spread disease nearly as widely as some other indigenous-breeding species (notably the north-south internal migrants, such as pied oystercatchers and wrybills). Juvenile northern New Zealand dotterels wander more widely than adults, but tend to remain in coastal areas of the northern half of the North Island.

The current distribution of breeding sites (nearly all coastal) and of post-breeding flock sites (typically at larger estuaries) are well known as a result of three national censuses and subsequent monitoring by OSNZ. The population is concentrated in Northland and Auckland Conservancies, which between them hold almost 75% of individuals in the taxon. Northern New Zealand dotterels on the North Island west coast are the least well known and appear to be declining rapidly in numbers (Dowding 2001a). Information on breeding distribution there needs to be updated. Apart from Kaipara and Manukau Harbours, west-coast flock sites are visited less frequently, so that data on numbers, movements and catchment areas of each flock are limited.

Since the majority of the northern New Zealand dotterel population is now concentrated on part of the North Island east coast, it is likely that pressures imposed by development and growing recreational use of that coastline will increasingly impact on breeding, roosting and feeding habitat for most members of the population. Some measures to protect the most important sites are proposed in the new recovery plan (Dowding & Davis 2004). Funding for management of the North Island west-coast habitat is urgently required if the present range of this taxon is to be maintained (Dowding & Davis 2004).

3.6 BANDED DOTTEREL (TUTURIWHATU, *Charadrius bicinctus*)

The banded dotterel is an endemic plover found in the North, South, and Stewart Islands, and on two outlying island groups. Internationally the species is not considered threatened (BirdLife International 2005). There are two distinct subspecies: the nominate subspecies (*C. b. bicinctus*), which is found on mainland New Zealand, Stewart Island and the Chatham Islands, and the Auckland Island banded dotterel (*C. b. exilis*), which is confined to the Auckland Islands.

3.6.1 Banded dotterel (*C. b. bicinctus*)

Introduction

The banded dotterel breeds only in New Zealand, but more than half of the national population spends the non-breeding season in Australia (Pierce 1999), where it is known as the double-banded plover. The total population of banded dotterels has been estimated to exceed 50 000 birds (Heather & Robertson 1996; Pierce 1999), but the taxon is believed to be declining. Nationally it is considered threatened and is ranked Category 5 Gradual Decline (Hitchmough & Bull 2004).

Important breeding sites

The main breeding habitats used by banded dotterels are 'dry, open, stable areas of shingle, sand or stones, on riverbeds, lakeshores, seashores, fields or mountain tops and slopes' (Bomford 1986). Banded dotterels return to the breeding grounds from July to September, and lay from July to December (Heather & Robertson 1996). Pairs show high nesting-site fidelity, although juveniles (particularly females) often choose to nest some distance from their natal site (Pierce 1989).

Banded dotterels breed throughout much of mainland New Zealand, and on offshore and outlying islands, such as Great Barrier Island (Bell & Brathwaite 1964), Stewart Island (Child 1985), and the Chatham Islands (Freeman 1994; Nilsson et al. 1994). However, the main breeding concentrations are found in the shingle riverbeds of Hawke's Bay, Manawatu and the Wairarapa, and in the braided riverbeds of Marlborough, Canterbury, Otago and Southland (Heather & Robertson 1996). Around 20% of the total population breeds in Canterbury: 5000 pairs breed on the region's riverbeds and river terraces, coastal lakes, lagoons and beaches, and another 5000 pairs breed on rivers in the Mackenzie Basin (Heather & Robertson 1996).

Recent counts on the breeding grounds are scarce (Appendix 6, Table A6.1) and account for less than 10% of the estimated total population (50 000 birds; Pierce 1999). Based on OSNZ banding studies, R.J. Pierce (pers. comm.) has provided a list of additional breeding areas that probably hold 250 birds or more (Appendix 6, Table A6.1, footnote a). In addition to these sites, there are many small but cumulatively important population clusters in coastal Southland and coastal Canterbury (which exhibit different migration patterns to the large inland populations), as well as in Marlborough, on Westland beaches (e.g. CSN 36/3),

the Volcanic Plateau, and many North Island beaches north to Spirits Bay (R. Pierce, pers. comm.). Innes et al. (1982), during a survey of Tongariro National Park and environs in January 1982, found more than 70 birds and suggested that as a rough estimate up to 200 breeding birds were present. Birds also breed on the Waikato coast (at Waikorea, Ruapuke, Aotea and Kawhia Harbours, Taharoa and Marokopa; CSN 35/4), on riverbeds in the Nelson region (CSN 35/4), and in subalpine areas of Central Otago (Child 1969).

Declines have been noted at several breeding sites. Maloney (1999) compared spring counts of banded dotterels in nine rivers in the Upper Waitaki Basin from the 1960s with spring counts from the same areas from 1991 to 1994, and found that banded dotterel densities in the 1990s were only 20%–70% of those of the 1960s. Local breeding populations have also been lost from some sites, such as Taupo in the 1930s (Armstrong 1962), the western Firth of Thames since the 1980s, where one pair with chicks was seen at Miranda in 1983 (B. Chudleigh, pers. comm.) and no breeding is known of for the last 11 years (K. Woodley, pers. comm.), and in the Bay of Plenty from Tauranga to Whakatane and as far east as Ohope Spit and the Waiaua river mouth, since the 1980s (B. Chudleigh, pers. comm.).

Important non-breeding sites

Within 2 weeks of the chicks fledging, the family group disbands and birds join local post-breeding flocks (Pierce 1989). Although banded dotterels are fairly sedentary at some northern and coastal sites, other birds, especially those from inland South Island sites, move to coastal areas where they may over-winter or stop off temporarily before migrating further afield (Pierce 1999). Not all birds from inland South Island sites migrate: flocks of up to 50 birds remain on the western shores of Lake Wanaka in Central Otago throughout the non-breeding season (Child 1967), and small numbers of birds also winter in the Mackenzie Basin (Pierce 1999).

Monthly counts and banding studies have revealed that Lake Ellesmere is an important staging site for post-breeding banded dotterels that winter in Australia (O'Donnell 1985; Pierce 1999); in 1988, for example, there were 2900 birds on 19 February, but this declined to 459 in April (CSN 36/3). Numbers also peak in January–February at other staging sites, including Wainono Lagoon (= Lake Wainono) (Pierce 1980b), the Ashley Estuary, and braided river mouths in South and mid-Canterbury, such as the Rakaia, Rangitata, Ashburton and Waitaki Rivers (A. Crossland, pers. comm.). New River Estuary in Southland may also be a staging site for further migration (Appendix 6, Table A6.2). There is no evidence that Farewell Spit is a staging ground for further migration, but the Bay of Plenty may be. Many birds banded on breeding grounds in the South Island (especially Marlborough) were seen in the Bay of Plenty in January–February, but few were seen later (Pierce 1999).

Approximately 20 000 banded dotterels are estimated to remain in New Zealand over winter. Sites that regularly hold 200 birds (1% of the total New Zealand wintering population) are shown in Appendix 6, Table A6.2. The top-ten sites are shown in Table 8.

Large declines in the numbers of birds at some New Zealand wintering sites are evident. Fleming & Stidolph (1951) recorded more than 1000 banded dotterels

TABLE 8. TOP-TEN WINTERING SITES FOR BANDED DOTTERELS (*Charadrius bicinctus bicinctus*) IN NEW ZEALAND.

Site rank is based on the maximum figure in the range of counts. Range data are from Sagar et al. (1999) or, where that has been exceeded, Appendix 6. A site is designated 'critical' if it regularly holds 30% or more of the total population of this species; sites that also hold more than 100 or more than 1000 Arctic-migrant shorebirds are indicated (+ = yes; – = no).

RANK	SITE	RANGE OF COUNTS	CRITICAL SITE?	ARCTIC MIGRANTS ≥ 100	ARCTIC MIGRANTS ≥ 1000
1	Lake Ellesmere	305–2900	–	+	–
2	Parengarenga Harbour	141–1600	–	+	+
3	Farewell Spit	447–1442	–	+	+
4	Kaipara Harbour	85–1200	–	+	+
5	Manukau Harbour	63–963	–	+	+
6	Tauranga Harbour	6–743	–	+	+
7	Whangarei Harbour	5–689	–	+	+
8	Ohiwa Harbour	228–676	–	+	+
9	New River Estuary	129–600	–	+	+
10	Kawhia Harbour	16–543	–	+	+

at Waitakaruru (south-west Firth of Thames) in June 1949, and 2000 in March 1950, whereas on average less than 250 banded dotterels were counted in the Firth of Thames during the winters of 1984–1994 (Sagar et al. 1999). Fleming & Stidolph (1951) also recorded 3000 birds at Ohiwa Harbour in June 1949, while an average of 404 (maximum 676) banded dotterels were counted there from 1984 to 1994 (Sagar et al. 1999). In many cases, these lower counts probably reflect declines in the total population, but some could be a result of changes in site allegiance (as is probably the case for wrybills in the Firth of Thames).

An estimated 30 000 banded dotterels migrate to Australia annually (Heather & Robertson 1996); important wintering sites there are shown in Appendix 6, Table A6.3. There are records of many thousands of birds at some Australian sites, including a count of 10 000 birds at Egg Lagoon, King Island, near Tasmania in August 1959 (Green & McGarvie 1971, cited in Schulz 1990). More than 4000 birds are believed to winter in Tasmania alone (Pierce 1987). However, the maximum counted in Australia from 1981 to 1985 was c. 5600 in June 1985 (Lane 1987), and recent counts have found fewer banded dotterels: 2310 birds in winter 2001 (Skewes 2002) and 2799 birds in winter 2002 (Skewes 2003). It is likely that many important banded dotterel wintering sites in Australia have never been identified, a task made more difficult by the nomadic behaviour of some flocks: Appleby (1992) notes that the numbers using inland sites in the Colac Region were very variable and appeared to be at least partly dependent on environmental factors, such as heavy rains.

Three sites identified as of international importance to banded dotterels (Corner Inlet, Port Phillip Bay and Bellarine Peninsula, and Western Port in Victoria, all of which hold more than 500 banded dotterels), are listed under the Ramsar Convention (Ramsar List 2004) and have been included in the EAA Flyway site network (Loyn et al. 2001).

Small numbers of banded dotterels are also seen on islands in the SW Pacific and Tasman Sea. Records include:

- Fiji—regular sightings from March to August (Morgan & Morgan 1965; Smart 1971).
- Norfolk Island—from late February to August (Moore 1985, 1999; Endersby 1994), including one record of up to 60 individuals in June 1983 (Hermes et al. 1986).
- Lord Howe Island—occasional records of small flocks (Hutton 1968, cited in Endersby 1994).
- Vanuatu (McAllan 2003).
- New Caledonia (Garrett & Garrett 1975).

More surprisingly, in April 1980 Pierce (1980a) saw a banded dotterel on Enderby Island in the Auckland Islands, roosting and foraging with Auckland Island banded dotterels (*C. b. exilis*).

Movements

The 1985–1990 colour-banding study of banded dotterels undertaken by OSNZ provided much of what is known about banded dotterel migration. Pierce (1999) summarised its findings as follows:
'Sight-recoveries indicated that most birds in inland regions of the southern half of the South Island migrated to Australia, but coastal breeding birds in the South Island were mostly sedentary. Inland birds north of Canterbury mostly moved within New Zealand, particularly to harbours in the North Island but with regionally specific patterns—Westland birds mainly to Farewell Spit, Marlborough birds to the northern North Island and Farewell Spit, southern North Island birds either locally or to the Auckland region, and most Hawke's Bay and Volcanic Plateau birds to Bay of Plenty and Auckland. Breeding habitat modified this pattern; coastal birds were mainly sedentary, whereas birds on nearby inland riverbeds were migratory.'

Pierce (1989) noted that fledging date also affected whether birds were sedentary or became migratory. Winter re-sightings of chicks that fledged on the Cass River Delta in November and December were all in Australia, while chicks that fledged later in the season wintered locally on the shores of Lake Tekapo. In a later study, Pierce (1999) found that juveniles from the Mackenzie Basin left the breeding grounds earlier than adults, but that there were no differences in general winter destination amongst juveniles, adult males and adult females.

The trans-Tasman migrants arrive on their wintering grounds from February to April and depart in July and August once they have moulted into full or near-full breeding plumage (Barter & Minton 1987). Banding studies by the Victoria Wader Study Group showed high wintering-site fidelity in Australia: only 6 of 241 re-trapped marked birds had moved, and all except one were still within the same bay (Barter & Minton 1987). Unlike Arctic-breeding migrants, many of which remain on the wintering grounds during their first year, all first-year banded dotterels moult into breeding plumage and return to New Zealand for the breeding season (Barter & Minton 1987).

Although post-breeding movements occur in stages, with many birds forming post-breeding flocks before migrating to wintering grounds, pre-breeding movements tend to be direct from the wintering to breeding grounds, and usually occur in August (Pierce 1999).

Overlap with Arctic migrants

Many banded dotterels that winter in New Zealand use coastal sites frequented by large numbers of Arctic migrants, the sub-adults of which often remain in New Zealand during the austral winter. Coastal wintering sites in Australia also support high numbers of Arctic-breeding shorebirds (for example, Western Port had an annual average of 12 120 Arctic waders from 1973 to 1998; Loyn et al. 2001). The small numbers of banded dotterels wintering elsewhere in the Pacific also associate with Arctic migrants, including Pacific golden plovers, turnstones, and bar-tailed godwits (Morgan & Morgan 1965; Garrett & Garrett 1975).

The only banded dotterels unlikely to come into contact with Arctic migrants are those remaining in inland areas of the South Island during the winter (Lake Wairarapa in the North Island was visited by up to 216 bar-tailed godwits annually; Robertson & Heather 1999).

Discussion

Banded dotterels in both New Zealand and Australia winter in association with large numbers of Arctic migrants. There is clear potential for disease transfer from Australia to New Zealand (and vice-versa), within New Zealand and, to a much lesser extent, between Pacific Islands and New Zealand.

A number of information gaps exist:

1. Many major Australian wintering sites remain unidentified. Approximately 30 000 birds are believed to cross the Tasman each year (Heather & Robertson 1996), yet less than half of these have been accounted for in Australia (Appendix 6, Table A6.3).
2. An accurate, up-to-date estimate of the total population is required. Until the mid-1990s, Lane's (1987) estimate of the total population (at least 12 450 individuals, based on counts of 5600 in Australia and 6850 in New Zealand), was regarded as the most accurate assessment available (for example, see Marchant & Higgins 1993). Heather & Robertson (1996) estimated the total population to be c. 50 000, but did not elaborate on how their estimate had been reached. Pierce (1999) stated that the total population probably exceeded 50 000 individuals, based on his estimate of 4000 or more birds in Tasmania (Pierce 1987), unpublished data from the breeding grounds, and proportions of colour-banded birds seen at non-breeding sites (R. Pierce, pers. comm.). Given that this taxon is considered to be in decline (Hitchmough & Bull 2004), and that local breeding populations are being lost, a census appears to be urgently required. However, given the logistical difficulties of counting such a widely dispersed taxon during the breeding season, and the fact that many wintering sites in Australia are apparently unknown, an accurate census would be difficult at any time of the year.
3. Recent counts from many breeding areas are also lacking (see Appendix 6, Table A6.1), so that large changes in abundance at major breeding sites could easily pass unnoticed.

3.6.2 Auckland Island banded dotterel (*C. b. exilis*)

Introduction

Falla (1978) described the banded dotterels on the Auckland Islands as *C. b. exilis*, a subspecies distinct from *C. b. bicinctus* found on the New Zealand mainland, noting the larger size and different plumage of the Auckland Island birds. The subspecies is apparently restricted to the Auckland Islands, although there is insufficient evidence to determine whether the two banded dotterels recorded on Campbell Island in March 1944 were *C. b. exilis* or *C. b. bicinctus* (Falla 1978).

A survey in November 1989 located 730 Auckland Island banded dotterels: 273 on Adams Island, 440 on Enderby Island, 6 on Ewing Island, 13 on Rose Island and 1 on the main Auckland Island (Walker et al. 1991). This survey, which was the first to be carried out during the breeding season, revealed that the total population was considerably higher than had previously been estimated: 155 birds (Pierce 1980a), and less than 100 birds (Falla 1978).

