

Bird use of the sediment settlement ponds and roost areas at Port Whangarei

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ABSTRACT

The sediment ponds and tidal flats at Port of Whangarei have been significant roost areas for waders since they were created from dredge tailing in the late 1960s. In 1971, 11 species of waders fed or roosted in this area; New Zealand Dotterel (*Charadrius obscurus*), White-fronted Tern (*Sterna striata*), Caspian Tern (*S. caspia*) and Black-backed Gull (*Larus dominicanus*) bred there, and on six islands of mud and shell. Intensive observation in 1979-80 and 1995-98 found that the residency status of many species had changed. There were significant declines in the numbers of New Zealand Dotterel, Caspian Tern and Skylark (*Alauda arvensis*), and significant increases in the numbers of Red-billed Gull (*L. novaehollandiae scopulinus*) and House Sparrow (*Passer domesticus*). These changes were associated with development of sedimentation ponds and increases in weed-stabilised communities and cover by mangroves. Future bird use of this area is very dependent on the management of the ponds, and the rate of encroachment of mangroves or ponds over the main mudflat roost area. A new island would safeguard wader roosting in the upper harbour.

KEYWORDS: dredge ponds, waders, roosts, Whangarei.

INTRODUCTION

Whangarei Harbour runs southeast from Whangarei City to the east coast of the North Island (Figure 1). Four major catchments drain urban areas and pastoral farmland. The harbour is 24 km long, has 140 km of shoreline and covers 10,785 ha. At low tide 5393 ha are open water, 189 ha are saltmarsh, 1379 ha are mangroves, and 3824 ha are sand and mud flats.

The hydrology of the harbour is influenced by its length in relation to the tidal extension distance, and this influences the deposition of silt and the location of sand and mud flats (Miller 1980). The cement works at Portland fed fine limestone sediment into the upper harbour for 70 years and this caused substantial changes including the possible killing of eel grass (*Zostera* spp.).

The Port of Whangarei is located at the head of Whangarei Harbour (Figure 1). Access to the Port and the town basin has been maintained by dredging since the 1920s. An enlarged channel of 8.1 m depth below chart datum was dredged from Marsden Point to Port Whangarei in 1967-69 (Munro 1971). The tailings from the upper harbour were dumped onto the mudflats and mangroves west of the

