

Distribution and conservation of shorebirds in the Bay of Plenty, New Zealand, 1984–2003

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Distribution and conservation of shorebirds in the Bay of Plenty, New Zealand, 1984-2003

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Keith L. Owen, Toni D. Wilson, Paddy M. Latham and Kim D. Young

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Abstract

Shorebirds (Order *Charadriiformes*) have been counted at high tide roosts on harbours, estuaries and beaches in the Bay of Plenty since 1970. Twice yearly (summer and winter) counts started in winter 1984 and continue today. Data from 24 study sites (between Waihi Beach and East Cape) within the Bay of Plenty Region (the Region) are presented according to the distribution of each species and changes in abundance between seasons and over the duration of the study (winter 1984 to summer 2003). In addition, 64 roosting sites were identified in the Region.

During the southern summer an average of 163,000 shorebirds (over the period 1984-1994) comprising mainly migrants (139,000) from the northern hemisphere and native species (24,000) are found annually around the New Zealand coastline. Of that total, northern hemisphere migrant shorebirds in the Bay of Plenty summer comprised 11,143 shorebirds (8%). At this time most native shorebirds are inland at breeding sites, mainly in the South Island. However 837 (3.5%) of these were found during the summer in the Region.

During winter, an average of 130,000 (1984-1994 inclusive) mainly native shorebirds (112,000) and migrant shorebirds (18,000) visit New Zealand shores. Of these national numbers, mainly native shorebirds (3,595) (3.2%) and fewer migrant shorebirds (1,368) (7.6%) occurred in the Region.

More than 1% of the total national population of a number of shorebird species use Bay of Plenty harbours, estuaries and beaches at certain times of the year. They are bar-tailed godwit (*Limosa lapponica*) (9.3% summer & 1% winter), variable oystercatcher (*Haemotopus unicolor*) (9% summer & 7.7% winter), northern New Zealand dotterel (*Charadrius obscurus aquilonius*) (5.9% summer & 6% winter), Pacific golden plover (*Pluvialis fulva*) (6.6% summer), banded dotterel (*Charadrius bicinctus*) (3.9% winter), turnstone (*Arenaria interpres*) (2.51% summer), pied stilt (*Himantopus himantopus*) (1% summer & 2.9% winter), wrybill (*Anarhynchus frontalis*) (1.8% winter) and South Island pied oystercatcher (*Haemotopus ostralegus finschi*) (1.17% winter).

Four sites are nationally and internationally significant for a number of these species:

Tauranga Harbour held more than 1% of the national population of the following species: bar-tailed godwit (*Limosa lapponica*) (5% summer), black stilt (*Himantopus novaeseelandiae*) (4-6% winter), northern New Zealand dotterel (*Charadrius obscurus aquilonius*) (2.6% summer and 1.4% winter), turnstone (*Arenaria interpres*) (2.45% summer), variable oystercatcher (*Haemotopus unicolor*) (2.18% summer and 1.7% winter), banded dotterel (*Charadrius bicinctus*) (1.73% winter), wrybill (*Anarhynchus frontalis*) (1.73% winter) and pied stilt (*Himantopus himantopus*) (1.53% winter). It also held just less than 1% of the national population of South Island pied oystercatcher (*Haemotopus ostralegus finschi*) (0.93% winter). The harbour is notable for annually hosting the largest breeding population of

northern New Zealand dotterel in New Zealand at Matakana Island, and the largest Bay of Plenty post-breeding flock of northern New Zealand dotterel in the winter. It also supports a number of uncommon migratory shorebird species.

Ohiwa Harbour held at least 1% of the national population of the following species: bar-tailed godwit (*Limosa lapponica*) (3.8% summer), variable oystercatcher (*Haemotopus unicolor*) (1.6%, summer & 2.8% winter), northern New Zealand dotterel (*Charadrius obscurus aquilonius*) (1% summer & 2.5% winter), Pacific golden plover (*Pluvialis fulva*) (1.8% summer) and banded dotterel (*Charadrius bicinctus*) (1.58% winter). The harbour was notable for regularly hosting a large post-breeding flock of northern New Zealand dotterel in the winter and small flocks of eastern curlew (*Numenius madagascariensis*) and whimbrel spp. (*Numenius* species) in the summer.

Maketu Estuary / Kaituna River mouth held more than 1% of the national population of Pacific golden plover (*Pluvialis fulva*) (3.7% summer) and just less than 1% of the national population of northern New Zealand dotterel (*Charadrius obscurus aquilonius*) (0.94% winter). The estuary regularly hosts a post-breeding flock of northern New Zealand dotterel in the winter and is outstanding for the wide diversity of uncommon migratory northern hemisphere shorebird species found there annually. It is regionally significant for spur-winged plover (*Vanellus miles*) supporting the largest summer and winter concentrations in the Bay of Plenty.

Waihi Estuary / Pukehina Spit held 0.95% of the national summer population of Pacific golden plover (*Pluvialis fulva*). The estuary is also notable for regularly hosting a wide diversity of rare and vagrant shorebird species (Tim Barnard, pers.obs.).

The northern New Zealand dotterel (*Charadrius obscurus aquilonius*) numbers have increased substantially in the Bay of Plenty due to the successful dotterel protection programme on Matakana Island, and other sites.

Wrybill (*Anarhynchus frontalis*), turnstone (*Arenaria interpres*) and red knot (*Calidris canutus*) numbers declined in the region over the study period.

These trends are discussed in the text. Counts of rare and uncommon northern hemisphere migrant and native shorebirds are also given.

Recommendations are made for registration of internationally significant wetland sites, future shorebird surveys, and roosting site identification and protection.

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1. Introduction

Present day estuaries and tidal inlets are relatively recent coastal features in geological terms. They are ancestral valleys and bays that were flooded during a marine transgression that ended about 10,000 years ago. Rising sea-levels and waves built sandy barriers and spits across these features and catchments—run-off slowly filling them from the landward side. Many of these processes continue today as estuaries and harbours evolve and age (Hume, 2003).

Humans have used estuaries and coastal areas for a great variety of reasons for many centuries leading in recent decades to increasingly wide-spread and varied recreational use of coasts and estuaries (Davidson and Rothwell, 1993). Over the last 50 years, human development of the coastal zone in New Zealand for a wide range of uses has placed increased pressures on natural habitats and wildlife.

More recently, over the last three decades increased leisure time has led to increasingly widespread recreational pressure on our coasts and estuaries. The Bay of Plenty, North-East North Island, New Zealand (Figure 1) is no exception. These pressures are now considered the major concerns for the continuing safeguard of national and international important breeding, migrant, and wintering shorebirds which totally depend upon these places as habitat.

Given the increased human impacts on estuarine and coastal habitats of wading birds and lack of information about shorebird populations nationwide, the Ornithological Society of New Zealand (OSNZ) instigated the National Wader or Shorebirds Count Scheme in 1983. The aims of the study (Sagar et al. (1999) were to determine:

1. The numbers and distribution of shorebirds or waders (Order *Charadriiformes*) occurring at coastal sites throughout New Zealand
2. Seasonal changes in the distribution and numbers of shorebirds (between winter and summer)
3. Annual changes in the numbers of shorebirds

Here we present an analysis of the numbers and distribution of shorebirds in the Bay of Plenty during the period 1984–2003. We consider the contribution that Bay of Plenty shorebirds make to national shorebird populations, and whether these achieve the Ramsar Convention criteria for wetlands of international importance (Ramsar Convention, 2000). In addition, we describe the locations and properties of shorebird roost sites. Furthermore, we discuss some outcomes from conservation management programmes for shorebirds in the Bay of Plenty. Together with a previous OSNZ study carried out in the Nelson Region (Schukard, 2002), this study contributes towards a national understanding of shorebird population, abundance and distribution.

2. Study area

The study area (Figure 1) includes the main estuarine and soft foreshores of the Bay of Plenty region situated in the North Island, New Zealand. The Bay of Plenty coast has a low tidal range of about 1.6 metres (spring tide range) which is average for New Zealand, and common for the estuaries and tidal inlets found in the study area.

The study area includes 24 sites stretching from Waihi Beach in the west (situated north of Tauranga Harbour) to East Cape in the east. It covers approximately 700 kilometres of coastline including estuarine margins. Many of the sites (ecological units) are tidal estuaries, mouths of rivers and streams, bays, beaches or islands. In general these are relatively small in area with the exceptions of Tauranga and Ohiwa Harbours.

Tauranga Harbour at 21,800 hectares (at mean high water spring tide level) (Power, et al., 1991), is one of the largest harbours in New Zealand and the largest by far in the study area. Matakana Island, New Zealand's largest barrier island, with an ocean beach extending for 24 kilometres protects Tauranga Harbour. It is a notable site for roosting and breeding shorebirds.

Ohiwa Harbour, at 2,800 hectares (at mean high water spring tide level) (Bay of Plenty Regional Water Board, 1977), is the second largest shorebird habitat in the study area. The next largest are the Maketu Estuary / Kaituna River mouth, and Waihi Estuary / Pukehina Spit, and the Whakatane River mouth. All of these sites are in the western half of the Bay of Plenty.

In the eastern half of the Bay of Plenty most of the sites are small estuaries, river and stream mouths. The largest ones are Waiotahi River estuary, Waioeka River estuary and Waiaua River estuary.