The Auckland Island banded dotterel is considered Threatened, and is classified nationally as Category 7 Range Restricted, with the qualifiers ST (Stable) and HI (Human Induced; the present distribution is a result of human activity) (Hitchmough & Bull 2004).

Important breeding sites

Walker et al. (1991) recorded breeding on Enderby Island (eight nests found and many birds displaying breeding behaviour) and Adams Island (11 nests and other birds displaying breeding behaviour). Falla (1978) stated that 'there is no evidence of lack of breeding success of pairs nesting on the main island', and noted that a nest containing three eggs was found near Chambres Inlet, Auckland Island, on 4 October 1943. During their survey, Walker et al. (1991) failed to find any banded dotterels nesting on the main island, possibly because of predation by cats and pigs.

Removal of much of the forest on Enderby Island and the introduction of grazing mammals in the 19th century has created large areas of moorland, probably increasing the amount of suitable breeding habitat for Auckland Island banded dotterels (Walker et al. 1991).

Important non-breeding sites

Pierce (1980a) observed 148–155 birds foraging at Derry Castle Reef, on the northern shores of Enderby Island in April 1980, and only five birds elsewhere on Enderby. Pierce (1980a) suggested that the 155 banded dotterels present at Derry Castle Reef were probably close to the total population, as other expedition members saw no dotterels on visits to coastal areas and islands near Port Ross (at the northern end of main Auckland Island).

The congregation at Derry Castle Reef may reflect part of an annual movement. However, Walker et al. (1991) did not record how many of the 440 birds seen on Enderby in November 1989 were in this coastal area. The large disparity between the total breeding population estimate and estimates made at other times of the year may be due to Auckland Island banded dotterels migrating to an unknown location during the non-breeding season.

Movements

Movement patterns of the Auckland Island banded dotterel are not well known (Marchant & Higgins 1993). Falla (1978) suggested the birds move annually from their breeding grounds, which are over 600 m a.s.l., down to the coast, and noted that small flocks and odd pairs of post-breeding adults and some juveniles appeared on the tidal shorelines of Enderby Island in mid- to late summer. Walker et al. (1991) noted apparent nightly movements during the breeding season from higher ground down to beaches, presumably to feed, and also observed one solitary bird flying to Rose Island and another flying from Rose to Enderby Island. No banded dotterels were observed on Ewing Island during the day, but six were seen at night, suggesting that the birds were flying to the island each evening (Walker et al. 1991).

Overlap with Arctic migrants

From October to March, Derry Castle Reef is visited by small flocks of Arctic waders that associate with the banded dotterels (Falla 1978). Pierce (1980a) observed up to 100 turnstones, three grey-tailed tattlers (*Tringa brevipes*) and one *C. b. bicinctus* at Derry Castle Reef in November 1980. Turnstones were also seen on Enderby Island in December 2003 and February 2004 (N. Milius, pers. comm.). Other Arctic migrants recorded on the Auckland Islands include the Pacific golden plover, bar-tailed godwit, black-tailed godwit *(Limosa limosa),* lesser knot, red-necked stint, sharp-tailed sandpipers (*Calidris acuminata*) and curlew sandpipers *(C. ferruginea)* (Bartle & Paulin 1986; Shirihai 2002).

Discussion

Small flocks of Arctic-migrant shorebirds visit the Auckland Islands annually and are in contact with banded dotterels; therefore, there is the potential for disease transfer. It is not clear whether any banded dotterels migrate away from the Auckland Islands, but they appear to move between islands and could therefore spread disease locally.

There have been no surveys of the Auckland Island banded dotterel population since 1989 (P. McClelland, pers. comm.). More information is needed on the sites used by this subspecies during the non-breeding season. Walker et al. (1991) recommended that further investigation into the winter distribution of dotterels on the Auckland Islands should be made, and that the entire population should be checked at 5-yearly intervals.

3.7 WRYBILL (NGUTU PARE, *Anarhynchus frontalis*)

Introduction

The wrybill is a threatened endemic plover with a distinctive long bill that is curved to the right. It is classified internationally as Vulnerable (BirdLife International 2005) and by DOC as Category 3 Nationally Vulnerable (Hitchmough & Bull 2004). Threats to the wrybill population have been outlined by Dowding & Murphy (2001) and Riegen & Dowding (2003).

Wrybills breed only in braided riverbeds east of the main divide in Canterbury and Otago. From December, birds migrate north and most individuals winter in the large harbours around Auckland. It would be impossible to make accurate counts of the whole population on the breeding grounds; therefore, estimates have long been based on counts of wintering flocks in the North Island. These counts have shown considerable variability (Veitch & Habraken 1999), but in recent years the winter population has probably numbered 4500–5000 birds (Riegen & Dowding 2003). Assessing the total effective population size is also difficult, partly because the number of juveniles appears to fluctuate considerably from year to year (Hughey 1985; Sagar et al. 1999). Summer counts (made during November) from coastal estuaries (Sagar et al. 1999) suggest an average of c. 250 birds not breeding; this may be an underestimate, however, as breeding-season counts from single coastal locations (notably Lake Ellesmere and Wainono Lagoon) may occasionally be close to or exceed this total (see Appendix 7, Table A7.1). In addition, there is some evidence of a gender bias in the adult population in the Tasman River, due to the higher mortality of males (E.C. Murphy & JED, unpubl. data); as a result, there may be some adult female wrybills on the breeding grounds that are not paired. We therefore assume a total effective population size of 2000 pairs.

Important breeding sites

The breeding range of the wrybill has contracted over the past 100 years. Many of the known breeding rivers listed by Hay (1984) (and later reported in Marchant & Higgins 1993) appear to be either no longer occupied or have very few birds. The majority of individuals are currently probably found in three or four of the largest catchments: the Upper Waitaki Basin, the upper Rangitata, the Rakaia and (possibly) the Waimakariri (Riegen & Dowding 2003). Within these catchments, wrybill numbers and densities may vary considerably between areas or rivers, as found, for example, in the rivers of the Upper Waitaki basin during 1991–1994 (Maloney et al. 1997).

Identification of breeding areas of current importance for this dispersed, cryptic species is probably incomplete. Areas that are (or may be) important at the 1% level are shown in Table 9. No rivers in Otago are definitely known to have 20 or more pairs or 50 individuals at present, although the Dart is close, with four counts in the range of 30–44 birds between 1990 and 2002 (B. Lawrence, pers. comm.). A count of 21 birds was made in the Matukituki Valley in 1984, and 18 birds were counted in the Hunter Valley in 2000 (S. Thorne, pers. comm.).

TABLE 9. BREEDING AREAS OF KNOWN OR POSSIBLE IMPORTANCE TO WRYBILLS (*Anarhynchus frontalis*).

Sites are considered to be important if they hold 1% or more of the population (at least 50 birds or 20 pairs) (+ = yes; – = no; ? = uncertain).

SITE	IMPORTANCE AT 1% LEVEL	NOTES / SOURCE
Waimakariri River		
Upper Waimakariri	?	33 birds in 1981 (O'Donnell & Moore 1983). Large area of good habitat, but present status unclear; survey required.
Lower Waimakariri	+	At least 20 pairs in 2002/03 season (A. Crossland, pers. comm.).
Rakaia River		
Upper Rakaia	+	219 birds (O'Donnell & Moore 1983). At least 30 pairs in c. 7-km segment, 1999/2000 (JED, unpubl. data).
Lower Rakaia	+?	82 birds (O'Donnell & Moore 1983). Current status unknown, but four pairs and ten birds in 2 km of riverbed in Oct 2001; suggests at least 20 pairs in whole lower river (JED, unpubl. data).
Ashburton River	–?	Confirmed breeding location in Hay (1984); no birds seen during survey in Nov 2003 (C. O'Donnell, pers. comm.).
Rangitata River		
Upper Rangitata	+	216 birds in 16-km segment, 2001 (C. O'Donnell, pers. comm.).
Lower Rangitata	–?	No records in Hay (1984) or Bull et al. (1985). Less than 15 birds in 2001 (S. Butcher, pers. comm.).
Waitaki River		
Upper Waitaki Basin		
Tasman River	+	151 birds (Maloney et al. 1997)[a]. At least 30 pairs on true right-side alone during period 2000–2003 (M. Elliott & JED, unpubl. data).
Godley River	+	258 birds (Maloney et al. 1997)[a].
Cass River	+	About 100 birds (Pierce 1983); 65 birds (Maloney et al. 1997)[a].
Hopkins River	+	112 birds (Maloney et al. 1997)[a].
Tekapo River	+	At least 25 pairs during period 1999–2003 (M. Elliott & JED, unpubl. data).
Ahuriri River	+	84 birds (Maloney et al. (1997)[a].
Lower Waitaki	–	Probably very few pairs (K. Brown, pers. comm.).

[a] Minimum number of birds recorded.

Important non-breeding sites

The first attempt to identify important wintering sites and to collate counts of winter flocks was that of Sibson (1963). Since then, counts have been recorded for the period 1975–1980 by Hay (1984), for the period 1984–1994 by Sagar et al. (1999), and for May 1994 by a national census (Davies 1997). Locations of important North Island wintering sites are shown in Figure 7.1 of Hay (1984) and Figure 1 of Davies (1997). Counts of important wrybill autumn / winter flocks are shown in Appendix 7, Table A7.1; a list of the top-ten sites is provided in Table 10. All these sources show that there are two estuaries of outstanding importance to wrybills in winter: the Firth of Thames and Manukau Harbour. Together, these are estimated to hold c. 85% of the total population, and consequently have been given 'critical' site status. Counts from these two harbours for the period 1960–1998 are given in Veitch & Habraken (1999). There are also a number of significant but smaller flocks in the northern North Island (Parengarenga, Whangarei, South Kaipara, Waitemata and Tauranga Harbours), all of which typically have 100–300 birds.

There are also wintering sites for this species on the eastern and northern coasts of the South Island, notably Motueka Sandspit, Waimea Inlet and Lake Ellesmere. The numbers of birds wintering at these sites are not large (see Appendix 7, Table A7.2), but these and other coastal areas of the South Island are also clearly important to wrybills during migration (see Movements below).

TABLE 10. TOP-TEN AUTUMN / WINTER SITES FOR WRYBILLS (*Anarhynchus frontalis*).

Site rank is based on the maximum figure in the range of recent counts (Appendix 7, Table A7.1). A site is designated 'critical' if it regularly holds 30% or more of the total population of this species; sites that also hold more than 100 or more than 1000 Arctic-migrant shorebirds are indicated (+ = yes; – = no).

RANK	SITE	RANGE OF RECENT COUNTS	CRITICAL SITE?	ARCTIC MIGRANTS ≥ 100	ARCTIC MIGRANTS ≥ 1000
1	Manukau Harbour[a]	1880–2773	+	+	+
2	Firth of Thames	1591–2155	+	+	+
3	Lake Ellesmere	38–300	–	+	–
4	Kaipara Harbour[b]	180–298	–	+	+
5	Waitemata Harbour	34–208	–	+	+
6	Whangarei Harbour	52–156	–	+	+
7	Parengarenga Harbour	67–137	–	+	+
8	Tauranga Harbour	26–135	–	+	+
9	Porangahau Estuary	39–84	–	+	–
10	Wherowhero Lagoon	37–80	–	+	–

[a] Two major flocks: one upper-Manukau flock (typically 1800–2000 birds) and one south-Manukau flock (600–900 birds); both flocks occasionally break up into sub-flocks.

[b] Possibly two or three separate flocks; more data required.

Movements

Northward migration:

Hay (1984, Figure 7.6) plotted 'probable' migration routes of wrybills based on sightings recorded in CSN up to 1984. He noted that there were 'relatively few records of wrybills in areas intermediate between the breeding and wintering ranges, indicating that migration is rapid and probably direct'. However, some birds certainly pause at South Island east-coast sites (particularly Lake Ellesmere) during their northward migration, e.g. the 450 birds seen on 26 December 1997 (CSN 48/2) is a substantially greater number than the number moulting or wintering at the site. Occasional counts of 25–30 birds at Farewell Spit in January (Edgar 1974; Dennison & Robertson 1979) suggest that some birds also pause there during their northward migration. Birds are also regularly seen at Waimea Inlet and Manawatu Estuary in January, but these are also wintering sites for small groups, and their importance for migration is not clear. Smaller groups clearly also migrate up the east coast of the North Island, with records of birds or small winter flocks at Porangahau, Ahuriri and Wherowhero (Gisborne). Whether birds that winter in the Bay of Plenty (mainly Tauranga Harbour) use this eastern route is unknown.

Southward migration:

Adults normally leave the large northern harbours in August, with a second, smaller departure (assumed to be of first-year birds, which will not breed) in October (Marchant & Higgins 1993). It is not clear whether any birds fly directly to the breeding grounds, but many certainly migrate via the estuaries on the South Island east coast. The highest numbers seen at Washdyke Lagoon, Timaru, were in August and October (Sagar 1976), presumably coinciding with the departures of adults and first-year birds respectively from northern harbours. A similar pattern was seen at Wainono Lagoon, where numbers peaked in September and October (Pierce 1980b). Interestingly, neither Washdyke Lagoon nor Wainono Lagoon appear to be used during northward migration. Observations at Lake Ellesmere suggest that large numbers of wrybills may pass through briefly in August and September, as shown by counts of 341 birds on 12 August 1998 and 299 birds on 17 August 2003 (Appendix 7, Table A7.2). Fluctuating totals and sightings of different colour-banded birds suggest high turnover at the site, with most birds probably present for only 1–4 days (C. Hill & JED, unpubl. data). Other sites that have occasional records of flocks of 50 or more birds on migration include Waimea Inlet, which had 101 birds in August–September 2000 (CSN 39/3), and Ashley Estuary, which had 85 birds on 21 August 1990 (CSN 39/3) and 157 birds on 13 August 1995 (CSN 48/2). Other east-coast sites with records of smaller numbers are Lake Grassmere, which had ten birds on 15 August 1990 (CSN 39/3), and Avon-Heathcote, which had 33 birds on 31 August 1992 (CSN 42/2). Occasional counts of 30–120 birds in Manawatu in October suggest that non-breeders may pause there during their southward migration (P. Battley, pers. comm.).

Movement between autumn / winter sites

Most adults are faithful to their wintering sites (Hay 1984; Davies 1991; JED, unpubl. data), but Davies (1997) noted that some individuals used two sites during a season, moulting (January–April) at Jordan's Farm, South Kaipara Harbour, and then moving to the Firth of Thames (c. 105 km away) to spend the remainder of the winter. Monthly counts of the Firth of Thames flock over a 6-year period (Veitch 1999) show a peak in May (which is consistent with post-moult movement to the Firth), but also show a decline in June and July, for which there appears to be no obvious explanation. Recent sightings of colour-banded birds suggest that there is some movement of adults between other wintering flocks. For example, individual birds have been detected moving (within one autumn-winter period) from Firth of Thames to upper Manukau Harbour, southern Manukau to Firth of Thames, Kaipara to south Manukau, and Firth of Thames to Mangawhai then to south Manukau (JED, unpubl. data). The extent and importance of these movements is largely unknown; to date, however, they appear to be occasional and may not involve large numbers of birds.

What is clearer is that individual winter flocks may move between high-water roost sites in the medium or short term, and / or split up into groups of varying size, with different sub-flocks using different roosts, and then re-form regularly. For example, the Miranda flock may roost as a single unit at any of several locations along a 5-km stretch of coastline, or may split up and roost at two or more sites. Up to 500 birds from this flock (identifiable from colour-banded birds) have been recorded temporarily at Thames, which is 20 km from Miranda on the other side of the Firth of Thames. Similarly, the upper Manukau flock may move between at least three roosts that are 2–7 km apart, sometimes staying together and sometimes splitting up (A. Riegen & JED, unpubl. data).

Links between wintering and breeding sites

There is no evidence to date of any links between breeding rivers and wintering locations. Hay (1984) found adults that had been banded in the upper Rakaia River wintering in at least five northern harbours, and concluded that 'dispersal of Rakaia River adults through the winter populations was not significantly different from that expected by chance'. Recent colour-banding of birds in the Tasman and Tekapo Rivers (Mackenzie Basin) has yielded similar results: birds from these two rivers have been seen in winter at all significant flock sites, including all of the top-ten sites shown in Table 10 (JED, unpubl. data).