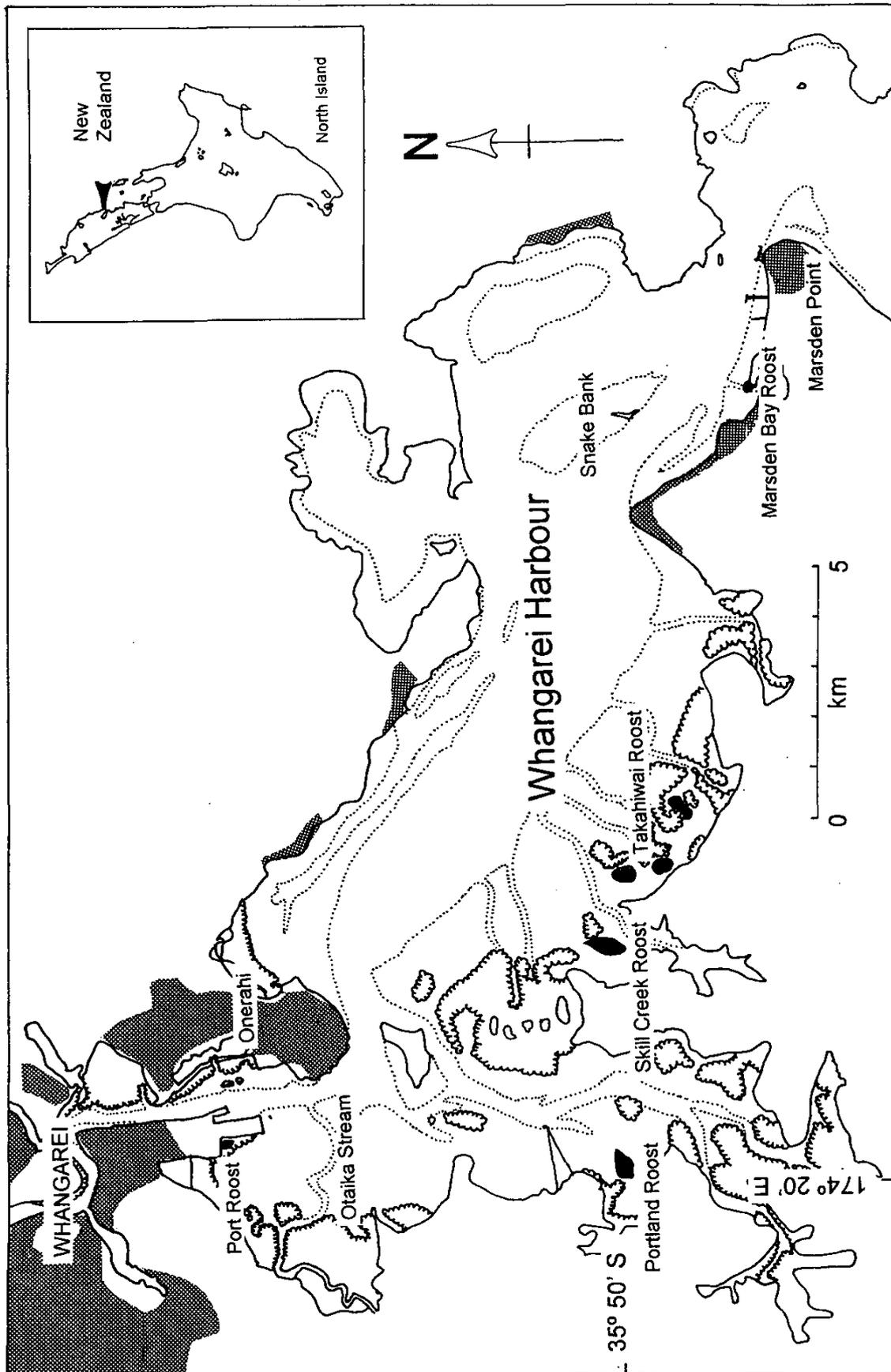


FIGURE 1 - Distribution of the major wader roosts in Whangarei Harbour. Shaded regions are built-up areas.

existing port and east of it near Onerahi (Figure 1). The tailings from the lower harbour were also dumped on Snake Bank producing short-lived shell islands. At the port, this dumping formed an extensive area of open mud and shell banks, shallow rain-filled ponds, shrublands and grasslands, during the early 1970s (Munro 1971). Between 1968 and 1972 six low islands extended from the southern margin of this area towards the channel of the Otaika Stream (Figure 1). Five of these islands were covered or gradually eroded by 1979, and in 1996 the last island was submerged during mean high tides (Figure 2c).

The tailing area at the port was built up by controlled sediment pond development (Munro 1971, 1972) and then consolidated by the 1980s (Parrish 1984). It now comprises areas of sediment ponds, a sawmill, storage areas for logs and wood chips. Some additional warehouses were built near existing facilities in the 1980s and in 1992.

The current active settlement ponds cover 17 ha on the southern margin of the port (Figure 2). Dredging, pond bund maintenance and road management have maintained most of the pond region as open habitat with shallow ponds of varying salinity and areas of weeds.

The ponds' area is one of six roosts for waders in Whangarei Harbour that have been surveyed in November for 27 years, and in winter since the early 1970s (Munro 1971, Parrish 1984, Parrish & Lock 1997, Northland branch of the Ornithological Society of New Zealand (OSNZ) unpubl. data).

In 1979-80 Richard Parrish (GRP) surveyed the Whangarei Port area as part of a more extensive study of Whangarei Harbour (Parrish 1984), and between 1995-1998 Tony Beauchamp (AJB) surveyed part of the port. This study uses raw data from the 1979-80 survey (Parrish 1984), and data from the 1995-98 survey, to assess species use of this area. The recent data are used to describe how management of this area has affected bird usage and distribution.

METHODS

GRP counted waterfowl 32 times on foot on a transect along the western consolidated area, sedimentation pond A and outwash area at Port Whangarei (Figure 2b), between 3 August 1979 and 29 July 1980. Birds were counted using binoculars (8x) or a telescope (20x). Most surveys were at high tide and when tides reached between 2.4 and 3.1 m above chart datum. Flocks of passerines were counted or estimated during the 27 counts after 16 August 1979.

AJB counted all species 28 times on foot along a different route around ponds 1, 3, 4 and 5 (Figure 2c), between 14:00 and 18:00 h, between 17 June 1995 and 21 June 1998. Birds were counted using binoculars (8x) or a telescope (15x-45x). The location and activities of all birds were mapped and the water levels in each pond and changes to the banks or roads around each pond, noted. Most