Information about the physical and biological resources of these sites is derived from various documents prepared by the Department of Conservation and work carried out on coastal habitats in the Bay of Plenty Conservancy and elsewhere (Cromarty and Scott, 1995; Owen 1991; Owen 1993, Owen 1994).

For the purposes of this report the Bay of Plenty region has been split into two major areas; Western Bay of Plenty and Eastern Bay of Plenty, with the boundary splitting the two areas lying on the eastern side of Ohiwa Harbour at the East Coast-Hawke's Bay Conservancy boundary of the Department of Conservation (DOC). Therefore the western half of the study area lies in the Bay of Plenty Conservancy and the eastern half in East Coast-Hawke's Bay Conservancy.

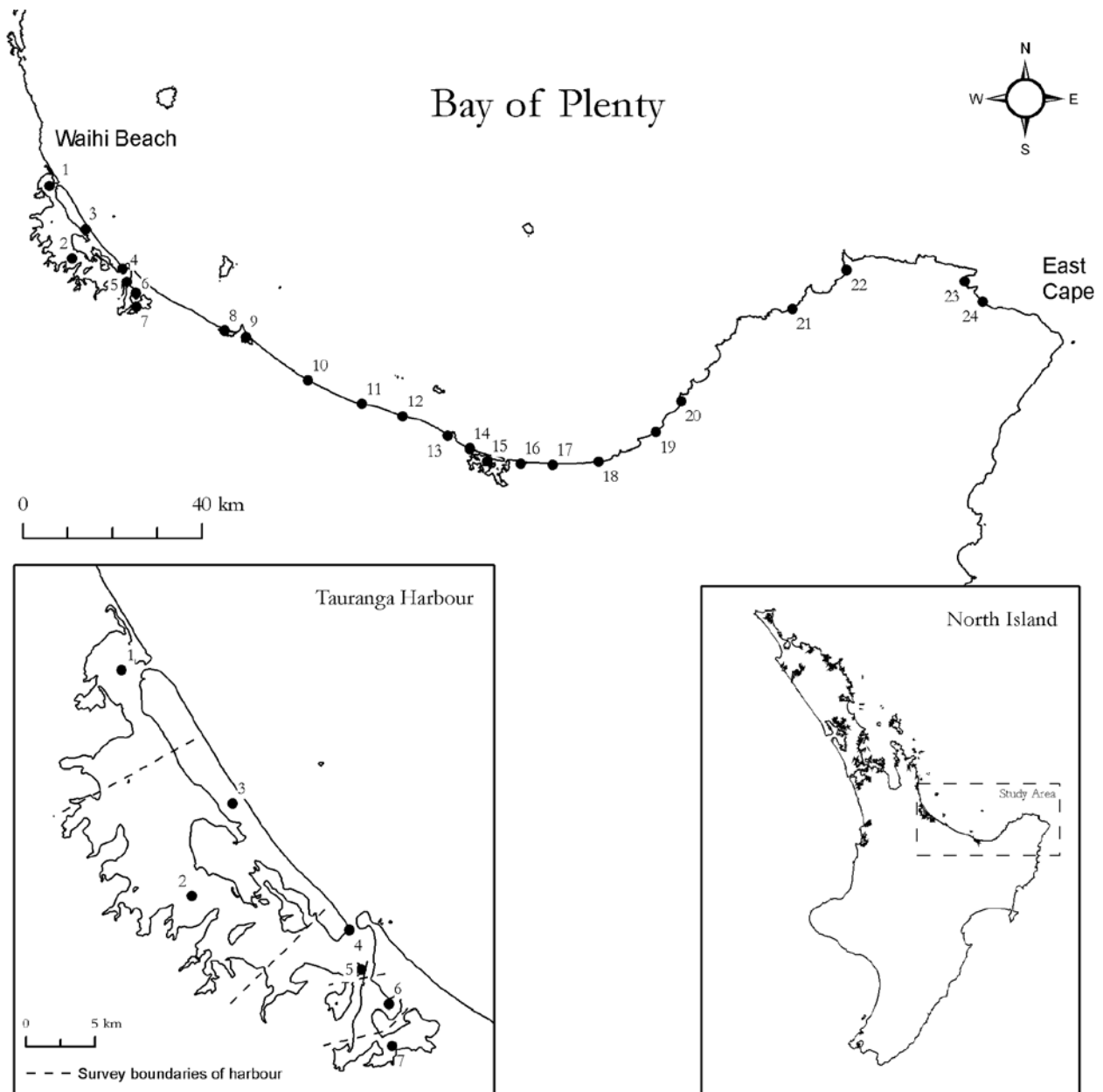


Figure 1. Location of sites mentioned in the text and tables

- | | |
|--|---|
| 1. North-west Tauranga Harbour | 13. Whakatane River estuary |
| 2. Central Tauranga Harbour | 14. Maraetotara Stream mouth |
| 3. Matakana Island (Whole Island) | 15. Ohiwa Harbour (Ohope Spit / Ohiwa Spit) |
| 4. Panepane Point | 16. Waiotahi River estuary |
| 5. Sulphur Point | 17. Waioeka River estuary and Kukumoa (incl. Otara River) |
| 6. Waipu Bay | 18. Waiaua River estuary (including Opape Beach) |
| 7. Waimapu Estuary / Welcome Bay / Rangataua Bay | 19. Hawaii River mouth |
| 8. Maketu Estuary and Kaituna River mouth | 20. Motu River estuary |
| 9. Waihi Estuary and Pukehina Spit | 21. Raukokore River mouth |
| 10. Otamarakau, Hauone, Pikowai, Herepuru | 22. Whangaparaoa Bay |
| 11. Matata Lagoon and Tarawera River mouth | 23. Hicks Bay |
| 12. Rangitaiki River mouth and Thornton Lagoon | 24. Te Araroa |

3. Methods

3.1 COUNTS

Counts were undertaken by teams containing experienced OSNZ members and volunteer observers. These were organised on a regional basis and synchronised to minimise errors resulting from movements of birds between roost sites. Organisers attempted to ensure that as many sites as possible were visited on the same day to reduce temporal differences, however this was not always possible. On some occasions the weather was unsuitable, tides were not right and insufficient numbers of observers were available. In such cases, counts were done as close to the chosen date as was possible or were unable to be completed (see section 3.1.1).

Counts were made at high tide, using binoculars and spotting scopes, when most shorebirds (and non-shorebirds) were concentrated on traditional high tide roosts within harbours, estuaries, islands, rivers and stream mouths and on beaches.

It should be noted that non-wading bird species (shags, herons, waterfowl, rails, gulls, terns and seabirds) although counted during the field work at roosts were specifically excluded from this paper. Common and scientific names and the status of each species are listed in Appendix 1.

Most counts were carried out during June to early-July, and November to early-December, being the months chosen for the winter and summer national survey of shorebirds. Counts are referred as “winter” and “summer” in the report, being the winter and summer counts respectively for that year. The main objective of the summer counts was to record the numbers of Northern Hemisphere migrants and native species, and winter counts were to record the numbers of native species which move to the coastal areas following inland breeding and the numbers of non-breeding Northern Hemisphere migrants present.

As many migrant shorebirds were still mobile in November, summer counts were considered unlikely to record the maximum number of migratory shorebirds present in the high summer. There were also some discrepancies in counts of individual species numbers between some years (and seasons) because some sites were not covered every time when birds were very likely to be present *e.g.* banded dotterel on Tauranga Harbour. The numbers of small shorebirds (*e.g.* sandpipers and stints) usually peaked late in December so census figures were often lower for these uncommon species than later on in the summer.

In the Eastern Bay of Plenty many of the sites east of Waiaua River estuary were counted infrequently, especially during the second decade of counts (1994–2003). This is reflected by a lack of species or numbers for these sites. Generally, these sites were relatively unproductive and less important compared to the large harbours, estuaries and river mouths in the Western Bay of Plenty *i.e.*, Tauranga Harbour to Ohiwa Harbour.

Roost counts were usually carried out at mean high water spring or mean high water neap tide levels, with tides ranging between about 1.67 and 2.06 metres (Moturiki datum) (Land Information New Zealand (LINZ), 2005). The spring tide range in the Bay of Plenty is between 0.12 metres and 2.06 metres (Moturiki datum) (LINZ, 2005). Counts all began within one to two hours of high tide. This is when the bulk of shorebirds in an estuary or along a coastal stretch are forced to congregate at roosts over the high tide period until the tide recedes and allows birds to recommence feeding.

On some occasions, counts were undertaken along the seaward and harbour sides of Matakana Island including the low-lying sandy Tahunamanu Island. These were carried out by Dave Wills (DOC, Tauranga) when on the island managing the northern New Zealand dotterel protection programme. On these occasions most roosting shorebirds (except for variable oystercatchers and northern New Zealand dotterel) were recorded at Waikoura Point, Panepane Point and on Tuhunamanu Island. No separation of data between sites was given, so data from these counts were combined.

Counts from observers were collated by Paddy Latham (P.L) the regional organiser before forwarding details to the national organiser for inclusion in the OSNZ National Wader Counts (1983-1994). This data was published in 1999 (Sagar et al. 1999). Bay of Plenty counts covered by this paper include the data from that period (1983-1994), and also include additional twice yearly counts for the period 1994-2003, thus covering a 20 year period (1983-2003).

The number of times the 24 sites were visited by observers during summer and winter, over the 20 year study period, is set out below (Table 1).

TABLE 1. NUMBER OF TIMES EACH SITE WAS VISITED OVER THE 20 YEAR STUDY PERIOD.