There are limited data on dispersal from wintering sites to breeding rivers, but these also lend strong support to the suggestion that there are no links between the two. Four adults that had been colour-banded at Miranda, Firth of Thames, were seen in the Cass, Godley, Tasman and Ahuriri Rivers (Hay 1984). Large numbers of birds have also been metal-banded by the New Zealand Wader Study Group at Miranda. To date, 35 birds from that study have been recaptured in four widely-spaced South Island rivers (3 in the Ashley, 7 in the upper Rakaia, 16 in the Tasman, and 9 in the Tekapo) (JED, unpubl. data).

Overlap with Arctic migrants

All major wrybill flocks are at estuaries that also hold large numbers of Arctic migrants (Table 10). Therefore, almost the entire wrybill population is in contact with large flocks of bar-tailed godwits and / or lesser knots between January and April each year.

Discussion

It is clear that there is extensive overlap in range between non-breeding flocks of wrybills and Arctic migrants. All the available data suggest that each winter flock of wrybills disperses to many rivers to breed, passing through one or more east-coast South Island sites on the way. This suggests that any disease present in shorebirds at the wintering sites listed in Table 10 and Appendix 7 has the potential to spread to east-coast South Island estuaries and all the braided rivers in Canterbury and northern Otago that have breeding populations of wrybills.

The two wintering sites (Manukau Harbour and Firth of Thames) are critical to the survival of the species; any impacts (disease or other potential threats) at these sites could be catastrophic for the population. The behaviour of the species whilst wintering, feeding and roosting, when individuals congregate in large, very tight flocks, is likely to exacerbate such impacts. It should also be noted that the large upper-Manukau flock has an important feeding site in the upper Tamaki River (often used by 1000 birds or more); this is clearly also a critical site for the species, but because it is not a roost site it does not feature in the usual lists of important sites.

There are a number of information gaps:

1. The breeding distribution of this species is greatly in need of being updated; the distribution is probably contracting and the bulk of individuals may now be confined to four large catchments. Dedicated searches are required, particularly in the smaller Canterbury rivers that have held wrybills for the past two to three decades, and in Otago rivers at the southern end of the species' range.
2. The extent and importance of the habitat network used by wrybills during migration (particularly on the South Island east coast) are not yet well understood. More information is required on the importance of east-coast estuaries to juveniles, migrating adults and breeding adults during spring floods. The fact that these sites may only be used for short periods does not lessen their importance to this species.
3. Censuses of the wrybill population are only possible in winter, and even then the degree of short-term movement between sites that has become apparent recently (Riegen & Dowding 2003) makes accurate and reproducible counting extremely difficult. To improve annual counts, more information is required on these local movements between wintering sites.
4. Little is known about movement patterns of juveniles (pre-breeding) or about natal-site fidelity.

Gaining information about topics 2–4 above requires colour-banding of adults and chicks and extensive, targeted searches for these birds. The present programme does not provide sufficient data. More banding and search effort are required (banding is currently undertaken on a voluntary basis and searches for banded birds are irregular and limited in coverage).

3.8 OTHER ENDEMIC SHOREBIRDS

In addition to the Auckland Island banded dotterel (above), there are four endemic species that occur largely or entirely as isolated populations on outlying islands. Some of these populations also come in contact with Arctic-migrant shorebirds and thus are potentially at risk of acquiring disease from this source.

3.8.1 Chatham Island oystercatcher (torea, *Haematopus chathamensis*)

This species currently numbers c. 170 mature individuals (Moore 2004) and is classified as Endangered (BirdLife International 2005) and Category 1 Nationally Critical (Hitchmough & Bull 2004). As a result of recent intensive management, most of the population is now on main Chatham Island, with smaller numbers on Pitt, South East and Mangere Islands. Breeding birds are largely sedentary, but there is some local movement of juveniles within and (to a lesser extent) between islands. Particularly on Chatham Island, this species has the potential to come into contact with Arctic-migrant shorebirds. Typically, 500 turnstones, 500–2000 lesser knots, 100–700 bar-tailed godwits, and a few Pacific golden plovers reach the islands in summer, most of them occurring around Te Whanga Lagoon, Chatham Island (Freeman 1994; Sagar et al. 1999; Aikman & Miskelly 2004).

3.8.2 Shore plover (tuturuatu, *Thinornis novaeseelandiae*)

This species currently numbers c. 120 mature individuals (Dowding et al. 2005) and is classified as Endangered (BirdLife International 2005) and Category 1 Nationally Critical (Hitchmough & Bull 2004). On the Chatham Islands, it is largely confined to South East and Mangere Islands (Dowding et al. 2005), where Arctic migrants occur only as rare stragglers (Nilsson et al. 1994). However, a population that has recently established on an island off the coast of the North Island, New Zealand (Dowding et al. 2005), is in regular contact with flocks of 100–150 turnstones and 40–60 bar-tailed godwits each spring and summer.

3.8.3 New Zealand snipe (hakawai, *Coenocorypha aucklandica*)

The current checklist (Checklist Committee 1990) recognises three extant subspecies of New Zealand snipe, each confined to a group of outlying islands: the Auckland Island snipe (*C. a. aucklandica*, Category 7 Range Restricted), the Snares Island snipe (*C. a. huegeli*, Category 7 Range Restricted) and the Antipodes Island snipe (*C. a. meinertzhagenae*, Category 7 Range Restricted). Some or all of these may be better treated as 'recent species' (Higgins & Davies 1996). There is also the recently discovered snipe from Jacquemart Island (Campbell Island snipe, Category 1 Nationally Critical), which may be part of this taxon. Arctic-migrant shorebirds (notably turnstones) reach the Auckland Islands annually, and the potential exists for disease transfer to local species. Only small numbers of Arctic migrants (and vagrants from a variety of other orders) reach the Snares Islands (see Miskelly et al. 2001), and the risk of disease transfer to snipe there appears to be low. Few godwits and knots reach the

Antipodes Islands (Higgins & Davies 1996), but turnstones may be regular visitors in small numbers (Checklist Committee 1990). A very small number of bar-tailed godwits have been recorded on Campbell Island (Miskelly 2000), and the chance of Arctic migrants coming into contact with snipe on Jacquemart Island will be negligible.

3.8.4 Chatham Island snipe (*Coenocorypha pusilla*)

This species currently numbers at least 1000 pairs (Aikman et al. 2001) and is classified as Vulnerable (BirdLife International 2005) and Category 7 Range Restricted (Hitchmough & Bull 2004). It is confined to four small islands (South East, Mangere, Little Mangere and Star Keys); all these islands receive very few or no Arctic migrants, and this, coupled with differences in habitat use (snipe are normally found away from the shoreline, under cover of vegetation), suggests that Chatham Island snipe will come into contact with Arctic-migrant waders very rarely.

3.9 SITES OF PARTICULAR IMPORTANCE

Some sites identified in the individual species accounts above are clearly important for more than one taxon. An attempt to identify the most important sites nationally is shown in Table 11. The main criterion for inclusion in the table was that a site must be in the top-ten list for two or more of the seven indigenous-breeding species considered in this report; this resulted in a list of 14 sites. We then added sites important (at the top-ten or 1% level) for three or more taxa (a further five sites). Finally we added three sites not included by either criterion that are (or may be) critical at the 30% level for single taxa.

It must be emphasised that there are inevitably many wintering sites of high significance to shorebirds in New Zealand that are not included in Table 11. There are 14 further sites that are top-ten sites for only one indigenous-breeding species, and there are many sites that are significant at the 1% level for two species (particularly for the variable oystercatcher and northern New Zealand dotterel, which are more dispersed, sedentary taxa).

In spite of these caveats, Table 11 does appear to identify many of the most important shorebird wintering sites in New Zealand. Excluding the sites critical for a single taxon, there are 19 sites, and most of these are recognised as important wetlands nationally. Two of them (Firth of Thames and Farewell Spit) are already Ramsar sites, Kaipara Harbour has been proposed as one (S. Gibbs, Royal Forest & Bird Protection Society, pers. comm.), and Parengarenga Harbour was being investigated for possible listing (Cromarty & Scott 1996). Fifteen of the 19 sites (and two single-species critical sites) are listed as significant wetlands by Cromarty & Scott (1996) or contain wetlands listed therein; the four exceptions are:

- Mangawhai Estuary (North Auckland)
- Matarangi Spit / Whangapoua Harbour (Coromandel Peninsula)
- Aotea Harbour (Waikato west coast)
- Wainono Lagoon (South Canterbury)

TABLE 11. WINTERING / NON-BREEDING SITES OF NATIONAL IMPORTANCE FOR SEVEN SPECIES OF INDIGENOUS-BREEDING SHOREBIRDS.

POC = pied oystercatcher (*Haematopus finschi*), VOC = variable oystercatcher (*Haematopus unicolour*), PST = pied stilt (*Himantopus himantopus leucocephalus*), BST = black stilt (*Himantopus novaezelandiae*), NZD = New Zealand dotterel (*Charadrius obscurus*), BDT = banded dotterel (*C. bicinctus*), WRY = wrybill (*Anarhynchus frontalis*), AM = Arctic migrants. For indigenous-breeding taxa, + indicates that the site is important at the 1% level or higher, ++ indicates a top-ten wintering site, and +++ indicates that the site is critical for the taxon (i.e. holds 30% or more). For Arctic migrants, • indicates that the site is regularly used by 100 or more birds, and •• that the site is used by 1000 or more. A dash (–) indicates that a species may be present at a site, but numbers do not normally reach the above thresholds.

SITE	POC	VOC	PST	BST	NZD	BDT	WRY	AM
Sites of national importance for two or more taxa								
Parengarenga Harbour	–	++	++	–	++	++	++	••
Houhora Harbour	–	+	+	–	+	+	+	••
Rangaunu Harbour	–	++	+	–	++	–	–	••
Whangarei Harbour	++	++	++	–	++	++	++	••
Mangawhai Estuary	–	++	–	–	++	–	–	•
Kaipara Harbour	++	?[a]	++	++	++	++	++	••
Manukau Harbour	++	–	++	++	+	++	+++	••
Firth of Thames	++	–	++	++	+	–	+++	••
Aotea Harbour	++	–	+	–	–	+	–	••
Kawhia Harbour	++	–	+	++	–	++	–	••
Matarangi Spit	–	++	–	–	++	+	–	••
Tauranga Harbour	+	+	++	++	++	++	++	••
Ohiwa Harbour	–	++	–	–	++	++	–	••
Farewell Spit	++	+	+	+	+[b]	++	–	••
Tasman Bay	++	++	++	+	–	–	–	••
Avon-Heathcote Estuary	++	+		+	–	–	–	••
Lake Ellesmere	–	–	++	++	–	++	++	•
Wainono Lagoon	–	–	+	++	–	+	–	–
Awarua Bay	–	+	–	–	++[b]	+	–	•
Sites of critical importance for single taxa								
Upper Waitaki Basin	–	–	–	+++	–	–	–	
Paterson Inlet	–	+	–	–	+++[b]	–	–	•
Auckland Islands	–	–	–	–	–	+++?[c]	–	•

[a] Probably significant at 1% level but insufficient data.

[b] Southern subspecies (*C. o. obscurus*).

[c] It is not clear whether the bulk of the Auckland Island banded dotterel (*C. b. exilis*) population remains on the Auckland Islands in winter; if it does, the site is critical for the subspecies.

The sites in Table 11 are also clearly very important for Arctic migrants; excluding the single-species critical sites, 18 out of 19 sites have 100 or more Arctic migrants annually, and at least 15 of the 19 have 1000 or more. Not surprisingly, most of the sites in Table 11 are large harbours or estuaries with extensive inter-tidal feeding areas capable of supporting large shorebird populations.

4. General discussion

Broadly speaking, our review suggests that the important breeding and non-breeding sites for indigenous shorebirds in New Zealand are well known. At larger spatial scales, movement patterns and the links between breeding and non-breeding sites are reasonably well understood for some species (e.g. New Zealand dotterel, banded dotterel and wrybill), but less well known for others (e.g. variable oystercatcher). At smaller scales, particularly within individual estuaries or harbours, there is often a lack of detail about feeding areas and usage of alternative roost sites for most species.

4.1 LIMITATIONS OF THE DATA

Even where much information exists for a species or site, the counts have often not been collected systematically, and the data we have used may have a number of limitations.

First, defining individual sites during breeding is virtually impossible. Most of the taxa considered here breed as dispersed pairs; some clumping of pairs occurs in areas of favourable habitat, but pairs are often thinly spread along beaches (northern New Zealand dotterel and variable oystercatcher), in large riverbeds (banded dotterel and wrybill), or in other habitat types (pied oystercatcher in farmland). For some species, identification of nationally important breeding sites is possible, while for others larger areas or regions are the most (or only) appropriate scale.

Second, wintering counts are often reported on different scales. For example, counts of variable oystercatchers in Golden Bay are total counts from up to 11 individual sites along a stretch of coastline (Schuckard 2002); similarly, counts from the larger northern estuaries, particularly Kaipara and Manukau Harbours, may sum counts of discrete flocks (see appendices for examples). Sometimes the total in such an area may reach the 1% threshold (and thereby national significance for the taxon), but there may be no individual site (or potential management unit of several clustered sites) within the area that reaches this level. Subjective decisions about what constitutes a 'site' are therefore often required.

Third, wintering flocks of most species may split up and move between high-water roosts (and probably feeding areas) within and between seasons. For some species, flocks may break up into smaller groups, re-form and move between roosts within periods of weeks or even days. Much of the variability in some site / species counts shown in the appendices may be due to this behaviour.

Fourth, effort is often different between counts (even at a single site), and the level of effort is rarely, if ever, indicated. Particularly in large harbours, where there may be several flocks of a species or multiple roosts, lower counts may simply reflect less effort, a lack of local knowledge, or access difficulties (private property, water barriers, etc.). In the appendices, we have routinely omitted low counts from sites when other data suggest that they are substantial under-estimates.

4.2 CONSERVATION MANAGEMENT ISSUES

4.2.1 Key regions for indigenous shorebirds

On a broad scale, certain key regions or habitat groupings can be identified as important for various combinations of indigenous-breeding shorebird species:

1. The east-coast beaches and smaller estuaries of Northland, Auckland, Coromandel Peninsula and Bay of Plenty are particularly important as breeding and wintering sites for two dispersed and relatively sedentary taxa, the variable oystercatcher and northern New Zealand dotterel.
2. The large, northern harbours (particularly Kaipara, Manukau and Firth of Thames, but also Parengarenga, Whangarei and Kawhia for some species) are vital wintering grounds for all the internal migrants (pied oystercatcher, pied stilt, black stilt, banded dotterel and wrybill), as well as being important in some cases for the variable oystercatcher and New Zealand dotterel.
3. The estuaries of the northern coast of the South Island (particularly Farewell Spit and Tasman Bay) are important for most species as wintering areas (pied oystercatchers and banded dotterels are present in high numbers) and may be important to other species during migration (e.g. wrybills).
4. The estuaries on the east coast of the South Island are, with the exception of Lake Ellesmere, generally smaller than the North Island harbours identified in region 2 above. However, these estuaries, lagoons and river mouths (particularly those between Ashley Estuary and Waitaki River) form an extremely important network of sites; the larger sites are used for wintering (mainly by pied oystercatchers, pied stilts, black stilts and banded dotterels), and most of them are important as migration stop-over sites (notably for banded dotterels and wrybills, but also other species). These sites are probably also important breeding-season refuges and feeding areas when large floods occur in the central South Island breeding rivers.
5. The large braided riverbeds and surrounding areas in inland regions of the central South Island (Canterbury and Otago) are vital breeding strongholds for five of the seven species considered here (pied oystercatcher, pied stilt, black stilt, banded dotterel and wrybill).

These regions are all clearly of primary importance to indigenous-breeding shorebirds. Some further analysis and research at a finer scale would be useful, notably for the east-coast South Island sites, whose importance may be underestimated. Some assessment of actual and potential threats to shorebirds in the important non-breeding areas (regions 1–4 above) is also overdue (see below).