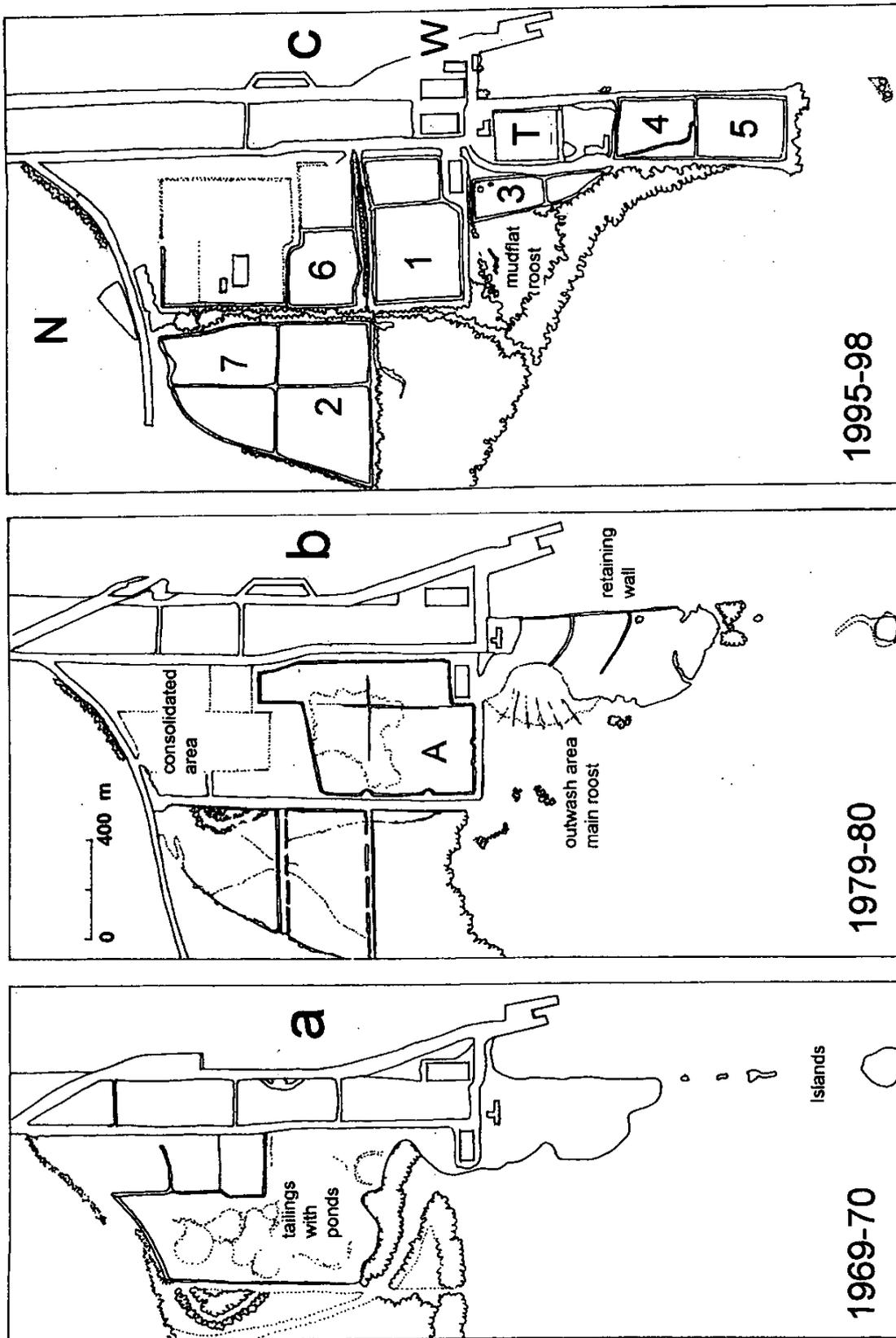


FIGURE 2 - Pond roost and sediment ponds status during each of the three intensive count periods. 1, 2, 3, 4, 5, 6, 7, A = Location of ponds referred to in the text, T = Tenix plant site, W = warehouse roost site.

counts were at full tide (2.3 to 2.9 m above chart datum). However, those on the 25 December 1995, 5 May 1996 and 9 July 1997 were during low tide, and those on 17 June 1995, 15 September 1996 and 1 February 1998 were counted at ebb half tide. The route used between 1995 and 1998 differed from that used in 1971 (Munro 1971, unpubl.) and during 1979 and 1980 because of the progressive development of the port (Figure 2a,b).

Additional records of the authors, OSNZ, and previously reported in Classified Summarised Notes are included. Statistical comparisons were made between the 1979-80 and the 1997-98 counts using comparable survey dates, and the species that were considered to have been counted accurately due to the different census routes and habitats.

RESULTS

Area management

In 1979-80 much of the inland area described as pond by Munro (1971) had been developed (Fig 2a). Half of this area was covered in weeds and the rest was open consolidated mud. Sediment ponds had been developed on some of the tailings and were filled and left to settle (area A, Figure 2b). Ponds 2 and 7 were enclosed, and there was some initial pond development in the area now holding the Tenix plant (Figure 2c).

In 1995-98 the area was actively managed to maintain the ponds and protect the pond bunds. Pond 3 was commissioned in 1995. Pond 2 was split into two areas between August and October 1997, and part of pond 4 was modified to enable water to flow between ponds 5 and 3 in October 1995 (Fig 2c).

Ponds 1, 2, 3 and 5 were filled with dredge tailings at various times during the study. Pond 2 was full in August 1995. Ponds 5 and 3 were linked and filled in tandem between November 1995 and February 1996; and ponds 2, 7 and 6 were also linked and filled between June and September 1997. In September 1997, and March and July 1998, rain filled ponds 1, 2 and 3 to between 5% and 100% of their surface areas. Pond 5 drained when a bank collapsed in September 1996, and then was dry mud until May 1998. Ponds 1, 2 and 3 were only completely dry in April and May 1997, and February and March 1998.