Note: Sites 1-7 belong to Tauranga Harbour (see text).

SITE NUMBER	SITE	SUMMER	WINTER
1	North-west Tauranga Harbour	17	18
2	Central Tauranga Harbour	17	18
3	Matakana Island	6	3
4	Panepane Point	8	11
5	Sulphur Point	17	18
6	Waipu Bay	12	15
7	Waimapu Estuary/Welcome Bay/Rangataua Bay	6	6
8	Maketu Estuary/Kaituna River mouth	19	19
9	Waihi Estuary/Pukehina Spit	19	18
10	Otamarakau/Hauone/Pikowai/Herepuru	14	17
11	Matata Lagoon/Tarawera River mouth	15	17
12	Rangitaiki River mouth/Thornton Lagoon	15	17
13	Whakatane River estuary	3	5
14	Maraetotara Stream Mouth	1	1

SITE NUMBER	SITE	SUMMER	WINTER
15	Ohiwa Harbour (Ohope Spit/Ohiwa Spit)	19	19
16	Waiotahi River estuary	18	17
17	Waioecka River estuary/Kukumoa (including Otara River)	17	17
18	Waiaua River estuary (including Opape Beach)	17	17
19	Hawai River mouth	1	0
20	Motu River estuary	7	0
21	Raukokore River mouth	1	0
22	Whangaparoa Bay	8	6
23	Hicks Bay	2	0
24	Te Araroa	2	1

3.1.1 Counts not undertaken

There was no census of the study area in summer 1995 and winter 2003.

Counts were not undertaken for Tauranga Harbour in summer 2001, winter 2002 and summer 2002 as the co-ordinator was absent and few observers were available. Winter counts ceased at Tauranga Harbour after winter 2001.

Counts at Otamarakau, Hauone, Pikowai, Herepuru, Matata Lagoon and Rangitaiki River mouth were not done in summer 2001. Counts at Otamarakau, Hauone, Pikowai and Herepuru were not carried out in winter 2002 or summer 2002. Matata Lagoon, Tarawera River mouth and Rangitaiki River mouth were not covered in summer 2002.

No counts were carried out east of Waiaua River estuary from summer 1984 to summer 1988 (covering 9 counting periods) and in summer 2000, summer 2001 and winter 2002.

Eastern Bay of Plenty sites, east of Ohiwa Harbour, were not surveyed in winter 2000.

High tide roosts on Tauranga Harbour at Matahui Point (summer 1984, winter 1988), Bowentown Beach and Bowentown Shell bank (winter 1988) were all flooded due to north-east storms and therefore no counts were carried out on these occasions.

With the above counts missed this could have resulted in an under-counting of most species. We therefore considered this issue when analysing the data.

3.2 ROOST SITES

Important physical resources include shorebird high tide roost sites. Wading bird species forage over inter-tidal flats of harbours, estuaries and of soft sediment beaches at low tide, and at high tide when their feeding grounds are covered by water they gather in flocks at specific sites called “high tide roosts”. In harbours and estuaries the maximum inflow of tidal currents usually occurs about three hours before high tide and the maximum outflow about three hours after high tide (de Lange et al. 2003). Thus high tides prohibit feeding by shorebirds for up to six hours, twice daily.

It is important to note that several high tide roost sites are often available at a harbour, estuary or beach, so that shorebirds can choose the most appropriate one depending on weather conditions, wind direction, timing, height of tide, and human and/or animal disturbances. Shorebirds will roost and feed both day and night as they are governed more by a tidal rhythm than a diurnal rhythm. Roosting patterns can differ from day to night and different species don't always roost together. Safe and relatively undisturbed roost sites are essential for wading birds during high tide periods.

The important characteristics of a good high tide shorebird roost include:

- Ideally good 360 degree visibility for security, preferably surrounded by water for some distance
- Sufficient elevation to be above neap or spring high tide levels
- Lack of human or animal disturbances
- Ease of access from the sea by wading
- Suitable substrate to roost on (e.g sand or shell)

If there are insufficient roosts available in a harbour or estuary, crowding at high tide by non-breeding migratory birds may prevent some local sedentary species such as variable oystercatchers from breeding at these sites (Keith Owen (K.O), pers. obs.). These roosts are dynamic in nature and are continually changing rendering their order of preference to roosting bird's variable. Therefore in a harbour or estuary it's important that several roosts are available at any one time. Traditionally shorebirds often habituate to a roost site between years and international migrants will frequently return to the same harbour and roost site each year.

When a roost site is lost or reduced in size through modification, shorebirds will still attempt to use such sites, often to their detriment e.g, the development of Sulphur Point reclamation in Tauranga Harbour for port development. Previously this site was a critical roost for shorebirds in the Harbour, but has now been largely lost to industrial development, although shorebirds still attempt to use the site today.

When a roost becomes unavailable in a harbour or estuary or along a section of coastline due to disturbance or development, shorebirds are forced to roost at an alternative site, often some distance away. There they congregate in flocks, often on an exposed beach where disturbances are less likely to occur until the tidal flats of the harbour or estuary are once again available and they can return to feed.

3.2.1 Roost site identification

OSNZ members identified a number of key roost sites around the Bay of Plenty's harbours, estuaries and along the coastline. Many of these were initially identified by Paddy Latham and Bruce Goffin in 1977 for the OSNZ shorebird study course in 1978, where shorebird roosts were identified in the Western Bay of Plenty between Bowentown and Ohiwa Harbour (Edgar, 1978). In addition, more recently, other roosts were located in Tauranga Harbour and Ohiwa Harbour during marsh bird surveys carried out between 1990 and 1992 (Owen, 1993, Owen, 1994).

Sixty four high tide roost's (spring and/or neap), were identified at the 24 sites within the study area. Many of these are key sites for roosting shorebirds while others are likely to be used only intermittently, when tidal and other environmental conditions are right. A description of each of the roosts is given in Appendix Two.

Twenty five roosts were identified around Tauranga Harbour and a further 39 around the rest of the Bay of Plenty Region. Most of these roosts were subsequently visited by the observers at six monthly intervals (summer and winter). The numbered sites of Appendix Two (1-24), correspond to the same site numbers shown in Figure 1, however at each site there was often more than one roost e.g Tauranga Harbour has 25 known roosts.

3.3 ANALYSIS OF COUNTS

3.3.1 Contribution of Bay of Plenty shorebirds to national populations

We calculated the average number of birds per species for the whole Bay of Plenty Region and for four key habitat units within the Region (Tauranga Harbour wide—north-west Tauranga Harbour, Central Tauranga Harbour and Sulphur Point; Maketu Estuary/Kaituna River mouth; Waihi Estuary/Pukehina Spit; and Ohiwa Harbour). We based these units on hydrological connectivity and proximity to one another which we assumed formed distinct habitat complexes. Averages were for the whole 20 year period where counts were undertaken. We then calculated the percentage of national population totals that each species average comprised.

3.3.2 Population trends and distributions of individual species

To maximise the potential to reveal trends over time in species abundance, we undertook analysis at several different temporal and spatial scales (see below). To do this we employed both descriptive and significance based analyses. For the latter, we used linear regression, and concluded that species abundances varied with time if ANOVA revealed the slope significantly differed from zero. We used SPSS statistical software package ver. 6.0 for all linear regressions, and Microsoft excel for all descriptive analyses.

Due to extreme constraints imposed by the sampling design (non-randomly selected sites leading to likely spatial correlation between sites), the results from all regressions should be treated with caution, and considered indicative only.

Analyses for summer and winter counts were undertaken separately.

Bay of Plenty wide

We pooled species abundances from all sites and regressed (Sokal & Ralph 1995) each species against year for the full 20 year period.

Site specific

We undertook linear regression for change of abundance of each species (total count) at each key site according to year for the full 20 year period. We divided sites into key habitat units. These were; north-west Tauranga Harbour, Central Tauranga Harbour, Sulphur Point, Maketu Estuary / Kaituna River mouth and Waihi Estuary / Pukehina Spit, and Ohiwa Harbour. We pooled total count for each species according to these units which we regressed against year for the full 20 year period.

4. Results

4.1 CONTRIBUTION OF BAY OF PLENTY SHOREBIRDS TO NATIONAL POPULATIONS

4.1.1 All species summer

An average of 163,000 shorebirds (over the period 1984–1994) comprising mainly migrants (139,000) from the northern hemisphere and native species (24,000) are found annually around the New Zealand coastline during the southern summer (Sager et al. 1999). Of that total the northern hemisphere migrant numbers found during the Bay of Plenty summer comprised 11,143 (8%) of these shorebirds (Table 2). Most native shorebirds at this time are inland at breeding sites, mainly in the South Island, however 837 (3.5%) of these were found in the Bay of Plenty study area (Table 2).

4.1.2 All species winter

During the winter an average of 130,000 (over the period 1984–1994) mainly native wading birds (112,000) and migrant wading birds (18,000) visited the New Zealand shores (Sager et al. 1999). During the winter, from these national numbers, mainly native shorebirds (3,595) (3.2%) and migrant shorebirds (1,368) (7.6%) occurred in the Bay of Plenty study area (Table 2).