Setting conservation management priorities for shorebirds requires consideration of a range of factors; while priorities will often be decided by the higher cost-effectiveness of managing a large site or one containing many birds, some smaller sites that are critical for certain species (e.g. during migration) may deserve higher priority. Our lists of non-breeding sites should provide a good preliminary indication of the important sites for each taxon. However, it is obvious from the available data that where detailed information on habitat use is required (e.g. for planning hearings or making impact assessments) further fieldwork and / or literature reviews will usually be required.

4.2.2 Mobility of winter flocks

It is clear that wintering flocks of a number of the species considered here are highly mobile. Birds may move between high-water roosts and / or feeding areas within a given estuary, or may move between estuaries that are normally considered separate sites. For example, many shorebirds move between the Waitemata and Manukau Harbours, presumably to take advantage of the extended feeding times resulting from the 3-hour tide differential (Dowding 2001b). The reasons for these movements are often not well understood and they may depend on a wide range of factors, including tide height, time of day (light or dark), level of disturbance, available shelter in relation to weather, food availability locally, potential predation, numbers of other species (security in larger flocks), aggression and / or competition for space from other species. There are also seasonal factors, with flocks of some species moving between estuaries after moulting, or just before or after migration. These movements can lead to considerable difficulties in assessing numbers reproducibly (and hence ascertaining the importance of a site) and can also cause uncertainty at a local level when assessing potential threats or implementing management responses.

4.2.3 Important feeding areas

While the major high-water roost sites are reasonably well known for many estuaries, the areas that are important for feeding are often much less well understood. Particularly in the case of the larger harbours, birds simply 'disappear' as the tide ebbs, so that we do not know where the bulk of them feed (or which other species they associate with). There are occasional exceptions where feeding areas are known, sometimes because Environmental Impact Assessments (EIAs) have been undertaken when resource consents are sought or opposed (e.g. Dowding 2001b; Pierce & Smuts-Kennedy 2003).

It should also be noted that most important sites have been identified from counts at high-water roosts, and that feeding areas may be some distance from those roosts (and sometimes in different catchments). For example, the large upper-Manukau Harbour wrybill flock regularly crosses the Auckland isthmus to feed in the upper reaches of the Tamaki River; this is a very important site for this species, which does not appear on the roost-site list. Clearly, high-water roost counts may not identify all the important non-breeding sites for a taxon.

4.2.4 Threats at non-breeding sites

In general, when conservation management of threatened shorebirds has occurred in New Zealand, it has usually concentrated on increasing productivity. In the case of the black stilt, this has largely been by captive rearing (at least in recent years) (Maloney & Murray 2002), but for most species it has usually involved *in situ* management at important breeding sites (e.g. Dowding & Murphy 2001; Moore 2004). While there are obvious threats from predation, habitat degradation and disturbance for many species on the breeding grounds, there has been much less emphasis on investigating threats at feeding, flocking and migration sites (Dowding & Murphy 2001). Threats at breeding sites may be more important overall, but for some taxa this is still only

an assumption. A detailed assessment of threats at (and to) non-breeding sites is required. Potential threats are likely to be numerous, and may include:

- Loss or degradation of roosting and feeding habitat through development in or near estuaries (housing estates, marinas, etc.).
- Degradation of feeding and roosting sites as a result of increasing disturbance caused by growing recreational use of beaches and estuaries.
- Loss of traditional roost sites or feeding areas to vegetation (such as mangroves and *Spartina*), for example in the Firth of Thames (Veitch 1978; Woodley 2004).
- Increased mortality in or near built-up areas as a result of a variety of factors, such as predation by domestic animals, air-strikes, and collisions with fences, power lines, buildings and other man-made structures.
- Exposure to toxic pollutants in estuaries following discharges or run-off from nearby industrial sites or urban areas. For example, blood levels of lead in oystercatchers were on average 2.5 times higher in the upper Manukau Harbour (near central Auckland) than in the Kaipara Harbour, which is largely rural (Thompson & Dowding 1999).

4.2.5 Shorebird habitat networks are not static

Up-to-date information is clearly important for conservation management decision-making and for assessing potential impacts of proposed developments on species and habitats. Therefore, in many cases the information in this report will need to be updated before use. The status of some taxa may change as they increase or decline (overall or at individual sites), resulting in the need to add or remove sites of significance at the 1% level. However, site-allegiance may also change without large overall increases or declines, and within relatively short periods. For example, the significant decline in the number of wrybills using the Firth of Thames and the corresponding increase in the Manukau Harbour has occurred in less than a decade (Riegen & Dowding 2003). The distribution of the New Zealand dotterel in the North Island is changing, possibly in response to the distribution of managed sites (Dowding 2001a), and the number of pied oystercatchers wintering in Golden Bay and Tasman Bay is declining, despite an overall increase in numbers nationally (Schuckard 2002).

4.3 SHOREBIRDS AND BIOSECURITY

The data presented in the species accounts above clearly show that significant proportions of all indigenous-breeding shorebird taxa found on or around mainland New Zealand come into contact with Arctic-migrant shorebirds. Assessing the number of migrants that might be required at a site to pose a high risk of disease transfer to indigenous-breeding shorebirds is difficult. However, we note that at least 15 of the 19 nationally important estuaries identified in Table 11 have 1000 or more migrants visiting annually. The majority of these migrants (mostly bar-tailed godwits and lesser knots) breed in eastern Asia and / or move through the EAA flyway (Riegen 1999). Therefore, they are potentially in contact with birds carrying a range of pathogens, including the H5N1 strain of avian influenza that has recently been prevalent in poultry in eastern Asia.

However, whether migration through the flyway is actually likely to result in disease transfer to New Zealand is less certain.

In the case of influenza viruses, by far the highest infection rates are found in waterfowl (Order Anseriformes—ducks, geese and swans), which are believed to be the main reservoir of avian influenza viruses in the wild (Alexander 2000). However, no waterfowl migrate to New Zealand.

Charadriiform birds also carry avian influenza, but at much lower rates. One estimate put the infection rate in this group at 2.2% (Alexander 2000), but most samples in that study were from gulls (Suborder Lari) rather than shorebirds (Suborder Charadrii). Hanson (2003) found infection rates of 9.1% in turnstones and 1.2% in lesser knots in Delaware Bay, but these rates were probably atypically high, both because there can be an unusually high density of shorebirds present at that site, and because the sampling catchment also has a huge poultry population, which may be infecting shorebirds through run-off (D.S. Melville, pers. comm.). Rates of avian influenza infection among shorebirds in the EAA flyway appear to be much lower. Only one positive sample was obtained from 1048 shorebirds in Hong Kong in 1988–1990 (D.S. Melville, pers. comm.). Infection rates in north-western Australia in the period 1990–2000 were also extremely low: no virus was isolated from 995 shorebirds tested by cloacal swab (although a few blood samples tested positive for avian influenza antibodies, suggesting recent exposure) (Curran 2003). No avian influenza has been detected in shorebirds trapped at Sungei Buloh, Singapore (Singapore Government 2004). Based on his own work and that of McKenzie et al. (1984), Curran (2003) concluded that although migratory waders were a potential source of introduction of avian influenza to Australia, the very low prevalence rates of the virus in the group made the risk 'minimal'. Given that many fewer Arctic migrants visit New Zealand (200 000 or less; Sagar et al. 1999) than Australia (almost 2 million; Lane 1987), the risk here should be even lower.

In addition to the disease risks posed by migrants from northern areas of the EAA flyway, it should be noted that some bird species have the potential to introduce disease from (or to) Australia each year. As well as the small number of one-way vagrants that reach New Zealand, an estimated 30 000 banded dotterels and hundreds of cattle egrets (*Bubulcus ibis*) migrate annually between the two countries.

Many of the large harbours in New Zealand are important for several indigenous-breeding shorebird species, and a number of these species are known to move between wintering sites. This suggests that if disease is brought to New Zealand by Arctic-migrant shorebirds and spreads to indigenous-breeding shorebirds, there is likely to be further spread within the country by the latter group, both between species and between wintering sites. Spread could also occur from wintering sites to inland breeding grounds, but the timing of disease arrival and persistence are factors that must be considered. Any disease brought to New Zealand by Arctic migrants is most likely to arrive in September, by which time most internal north-south migrants (pied oystercatcher, wrybill, some pied, black and hybrid stilts, and some banded dotterels) will already be in the South Island. While it is still possible for non-breeding birds migrating later in spring to act as vectors, there are many fewer

of these. Any disease would have to persist until January, when individuals return to their northern wintering grounds, for the bulk of the adult population of these species to be exposed to it.

While the chance of disease spreading among the dispersed breeding populations of wrybills, banded dotterels and pied oystercatchers in large South Island riverbeds seems much lower than in the dense flocks found at wintering sites, there are two threatened species (black-billed gull *Larus bulleri*, and black-fronted tern *Sterna albostriata*) in many of these rivers that could, because of their colony-nesting behaviour, be affected more severely if disease were imported to those areas.

Although the risk of avian influenza arriving in New Zealand via Arctic-migrant shorebirds appears to be very low, it is finite. Depending on the strain or subtype (H5 and H7 subtypes appear most likely to evolve HP strains; Melville 2004), the potential impacts on human health, the economy and endemic biodiversity could be substantial. Local monitoring of Arctic-migrant shorebirds for avian influenza (and other pathogens) would therefore be a wise precaution; if possible, it should include turnstones, which may show higher avian influenza infection rates than other species (e.g. Hanson 2003).

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Appendix 1

NEW ZEALAND PIED OYSTERCATCHER (*Haematopus finschi*)

TABLE A1.1. IMPORTANT NON-BREEDING SITES FOR PIED OYSTERCATCHERS.

Sites included are those where 1300 birds or more (1% of the estimated total population) were recorded during the non-breeding season. Counts are mainly from 1999–2004, but also include mean winter counts from 1984–1994 (Sagar et al. 1999), mean monthly counts (Crossland 1993), and mean February and June counts from 1984–2001 (Schuckard 2002).

SITE	COUNT	DATE	SOURCE
Whangarei Harbour	≥ 2548	11 Mar 2000	CSN 48/3
	2195	17 June 2000	CSN 48/3
	≥ 1658	11 Mar 2001	CSN 49/2
	619	30 June 2001	CSN 49/2
	1853	8 Mar 2003	CSN 2002/03, unpubl. report
Kaipara Harbour	13 554[a]	1983–1994	Sagar et al. (1999)
	15 167[b]	15 June 2002	CSN 50/2
	17 829[b]	14 June 2003	CSN 2002/03, unpubl. report
Manukau Harbour	25 707[a]	1983–1994	Sagar et al. (1999)
	29 447[c]	1990–1998	Veitch & Habraken (1999)
	23 835	24 June 2001	OSNZ wader counts
	21 868	16 June 2002	OSNZ wader counts
	29 361	15 June 2003	OSNZ wader counts
Firth of Thames	12 618[a]	1983–1994	Sagar et al. (1999)
	17 834[c]	1990–1998	Veitch & Habraken (1999)
	16 316	8 June 2003	Vaughan (2003)
Aotea Harbour	980	17 June 2000	CSN 48/3
	694	16 June 2002	CSN 50/2
	2007	14 June 2003	CSN 2002/03, unpubl. report
Kawhia Harbour	3390	5 July 1999	CSN 48/3
	2467	17 June 2000	CSN 48/3
	3803	23 June 2001	CSN 49/2
	1200	16 June 2002	CSN 50/2
	2882	14 June 2003	CSN 2002/03, unpubl. report
Tauranga Harbour	1567	7 June 1999	CSN 47/4
	1336	24 June 2000	CSN 48/3
	1063	13 Mar 2001	J. Heaphy, pers. comm.

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Table A1.1—continued

SITE	COUNT	DATE	SOURCE
Farewell Spit	7443[a]	1983–1994	Sagar et al. (1999)
	6258	June 2002	OSNZ Nelson / Golden Bay[d]
	8429	Feb 2003	OSNZ Nelson / Golden Bay
	8158	June 2003	OSNZ Nelson / Golden Bay
	4934	Feb 2004	OSNZ Nelson / Golden Bay
Golden Bay	3833	Feb 1984–2001	Schuckard (2002)
	2577	June 1984–2001	Schuckard (2002)
	1582	June 2002	OSNZ Nelson / Golden Bay
	5523	Feb 2003	OSNZ Nelson / Golden Bay
	1096	June 2003	OSNZ Nelson / Golden Bay
	4684	Feb 2004	OSNZ Nelson / Golden Bay
Tasman Bay	2853	Feb 1984–2001	Schuckard (2002)
	3805	June 1984–2001	Schuckard (2002)
	1648	June 2002	OSNZ Nelson / Golden Bay
	4064	Feb 2003	OSNZ Nelson / Golden Bay
	2337	June 2003	OSNZ Nelson / Golden Bay
	4709	Feb 2004	OSNZ Nelson / Golden Bay
Avon-Heathcote Estuary	3006[a]	1983–1994	Sagar et al. (1999)
	5000	Jan & Mar	Crossland (1993)
	4685	24 May 1998	CSN 48/2
	3644	21 June 1998	CSN 48/2
	4741	21 Apr 1999	CSN 48/2
	4810	28 Jan 2004	A. Crossland, pers. comm.

[a] Mean of annual OSNZ winter wader-counts, 1983–1994 (Sagar et al. 1999).

[b] North Kaipara and South Kaipara counts combined (CSN 50/2; CSN 2002/03, unpubl. report).

[c] Mean of annual winter counts, Manukau Harbour and Firth of Thames (Veitch & Habraken 1999).

[d] OSNZ Nelson / Golden Bay Branch wader census data (R. Schuckard, pers. comm.).

Appendix 2

VARIABLE OYSTERCATCHER (*Haematopus unicolor*)

TABLE A2.1. IMPORTANT BREEDING-SEASON SITES FOR VARIABLE OYSTERCATCHERS.

Sites included are those where 20 pairs or more (1% of the estimated effective population) or 45 adults or more (1% of the estimated total population) have been recorded during the breeding season. In some areas, there are large flocks of non-breeding birds (sub-adults and unpaired adults), but counters rarely distinguish between these and breeding adults; many breeding-season records will therefore include them. A site is clearly of major breeding importance if records show more than 20 pairs; where records show ≥ 45 'Total birds', the site is still important for the taxon at this time of year but may or may not be an important breeding site.