The island near the southern end of Pond 5 was an important roost at the start of the study. This island gradually eroded and by May 1998 was generally covered by neap high tides during calm conditions.

The dredge's floating pipeline was anchored on the eastern margin of pond 4 until June 1996.

Bird residency and seasonal presence

In 1979-80 and 1995-98 there were between 14 - 28 and 19 - 27 species

TABLE 1 - The change in status of birds at the Port Whangarei sedimentation pond and roost area. Data are: Maximum number recorded in counts in the time, residency (A = absent, NR = not recorded as part of the survey, S = seasonal visitor [a = autumn w = winter sp = spring, su = summer], O = occasional visitor F = frequent visitor, R = resident), B = breeding recorded.

Species	Max count and residency		Max at other times	
	1969-71	1979-80	1995-98	1969-98
Australasian Gannet	1, O	A	2, O	2 (20/8/95, AJB)
Black Shag	A	6, S	2, O	
Pied Shag	A	5, R	57, R	74 (25/7/93, GRP)
Little Black Shag	A	4, S [w]	89, S [w]	98 (15/5/98, AJB)
Little Shag	A	6, R	8, O	
Spotted Shag	A	A	A	1 (Taylor & Parrish '91)
White-faced Heron	20, R	50, R	62, F	
White Heron	A	A	1, O	
Reef Heron	A	1, O	1, O	
Australasian Bittern	NR	A,	1, O	
Royal Spoonbill	A	A	39, S [a/w/sp]	60 (4/7/98, AJB)
Paradise Shelduck	NR	7, O	14, O	
Grey Duck/Mallard	300, S [a/w]	300, R	165, R	
Grey Teal	NR	1, O	68, S [w]	
New Zealand Shoveler	NR	3, O	12, S [w]	26 (8/7/78, GRP)
Australasian Harrier	NR	2, R	3, R	
Californian Quail	NR	A	3, O	
Ring-necked Pheasant	NR	A	1, O	
Banded Rail	A	A	A	1 (2/2/94, AJB)
Pukeko	NR	10, R	23, R	
SIPO	150, S [su/w/sp]	337, R	400, R	600 (9/3/93, GRP)
Variable Oystercatcher	A	1, O	2, S [su]	
Pied Stilt	500, R	1000, R	803, R	
New Zealand Dotterel	20, R, B	25, R	2, O	30 (8/7/78, GRP)
Banded Dotterel	200, S [su]	57, R	1, O	
Wrybill	100, F	146, R	58, S [su/a]	
Golden Plover	A	22, O	11, O	63 (2/1/91, GRP)
Spur-winged Plover	A	A	9, R	24 (16/8/98, AJB)
Turnstone	10, F	1, O	3, O	
Lesser Knot	2500, S [su]	823, S [sp/su/a]	600, S [sp/su/a]	4000 (25/12/91 GRP)
Curlew Sandpiper	A	A	A	5 (7/3/77, OSNZ)
Sharp-tailed Sandpiper	1, O	A	A	2 (23/4/78, GRP)
Red-necked Stint	1, O	A	3, O	
Asiatic Whimbrel	A	A	A	1 (25/12/91 GRP)
Asiatic Black-tailed Godwit	A	A	A	1 (3/3/79, OSNZ count)
Bar-tailed Godwit	2400, S [su/a]	685, S [su]	956, S [su]	7200 (5/2/94, GRP)
Common Sandpiper	A	A	A	1 (9/2/92, GRP)
Terek Sandpiper	1, O	A	A	3 (24/12/91, GRP)
Sharp-tailed Sandpiper	1, O	A	A	2 (23/4/78, GRP)
Red-necked Stint	1, O	A	3, O	
Black-backed Gull	60, R, B	85, R	1000, R, B	
Red-billed Gull	400, R, B	325, R	780, R, B	
Caspian Tern	30, R, B	28, R	5, F	
White-fronted Tern	200, F, B	86, F	61, F	
Fairy Tern	A	A	A	5 (7/3/81, OSNZ)
Little Tern	A	A	A	9 (2/2/91, GRP)
Rock Pigeon	NR	A	2, O	
Shining Cuckoo	NR	A	1, O	
New Zealand Kingfisher	NR	19, S [a/w/sp]	9, S [a/w/sp]	

TABLE 1 - *Continued.*

Skylark	NR	30, R	13, R
Welcome Swallow	NR	47, R	238, R
New Zealand Pipit	NR	2, F	2, S [w/sp]
Dunnock	NR	A	3, F
Blackbird	NR	2, F	7, F
Song Thrush	NR	9, F	2, O
Grey Warbler	NR	2, O	3, O
North Island Fantail	NR	1, O	2, O
Silvereye	NR	20, S [a/w/sp]	36, S [a/w/sp]
Chaffinch	NR	73, S [a/w/sp]	260 S [w/sp]
Greenfinch	NR	2, O	2, O
Goldfinch	NR	56, S [a/w/sp]	63, R
Yellowhammer	NR	4, S [a/w/sp]	4, O
Redpoll	NR	4, O	A
House Sparrow	NR	22, F	44, R
Starling	NR	56, R	6000, R
Myna	NR	38, R	11, R

recorded each count, respectively. The total number of species increased from 43 in 1979-98 to 53 in 1995-98 (Table 1).