TABLE 2. NUMBERS OF MIGRATORY AND RESIDENT SHOREBIRDS IN THE STUDY AREA IN SUMMER AND WINTER COMPARED TO NATIONAL TOTALS (AVERAGE OVER THE PERIOD 1983–1994) (TOTALS FOR ELEVEN SHOREBIRD SPECIES—APPENDICES 3–13)

	TOTAL	MIGRANT	NATIVE
Summer			
Total in study area	12,080	11,143	837
New Zealand	163,000	139,000	24,000
Winter			
Total in study area	4,958	1,363	3,595
New Zealand	130,000	18,000	112,000

4.1.3 Individual species per site

Within the Bay of Plenty Region and within the four key sites (Tauranga Harbour, Maketu Estuary/Kaituna River mouth, Waihi Estuary/Pukehina Spit and Ohiwa Harbour), population numbers of a number of species were above the 1% threshold for wetlands of international importance according to the Ramsar Convention criteria.

Tauranga Harbour was internationally significant for variable oystercatcher, pied stilt, northern New Zealand dotterel, banded dotterel, wrybill, turnstone and bar-tailed godwit (Table 3). The harbour also hosted a number of

rare and uncommon migratory shorebird species (Section 4.2.12) and was the only site to annually host the critically threatened black stilt (Section 4.2.12).

Maketu Estuary/Kaituna River mouth held more than 1% of the national population of Pacific golden plover and just under 1% for northern New Zealand dotterel (Table 3). The estuary was also outstanding for the number of rare and uncommon migratory northern hemisphere shorebird species it hosted (it was the hot spot for an additional 12 species) (Section 4.2.12).

Waihi Estuary/Pukehina Spit held more than 1% of the national summer population of northern New Zealand dotterel and just under 1% of the national population of Pacific golden plover (Table 3, notes 1 and 2). The estuary is also notable for regularly hosting a wide diversity of rare and uncommon migratory northern hemisphere shorebird species (Tim Barnard, pers.obs.).

Ohiwa Harbour held more than 1% of the national population of variable oystercatcher, northern New Zealand dotterel, banded dotterel, Pacific golden plover and bar-tailed godwit (Table 3). The harbour was notable for regularly hosting small flocks of eastern curlew and whimbrel species.

Tauranga Harbour and Ohiwa Harbour supported the highest numbers of banded dotterel during winter with consistent numbers over the period (Table 3), followed by Maketu Estuary/Kaituna River mouth and Waihi Estuary/Pukehina Spit (Appendix 7).

TABLE 3. THE PERCENT OF NATIONAL ESTIMATES FOR EACH SHOREBIRD SPECIES REPRESENTED IN THE BAY OF PLENTY AND/OR AT KEY SITES. (PERCENTAGES IN BOLD FALL ABOVE THE RAMSAR CONVENTION CRITERIA OF 1% OF THE NATIONAL POPULATION OF THAT SPECIES OR SUBSPECIES. THIS RENDERS THE SITE INTERNATIONALLY IMPORTANT FOR THE SPECIES).

Notes:

1. Maketu Estuary/Kaituna River mouth held 0.94% of the national winter population of northern New Zealand dotterel,
2. Waihi Estuary/Pukehina Spit held 0.95% of the national summer population of Pacific golden plover.
3. Numbers in brackets below percentages represent mean number birds per years given.

SPECIES (OR SUBSPECIES)	NEW ZEALAND ESTIMATE		PERCENT OF NATIONAL POPULATION						
			BAY OF PLENTY		TAURANGA HARBOUR		MAKETU ESTUARY / KAITUNA RIVER MOUTH	OHIWA HARBOUR	
	summer	winter	summer	winter	summer	winter	summer	summer	winter
South Island pied oystercatcher		112,675 (Sagar et al. 1999)	0.3% (335, 1984-2002)	1.17% (1 320, 1984-2002)	0.89% (996, 1984-2001)				0.25% (281, 1984-2002)
Variable oystercatcher	4 000 (Sagar et al. 1999)		9% (361, 1984-2001)	7.7% (307, 1984-2001)	2.18% (87, 1984-2003)	1.71% (68, 1984-2001)		1.6% (65, 1984-2003)	2.8% (111, 1984-2002)
Pied stilt	30 000 (Sagar et al. 1999)		0.6% (181, 1984 -2003)	2.9% (871, 1984-2001)	1.53% (460, 1984-2001)				
Northern New Zealand dotterel	1 700 (Dowding, 2005)		5.9% (101, 1984 -2003)	6% (102, 1984-2003)	2.6% (45, 1984 -2003)	1.4% (24, 1984-2003)		1% (17, 1984 -2003)	2.5% (43, 1984 -2003)
Banded dotterel	20 000 (Sagar et al. 1999)		0.1% (40, 1984-2002)	3.9% (775, 1984-2002)	1.73% (346, 1984-2001)				1.58% (316, 1984 -2002)
Wrybill		4 100 (Keey, 2005)		1.8% (73, 1984-2002)	1.73% (71, 1984-2001)				
Pacific golden plover	649 (Sagar et al. 1999)		6.6% (43, 1984 -2003)				3.7% (24, 1984 -2003)	1.8% (12, 1984 -2003)	
Turnstone	7000 (Heather & Robertson, 1996)		2.51% (176, 1984 -2003)		2.45% (172, 1984-2003)				
Red knot ¹	59 000 (Sagar et al. 1999)		0.22% (133, 1984 -2003)		0.05% (28, 1984-2003)				
Eastern bar-tailed godwit ²	102 000 (Sagar et al. 1999)		9.3% (9460, 1984-2003)	1% (1052, 1984-2003)	5% (5065, 1984-2003)			3.8% (3848, 1984-2003)	

¹ Red knots visiting New Zealand are mainly of the race (*Calidris canutus rogersi*). Some birds may be of the sub-species *C. canutus canutus*.

² Bar-tailed godwit visiting New Zealand is mainly of the race *Limosa lapponica baueri*.

4.2 POPULATION TRENDS AND DISTRIBUTIONS OF INDIVIDUAL SPECIES

For each of the eleven native or northern hemisphere migrant species discussed below, we provide a short introduction of their distribution, breeding range, seasonal movement, numbers, and if applicable national threat classification (Molloy et al. 2002; Hitchmough, 2002). Following this, a detailed account of each Bay of Plenty site inhabited by the species and its seasonal distribution patterns over the 20 year study period is given and illustrated in Figures 2 to 23. Regression analysis of population trends (growths and declines) are presented in Tables 4 a and b. Individual species accounts follow the order of the Checklist of the Birds of New Zealand and the Ross Dependency, Antarctica (Turbott (convenor) 1990).

4.2.1 South Island pied oystercatcher

South Island pied oystercatcher (hereafter referred to as “pied oystercatcher”), *Torea (Haematopus ostralegus finschi)* is a native species. It breeds mainly east of the Southern Alps in the South Island, on braided shingle riverbeds and on the shores of mountain lakes up to 2000 m above sea level. It is also recorded from flat paddocks, cultivated farmland or stubble (Marchant and Higgins 1993). In recent years a few have bred in Hawke’s Bay and Wairarapa in the North Island on riverbeds (Heather and Robertson, 1996).

Most birds migrate north and spend the winter in the North Island. Manakau Harbour, Kaipara Harbour and the Firth of Thames are the main congregations in the North Island (Sagar et al. 1999). The numbers of this species have increased rapidly with the conversion of tussock land to pasture and since it became protected by law in 1940 (Heather and Robertson, 1996).

Bay of Plenty wide

Pied oystercatcher numbers recorded over the study period at the 24 sites are shown in Figures 2a and b and Appendix 3. Pied oystercatcher favoured only four harbours and estuaries, each with substantial intertidal flats. Tauranga Harbour supported the highest numbers followed by Ohiwa Harbour, then Maketu Estuary/Kaituna River mouth and lastly Waihi Estuary/Pukehina Spit. Apart from these sites, no pied oystercatchers were present at the other 20 sites counted including the moderately sized Waiotahi River, Waioeka River and Waiaua River estuaries in the eastern Bay of Plenty (Appendix 3).

Summer numbers of principally juveniles and non-breeders were much lower than winter as expected because most adults were away at breeding grounds. This led to an average of approximately 70 birds through the 1980s, which progressively increased to a total of 869 birds in 2003 (the largest summer count recorded) (Appendix 3). This substantial rise in numbers over the entire survey period for both summer (3.2%) and winter (8.2%) reflects increased numbers nationally (Table’s 4a and b).

The over-wintering population in the Bay of Plenty has progressively increased from approximately 540 birds in the mid 1980s to 2620 birds by 1999. This was highly significant, (Table 4b). For reasons unknown numbers reduced substantially from 2408 birds in winter 2000 to 1515 in winter 2001 (Appendix 3). This reduction may have arisen through a large flock on one of the harbours or estuaries being missed during counting. The winter average of 1320 birds per year over the study period accounts for 1.17% of the national population (Table 3).

The change in number of pied oystercatcher during summer and winter seasons from 1984 to 2003 for the four key habitats (Tauranga Harbour; Maketu Estuary/Kaituna River mouth; Waihi Estuary/Pukehina Spit; and Ohiwa Harbour) are shown in Figures 3a and b with lines showing statistically significant trends i.e.: $p \leq 0.05$). Increases were statistically significant at Tauranga Harbour (summer and winter), Ohiwa Harbour (summer and winter), Maketu Estuary/Ohiwa River mouth (summer and winter) and Waihi Estuary/Pukehina Spit (summer and winter).