SITE	PAIRS	TOTAL BIRDS	DATE	SOURCE
Parengarenga Harbour		71	26 Nov 1994	CSN 43/3
Houhora Harbour		58	Nov 1997	CSN 47/4
Rangaunu Harbour		72	Nov 1997	CSN 47/4
		154	14 Nov 1999	CSN 48/3
Whangarei Harbour		399	24 Nov 1996	CSN 45/4
		129	22 Nov 1998	CSN 47/4
		88	27 Nov 1999	CSN 48/3
		91	12 Nov 2000	CSN 49/2
		188	18 Nov 2001	CSN 50/2
		191	23 Nov 2002	CSN 02/03, unpubl. report
Ruakaka Estuary		115	22 Nov 1998	CSN 47/4
		95	12 Nov 2000	CSN 49/2
	c. 23		2001/02	CSN 50/2
	c. 25		2002/03	CSN 02/03, unpubl. report
	23		2003/04	Maguire (2004)
Waipu Estuary	c. 40		2000/01	CSN 49/2
	c. 40		2001/02	CSN 50/2
	c. 26		2002/03	CSN 02/03, unpubl. report
	46		2003/04	Maguire (2004)
Mangawhai Estuary	c. 30		2000/01	CSN 49/2
	27		2001/02	CSN 50/2
	c. 25		2002/03	CSN 02/03, unpubl. report
	31		2003/04	Maguire (2004)
Kaipara Harbour		133	24 Nov 1996	CSN 45/4
		45	17 Nov 2001	CSN 50/2
Omaha		45	07 Nov 2000	JED, unpubl. data
		54	13 Nov 2001	JED, unpubl. data
		49	17 Sep 2003	JED, unpubl. data

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Table A2.1—continued

SITE	PAIRS	TOTAL BIRDS	DATE	SOURCE
Browns Island		63	14 Dec 2000	CSN 49/2
Port Waikato		77[a]	7 Dec 1997	CSN 47/4
Matarangi Spit		57	24 Oct 1997	CSN 47/4
Opoutere	c. 30		2001/02	Hare (2002)
	27		2002/03	Hare (2003)
Matakana Island	36		9 Dec 1994	CSN 43/3
	48		2 Dec 1996	CSN 45/4
	39		19 Dec 1997	CSN 47/4
	60		6 Dec 2000	CSN 49/2
Little Waihi		50–60	Nov 1993	CSN 42/3
		50	5 Nov 1994	CSN 43/3
		41	17 Nov 1996	CSN 45/4
		72	18 Nov 2000	CSN 49/2
Ohiwa Harbour		70	14 Nov 1996	CSN 45/4
		30	16 Dec 1997	CSN 47/4
Mahia Peninsula		86	10 Nov 1990	CSN 39/3
Portland Island		75	14 Nov 1999	CSN 48/3
		62	11 Dec 2002	CSN 02/03, unpubl. report
Ohau Estuary		47	24 Nov 1993	CSN 42/3
Wellington Harbour	c. 20			Marchant & Higgins (1993)
		c. 37–57[b]	1986–1988	Robertson (1992)
		62	11 Dec 2002	CSN 02/03, unpubl. report
Farewell Spit	c. 24		Feb 1992	CSN 41/3
	c. 20			Marchant & Higgins (1993)
		55	Nov 1997	Schuckard (2002)
		90	Nov 1998	Schuckard (2002)
		64	Nov 1999	CSN 50/3
		29	Nov 2000	CSN 50/3
Motueka Sandspit		70	Oct–Dec 1999	Schuckard (2002)
		63	Oct–Dec 2000	Schuckard (2002)
	≥ 25		2003/04	P. Samways, pers. comm.
Waimea Inlet		95[c]	1984–2001	Schuckard (2002)
		482	Oct 1999	Schuckard (2002)

[a] Combined counts from Sand Island and Sunset Beach.

[b] Range of Sep–Jan averages 1986–1988, calculated from Figure 11 of Robertson (1992).

[c] Means of annual counts Oct–Dec (Schuckard 2002).

TABLE A2.2. IMPORTANT NON-BREEDING SITES FOR VARIABLE OYSTERCATCHERS.

Sites included are those where 45 birds or more (1% of the estimated total population) were recorded during the non-breeding season. As noted in Section 3.2, it seems likely that some significant wintering sites for this taxon (particularly in the South Island) have not yet been identified.

SITE	COUNT	DATE	SOURCE
Parengarenga Harbour	162	20 June 1992	CSN 41/1
	138	4 June 1995	CSN 43/3
	176	Mar 1997	National NZD census[a]
	102	24 June 2000	CSN 48/3
Great Exhibition Bay	92[b]	1983–1994	Sagar et al. (1999)
	61	20 June 1992	CSN 41/1
90-mile Beach	87	Mar 1997	National NZD census[a]
Houhora / East Beach	72	3 June 1995	CSN 43/3
	94	Mar 1997	National NZD census[a]
	87	2 Apr 2000	CSN 48/3
	65	09 Jan 2001	CSN 49/2
	55	12 May 2002	CSN 50/2
Rangaunu Harbour	65	3 June 1995	CSN 43/3
	173	29 June 1997	CSN 45/4
	120	25 June 2000	CSN 48/3
Herekino Harbour	147	Mar 1997	National NZD census[a]
Whananaki Estuary	57	21 July 1991	CSN 41/1
Ngunguru Estuary	108	Mar 1997	National NZD census[a]
Pataua South	100	25 Mar 1987	CSN 35/4
Whangarei Harbour	257	30 Mar 1997	CSN 45/4
	227	8 Mar 1998	CSN 47/4
	71	11 Mar 2001	CSN 49/2
	51	30 June 2001	CSN 49/2
	315	2 Mar 2002	CSN 50/2
	243	27 June 2002	CSN 50/2
	134	8 Mar 2003	CSN 02/03, unpubl. report
	52	7 June 2003	CSN 02/03, unpubl. report
Ruakaka Estuary	120	9 Mar 1994	CSN 42/3
	174	7 Mar 1999	CSN 47/4
	109	11 Mar 2000	CSN 48/3
	86	11 Mar 2001	CSN 49/2
	105	30 June 2001	CSN 49/2
	62	8 Mar 2003	CSN 02/03, unpubl. report
	204	7 June 2003	CSN 02/03, unpubl. report

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Table A2.2—continued

SITE	COUNT	DATE	SOURCE
Waipu Estuary	126[b]	1983–1994	Sagar et al. (1999)
	238	9 June 1996	CSN 44/2
	121	Mar 1997	National NZD census[a]
	195	8 Mar 1998	CSN 47/4
	130	11 Mar 2000	CSN 48/3
	243	11 Mar 2001	CSN 49/2
	133	8 Mar 2003	CSN 02/03, unpubl. report
Mangawhai Estuary	100[b]	1983–1994	Sagar et al. (1999)
	248	30 Mar 1997	National NZD census[a]
	128	21 June 1998	CSN 47/4
	147	10 Apr 2001	CSN 49/2
	149	23 Apr 2003	CSN 02/03, unpubl. report
Omaha	55	18 June 2000	CSN 47/4
	48	26 June 2001	CSN 49/2
	45	29 Aug 2002	S. Chamberlin, pers. comm.
	48	14 Mar 2003	S. Chamberlin, pers. comm.
	53	4 Aug 2003	S. Chamberlin, pers. comm.
Browns Island	85	18 July 2002	CSN 02/03, unpubl. report
Port Waikato	61	28 Apr 1996	CSN 44/2
	76	15 June 2000	CSN 45/4
Matarangi Spit	194	3 Apr 1994	CSN 42/3
	187	2 Feb 1995	CSN 43/3
	175	11 Apr 1996	CSN 44/2
	140	20 Apr 1997	CSN 45/4
	164	5 Apr 1998	CSN 47/4
	c. 180	3 Apr 2001	CSN 49/2
Whitianga	60	11 Mar 1997	CSN 45/4
Tairua Harbour / Pauanui	61	29 May 1994	CSN 42/3
	55–58	Feb–Mar 2002	OSNZ wader counts
	max. 72	Sep–Apr 2003	M. Larcombe, pers. comm.
	max. 90	Jan–Feb 2003	Pierce & Smuts-Kennedy (2003)
	57	26 Apr 2004	JED, unpubl. data
Opoutere	81	5 Feb 1995	CSN 43/3
	77	10 Feb 1996	CSN 44/2
	69	8 Feb 1997	CSN 45/4
Bowentown Beach	49	27 June 1989	CSN 37/3&4
	71	28 June 1998	CSN 47/4

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Table A2.2—continued

SITE	COUNT	DATE	SOURCE
Tauranga Harbour	82	18 Feb 1988	CSN 36/3
	74[b]	1983–1994	Sagar et al. (1999)
	66	24 June 2000	CSN 48/3
	51	13 Mar 2001	J. Heaphy, pers. comm.
Maketu / Kaituna Cut	72	26 June 1994	CSN 42/3
	60	14 June 1998	CSN 47/4
	50	20 June 1999	CSN 47/4
	56	11 June 2000	CSN 48/3
	63	5 Mar 2001	CSN 49/2
	60	23 Mar 2003	CSN 02/03, unpubl. report
Little Waihi / Pukehina	60[b]	1983–1994	Sagar et al. (1999)
	71	20 Mar 1988	CSN 36/3
	64	27 Mar 1989	CSN 37/3&4
	125	4 July 1992	CSN 41/4
	41	20 June 1999	CSN 47/4
	52	11 June 2000	CSN 48/3
Ohiwa Harbour	82[b]	1983–1994	Sagar et al. (1999)
	275	20 June 1999	CSN 47/4
	170	12 Mar 2000	CSN 48/3
	250	27 May 2001	CSN 49/2
	250	3 Apr 2002	CSN 50/2
	350	19 Jan 2003	CSN 02/03, unpubl. report
Mahia Peninsula	45	24 June 1995	CSN 43/3
	43	28 June 1997	CSN 45/4
	58	20 June 1999	CSN 47/4
	≥ 100	18 July 1999	CSN 48/3
Portland Island	47	14 Jan 2001	CSN 49/2
	53	9 Feb 2002	CSN 50/2
Ohau Estuary	50	24 June 1989	CSN 37/3&4
Waikanae Estuary	60	25 June 2000	CSN 49/2
Wellington Harbour	c. 45–95[c]	1986–1988	Robertson (1992)
	73[d]	11 Apr 1996	CSN 48/2
	c. 200	3 May 1999	CSN 47/4

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Table A2.2—continued

SITE	COUNT	DATE	SOURCE
Farewell Spit	60[b]	1983–1994	Sagar et al. (1999)
	111	June 1999	CSN 50/3
	90	June 2000	CSN 50/3
	108	June 2001	CSN 50/3
	93[e]	June 2004	OSNZ Nelson
Motueka Sandspit	118	17 June 2003	P. Samways, pers. comm.
	154[e]	June 2004	OSNZ Nelson
Waimea Estuary	205[f]	1984–2001	Schuckard (2002)
	97[g]	1984–2001	Schuckard (2002)
	131[e]	June 2004	OSNZ Nelson
Avon-Heathcote Estuary	59	June 1996	CSN 45/1
	69	June 1997	CSN 48/2
	52	6 Apr 1998	CSN 48/2
	75	June 1999	Crossland (2001)
Taieri River Mouth	59	23 Jan 1999	CSN 48/2
Jackson Bay	c. 50		Marchant & Higgins (1993)
Dusky Sound	47	10 July 1997	CSN 48/2
Awarua Bay	49	16 June 1996	CSN 45/1
Paterson Inlet, Stewart Island	77	June 1971	Baker (1972)
	105	Mar 1995	Dowding (1999a)
	69	Mar 1998	Dowding (1999a)
	61	Apr 1999	Dowding (1999a)

[a] National New Zealand dotterel census (JED, unpubl. data).
[b] Mean of winter counts, 1983–1994 (Sagar et al. 1999).
[c] Range of Feb–Aug averages 1986–1988, calculated from Figure 11 of Robertson (1992).
[d] Hutt Estuary only.
[e] OSNZ Nelson / Golden Bay Branch wader counts (R. Schuckard, pers. comm.).
[f] Mean of annual counts Jan–Mar (Schuckard 2002).
[g] Mean of annual counts Apr–June (Schuckard 2002).

Appendix 3

PIED STILT
(*Himantopus himantopus leucocephalus*)

Appendix 3.1—Counts of pied stilts

TABLE A3.1.1. COUNTS OF PIED STILTS FROM SITES THROUGHOUT NEW ZEALAND THAT TYPICALLY HOLD 300 OR MORE BIRDS (≥ 1% OF THE TOTAL POPULATION) IN PEAK SEASONS.

Counts are mainly from 1999–2003, but include mean seasonal counts from 1984–1994 (Sagar et al. 1999) and from 1984–2001 (Schuckard 2002). Sites have not been separated into breeding and non-breeding sites due to the pied stilt's long breeding season and the multiple use of individual sites by different stilt populations.

SITE	COUNT	DATE	SOURCE
Parengarenga Harbour	688	June / July 1984–1994	Sagar et al. (1999)
	c. 1200	20 June 1992	CSN 41/1
	1537	28 June 1997	CSN 45/4
Houhora Harbour	347	3 July 1989	CSN 38/3
	350	21 June 1992	CSN 41/1
	450	3 July 1994	CSN 43/3
Rangaunu Harbour	≥ 695	3 June 1995	CSN 43/3
	740	6 July 1996	CSN 45/4
Whangarei Harbour	418	June / July 1984–1994	Sagar et al. (1999)
	692	11 Mar 2000	CSN 48/3
	764	17 June 2000	CSN 48/3
	816	11 Mar 2001	CSN 49/2
	466	8 Mar 2003	CSN 02/03, unpubl. report
Kaipara Harbour	2651	June / July 1984–1994	Sagar et al. (1999)
	2078[a]	1 July 2000	CSN 48/3
	3676	23 June 2001	CSN 49/2
	4117	14 June 2003	CSN 02/03, unpubl. report
Manukau Harbour	3348	June / July 1984–1994	Sagar et al. (1999)
	5250	24 June 2001	OSNZ wader counts
	1846	16 June 2002	OSNZ wader counts
	5881	15 June 2003	OSNZ wader counts
Firth of Thames	3452	June / July 1984–1994	Sagar et al. (1999)
	3518	8 June 2003	Vaughan (2003)
Aotea Harbour	700	23 June 2001	CSN 49/2
	64	16 June 2002	CSN 50/2

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Table A3.1.1—continued

SITE	COUNT	DATE	SOURCE
Kawhia Harbour	553	5 July 1999	CSN 48/3
	405	23 June 2001	CSN 49/2
Tauranga Harbour	441	June / July 1984–1994	Sagar et al. (1999)
	610	24 June 2000	CSN 48/3
	533	13 Mar 2001	J. Heaphy, pers. comm.
Little Waihi	350	Apr 1969	CSN 19/supplement
	412	7 May 1989	CSN 37/3&4
	450	9 May 1993	CSN 41/4
Korito Lagoon	c. 400	24 June 1995	CSN 43/3
	342	20 June 1997	CSN 45/4
Whakaki Lagoon	446	25 Jan 1998	CSN 47/4
	2318	6 June 1998	CSN 47/4
	660	13 Mar 1999	CSN 47/4
	614	23 June 2000	CSN 48/3
Ahuriri / Westshore	605	June / July 1984–1994	Sagar et al. (1999)
	1645	10 June 1995	CSN 43/3
	1073	17 June 2000	CSN 48/3
	381	27 May 2001	CSN 49/2
	561	14 June 2003	CSN 02/03, unpubl. report
Manawatu Estuary	425	7 May 1989	CSN 37/3&4
	c. 400	5 May 1990	CSN 38/4
	625	4 May 1991	CSN 39/3
	344	5 June 1993	CSN 41/4
	305	8 May 1994	CSN 42/3
Lake Wairarapa	988	June / July 1984–1994	Sagar et al. (1999)
	775	7 July 1991	CSN 41/1
	2000	24 June 2002	CSN 50/2
Tasman Bay	287	June 1984–2001	Schuckard (2002)
	233	Feb 1984–2001	Schuckard (2002)
	257	June 2002	OSNZ Nelson / Golden Bay[b]
	481	June 2003	OSNZ Nelson / Golden Bay[b]
	784	June 2004	OSNZ Nelson / Golden Bay[b]
Lake Forsyth	411	18 Mar 1995	CSN 43/4
	448	24 Jan 1996	CSN 45/1
	507	Feb 1996	A. Crossland, pers. comm.
	382	1 Feb 1998	CSN 48/2
	567	30 Jan 1999	CSN 48/2

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Table A3.1.1—continued

SITE	COUNT	DATE	SOURCE
Lake Ellesmere	1110	Nov / Dec 1984–1994	Sagar et al. (1999)
	2328	Feb 1996	A. Crossland, pers. comm.
	1476[c]	30 Nov 2001	CSN 02/03, unpubl. report
	1449	23 Feb 2002	CSN 02/03, unpubl. report
Wainono Lagoon	≥ 346	2 Mar 1996	A. Crossland, pers. comm.
	374	5 Oct 1996	CSN 48/2
	498	8 Dec 1996	CSN 48/2
	380	June 2003	OSNZ wader counts

[a] South Kaipara Head only.

[b] OSNZ Nelson / Golden Bay Branch wader census data.

[c] Greenpark Sands only.

Appendix 3.2—Pied stilt movement patterns

The following regional accounts of pied stilt movement patterns in New Zealand were provided by R.J. Pierce (unpublished data).

Northland

Post-breeding dispersal occurred mainly in summer months to nearby harbours and estuaries. Eighty percent of late summer-winter sightings were at sites < 10 km from the breeding grounds. Some birds shifted longer distances, e.g. a Dargaville chick seen 2 years later at Whangarei Harbour, 45 km away. One long-distance recovery was made: an adult female, who was originally banded at Kiripaka and who returned there to breed in the following two seasons, was found 250 km further south at Kokopu, South Auckland, in a pre-breeding concentration 4 years later.