The species that were seen in all seasons, and in greater than 70 percent of the counts, were considered resident. In both survey periods these species were the Grey Duck (*Anas superciliosa*)/ Mallard (*Anas platyrhynchos*), Pied Stilt (*Himantopus leucocephalus*), Southern Black-backed Gull (*Larus dominicanus*), Red-billed Gull (*L. novaehollandiae scopulinus*), Skylark (*Alauda arvensis*) and Welcome Swallow (*Hirundo tabitica neoxena*). In 1979-80, Wrybill (*Anarhynchus frontalis*), New Zealand Dotterel (*Charadrius obscurus*) and Caspian Tern (*Sterna caspia*) were resident. However, in 1995-98, Wrybill used the area less frequently (Table 2), New Zealand Dotterel were generally absent, and Caspian Tern roosted there in significantly lower numbers (Table 2). Pied Shag (*Phalacrocorax varius*), Pukeko (*Porphyrio p. melanotus*), Blackbird (*Turdus merula*), Goldfinch (*Carduelis carduelis*), House Sparrow (*Passer domesticus*) and Starling (*Sturnus vulgaris*) were encountered more frequently between 1995-98. In 1979-80 the Spur-winged Plover (*Vanellus miles novaehollandiae*) was absent, but it was resident by 1995.

Frequently encountered non-migratory species in both periods were White-faced Heron (*Ardea novaehollandiae*), Little Shag (*Phalacrocorax melanoleucos*), Australian Harrier (*Circus approximans*) and White-fronted Tern (*S. striata*). Common migratory species were South Island Pied Oystercatcher (SIPO: *Haematopus ostralegus finschi*), Bar-tailed Godwit (*Limosa lapponica*) and New Zealand Kingfisher (*Halcyon sancta vagans*). Banded Dotterel (*Charadrius bicinctus*) were common in 1979-80, but were seen significantly less frequently in the later counts (Table 2). Royal Spoonbills (*Platalea regia*) were not seen in 1979-80, but were common in 1995-98, when numbers increased annually with maxima of 30, 34, 38 and 60 birds respectively. Grey Teal (*Anas gracilis*) were seen once during the 1979-80 counts, but were frequent late summer and autumn visitors during 1995-98.

Most passerines were seen throughout the year and were most numerous when suitable foods were available. Other birds, including Dunnock (*Prunella modularis*), Blackbird, Song Thrush (*Turdus philomelos*) and Grey Warbler (*Greygona igata*) were probably resident but were counted more frequently during the seasons when they sang.

In 1995-98, 10 species were recorded in only one or two counts. These included irregular visitors to Whangarei Harbour like Red-necked Stint (*Calidris ruficollis*) in November 1997 to January 1998, and White Heron (*Egretta alba modesta*) in June and July 1998. Five species including the Shining Cuckoo (*Chrysococcyx lucidus*), Californian Quail (*Callipepla californica*), Rock Pigeon (*Columba livia*), Ring-necked Pheasant (*Phasianus colchicus*), North Island Fantail (*Rhipidura fuliginosa*) were transient. Other species, including the Australasian Gannet (*Morus serrator*), Turnstone (*Arenaria interpres*), Pacific Golden Plover (*Pluvialis fulva*), Banded Dotterel and New Zealand Dotterel, were resident in or regular visitors to Whangarei Harbour but used the port area infrequently.

Seasonal use of the area

Some of the species of birds used the port region seasonally (Table 2). Bar-tailed Godwits were present between November and January each year and in 1997 and 1998 a few birds remained until May. Lesser Knot (*Calidris canutus*) showed a similar but less consistent pattern. Wrybill (*Anarhynchus frontalis*) were most numerous between February and May. Royal Spoonbill roosted there each year between April and October, with peak numbers in July and August.

Kingfisher, New Zealand Pipit (*Anthus novaeseelandiae*) Greenfinch (*Carduelis chloris*) and Yellowhammer (*Emberiza citrinella*) were present mainly in winter. Most finches and passerines were transient within the area and concentrated at food sources. Silvereye (*Zosterops lateralis*), Goldfinch and House Sparrow were most numerous in late autumn and in winter, and Chaffinch (*Fringilla coelebs*) formed large flocks in July.