Tauranga Harbour

The combined summer counts for all sites counted (Table 1—Sites 1 to 7) belonging to Tauranga Harbour ranged from 6 (1988) to 630 (1997), averaging 220 (1984–2000) (Appendix 3). The harbour averaged 90 in the first decade (1984–1993) then increased substantially at several of the sites, averaging 438 over the second decade (1994–2001). The average number of pied oystercatcher at each harbour site during the summer (1984–2003) is shown in Figure 2a.

The combined winter counts for all sites counted (Table 1—Sites 1 to 7) belonging to Tauranga Harbour ranged from 118 (1988) to 2086 (1997), averaging 996 (1984–2001) or 0.89% of the national population (Table 3) with no more than 875 birds recorded over the first decade (1984–1993) (Appendix 3). Numbers reached a maximum of 2086 (1997) as numbers increased substantially at several sites in the harbour over the second decade (1994–2001). The average number of pied oystercatcher for each site in the harbour during the winter (1984–2001) is shown in Figure 2b. About 22% of the pied oystercatcher winter numbers (average 220 birds) remain at the harbour over the summer.

TABLE 4A. SUMMARY OF REGRESSION ANALYSES PER SPECIES PER SITE—SUMMER

KEY SPECIES	BAY OF PLENTY WIDE	TAURANGA HARBOUR	MAKETU ESTUARY / KAITUNA RIVER MOUTH (ME / KRM)	WAIHI ESTUARY / PUKEHINA SPIT	OHIWA HARBOUR	SUMMARY OF TRENDS
South Island piced oystercatcher	Increase 3.24% df _{1,266} , P <0.001, R ² =0.09	Increase 6.00% df _{1,15} , P <0.001, R ² =0.54	Increase 3.10% df _{1,17} , P =0.024, R ² =0.27	Increase 1.90% df _{1,17} , P =0.058, R ² =0.20	Increase 11.4% df _{1,17} , P <0.001, R ² =0.74	Increase across all sites
Variable oystercatcher	Increase 0.91% df _{1,266} , P <0.003, R ² =0.03	Increase 0.53% df _{1,81} , P =0.009, R ² =0.01	Increase 1.50% df _{1,17} , P <0.033, R ² =0.24	No change P = 0.134	Increase 5.25% df _{1,17} , P =0.002, R ² =0.44	Increase across most sites
Pied stilt	Decrease P <0.211	Too few birds	Decrease -4.50% df _{1,17} , P =0.034, R ² =0.24	Too few birds	Too few birds	Patchy distribution. Decrease at ME/KRM
Northern New Zealand dotterel	Increase P = 0.961	Increase ¹ From 1992 onwards 3.74% df _{1,6} , P =0.003, R ² =0.78	Decrease 0.60% df _{1,17} , P =0.003, R ² =0.41	Decrease P = 0.113	Decrease P = 0.868	Increases and decreases. See note ¹
Banded dotterel	Decrease -0.38% df _{1,81} , P =0.005, R ² =0.09	*Sulphur Point—Decrease -1.46% df _{1,15} , P =0.001, R ² =0.54	Too few birds	Too few birds	Too few birds	General decrease but too few birds for analysis.
Wrybill	Too few birds	Too few birds	Too few birds	Too few birds	Too few birds	General decrease across the Bay of Plenty but too few birds for analysis.
Pacific golden plover	No change P = 0.488	Too few birds	Too few birds	Too few birds	Too few birds	Too few birds at specific sites for analysis
Spur-winged plover	Increase 6.67% df _{1,17} , P =0.060, R ² =0.37	Too few birds	Increase P = 0.087	Too few birds	Too few birds	General increase but too few birds at specific sites for analysis..
Tumstone	Decrease -3.59% df _{1,81} , P =0.032, R ² =0.06	*N.W Tauranga Harbour—Decrease -13.62% df _{1,15} , P <0.001, R ² =0.60	Decrease -1.75% df _{1,17} , P <0.001, R ² =0.64	Too few birds	Too few birds	General decrease This was significant in NW Tauranga Harbour and ME/KRM.
Red knot	Decrease P = 0.146	Too few birds	Too few birds	Too few birds	Too few birds	General decrease, but too few birds at specific sites for analysis.
Eastern bar-tailed godwit	Decrease P = 0.669	*Central Tauranga Harbour—Increase 254.00% df _{1,15} , P =0.001, R ² =0.52 *NW Tauranga Harbour—Decrease -96.60% df _{1,15} , P =0.014, R ² =0.34 *Sulphur Point—Decrease -140.30% df _{1,15} , P =0.001, R ² =0.56	Increase 22.00% df _{1,17} , P =0.015, R ² =0.30	No change P = 0.096	Decrease. P = 0.096	General decrease. but increase in Central Tauranga Harbour. Godwits also increased at the ME/KRM

Notes:

* indicates sites where there were too few birds across whole site to perform analysis but analysis was carried out on a sub-site within that site where bird numbers allowed.

¹ Regression undertaken for counts that included Matakana Island within the Tauranga Harbour site counts. This included years 1992, 1993, 1994, 1996, 1997, 1998, 1999, 2000 and 2003.

TABLE 4B. SUMMARY OF REGRESSION ANALYSES PER SPECIES PER SITE—WINTER

KEY SPECIES	BAY OF PLENTY WIDE	TAURANGA HARBOUR	MAKETU ESTUARY / KAITUNA RIVER MOUTH	WAIHI ESTUARY / PUKEHINA SPIT	OHIWA HARBOUR	SUMMARY OF TRENDS
South Island pied oystercatcher	Increase 8.2% df _{1,258} , $P < 0.001$, $R^2 = 0.05$	Increase 50.1% df _{1,16} , $P < 0.001$, $R^2 = 0.60$	Increase 12.30% df _{1,17} , $P < 0.001$, $R^2 = 0.64$	Increase 4.0% df _{1,17} , $P = 0.003$, $R^2 = 0.40$	Increase 22.50% df _{1,17} , $P = 0.003$, $R^2 = 0.42$	Increase at all sites
Variable oystercatcher	Increase 0.9% df _{1,261} , $P = 0.056$, $R^2 = 0.01$	Decrease $P = 0.401$	Increase 2.00% df _{1,17} , $P = 0.032$, $R^2 = 0.24$	Decrease $P = 0.634$	Increase 11.00% df _{1,17} , $P < 0.001$, $R^2 = 0.53$	Patchy increases and decreases
Pied stilt	Decrease $P = 0.130$	Decrease $P = 0.132$	Decrease -13.88% df _{1,17} , $P = 0.005$, $R^2 = 0.38$	Decrease $P = 0.431$	Decrease $P = 0.212$	General decrease across all sites in the Bay of Plenty
Northern New Zealand dotterel	Decrease -0.49% df _{1,84} , $P < 0.008$, $R^2 = 0.08$	No analysis done as Matakana Island was not counted	Decrease -1.4% df _{1,17} , $P < 0.001$, $R^2 = 0.62$	Decrease $P = 0.982$	Decrease $P = 0.288$	General decrease across all sites
Banded dotterel	Decrease $P = 0.46$	*NW Tauranga Harbour—Decrease -7.23% df _{1,16} , $P = 0.032$, $R^2 = 0.26$ *Sulphur Point Decrease $P = 0.246$	No change $P = 0.647$	Too few birds	Decrease -19.46% df _{1,17} , $P < 0.001$, $R^2 = 0.54$	General decrease across all sites
Wrybill	Decrease -1.24% df _{1,84} , $P = 0.008$, $R^2 = 0.08$	Tauranga Harbour—Decrease -4.292% df _{1,16} , $P < 0.01$, $R^2 = 0.50$ *Sulphur Point Decrease -3.66% df _{1,16} , $P = 0.003$, $R^2 = 0.43$	Too few birds	Too few birds	Too few birds	General decrease across most sites. This was significant decrease at Tauranga Harbour.
Pacific golden plover	No winter birds	No winter birds	No winter birds	No winter birds	No winter birds	No winter birds
Spur-winged plover	Increase $P = 0.652$	Too few birds	Increase $P = 0.206$	Too few birds	Too few birds	General increases across sites
Turnstone	Decrease -0.64% df _{1,84} , $P = 0.011$, $R^2 = 0.08$	*NW Tauranga harbour—Decrease -2.40% df _{1,16} , $P = 0.008$, $R^2 = 0.37$	No winter birds	No winter birds	No winter birds	General decrease
Red knot	No winter birds	No winter birds	No winter birds	No winter birds	No winter birds	No winter birds
Eastern bar-tailed godwit	Decrease $P = 0.104$	*NW Tauranga harbour—Decrease -10.58% df _{1,16} , $P = 0.018$, $R^2 = 0.30$	Decrease $P = 0.787$	Decrease $P = 0.265$	Decrease $P = 0.459$	General decrease but non-significant at all sites.

Notes: * indicates sites where there were too few birds across whole site to perform analysis but analysis was carried out on a sub-site within that site where bird numbers allowed.

Maketu Estuary / Kaituna River mouth

Summer counts ranged from 2 (1999) to 130 (2002), averaging 22 (1984–2000) (19 counts) (Appendix 3). There were no birds present during any of the summer counts in the first decade (1984–1993) (10 counts), however numbers increased significantly over the second decade, ranging from 2 (1999) to 130 (2002), averaging 46 per year (1994–2003) (9 counts). The average number of pied oystercatcher at the estuary during the summer (1984–2003) is shown in Figure 2a.