Auckland–Waikato

The majority of post-breeding sightings (c. 60%) were within 10 km of the breeding grounds, and most other sightings (35%) were 11–20 km away, with no significant difference in distance moved between adults and juveniles. Typical movements included many adults and chicks from the Kokupa area breeding grounds moving to the Firth of Thames, and birds in South Auckland moving to Manukau Harbour. Long-distance movements comprised two adults moving over 500 km south to the Wairarapa and Marlborough. Most breeding birds returned approximately to their previous season's breeding area, but there was a tendency for 1-year-old birds to visit more distant sites from their natal area.

East Coast

Wairoa birds were typically re-sighted locally, with the breeding areas also providing autumn feeding grounds. The longest distance moved was that of a pair who moved 70 km from Wairoa to Westshore, Hawke's Bay, where they subsequently nested.

Hawke's Bay

Most Hawke's Bay birds were sedentary, spending the year at coastal sites, e.g. Ahuriri Estuary and Clive. Some local movements of up to 20 km occurred, e.g. from Tukituki River and other inland sites to coastal lagoons and estuaries. Two birds have departed from this pattern: an adult was found in two consecutive autumn-winters 610 km away at Rangaunu Harbour, Northland, and another adult was found at Kopuku, South Auckland / Waikato.

Wairarapa

Nearly all Wairarapa adults and chicks moved from local riverbed breeding grounds to the shores of Lake Wairarapa, 12–40 km away. One bird departed from this pattern—an adult that spent three consecutive autumns 500 km away at Jordans, Kaipara Harbour.

Taranaki–Manawatu

Most birds were banded at coastal lagoons and estuaries (e.g. Ohau Lagoon and Waikanae) where birds were resident. One local movement of 12 km was recorded in Taranaki.

Nelson

Most birds banded were chicks in the Nelson Haven area. All recoveries were from the local area within 10 km of the natal site.

North Canterbury

Birds were banded at many localities in the Christchurch area. Most sightings were in the local area at the Avon-Heathcote Estuary, Bexley and Lake Ellesmere, with most dispersal distances < 10 km. Several shifts of c. 30 km were also recorded between the Avon-Heathcote estuary and Lake Ellesmere. One chick banded at Birdlings Flat was re-sighted once the following spring, 1040 km away at Parengarenga Harbour, Northland. Most breeding birds returned to their previous year's breeding grounds, but a few local shifts also occurred.

Mid-Canterbury

All three post-breeding sightings represented long-distant shifts of 820–920 km to Manukau Harbour (n = 1) and Kaipara Harbour (n = 2)—all different birds, one a juvenile. Two other adults were found back at the same nesting grounds as the previous year.

South Canterbury

Two chicks banded at coastal Wainono Lagoon were found the following autumn and winter at the same locality.

Mackenzie Basin

All post-breeding sightings were from outside the Mackenzie Basin from Lake Ellesmere (200 km) to Kaitaia (1060 km). Summer sightings were at Lake Elterwater and Lake Grassmere in Marlborough, and Kaipara Harbour, while autumn-winter sightings were at Kawhia Harbour, Kaipara Harbour and Kaitaia. The Kaitaia bird was also seen at Lake Grassmere in February of two separate years. Breeding birds were found at approximately the same sites between years.

East Otago

Post-breeding sightings included a combination of local residents and long-distance migrants. Some local movements of up to 42 km occurred in summer and early autumn, e.g. East Taieri to Hoopers Inlet and Waikouaiti Estuary. However, autumn-winter sightings were mostly from Manukau and Kaipara Harbours, 1050–1300 km away. Breeding birds were found in approximately the same breeding areas between years.

Central Otago

Few post-breeding sightings were made in summer on local riverbeds. All other post-breeding recoveries were from outside Central Otago. These comprised two birds sighted at Lake Grassmere (585 km away), two birds in the Firth of Thames (960 km), three birds at Manukau Harbour (985 km), and two birds at Kaipara Harbour (1050–1100 km).

Southland

One bird was seen in a post-breeding flock locally. All other post-breeding sightings were from the northern North Island 1175–1360 km away: Manukau (n = 1), Kaipara (n = 3) and Parengarenga (n = 1) Harbours. All re-sightings of nesting birds at the breeding grounds were of adults within 1 km of the previous season's nesting area.

Appendix 4

BLACK STILT (*Himantopus novaezelandiae*)

TABLE A4.1. SIGHTINGS OF BLACK STILTS (B) AND DARK HYBRIDS (H) OUTSIDE THE UPPER WAITAKI BASIN, JAN 1990–MAY 2004.

Dark hybrids are nodes F–I of Pierce (1984b). Data presented includes the site at which birds were seen (Site); the maximum number of individuals in any one year (Max. number); the number of years (Years) and the months (Months: numbered consecutively from 1 = Jan to 12 = Dec) during which black or dark hybrid stilts were reported from that site; and references (CSN volume/issue, except CSN 02/03, which are unpublished reports; ON—OSNZ News; personal communications from: AR—Adrian Riegen; BH—Barry Hartley; BS—Brent Stephenson; CP—Chris Petyt; DM—David Melville; FH—Francois Hupet; OC—OSNZ Canterbury; PB—Phil Battley; PS—Pauline Samways; RS—Rob Schuckard; and SW—Steve Wood).

SITE	MAX. NUMBER		YEARS	MONTHS	REFERENCES
	B	H			
Kaipara Harbour[a]	4	3	11	1–8, 11	43/3, 44/2, 45/4, 47/4, 48/3, 49/2, 50/2, AR
Manukau Harbour[a]	7[b]		12	2–8, 10, 11	41/4, 42/3, 43/3, 44/2, 45/4, 47/4, 48/3, 50/2, AR
Puni		2	1	7	44/2
Firth of Thames	1	1	5	1, 4, 6, 11	43/3, 44/2, 45/4, 47/4, PB
Whangamarino (Kopuku)		1	1	7	41/4
Tauranga Harbour[ac]	4	2	8	3, 5–7, 11	39/3, 41/4, 44/2, 45/4, 47/4, 48/3, 49/2, 50/2
Kawhia Harbour[a]	7	9	14	1, 5–7, 11	39/3, 41/4, 43/3, 44/2, 45/4, 47/4, 48/3, 49/2, 50/2, 02/03, ON 70–72
Lake Whangape	1		1	1	39/3
Mokau Estuary[a]	1	1	7	1–8, 10	47/4, 48/3, 50/2, BH
Tongaporutu Estuary		1	3	1–3	47/4, BH
Mohakatino Estuary		1	2	1, 4–7	47/4, 48/3, BH
Waiongana Estuary[a]		1	1	1	47/4
Urenui Estuary		2	1	1	BH
Ngamotu Lagoon		1	1	6	CSN 41/1
Bay View Marsh		1	1	10	BS
Manawatu Estuary		1	3	1, 2, 4–6, 11, 12	39/3, 45/4, 47/4
Farewell Spit		2	4	1, 4, 8, 11	CP
Taupata Creek		2	1	3	CP
Motueka Sandspit[a]		4	4	1–7	RS, DM, PS, SW, 02/03
Lake Grassmere	1		1	1	39/3
Wairau Lagoon	2		1	3, 4	FH
Ashley Estuary[a]	1	3	5	2–6, 8, 12	48/2, OC
Ashley River, inland	1		1	10	OC
Travis Swamp		1	1	8	45/1
Avon-Heathcote		1	1	1	39/3
Lyttelton Harbour[ad]	1	1	1	6 or 7	JED, pers. obs.
Lake Ellesmere[a]	7[e]	11	13	1–12	39/3, 41/3, 42/2, 42/4, 43/4, 45/1, 48/1, OC

Continued on next page

Table A4.1—continued

SITE	MAX. NUMBER		YEARS	MONTHS	REFERENCES
	B	H			
Rakaia River mouth[a]	1		1	5	48/2
Upper Ashburton River		1	1	11	39/3
Hinds	1		1	5	50/3
Opihi River mouth[a]		1	2	1, 6	OC
The Levels, Timaru	1		1	3	48/2
Washdyke Lagoon[a]	1	1	4	2, 3, 6, 9	48/2, 02/03, OC, CP
Wainono Lagoon	1	2	5	3, 6	39/3, 43/4, 48/2, OC
Morven	1		1	4	OC
Otematata River mouth	1		2	2, 4	45/1, 48/2
Waitaki Bridge	1		1	2	OC
Kakanui River	1		1	10	45/1
Brighton[a]	3		1	3	02/03
Gore	1		1	6	50/3

[a] Sites where banded birds were seen.

[b] Recorded as seven black stilts in CSN; however, some may have been hybrids, as not all records differentiated pure black birds from dark hybrids.

[c] Matahui Point.

[d] One other record from this site, in August 1988 (see section 3.4).

[e] Seven different colour-banded birds seen from 18 Dec 2002 to 14 Nov 2003 (OSNZ Canterbury, unpubl. report).

Appendix 5

NEW ZEALAND DOTTEREL (*Charadrius obscurus*)

Appendix 5.1—Southern New Zealand dotterel (*C. o. obscurus*)

TABLE A5.1.1. RECENT COUNTS (2001–2004) OF SOUTHERN NEW ZEALAND DOTTERELS AT THE THREE MAIN WINTERING FLOCK SITES.

The number of individuals has increased rapidly since 1995; only counts from the past 4 years are shown. All information has been sourced from annual monitoring by Stewart Island Field Centre, DOC; old recovery plan task 8.3.3 (Dowding 1993).

SITE	COUNT	DATE
Awarua Bay, Southland	46	Apr 2001
	59	Apr 2002
	59	Apr 2003
	57	Apr 2004
Paterson Inlet / Mason Bay	105	Apr 2001
	120	Apr 2002
	108	Apr 2003
	109	Apr 2004
Cooks Arm, Port Pegasus	14	Apr 2001
	15	Apr 2002
	15	Apr 2003
	24	Apr 2004

TABLE A5.1.2. RECORDS OF SOUTHERN NEW ZEALAND DOTTERELS AT SITES OTHER THAN STEWART ISLAND AND AWARUA BAY SINCE 1985.

Asterisks denote sites at which birds that were colour-banded on Stewart Island have been seen.

SITE	COUNT	DATE	SOURCE
Farewell Spit*[a]	6	May 1989	CSN 37/3&4
	1	24 May 1990	CSN 38/4
	5	May 1991	CSN 41/3
	4	Nov 1992	CSN 45/1
	2	May 1994	CSN 45/1
	1	10 Sep 1995	CSN 45/1
Westhaven Inlet*	1	May 1991	Dowding & Murphy (1993)
Motueka Sandspit*	2	17 Nov 1988	CSN 37/3&4
	1	Mar 1991	Dowding & Murphy (1993)
Wairau Lagoons*	1	1 Apr 1993	CSN 42/2
	1	Mar 1999	N. Dillon, pers. comm.
Marlborough[b]	1	13 June 1990	CSN 38/4
Barrytown[c]	3	19 Sep 1985	CSN 34/2
Ashley Estuary*	1	26 Jan 2001	N. Allen, pers. comm.
Avon-Heathcote Estuary	1	Sep / Oct 1989	CSN 38/4
Kaitorete Spit	1	30 Sep 1993	CSN 42/4
Waituna Lagoon	1	22 Jan 1987	Barlow (1993)
Fortrose Estuary	1	10 Feb 1989	Barlow (1993)
New River Estuary[d]	3	20 Jan 1986	CSN 34/2
	3	10 Jan 1987	Barlow (1993)
	2	16 Feb 1992	Barlow (1993)
Oreti Beach[d]	4	28 Aug 1985	CSN 34/2
	4	7 Aug 1986	Barlow (1993)
	1	3 Jan 2000	CSN 49/2

[a] Many records of small numbers (one to eight birds) before 1985.

[b] Exact location not given; possibly Wairau Lagoons.

[c] West Coast, north of Greymouth.

[d] Numerous other records of small numbers at these sites between 1952 and 1992 are given by Barlow (1993).

Appendix 5.2—Northern New Zealand dotterel (*C. o. aquilonius*)

Two complete surveys of the northern New Zealand dotterel breeding distribution were undertaken during October 1989 and October 1996. The results of these are contained in unpublished databases held by DOC Conservancies and one of the authors (JED). Important breeding sites identified in the surveys or subsequently are listed in Table A5.2.1, and important non-breeding sites are listed in Table A5.2.2. The taxon is widely and thinly spread along the coastline, so that counts sometimes include groups of birds from quite long stretches of coast; these counts have been omitted where identified.

TABLE A5.2.1. IMPORTANT BREEDING SITES FOR NORTHERN NEW ZEALAND DOTTERELS.

Sites included are those where six or more pairs (1% of the total effective population) or 15 or more adults (1% of the total population) were recorded during the breeding season, either during the 1989 and 1996 national censuses or more recently.

SITE	COUNTS		DATE	SOURCE
	PAIRS	TOTAL ADULTS		
Northland / Auckland population				
Waikuku / Whareana Beach	10	23	22 Oct 1989	National NZD census[a]
		39	Oct 1996	National NZD census[a]
		27	27 Aug 2000	CSN 49/2
		16	20 Sep 2001	CSN 50/2
Ngakeno Beach		15	Oct 1996	National NZD census[a]
Kokota Spit	16	39	23 Oct 1989	National NZD census[a]
		25	Oct 1996	National NZD census[a]
Kowhai Beach	9		16 Nov 1992	CSN 41/4
Walker Island / Rangaunu Harbour	6		17 Nov 1992	CSN 41/4
	9	18	Oct 1996	National NZD census[a]
		30	Nov 1997	CSN 47/4
Karikari Bay		20	18 Oct 1986	CSN 36/3
		21	Oct 1989	National NZD census[a]
		14	Oct 1996	National NZD census[a]
Takou Bay		16	Oct 1989	National NZD census[a]
		28	Oct 1996	National NZD census[a]
Bay of Islands		44	Oct 1996	National NZD census[a]
Bland Bay		27	Oct 1996	National NZD census[a]
Kauri Mountain / Ocean Beach		32	Oct 1989	National NZD census[a]
		28	Oct 1996	National NZD census[a]

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Table A5.2.1—continued

SITE	COUNTS		DATE	SOURCE
	PAIRS	TOTAL ADULTS		
Whangarei Harbour		21	15 Nov 1997	CSN 47/4
	6		2000/01	CSN 49/2
	7		2001/02	CSN 50/2
Ruakaka	6		1992/93	CSN 41/4
	6		2001/02	CSN 50/2
	c. 7		2002/03	Hansen & Hazel (2003)
Waipu	18		1992/93	CSN 41/4
		51	6 Nov 1993	CSN 42/3
		21	Oct 1996	National NZD census[a]
		39	27 Nov 1999	CSN 48/3
	c. 16		2000/01	CSN 49/2
	16		2001/02	CSN 50/2
	c. 14		2002/03	Hansen & Hazel (2003)
Mangawhai		81	Oct 1996	National NZD census[a]
	≥ 30		1998/99	CSN 47/4
	c. 30		2000/01	CSN 49/2
		132	3 Nov 2001	CSN 50/2
		106	9 Nov 2002	CSN 02/03, unpubl. report
South Kaipara Head		27	14 Nov 1996	CSN 45/4
		38	29 Aug 1999	CSN 48/3
		30	25 Nov 2000	CSN 49/2
		34	17 Nov 2001	CSN 50/2
		30	23 Nov 2002	CSN 02/03, unpubl. report
Pakiri River		19	9 Oct 2002	SPC/JED[b]
	7	20	6 Sep 2003	G. Pulham, pers. comm.
Omaha		23	Oct 1996	National NZD census[a]
	8		2000/01	C. Zeiler, pers. comm.
	8		13 Nov 2001	SPC/JED[b]
	9		8 Nov 2002	SPC/JED[b]
	10	30	Nov 2003	SPC/JED[b]
Browns Island	10[c]		23 Nov 2001	CSN 50/2
Whakanewha, Waiheke	6		Oct 2003	A. Spence, pers. comm.
Manukau Harbour		18[d]	1990–1998	Veitch & Habraken (1999)
		23	Oct 1996	National NZD census[a]

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Table A5.2.1—continued

SITE	COUNTS		DATE	SOURCE
	PAIRS	TOTAL ADULTS		
Coromandel / Bay of Plenty population				
Whangapoua, Great Barrier Island		20–24	Oct 2001	J. Ogden, pers. comm.
	c. 11	22–27	Nov 2003	J. Ogden, pers. comm.
Waikawau Bay	11		2001/02	J. van de Wetering, pers. comm.
	10		2003/04	P. Stewart, pers. comm.
Ohui	7		Nov 2002	Dowding (2003)
	5		Nov 2003	W. Hare, pers. comm.
Opoutere		21	Oct 1996	National NZD census[a]
	17		30 Sep 2000	CSN 49/2
	15		2001/02	Hare (2002)
	15		2002/03	Hare (2003)
	13		2003/04	P. Stewart, pers. comm.
Matakana Island[e]	35		2000/01	Murray (2003)
	34		2001/02	Murray (2003)
	41		2002/03	Murray (2003)
	40		2003/04	Palmer (2004)
Maketu	9		7 Nov 1987	CSN 36/3
	6		4 Nov 1990	CSN 39/3
	8		15 Nov 1992	CSN 41/4
Ohiwa Harbour	8		3 Nov 1990	CSN 39/3
		19	Oct 1996	National NZD census[a]
	6		18 Nov 2000	CSN 49/2

[a] National New Zealand dotterel census (JED, unpubl. data).