Bird use of sediment ponds

In 1979-80 the ponds were generally full of water and were used by ducks and Welcome Swallows. Up to 403 Pied Stilts fed regularly in ponds 2 and 7 (Figure 2b, c). Bar-tailed Godwit, Knot, Wrybill, Banded and New Zealand Dotterel roosted regularly in Pond A, and Banded Dotterel used the area now occupied by the Tenix plant (Figure 2b, c).

In 1995-98, ponds that were full or had pools of water held significantly more White-faced Heron (Mann Whitney U = 2116.0, $P < 0.006$), Mallard/Grey Ducks (Mann Whitney's U = 1454.5, $P < 0.001$), Pied Stilt (Mann Whitney U = 1075.5, $P < 0.001$), Bar-tailed Godwit (Mann Whitney U = 2219.0, $P < 0.032$), and Welcome Swallow (Mann Whitney U = 1634.5, $P < 0.001$) than ponds that lacked water.

TABLE 2 - Changes on the status of some species in the sediment pond area between 1979-80 and 1997-98. Data are: n, mean, se, median. * = $P < 0.05$.

Species	1979-80	1997-98	Mann-Whitney U	P value
White-faced Heron	8, 18.0, 17.6, 18.0	8, 6.5, 9.9, 2.0	43.0	0.241
Paradise Shelduck	8, 1.1, 2.5, 0	8, 5.5, 5.7, 4.5	17.0	0.082
Pukeko	8, 2.1, 2.2, 1.5	8, 5.9, 4.2, 5.0	14.0	0.057
SIPO	8, 112.0, 121.5, 61.0	8, 127.6, 168.9, 62.5	33.0	0.916
Pied Stilt	8, 222.5, 323.5, 120.0	8, 240.1, 221.9, 160.0	27.5	0.636
New Zealand Dotterel	8, 6.6, 9.1, 2.5	8, 0, 0, 0	56.0	0.004 *
Banded Dotterel	8, 8.0, 14.9, 0	8, 0, 0, 0	44.0	0.064
Wrybill	8, 43.5, 51.1, 34.5	8, 17.8, 22.4, 8.5	44.0	0.196
Lesser Knot	8, 107.0, 289.4, 0	8, 9.4, 24.6, 0	37.0	0.523
Bar-tailed Godwit	8, 206.3, 228.1, 165.5	8, 185.4, 327.5, 31.5	41.5	0.315
Black-backed Gull	8, 37.0, 27.0, 27.0	8, 66.9, 70.8, 44.5	26.5	0.563
Red-billed Gull	8, 5.9, 8.7, 3.5	8, 32.0, 45.4, 21.0	13.0	0.044 *
Caspian Tern	8, 8.0, 6.9, 7.5	8, 0.9, 1.0, 0.5	55.5	0.012 *
Skylark	7, 13.3, 7.9, 15.0	7, 4.4, 3.5, 4.0	41.5	0.029 *
House Sparrow	7, 1.0, 1.7, 0	7, 8.0, 5.6, 8.0	2.5	0.004 *

The clouds of midges on the calm margins of full ponds attracted between 50 and 230 Welcome Swallow. Full ponds were also used by Grey Duck and Mallard and as bathing areas for gulls. The islands formed in pond 3 when it was full were roost sites for ducks and breeding sites for Red-billed Gull, in November 1997.

Partly full ponds were used by many species. Royal Spoonbills roosted in pond 3 when the water depth was no greater than their proximal tarsometatarsi (approximately 20 cm). Pied Stilts were the waders most frequently encountered feeding in ponds (5-12%) and were most influenced by changes in water level. Pied Stilt numbers were highest there in the driest times in summer and lowest whenever farm fields were saturated. In 1980, 1000 Pied Stilts and hundreds of Red-billed Gulls fed on the overflow region near the current Tenix site (Figure 2b, c). Shallow pools attracted New Zealand Shoveler (*Anas rhynchos*), Grey Duck, Grey Teal and Paradise Shelduck (*Tadorna variegata*) and were breeding sites for Paradise and Grey Ducks in October-November 1997.

TABLE 3 - Bird use of the roost sites at Port Whangarei. Data are; n, mean, se, median.