Winter counts ranged from 1 (1985) to 250 (2002), averaging 69 (1984–2002) (19 counts) (Appendix 3). The average number of pied oystercatcher at the estuary during the winter (1984–2003) is shown in Figure 2b. Over the first decade (1984–1993) (10 counts), birds were recorded in only 2 winter counts, 1 bird in 1984 and 3 birds in 1988 (Appendix 3). Over the second decade, numbers substantially increased ranging from 114 (1994) to 250 (2002), averaging 144 per year (1994–2002) (9 counts).

Between 1984 and 1993 there were only two records of birds at the estuary (20 counts, both winter and summer), yet the adjacent Waihi Estuary, only 2 kilometres away, had birds present every year (P.L. pers. comm).

Why Maketu Estuary is now frequently inhabited by pied oystercatcher since 1994 is unclear. Perhaps it reflects a natural but rapid build up in numbers of pied oystercatcher in the region over time. Or perhaps it has something to do with a reduction in salinity levels in the estuary since 1994, due to the re-diversion of part of the Kaituna River freshwater flow back into the estuary through the newly installed diversion control structure at Fords Cut? This allowed between 10–20% of the freshwater flow from the nearby river to re-enter the estuary. Perhaps this provided a better habitat for increased numbers of shellfish (cockles/pipis), both important prey items of pied oystercatcher.

The data shows that pied oystercatcher numbers started to rise from winter 1994. Whatever occurred created an environment where good numbers of birds now regularly use the estuary. This is in total contrast with the variable oystercatcher which has been recorded on most counts at both estuaries over the whole duration of the study (Appendix 4).

Waihi Estuary / Pukehina Spit

Summer numbers ranged from 2 to 90 over the period 1984–2003 (19 counts) and averaged 19 per year. Numbers ranged from between 2 and 27 over the first decade (1984 to 1993) and averaged 15 birds each year, then increased to 23 birds on average each year over the second decade (1994 to 2003) with the range between 2 (2002) and 90 birds (2003) (Appendix 3). The average number of pied oystercatcher at the estuary during the summer (1984–2002) is shown in Figure 2a.

Winter numbers ranged from between 3 and 12 over the first decade (1984 to 1993), then increased to average 55 birds over the second decade (1994 to 2003) (Appendix 3). Highest numbers recorded was 150 birds (winter 2002). The average number of pied oystercatcher at the estuary during the winter (1984–2002) is shown in Figure 2b.

Obiwa Harbour

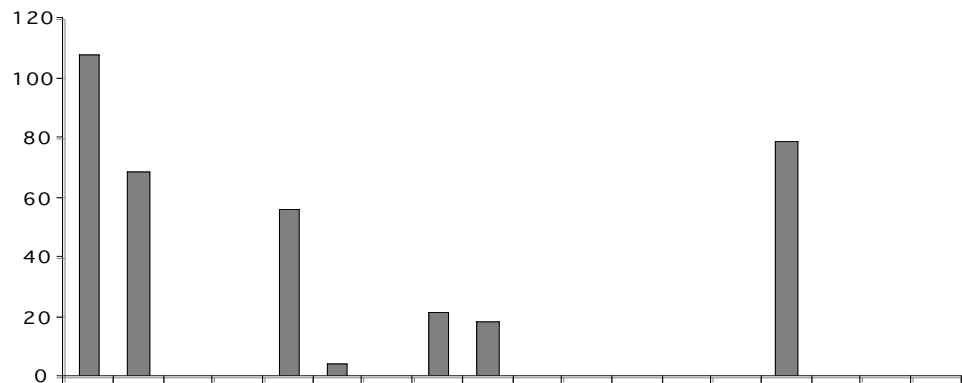
At Obiwa Harbour summer counts ranged from 0 (1989) to 246 (2002), averaging 79 (1984–2003) (Appendix 3). Numbers ranged from 3 (1985) to 41 (1992) over the first decade (1984–1993) (10 counts), averaging 12 per count, then increased substantially over the second decade (1994–2003) (9 counts) averaging 140. The average number of pied oystercatcher at the harbour during the summer (1984–2003) is shown in Figure 2a.

Winter numbers also increased substantially over the study period by 22.5% (Appendix 3; Table 4b). Winter counts ranged from 80 (1984) to 800 (1999), a ten fold increase although numbers did fluctuate during that period averaging 281 (1984–2002) (19 counts) (Appendix 3). Numbers ranged from 80 (1984) to 320 (1993) over the first decade (1984–1993) (10 counts), averaging 165 each year. Numbers ranged from 220 (2002) to 800 (1999) over the second decade (1994–2002) (9 counts), averaging 410 each year. The average number of pied oystercatcher at the harbour during the winter (1984–2002) is shown in Figure 2b.

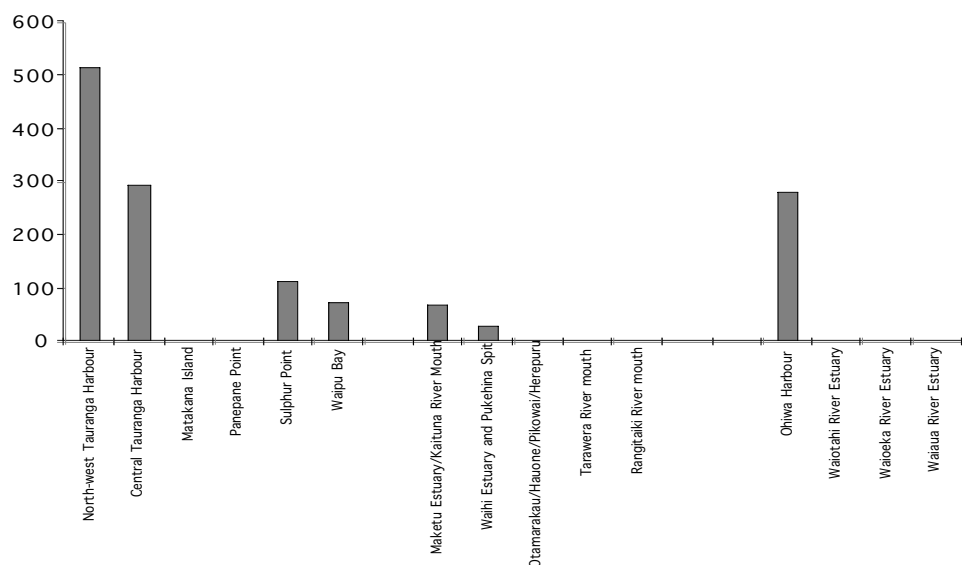
Eastern Bay of Plenty

No pied oystercatcher were recorded during winter or summer at any of the nine sites located east of Obiwa Harbour (Appendix 3) although only Waiohahi River estuary, Waioeka River estuary /Kukumoa and Waiaua River estuary were counted regularly.

(2a) Summer

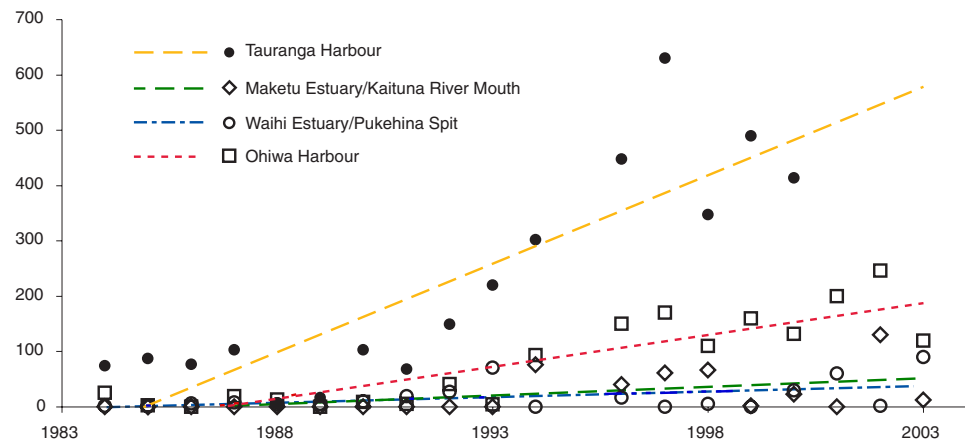


(2b) Winter

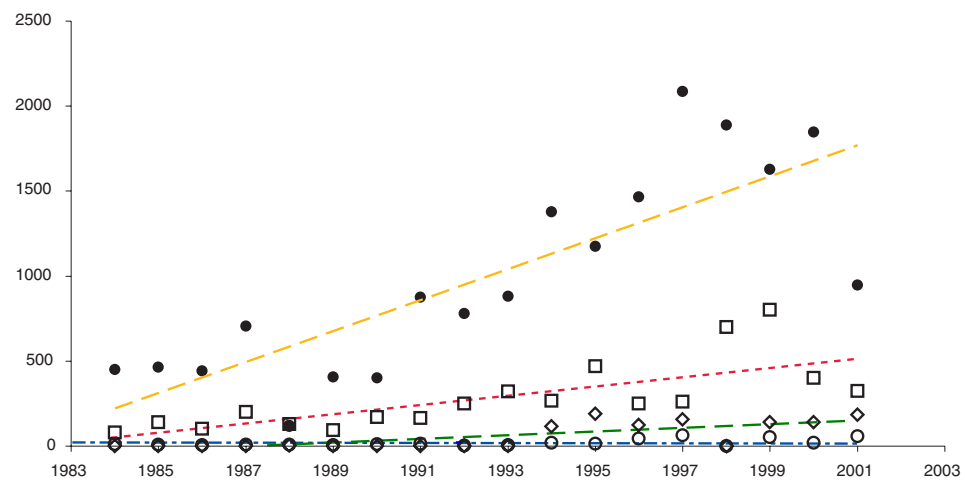


Figures 2a and b. Average number of South Island pied oystercatcher for each site visited eight or more times (except for Matakana Island which was not visited). Sites are shown in east to west direction across the Bay of Plenty Region.