[b] S.P. Chamberlin & JED, unpubl. data.

[c] Other counts lower; further data required.

[d] Mean of November counts, 1990–1998.

[e] Several distinct breeding areas managed as a unit; e.g. the northern group around Waikoura Point are c. 20 km from the southernmost group at Panepane Point.

TABLE A5.2.2. IMPORTANT NON-BREEDING SITES FOR NORTHERN NEW ZEALAND DOTTERELS.

Sites included are those where 15 or more birds (1% of the total population) were recorded during the non-breeding season, either during the March 1990 and 1997 national censuses or more recently.

SITE	COUNT	DATE	SOURCE
Northland / Auckland population			
Whareana	43	Mar 1990	National NZD census[a]
	20	6 May 2000	CSN 48/3
Kokota Spit / Parengarenga	59	30 Mar 1986	CSN 34/2
	96	Mar 1990	National NZD census[a]
	110	23 Feb 1992	CSN 41/1
	75	23 Apr 1993	CSN 41/4
	19	Mar 1997	National NZD census[a]
Kowhai Beach / Houhora Harbour	49	Mar 1990	National NZD census[a]
	48	3 June 1995	CSN 43/3
	42	6 July 1996	CSN 45/4
Rangaunu Harbour / Walker Island	13–64	1984–1994	Sagar et al. (1999)
	42	26 Mar 1991	CSN 39/3
	40	3 June 1995	CSN 43/3
	42	29 Jan 1996	CSN44/2
	38	Mar 1997	National NZD census[a]
Karikari Bay	18	7 Apr 1991	CSN 39/3
	22	18 Mar 1993	CSN 41/4
	23	7 May 1994	CSN 43/3
Takou Bay	20	Mar 1990	National NZD census[a]
	24	2 Feb 1995	CSN 43/3
	31	Mar 1997	National NZD census[a]
Tahoranui River (Taronui Bay)	15	Mar 1990	National NZD census[a]
	41	Mar 1997	National NZD census[a]
Bay of Islands[b]	48	Mar 1997	National NZD census[a]
Bland Bay	48	Mar 1990	National NZD census[a]
	35	Mar 1997	National NZD census[a]
Whananaki	41	Mar 1990	National NZD census[a]
	29	10 June 1991	CSN 39/3
	34	28 Mar 1994	CSN 42/3
	27	25 May 1995	CSN 43/3
	33	Mar 1997	National NZD census[a]
	50	Mar 2003	Annual flock counts[c]
Ngunguru	27	27 Jan 1993	CSN 41/4
	35	Mar 1994	Annual flock counts[c]
	30	Mar 1995	Annual flock counts[c]
	32	Mar 1997	National NZD census[a]

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Table A5.2.2—continued

SITE	COUNT	DATE	SOURCE
Kauri Mountain / Ocean Beach[d]	21	Mar 1990	National NZD census[a]
Whangarei Harbour	78	30 Mar 1997	CSN 45/4
	27	8 Mar 1998	CSN 47/4
	31	11 Mar 2000	CSN 48/3
	48	2 Mar 2002	CSN 50/2
	60	27 June 2002	CSN 50/2
Ruakaka	19	Mar 1990	National NZD census[a]
	26	24 Apr 1993	CSN 41/4
	10	Mar 1997	National NZD census[a]
	44	30 June 2001	CSN 49/2
	16	7 June 2003	CSN 02/03, unpubl. report
Waipu	52	Autumn 1993	CSN 41/4
	21	Mar 1997	National NZD census[a]
	47	7 Mar 1999	CSN 47/4
	35	11 Mar 2000	CSN 48/3
	44	Mar 2002	Annual flock counts[c]
	35	Mar 2003	Annual flock counts[c]
Mangawhai	131	Mar 1999	Annual flock counts[c]
	128	Apr 2001	Annual flock counts[c]
	123	Mar 2002	Annual flock counts[c]
	150	Mar 2003	Annual flock counts[c]
	112	7 Apr 2004	JED, unpubl. data
Mitimiti[e]	29	Mar 1990	National NZD census[a]
	32	24 Apr 1993	CSN 41/4
Webbers Spit, Kaipara Harbour[e]	39	Mar 1990	National NZD census[a]
Tapora, Kaipara Harbour	51	Mar 1999	Annual flock counts[c]
	63	Mar 2001	Annual flock counts[c]
	54	Mar 2002	Annual flock counts[c]
	44	Mar 2003	Annual flock counts[c]
	55	Mar 2004	S. Chamberlin, pers. comm.
South Kaipara Head	61	Mar 1999	Annual flock counts[c]
	51	Mar 2000	Annual flock counts[c]
	49	Mar 2001	Annual flock counts[c]
	77	15 June 2002	CSN 50/2
	61	Mar 2003	Annual flock counts[c]
Omaha	71	Mar 2000	Annual flock counts[c]
	52	Mar 2001	Annual flock counts[c]
	66	Mar 2002	Annual flock counts[c]
	83	Mar 2003	Annual flock counts[c]
	79	Mar 2004	Annual flock counts[c]

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Table A5.2.2—continued

SITE	COUNT	DATE	SOURCE
Waitemata Harbour	24	29 Mar 2003	Annual flock counts[c]
Browns Island	34	Mar 2001	Annual flock counts[c]
	27	Mar 2002	Annual flock counts[c]
	33	Mar 2003	Annual flock counts[c]
	32	Mar 2004	Annual flock counts[c]
Manukau Harbour			
Auckland Airport	33	Mar 1999	Annual flock counts[c]
	24	9 Apr 2000	CSN 48/3
	27	Mar 2001	Annual flock counts[c]
	14	Mar 2002	Annual flock counts[c]
	27	Mar 2003	Annual flock counts[c]
	23	6 Apr 2004	JED, unpubl. data
Karaka, Manukau Harbour	16	1 Apr 1997	CSN 45/4
	18	22 Feb 1999	A. Habraken, pers. comm.
	19	7 Mar 2000	CSN 48/3
	23	Mar 2003	Annual flock counts[c]
Te Matuku, Waiheke Island	17	Mar 2001	Annual flock counts[c]
	20	Mar 2002	Annual flock counts[c]
	20	Mar 2003	Annual flock counts[c]
	21	14 Apr 2004	JED, unpubl. data
Whitford	24	Mar 2000	Annual flock counts[c]
	19	26 Mar 2001	CSN 49/2
	23	Mar 2002	Annual flock counts[c]
	33	Mar 2003	A. Habraken, pers. comm.
	30	Mar 2004	Annual flock counts[c]
Mataitai	24	Apr 2000	Annual flock counts[c]
	31	8 Apr 2001	A. Habraken, pers. comm.
	42	Mar 2002	Annual flock counts[c]
	36	Mar 2003	Annual flock counts[c]
	34	Mar 2004	Annual flock counts[c]
Kaiaua / Miranda, Firth of Thames	20	8 Apr 1996	CSN 44/2
	23	8 Mar 1997	CSN 45/4
	19	7 Feb 1998	CSN 47/4
	14	5 Feb 2000	B. Woolley, pers. comm.
	16	24 Mar 2003	Annual flock counts[c]
Kawhia Harbour / Ocean Beach[f]	35	13 Mar 2002	CSN 50/2

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Table A5.2.2—continued

SITE	COUNT	DATE	SOURCE
Coromandel / Bay of Plenty population			
Whangapoua, Great Barrier Island	51	Mar 2001	Annual flock counts[c]
	57	Mar 2002	Annual flock counts[c]
	44	Mar 2003	Annual flock counts[c]
	59	Mar 2004	Annual flock counts[c]
Colville	25	7 Mar 1991	CSN 39/3
	44	17 Apr 1993	CSN 41/4
	36	12 Apr 1996	CSN 44/2
	17	27 Jan 1997	CSN 45/4
	32	18 Mar 2001	B. Woolley, pers. comm.
Coromandel Harbour	22	20 Feb 1991	CSN 39/3
Matarangi	68	4 Mar 2001	CSN 49/2
	100	18 Mar 2001	B. Woolley, pers. comm.
	80	5 Mar 2003	W. Hare, pers. comm.
	104	7 Mar 2004	B. Woolley, pers. comm.
Tairua Harbour / Pauanui	16	22 Feb 2000	B. Woolley, pers. comm.
	24–27	Feb 2002	Owen (2003)
	22	27 Apr 2004	JED, unpubl. data
Opoutere	34	3 Feb 1996	CSN 44/2
	27	2 Feb 1997	CSN 45/4
	34	18 Mar 2001	W. Hare, pers. comm.
	37	21 Feb 2003	B. Woolley, pers. comm.
	30	14 Feb 2004	B. Woolley, pers. comm.
Whangamata	24	18 Apr 1993	CSN 41/4
	16	4 Feb 1997	JED, unpubl. data
	21	31 Jan 2000	JED, unpubl. data
	21	19 Mar 2001	B. Woolley, pers. comm.
	15	24 Jan 2003	B. Woolley, pers. comm.
Tauranga Harbour[g]	16–48	1984–1994	Sagar et al. (1999)
	113	13 Mar 2001	J. Heaphy, pers. comm.
	119	21 Mar 2003	J. Heaphy, pers. comm.
	97	24 Mar 2004	Palmer (2004)
Maketu[h]	65	5 Mar 1996	CSN 44/2
	18	13 Mar 2001	J. Heaphy, pers. comm.
	26	19 Mar 2002	CSN 50/2
	31	21 Mar 2003	CSN 02/03, unpubl. report

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Table A5.2.2—continued

SITE	COUNT	DATE	SOURCE
Pukehina[d]	16	Mar 1990	National NZD census[a]
	20	18 June 1995	CSN 43/3
Ohiwa Harbour	32–99	1984–1994	Sagar et al. (1999)
	91	29 Mar 1994	CSN 42/3
	75	21 Apr 1995	CSN 43/3
	71	26 Apr 1996	CSN 44/2
	62	16 Mar 1997	CSN 45/4
	76	15 May 2002	CSN 50/2
	76	21 Mar 2003	J. Groom, pers. comm.
	96	24 Mar 2004	J. Groom, pers. comm.
Portland Island	16	17 Feb 2002	G. Foreman, pers. comm.
	20	14 Feb 2003	CSN 02/03, unpubl. report

[a] National New Zealand dotterel census (JED, unpubl. data).

[b] Two flocks (15 birds at Waitangi and 20 at Rangihoua Bay) plus pairs on territory on several islands.

[c] Annual OSNZ / DOC flock counts; old recovery plan task 8.1.4 (Dowding 1993).

[d] Not recorded on other occasions; probably part of Whangarei Harbour flock.

[e] No recent counts; status unclear.

[f] Most other records in single figures; further data required.

[g] Many lower counts (and one very high count) exist; probably several groups in the harbour, sometimes apart, sometimes together, and probably moving between roosts.

[h] Variation in counts suggests possible movement between these two sites, which are close together.

Appendix 6

BANDED DOTTEREL (*Charadrius bicinctus bicinctus*)

TABLE A6.1. COUNTS OF BANDED DOTTERELS FROM IMPORTANT BREEDING SITES.

Maloney (1999) lists maximum number of banded dotterels counted from 1991 to 1994. Because there are few recent counts from the breeding grounds that reach the 1% threshold (of 500 birds), available counts above 0.5% (250 birds) are included.

SITE[a]	COUNT	DATE	SOURCE
Ngaruroro River	480	Oct 1986	CSN 35/4
Tutaekuri River	509	Oct 1986	CSN 35/4
Tukituki River	1149	Oct 1986	CSN 35/4
Wairau River	970	1985	Hallas (2003)
	502	1993, 1995, 1996[b]	Hallas (2003)
Awatere River	279	1996, 1997[c]	Hallas (2003)
Waiau River	292	Oct–Nov 1975	O'Donnell & Moore (1983)
Hurunui River	290	Oct–Nov 1978	O'Donnell & Moore (1983)
Ashley River	382	Oct–Nov 1980–1981	O'Donnell & Moore (1983)
Waimakariri River			
Upper Waimakariri	244	Oct–Nov 1981	O'Donnell & Moore (1983)
Lower Waimakariri	309	Oct–Nov 1980	O'Donnell & Moore (1983)
Lake Ellesmere[d]	≥ 500	1981–1982	O'Donnell (1985)
Wilberforce River	268	Oct–Nov 1978	O'Donnell & Moore (1983)
Rakaia River			
Upper Rakaia	619	Oct–Nov 1978	O'Donnell & Moore (1983)
Ashburton River	901	Oct–Nov 1981	O'Donnell & Moore (1983)
	387	24 Jan 1987	CSN 36/3
	456[e]	25 Nov 1990	CSN 39/3
Tasman River	599	Oct–Dec 1991–1994	Maloney et al. (1997)
Godley River	496	Oct–Dec 1991–1994	Maloney et al. (1997)

Continued on next page

Table A6.1—continued

SITE[a]	COUNT	DATE	SOURCE
Hopkins River	281	Oct–Dec 1991–1994	Maloney et al. (1997)
Tekapo River	496	Oct–Dec 1991–1994	Maloney et al. (1997)
Cass River Valley	781	October 1979	Pierce (1983)
	932	October 1982	Pierce (1983)
Cass River Delta	216[f]	Oct–Dec 1991–1994	Maloney (1999)
Ahuriri River	377	Oct–Dec 1991–1994	Maloney (1999)
Waitaki River	312	Oct–Nov 1974	O'Donnell & Moore (1983)

[a] Based on OSNZ banding studies, R.J. Pierce (pers. comm.) has suggested that the following additional areas probably also hold 250 or more breeding birds:
- North Island—Ruamahanga River (Manawatu River probably holds less than 250 birds).
- Canterbury—Upper Rangitata River.
- Otago—Matukituki River, Makarora River, Central Otago generally, including rivers and ranges, e.g. Old Man and Pisa Ranges.
- Southland—Apirama River, Riverton River.

[b] Upper Wairau surveyed in spring 1996, mid-Wairau in spring 1995, and lower Wairau in spring 1993.

[c] Only the middle (1996) and lower (1997) sections of the Awatere River were surveyed.

[d] Most pairs bred on Kaitorete Spit.

[e] 403 on south branch, 53 on north branch.

[f] Maloney (1999) count is only of Cass River delta, not entire Cass River valley as in Pierce (1983).

TABLE A6.2. COUNTS OF BANDED DOTTERELS FROM WINTERING / MOULT SITES IN NEW ZEALAND THAT TYPICALLY HOLD 200 OR MORE BIRDS (1% OF THE TOTAL NEW ZEALAND WINTERING POPULATION).

Counts are mainly from 1996–2003, but include mean counts from 1984–1994 (Sagar et al. 1999; Robertson & Heather 1999).