Species	Mudflat dry roost	Dry ponds with mud base	Dry ponds with weeds	Ponds full of water or with pools
Little Shag				75, 0.1, 0.7, 0
Little Black Shag				75, 0.05, 0.3, 0
White-faced Heron	28, 2.4, 10.9, 0	49, 0.04, 0.3, 0		75, 1.3, 4.7, 0
Grey Duck/Mallard		49, 0.04, .03, 0	16, 0.1, 0.5, 0	75, 6.8, 20.1, 0
SIPO	28, 3.2, 13.3, 0	49, 0.6, 4.1, 0		75, 4.6, 31.4, 0
Pied Stilt	28, 55.4, 143.5, 0	49, 17.5, 100.4, 0		75, 47.2, 94.9, 6.0
Wrybill	28, 0.9, 4.7, 0	49, 0.04, 0.3, 0		75, 2.2, 9.4, 0
Lesser Knot	28, 2.7, 13.3, 0	49, 12.3, 85.7, 0		75, 1.7, 11.9, 0
Bar-tailed Godwit	28, 63.6, 210.4, 0	49, 16.3, 114.3, 0		75, 5.9, 31.0, 0
Spur-winged Plover	28, 0.1, .06, 0	49, 0.06, 0.3, 0		75, 0.5, 1.5, 0
Black-backed Gull		49, 13.5, 26.6, 0	16, 8.4, 14.9, 0	75, 3.7, 11.6, 0
Red-billed Gull		49, 0.7, 2.4, 0		75, 13.7, 62.3, 0
Caspian Tern	28, 0.1, 0.4, 0	49, 0.2, 0.8, 0	16, 0.06, 0.3, 0	75, 0.07, 0.3, 0
Welcome Swallow	28, 0.3, 1.3, 0	49, 0.3, 1.5, 0	16, 0.2, 0.5, 0	75, 8.8, 26.5, 0

When the natural mudflat roost was not being used, Godwit and Knot were generally on dry ponds. Black-backed Gull used the weed free areas in pond 4, the dried mud on pond 5, and dry pipeline margins on Pond 1, as a breeding sites each summer. The dry pond beds were used significantly more frequently by Black-backed Gull (Mann Whitney U = 980.0, $P < 0.001$) and Red-billed Gull (Mann Whitney U = 563, $P < 0.056$) than the natural mudflat roost area.

The small ponds behind the Tenix Plant were used by Pukeko and were one of the four sites used by resident pairs of Skylark. A pair of Pied Stilts bred there in November 1997.

Pond bund margins and roadways

The bund walls of the ponds were constantly augmented using mud scooped from within the ponds, or from the area near the small ponds. Midges associated with bare mud attracted Welcome Swallows and New Zealand Pipits. Banks were generally overgrown by thistles, oxtongue (*Picris echioides*), scentless chamomile (*Matricaria inodora*), strawberry clover (*Trifolium fragiferum*) and cornbind

(*Polygonum convolvulus*) within a year. Chaffinch, Goldfinch, Greenfinch, Yellowhammer, Skylark, New Zealand Pipit, and House Sparrow fed on seed heads of thistles and other weeds. Stable margins were taken over by kikuyu grass (*Pennisetum clandestinum*), pampas (*Cortaderia selloana*) and wattles (*Acacia* spp.). Pampas heads were food for House Sparrow, Chaffinch, and Goldfinch, and the grass bases were food for Pukeko. The wattles provided nectar for House Sparrow and Silvereye in winter. Pukeko, Pied Stilt and Skylark used the pond bund margins as nest sites.

The roadways formed the margin between the ponds and the mangroves or coastal areas. New Zealand Pipit, Skylark, Yellowhammer and House Sparrow fed on the roads, and Kingfisher, Reef Heron, Variable Oystercatcher, Grey Duck, Pied Shag, Black Shag and Rock Pigeon used their coastal margins as roosts.

Mudflat roost

The natural mudflats were used significantly more often than sites in dry pond beds by White-faced Heron (Mann Whitney U = 601.00, $P < 0.035$), Pied Stilt (Mann Whitney U = 563.5, $P < 0.033$) and Bar-tailed Godwit (Mann Whitney U = 6.03.0, $P < 0.04$)

The natural mudflat roost was used most frequently by waders between November and May. During 7 of the 13 occasions that waders were present there, the roost comprised a single species of either Pied Stilt ($n = 2$), Bar-tailed Godwit ($n = 1$), White-fronted Heron ($n = 2$), or Caspian Tern ($n = 2$). On other occasions there were groups of between 3 and 6 species of waders there, including Pied Stilt, Bar-tailed Godwit, Lesser Knot, White-fronted Heron, SIPO, Spur-winged Plover, Red-necked Stint and Caspian Tern. However, when more than one species was present, there was a tendency for species separation, and the only species that mixed regularly were Bar-tailed Godwit and Lesser Knot while roosting, and Red-necked Stint and Pied Stilt when foraging.

Mangroves, islands, poles and floating pipelines

During 1979-80, the mangroves in ponds 2 and 7, and in front of pond 2 were used as roost sites by White-faced Herons and shags. In 1995-98, only the dead stumps in pond 2 were used. In both counts the live mangroves had resident populations of Grey Warbler, Blackbirds, Song Thrush, Dunnock, and transient Silvereye, Shinning Cuckoo and North Island Fantail. Kingfisher used the margin in autumn and winter. Over 6000 Starling, and hundreds of House Sparrow and Chaffinch roosted as a mixed flock in the mangroves west of ponds 3 and 4 in June 1997 and 1998. The three mangroves on the island were roost sites for Royal Spoonbill, White Heron and Pied Shag.