(3a) Summer



(3b) Winter



Figures 3a and b. Change in number of South Island pied oystercatcher during the summer (a) and winter (b) season from 1984 to 2003 for the four key habitat units (Lines show statistically significant trends i.e.: $p \leq 0.05$)

4.2.2 Variable oystercatcher

The variable oystercatcher, torea or torepango (*Haematopus unicolor*) is endemic to New Zealand. The total population is 4000 individuals (Sagar et al.1999). It is the only oystercatcher in the world with two colour forms. The variable oystercatcher breeds along the New Zealand coastline wherever there is pebble or sandy beaches, always near the high water mark. Mate and site fidelity is very strong. Eggs are usually laid in October and November. They are territorial during the breeding season. Fledging success is variable, 0.5 young per pair per year in protected sites (e.g. Matakana Island) but lower elsewhere. Low breeding success has been linked to human disturbance. Introduced mammals have also caused many losses through predation of chicks and eggs.

Historical counts undertaken by OSNZ members in January 1978 recorded 197 birds in the western Bay of Plenty, between Bowentown Heads (Tauranga Harbour) and Ohiwa Spit (Ohiwa Harbour) (Edgar, 1978). A Bay of Plenty wide census in October–November 1983 recorded 450 birds (c. 100 pairs and c. 250 non-breeders) (P.L.pers.comm.).

Several populations, especially in the North Island, are apparently on the increase. This study however showed that overall numbers stayed constant

over the years and between winter and summer counts. This reflects the relatively sedentary nature of this species. Variable oystercatcher breeding and wintering distributions are similar with some local movement to estuaries outside the breeding season, as estuaries are important feeding areas (Robertson and Heather (1996)). This is especially the case for bachelor flocks. These bachelor flocks move to and from estuaries at any time as they do not hold breeding territories (P.L. pers.comm).

Bay of Plenty wide

Bay of Plenty variable oystercatcher numbers recorded over the study period at the 24 sites are shown in Appendix 4. Average number per site over summer and winter (1984–2003) are shown in Figure 4a and b. Variable oystercatchers were well represented around the Bay of Plenty coastline during both winter and summer with numbers generally increasing over time (Appendix 4).

Variable oystercatchers were most frequently recorded at 18 sites in the western and central Bay of Plenty (Appendix 4). Although commonly recorded east of the Waiaua River estuary no more than 6 birds were recorded during a count at any one of these eastern Bay of Plenty sites (Appendix 4). Tauranga Harbour and Ohiwa Harbour supports the highest numbers followed by Maketu Estuary/Kaituna River mouth and Waihi Estuary/Pukehina Spit where both had similar numbers (Appendix 4).

Summer numbers averaged about 207 birds through the 1980s progressively increasing to 307 birds in the following decade (1994–2003) (Appendix 4). Bay of Plenty holds 9% (361 birds) of the national summer population (Table 3). The regional increase could be a reflection of increases in numbers assisted by protection programmes operating on Matakana Island, at Waiaua River estuary and elsewhere. Since 1993, predators have been controlled and breeding pairs monitored, thus greatly assisting recruitment of juveniles into the adult population, in the Bay of Plenty. For example, three juvenile variable oystercatchers banded at Matakana Island in January 1998 by K.O were recovered (2 alive and 1 dead) at Opoutere Beach, Coromandel Peninsula in November/December 2001.

The winter population in the Bay of Plenty has progressively increased from 108 birds in 1984 to a maximum of 486 birds by 1999 (Appendix 4). Bay of Plenty holds 7.7% (307 birds) of the national winter population (Table 3).

The change in number of variable oystercatcher during summer and winter seasons from 1984 to 2003 for the four key habitats (Tauranga Harbour; Maketu Estuary/Kaituna River mouth; Waihi Estuary/Pukehina Spit; and Ohiwa Harbour) are shown in Figures 5a and b with lines showing statistically significant trends i.e.: $p \leq 0.05$). Increases were statistically significant at Ohiwa Harbour (summer and winter), Maketu Estuary (summer and winter) and Tauranga Harbour (summer).

Tauranga Harbour

The combined summer counts for sites counted (Table 1—Sites 1 to 7) belonging to Tauranga Harbour, ranged from 28 (1998) to 218 (2000), averaging 87 (17 counts) (1984–2003) or 2.18% of the national total (Table

3, Appendix 4). This average is very similar to a Tauranga Harbour and Matakana Island count of 84 recorded in January 1978 (Edgar, 1978). Numbers averaged 69 in the first decade (1984-1993, 10 counts) then increased substantially averaging 110 over the second decade (1994-2003, 7 counts).

The average number of variable oystercatchers at each harbour site during the summer (1984-2003) is shown in Figure 4a. The increase in numbers at the harbour was statistically significant for summer (1984 to 2003) (Figure 5a).

The combined winter counts for sites counted (Table 1) belonging to Tauranga Harbour ranged from 11 (1988) to 108 (1985), averaging 68 (1984-2001) (18 counts) (Appendix 4). Over the first decade (1984-1993) no more than 108 birds were recorded at any one count and averaged 67 birds. Over the second decade numbers reached a maximum of 93 (2000) at any one count and averaged 66 birds as numbers remained constant over the second decade (1994-2003) (8 counts) (Appendix 4).

The average number of variable oystercatchers at each harbour site during the winter (1984-2003) is shown in Figure 4b.

On average the harbour holds 1.7% (68 birds) of the national variable oystercatcher winter numbers (Table 3), although its highest winter count in 1985 of 108 birds elevated the national percentage of birds on the harbour to 2.7%.

In contrast to the general trend, relative abundance appears to have declined over time during the winter seasons (1984-2003) at Sulphur Point (Appendix 4). The Matakana Island variable oystercatcher population increased substantially due to the predator control operations taking place there over the last decade with increased breeding success. However the harbour wide figures do not reflect this, perhaps simply because the bachelor flock at the harbour was not found on some census days (P.L. pers.comm).

Maketu Estuary / Kaituna River mouth

Summer counts ranged from 14 (1984) to 90 (2001), averaging 31 (1984-2003) (19 counts) (Appendix 4, Figure 4a). This number is similar to the January 1978 count of 40+ birds from the same site (Edgar, 1978). Numbers averaged 24 in the first decade (1984-1993) (10 counts) then increased, averaging 39 over the second decade (1994-2003) (9 counts). Increases in relative abundance over time (1984-2003) were statistically significant for both summer and winter (1984 to 2003) (Tables 5a and 5b).

Winter counts ranged from 0 (1998) to 94 (2002), averaging 42 (1984-2003) (19 counts) (Appendix 4, Figure 4b). Over the first decade (1984-1993) (10 counts) no more than 42 birds were recorded at any one count and averaged 30 birds. Over the second decade (1994-2002) (9 counts) numbers reached a maximum of 94 (2002) at any one count and averaged 55 birds as numbers increased at the estuary.

Waihi Estuary / Pukebina Spit

Summer counts ranged from 6 (1998) to 82 (2003), averaging 45 (1984–2003) (19 counts) (Appendix 4, Figure 4a). This average is substantially greater than the 26 birds recorded there in January 1978 (Edgar, 1978). Numbers averaged 43 in the first decade (1984–1993) (10 counts) then increased slightly, averaging 48 over the second decade (1994–2003) (9 counts).

Overall numbers stayed constant over the years during the summer counts, reflecting the sedentary nature of this species. This pattern was recognised by Robertson and Heather (1996) who point out that variable oystercatcher breeding and wintering distribution are similar with some local movement to estuaries outside the breeding season.

Winter counts ranged from 0 (1998) to 125 (1992), averaging 47 (1984–2002) (19 counts) (Appendix 4, Figure 4b). Relative abundance decreased over time during the winter seasons (1984–2003) at the estuary. Over the first decade (1984–1993) (10 counts) no more than 125 birds were recorded at any one count and averaged 62 birds. Over the second decade (1994–2002) (9 counts) numbers reached a maximum of 54 (2001) at any one count and averaged 31 birds as numbers decreased substantially at the estuary.

It is likely that on some occasions birds flew to Maketu Estuary as it has been noted that when variable oystercatcher numbers are low at Waihi Estuary they can often be correspondingly high at nearby Maketu Estuary (P.L. pers. comm.), however that does not fully explain the general decline.

Otaramarakau / Pikowai / Hauone / Herepuru

At Otaramarakau, Pikowai, Hauone and Herepuru, variable oystercatcher were present in both the summer and winter seasons. Summer counts ranged from 3 birds (2000) to 15 birds (1997) with an average 8 birds (14 counts) (Appendix 4, Figure 4a).

Winter numbers ranged from 2 birds (1985, 1993) to 14 birds (1997) with an average of 6 birds (17 counts) (Appendix 4, Figure 4b).

Numbers were very similar both summer and winter over both decades which was surprising given that human disturbances by fishers and four wheel drive (4WD) vehicles along this coastline have increased substantially over the last decade.