SITE	COUNT	DATE	SOURCE
Parengarenga Harbour	881	1984–1994	Sagar et al. (1999)
	c. 1600	Winter 1990	Onley (1990)
	1100	20 June 1992	CSN 41/1
	949	2 July 1994	CSN 43/3
	141	28 June 1997	A. Riegen, pers. comm.
Paua	280	4 Mar 2001	CSN 49/2
Houhora Harbour	c. 200	21 June 1992	CSN 41/4
Whangarei Harbour	290	1984–1994	Sagar et al. (1999)
	400	31 July 1991	CSN 41/4
	429	17 June 1995	CSN 43/3
	314	19 June 1999	CSN 47/4
	302	11 Mar 2001	CSN 49/2
	288	30 June 2001	CSN 49/2
	268	2 Mar 2002	CSN 50/2
	210	27 June 2002	CSN 50/2
	315	7 June 2003	CSN 2002–2003
Kaipara Harbour	459	1984–1994	Sagar et al. (1999)
	≥ 1200	Winter 1989	CSN 37/3&4
	613	22 June 1997	CSN 45/4
	700	15 June 2002	CSN 50/2
	799	14 June 2003	CSN 02/03, unpubl. report
Waitemata Harbour	200	30 Jan 1989	CSN 37/3&4
	250	28 May 1993	CSN 41/4
Manukau Harbour	642	1984–1994	Sagar et al. (1999)
	963	18 June 1995	CSN 43/3
	822	16 June 1996	CSN 44/2
	551	27 June 1998	CSN 47/4
	415	24 June 2001	OSNZ wader counts
	484	6 June 2002	OSNZ wader counts
Karaka	351	24 Feb 2001	CSN 49/2
Clarks & Karaka	440	18 May 2003	A. Riegen, pers. comm.
Auckland Airport	305	6 Apr 2004	JED, unpubl. data
South Manukau	282	23 May 2004	D. Lawrie, pers. comm.
Aotea Harbour	350	5 July 1999	CSN 48/3
	282	17 June 2000	CSN 48/3
Kawhia Harbour	347	1984–1994	Sagar et al. (1999)
	456	5 July 1999	CSN 48/3
	356	17 June 2000	CSN 48/3
	450	23 June 2001	CSN 49/2
	321	14 June 2003	CSN 02/03, unpubl. report

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Table A6.2—continued

SITE	COUNT	DATE	SOURCE
Matarangi Spit / Whangapoua Harbour	200	3 Apr 1994	CSN 42/3
Tauranga Harbour	334	1984–1994	Sagar et al. (1999)
	522	23 June 2000	CSN 48/3
	432	15 June 2001	CSN 49/2
Tauranga Aerodrome	c. 600	21 May 1989	CSN 37/3&4
	340	7 June 1997	CSN 45/4
	c. 450	16 June 1999	CSN 47/4
	432	June 2001	A. Riegen, pers. comm.
Ohiwa Harbour	404	1984–1994	Sagar et al. (1999)
	453	21 Apr 1995	CSN 43/3
	380	22 Mar 1992	CSN 41/4
	370	26 Apr 1996	CSN 44/2
	320	10 May 1997	CSN 45/4
	260	16 June 2002	CSN 50/2
	279	30 June 2003	CSN 02/03, unpubl. report
Lake Wairarapa	385	1984–1994	Robertson & Heather (1999)
	316	26 Jan 1992	CSN 41/4
Farewell Spit	1030	1984–1994	Sagar et al. (1999)
	727	Feb 1999–2001	Calculated from Schuckard (2002)
	773	June 1996–2001	Calculated from Schuckard (2002)
	691	Feb 2002	OSNZ Nelson / Golden Bay[a]
	678	June 2002	OSNZ Nelson / Golden Bay[a]
	593	Feb 2003	OSNZ Nelson / Golden Bay[a]
	730	June 2003	OSNZ Nelson / Golden Bay[a]
	496	Feb 2004	OSNZ Nelson / Golden Bay[a]
	385	June 2004	OSNZ Nelson / Golden Bay[a]
Lake Grassmere	227	10 June 1991	CSN 39/3
	≥ 300	18 Apr 1993	CSN 42/2
Lake Ellesmere	887	1984–1994	Sagar et al. (1999)
	2900	19 Feb 1988	CSN 36/3
	2554	18 Feb 1996	CSN 45/1
	2168	15 June 1996	CSN 45/1
	1307	20 June 1998	CSN 48/2
	978[b]	16 Jan 1999	CSN 48/2
	1109[c]	28 Mar 1999	CSN 48/2
	1328	23 Feb 2002	CSN 02/03, unpubl. report
Wainono Lagoon	380	Jan 1977	Pierce (1980b)
	242	6 Feb 1991	CSN 39/3
	137	2 Mar 1996	A. Crossland, pers. comm.

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Table A6.2—continued

SITE	COUNT	DATE	SOURCE
New River Estuary	283	17 June 1989	L. Esler, pers. comm.
	353	10 June 1990	L. Esler, pers. comm.
	184	15 June 1996	L. Esler, pers. comm.
	600	6 Feb 1997	CSN 48/2
	129	15 June 1997	L. Esler, pers. comm.
Awarua Bay, Southland	≥ 401	11 July 1992	L. Esler, pers. comm.

[a] Ornithological Society of New Zealand Nelson / Golden Bay Branch wader census data.

[b] Between Jarvis Road and L2 River.

[c] Greenpark Sands.

TABLE A6.3. COUNTS OF BANDED DOTTERELS FROM WINTERING SITES IN AUSTRALIA THAT TYPICALLY HOLD 300 OR MORE BIRDS (1% OF THE TOTAL AUSTRALIAN WINTERING POPULATION).

Counts are mainly from 1990 to 2002, but include a mean count from 1973 to 1998 (Loyn et al. 2001), a mean count from 1981 to 1985 (Lane 1987), and counts from a 1987 survey of Tasmania (Pierce 1987).

SITE	COUNT	DATE	SOURCE
Colac Region, Victoria	2180	26 Apr 1990	Appleby (1992)
	3700	6 July 1991	Appleby (1992)
Port Phillip Bay, Victoria[a]	1400[b]	1981–1985	Lane (1987)
	323	Winter 2000	Wilson (2001)
	539	Winter 2001	Skewes (2002)
	815	Winter 2002	Skewes (2003)
Corner Inlet, Victoria[c]	730	1981–1985	Lane (1987)
	330	Winter 2000	Wilson (2001)
	260	Winter 2001	Skewes (2002)
	827	Winter 2002	Skewes (2003)
Anderson's Inlet, Victoria	550[b]	1981–1985	Lane (1987)
	15	28 Mar 2003	J. & A. Whitelaw, pers. comm.[d]
	275	18 May 2003	J. & A. Whitelaw, pers. comm.[d]
	190	10 July 2003	J. & A. Whitelaw, pers. comm.[d]
Western Port, Victoria	500[b]	1981–1985	Lane (1987)
	598	1973–1998	Loyn et al. (2001)
	357	Winter 2001	Skewes (2002)
	449	Winter 2002	Skewes (2003)
SW coast, Victoria	300[b]	1981–1985	Lane (1987)
Robbins Passage, Tasmania	≥ 1000	June 1987	Pierce (1987)

Continued on next page

Table A6.3—continued

SITE	COUNT	DATE	SOURCE
North-west Tasmania	550[e]	1 Apr 1999	Wakefield & Wakefield (1999)
	c. 600[f]	12 July 1999	Wakefield & Wakefield (1999)
	450	Winter 2001	Skewes (2002)
	340	Winter 2002	Skewes (2003)
Cape Portland coast, Tasmania	680[b]	1981–1985	Lane (1987)
	≥ 307	June 1987	Pierce (1987)
	115	Winter 2000	Wilson (2001)
	152	Winter 2001	Skewes (2002)
	16	Winter 2002	Skewes (2003)
King Island, Tasmania	370[b]	1981–1985	Lane (1987)
	c. 400	June 1987	Pierce (1987)
Derwent estuary & Pittwater, Tasmania[g]	360[b]	1981–1985	Lane (1987)
	297	June 1987	Pierce (1987)
	148	Winter 2000	Wilson (2001)
	317	Winter 2001	Skewes (2002)
	92	Winter 2002	Skewes (2003)

a Includes East Port Phillip, Altona, Werribee / Avalon and Bellarine Peninsula / Mud Island.

b Maximum count rather than a mean.

c Includes Corner Inlet East and Corner Inlet West.

d These counts are only from the Inlet. The Whitelaws report that more plovers usually roost on the surf beaches at Inverloch and Venus Bay, outside the area of these counts. The Whitelaws' data were forwarded by B. Martin, Parks Victoria.

e Count from Anthony's Beach, near Smithton.

f Count from Shipwreck Point, Perkins Island.

g Includes Marion Bay.

Appendix 7

WRYBILL (*Anarhynchus frontalis*)

TABLE A7.1. COUNTS OF WRYBILLS FROM NORTHERN NORTH ISLAND WINTERING SITES THAT TYPICALLY HOLD 50 OR MORE BIRDS (≥ 1% OF THE TOTAL POPULATION).

Many counts of wintering flocks are available for this species, but, since individuals are mobile, there are often difficulties in obtaining consistent counts.

SITE	COUNT	DATE	SOURCE
Parengarenga Harbour	116[a]	1975–1980	Hay (1984)
	137[b]	1984–1994	Sagar et al. (1999)
	130	20 June 1992	CSN 41/1
	82	May 1994	Davies (1997)
	67	May 2001	ACR / JED[c]
Houhora Harbour	50	1975–1980	Hay (1984)
	34[b]	1984–1994	Sagar et al. (1999)
	c. 50	21 June 1992	CSN 41/1
Whangarei Harbour	145[a]	1975–1980	Hay (1984)
	136[b]	1984–1994	Sagar et al. (1999)
	115	May 1994	Davies (1997)
	52	May 2001	ACR / JED[c]
	138	June 2002	CSN 50/2
	156	May 2003	ACR / JED[c]
Kaipara Harbour	400–500	1956–1960	Sibson (1963)
	376[a]	1975–1980	Hay (1984)
	115[b]	1984–1994	Sagar et al. (1999)
	177	May 1994	Davies (1997)
	180	May 2001	ACR / JED[c]
	298	May 2002	ACR / JED[c]
	208	May 2003	ACR / JED[c]
Waitemata Harbour	12[a]	1975–1980	Hay (1984)
	14[b]	1984–1994	Sagar et al. (1999)
	c. 190	12 Apr 1992	CSN 41/4
	317	May 1994	Davies (1997)
	100	May 2001	ACR / JED[c]
	208	June 2002	CSN 50/2
	34	May 2003	ACR / JED[c]

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Table A7.1—continued

SITE	COUNT	DATE	SOURCE
Manukau Harbour	1500–1700	1956–1960	Sibson (1963)
	1047[a]	1975–1980	Hay (1984)
	1171[b]	1984–1994	Sagar et al. (1999)
	1610	May 1994	Davies (1997)
	1880	May 2001	ACR / JED[c]
	2646	May 2002	ACR / JED[c]
	2773	May 2003	ACR / JED[c]
Upper Tamaki River[d]	800–1000	May 2002	ACR / JED[c]
Firth of Thames	2500–2600	1956–1960	Sibson (1963)
	2905[a]	1975–1980	Hay (1984)
	1958[b]	1984–1994	Sagar et al. (1999)
	2651	May 1994	Davies (1997)
	1591	May 2001	ACR / JED[c]
	1382	May 2002	ACR / JED[c]
	2155	May 2003	ACR / JED[c]
Tauranga Harbour	94[a]	1975–1980	Hay (1984)
	71[b]	1984–1994	Sagar et al. (1999)
	101	8 Apr 1989	CSN 37/3&4
	65[e]	7 June 1992	CSN 41/4
	26	May 1994	Davies (1997)
	135	Mar 2001	N. Milius, pers. comm.

[a] Means of counts for the period (Hay 1984).

[b] Means of counts for the period (Sagar et al. 1999).

[c] Counts by NZWSG / OSNZ collated by A. Riegen & JED.

[d] Not a high-water roost; birds of upper Manukau flock use this site for feeding (A. Habraken & JED, unpubl. data).

[e] Sulphur Point only.

TABLE A7.2. COUNTS OF WRYBILLS FROM WINTERING / MOULT AND MIGRATION SITES IN THE SOUTHERN NORTH ISLAND AND SOUTH ISLAND.

These sites are of interest because of their locations, away from the major concentration of wintering sites in the northern North Island. Some of these are sites used all winter by wrybills, some appear to be used for moulting, and some are used during migration.

SITE	COUNT	DATE	SOURCE
Wherowhero Lagoon	37	22 Feb 1999	J. Quirk, pers. comm.
	57	28 May 2001	ACR / JED[a]
	≥ 60	30 May 2002	M. Bramwell, pers. comm.
	≥ 80	23 May 2003	M. Bramwell, pers. comm.
Porangahau Estuary	56[b]	1984–1994	Sagar et al. (1999)
	65	May 1994	Davies (1997)
	84	27 June 1999	CSN 47/4
	60	18 June 2000	CSN 48/3
	39	May 2001	ACR / JED[c]
	51	23 June 2002	CSN 50/2
	40	15 June 2003	CSN 02/03. unpubl. report
Manawatu Estuary	20	29 May 1994	Davies (1997)
	36	20 June 1997	CSN 45/4
	45–48	May 2001	CSN 48/3
	35–39	Feb–June 2001	CSN 49/2
	50	5 Apr 2003	CSN 02/03. unpubl. report
	42	18 May 2003	ACR / JED[c]
Motueka Sandspit	25	25 June 2001	CSN 50/3
	26	1 June 2003	P. Samways, pers. comm.
	42	15 July 2003	P. Samways, pers. comm.
	10	5 May 2004	P. Samways, pers. comm.
Waimea Inlet	47	13 June 1987	CSN 35/4
	37	5 June 2000	CSN 50/3
	101	Aug–Sep 2000	CSN 50/3
	23	22 June 2001	CSN 50/3
	32	14 May 2003	ACR / JED[a]
Ashley Estuary	57	27 Oct 1988	CSN 37/3&4
	85	21 Aug 1990	CSN 39/3
	157	13 Aug 1995	CSN 48/2
	36	4 Oct 1998	CSN 48/2
	28	18 Aug 2001	CSN 02/03, unpubl. report
	18	Oct 2003	S. Petch, pers. comm.

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Table A7.1—continued

SITE	COUNT	DATE	SOURCE
Lake Ellesmere	450	26 Dec 1997	CSN 48/2
	309	4 Jan 1998	CSN 48/2
	341	12 Aug 1998	CSN 48/2
	701	11 Oct 1998	CSN 48/2
	450	24 Nov 1998	CSN 48/2
	130	8 Mar 1999	C. Hill, pers. comm.
	142	29 Aug 1999	C. Hill, pers. comm.
	87	6 Mar 2000	CSN 49/2
	112	27 Nov 2000	CSN 50/3
	176	15 Mar 2001	JED, pers. obs.
	≥ 100	8 Apr 2001	CSN 50/3
	38	27 May 2001	ACR / JED[a]
	c. 300	27 Jan 2002	C. Hill, pers. comm.
	101	14 Mar 2002	JED, pers. obs.
	≥ 130	5 Apr 2003	C. Hill, pers. comm.
	299	17 Aug 2003	C. Hill, pers. comm.
	204	28 Aug 2003	C. Hill, pers. comm.
Washdyke Lagoon	19	Aug 1966–1972[b]	Sagar (1976)
	14	Oct 1966–1972[b]	Sagar (1976)
	29	9 Jan 1998	CSN 48/2
Wainono Lagoon	c. 15	Sep 1968–1977[c]	Pierce (1980b)
	c. 25	Oct 1968–1977[c]	Pierce (1980b)
	112	1 Nov 1987	CSN 36/3
	41	5 Oct 1996	CSN 48/2
	22	14 Oct 1997	CSN 48/2
	194	6 Nov 1998	CSN 48/2

[a] Unpublished OSNZ / NZWSG counts collated by A. Riegen & JED.

[b] Mean of counts for that month, 1966–1972 (Sagar 1976).

[c] Mean of counts for that month, 1968–1977 (Pierce 1980b).