The island and its mangroves were the principal roost for Royal Spoonbill. They deserted it only during a cyclone in June 1997; and when their numbers reached 60 in May 1998 and there was insufficient room. Pied Shags and the single White Heron also roosted with the spoonbills.

The old dredge pipeline support poles near the island, and on the eastern margin of the ponds, were used as roost sites by Pied Shag, Little Shag, Little Black Shag, Black-backed Gull, Red-billed Gull, and as a breeding site by pairs of White-fronted Tern in November 1997.

Floating dredge pipelines were anchored near the eastern margin of the ponds, and beside the wharf, until June 1996. Pied Shag, Black Shag, Little Shag, White-fronted Tern, Red-billed Gull, White-faced Heron and Reef Heron roosted on them and their lines. There was a significant reduction in the number of Pied Shag ($\chi^2 = 353.64$, d.f. = 2, $P < 0.0001$), and White-fronted Tern ($\chi^2 = 100.86$, d.f. = 2, $P < 0.001$) in counts when these pipelines were removed.

Wharf buildings

The roofs of most of the buildings were temporary roost areas for gulls. The roof of one store was the principal roost site for SIPO after October 1997 (Figure 2c), and the eaves of other buildings were breeding sites for Starling, House Sparrow and Myna (*Acridotheres tristis*). In 1979-80, Myna were seen throughout the area, however, in 1995-98 only one pair of Myna was present and they stayed within 100 m of the buildings.

DISCUSSION

Munro (1971, unpubl.) considered that the dredging at the harbour and sediment discharges from Portland Cement were helpful for seabirds. The dry reclaimed area created at the port was the main breeding area in Whangarei Harbour for New Zealand Dotterels in 1971, and up to 200 Banded Dotterels wintered there. Various waders also used the area as a high tide roost, including the Little Tern (*Sterna albifrons*) and Asiatic Whimbrel (*Numenius phaeopus variegatus*), that were absent in this study. The islands south of pond 5 were larger in 1971 and were nesting sites for Black-backed Gulls and White-fronted Terns, and roost sites for Red-billed Gulls and Caspian Terns (Munro 1971).

The data from this study and those of Munro (1971) can be used to assess the trends in bird use of the port area. There has been an increase in species diversity as the habitats have diversified, and as species like Royal Spoonbill and Spur-winged Plover have increased in distribution and density in New Zealand. The pond and port management regime has maintained or created foraging habitat or roost sites for nine species of waders, two shoreline and seabirds since the 1970s (Table 2). Waders roosted on dry mudflats, dry ponds, and the margin of partly filled ponds (Table 3), and SIPO roosted on a warehouse roof (Figure 2c). Current sedimentation pond management has favoured ducks, Pied Stilts, Black-backed Gulls and Red-billed Gulls. Pied Stilts fed in the shallow ponds, and Royal Spoonbills roosted in the ponds during high winds, and when the island was submerged, and there were insufficient roost sites in the mangroves.

Over time the port area has been used less by White-faced Herons, New Zealand Dotterels, Banded Dotterels, Bar-tailed Godwits, Wrybills, Caspian Terns and White-fronted Terns. The reason for the reduction of each species is not known and needs to be assessed as part of a wider study of bird species dynamics in Whangarei Harbour. The lower numbers of Pied Shag and White-fronted Tern in counts in the port area after the floating dredge pipelines were removed, showed that even minor habitat changes can significantly alter bird presence there. However, it does not necessarily mean there has been a decline in that species in Whangarei Harbour.

Whangarei Port is one of five major wader roost areas on the southern shores of Whangarei Harbour counted by the Northland Branch of OSNZ (Figure 1). The data collected contemporaneously with this study in June, November and March each year show that the port roost and ponds are still occasionally the roost area most favoured by Bar-tailed Godwits, Lesser Knots and Caspian Terns, especially during the largest spring tides. The ponds are the principal roost used by Royal Spoonbills.

The existence of the port area roost site is very dependent on future management. Without human intervention, the island at the southern tip of the port area is likely to disappear during the next three years. The main mudflat roost may disappear due to pond development or mangrove encroachment, and the management of the sediment pond area will change when a new logging port is established near Marsden Point. There is now less than five years storage at existing deposition rates in the existing storage ponds. A part of Pond 2 is likely to be retained for future sediment storage. However, future management will only continue to assist the wader population if ponds are inundated at least every two years. Less frequent inundation of the ponds bases will allow overgrowth by weeds and they will become unsuitable for waders.

Historically, islands created from dredge tailings have been important roost and breeding sites for seabirds. Shell bank roost sites further down Whangarei Harbour have been invaded by weeds and are now being restored by the Department of Conservation and OSNZ, and we are discussing with port authorities the creation of additional spring tide roost sites in Whangarei Harbour.

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