Matata Lagoon / Tarawera River mouth

Summer counts ranged from 1 (1991) to 6 (1993, 1994, 1997), averaging 3 (1985–2003) (15 counts) (Appendix 4, Figure 4a). Numbers averaged 2 in the first decade (1985–1993) (8 counts) and 3 over the second decade (1994–2003) (7 counts).

Winter counts ranged from 2 (8 counts) to 6 (1988), averaging 3 (1985–2001) (17 counts) (Appendix 4, Figure 4b). Over the first decade (1985–1993) (9 counts) no more than 6 birds were recorded at any one count and averaged 3 birds. Over the second decade (1994–2001) (8 counts) numbers reached a maximum of 4 (1995, 1998) at any one count and averaged 2 birds.

Rangitaiki River mouth / Thornton Lagoon

At Rangitaiki River mouth/Thornton Lagoon the summer numbers ranged from 2 (1985, 1989) to 14 (1996), averaging 4 (1985–2003) (15 counts) (Appendix 4, Figure 4a). Numbers averaged 3 in the first decade (1985–1993) (8 counts) then averaged 6 over the second decade (1994–2003) (7 counts).

Winter counts ranged from 2 (1991) to 43 (1994), averaging 14 (1986–2002) (17 counts) (Appendix 4, Figure 4b). Over the first decade (1986–1993) (8 counts) no more than 23 birds were recorded at any one count and averaged 7 birds. Over the second decade (1994–2002) (9 counts) numbers reached a maximum of 43 (1994) at any one count and averaged 20 birds as winter numbers increased with post-breeding flocking. Winter numbers have increased over time. This is possibly due to local residents undertaking nest protection along the coastline over the last decade?

Ohiwa Harbour

Summer counts over the study period ranged from 16 (1984, 1985) to 61 (1987), averaging 65 (1984–2003) (19 counts) (Figure 4a) or 1.6% of the national total (Table 3, Appendix 4). Numbers averaged 37 in the first decade (1984–1993) (10 counts) then increased substantially, averaging 112 over the second decade (1994–2003) (9 counts). The average count over the first decade is identical (37 birds) to that recorded in January 1978 on the harbour (Edgar, 1978).

Winter counts over the study period ranged from 11 (1984) to 275 (1999), averaging 111 or 2.8% of the national population (1984–2002) (19 counts) (Table 3, Appendix 4, Figure 4b). Over the first decade (1984–1993) (10 counts) no more than 136 birds were recorded at any one count and averaged 57 birds. Over the second decade (1994–2002) (9 counts) numbers reached a maximum of 275 (1999) at any one count and averaged 171 birds as numbers increased substantially at the estuary.

Overall numbers increased substantially at Ohiwa Harbour over the years, both winter and summer counts (Figures 5a and b). This trend is statistically significant and was greater than the national trend of a doubling of the population since the 1970s (Heather and Robertson, 1996). Local protection programmes on the islands and spits in the harbour and at nearby Waiaua River estuary may have assisted this increase?

Heather and Robertson (1996) note that variable oystercatcher breeding and wintering distribution is similar with some local movement to estuaries outside the breeding season. Most birds remain at the same territory throughout the year although some local migration has been observed. The above results support this conclusion. Post-breeding flocks establish on the harbour and it appears that local breeding pairs are joined by bachelor birds (sub-adults) from the surrounding coastal area and that these birds may make up a substantial number of the total.

Eastern Bay of Plenty

Variable oystercatchers were recorded during winter or summer at all of the nine sites located east of Ohiwa Harbour (Appendix 4) although

only Waiotahi River estuary, Waioeka River estuary/Kukumoa and Waiuia River estuary were counted on a regular basis. These sites are discussed below.

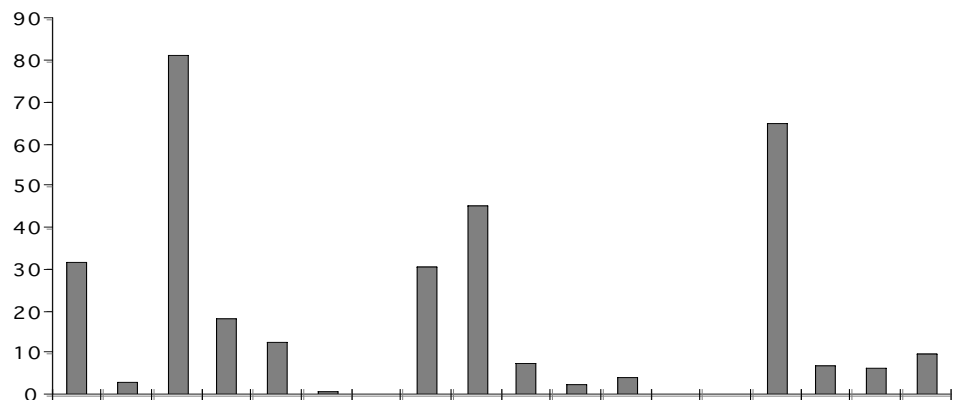
Waiotahi River estuary

Summer counts over the study period ranged from 0 (1986, 2002) to 14 (2001), averaging 7 (1984-2003) (18 counts) (Appendix 4, Figure 4a). Numbers averaged 6.6 in the first decade (1984-1993) (9 counts) and averaged 7.4 over the second decade (1994-2003) (9 counts).

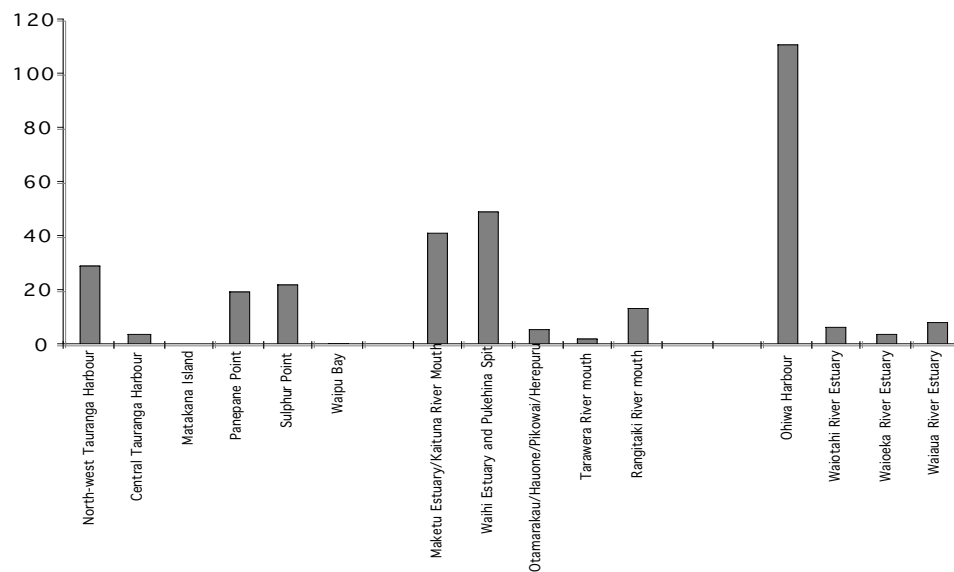
Winter counts over the study period ranged from 0 (1986, 2002) to 14 (1994), averaging 6.5 (1985-2002) (17 counts) (Appendix 4, Figure 4b). Over the first decade (1985-1993) (9 counts) no more than 13 birds were recorded at any one count and averaged 6.1 birds. Over the second decade (1994-2002) (8 counts) numbers reached a maximum of 14 (1994) at any one count and averaged 7 birds.

Numbers remained very static during both summer and winter at the estuary over the study period. These are probably resident breeding pairs that have stayed on their territories while their young have joined the nearby post-breeding flock on Ohiwa Harbour.

(4a) Summer



(4b) Winter



Figures 4a and b. Average number of variable oystercatcher for each site visited eight or more times (except for Matakana Island which was not visited). Sites are shown in east to west direction across the Bay of Plenty Region.

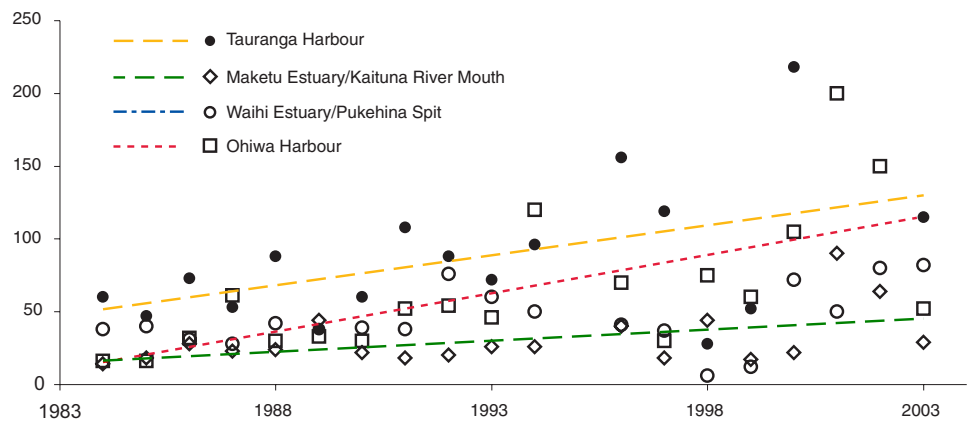
Waioeka River estuary / Kukumoa (including Otara River)

Summer counts over the study period ranged from 0 (1985) to 11 (1989), averaging 6.5 (1985-2003) (17 counts) (Appendix 4, Figure 4a). Numbers averaged 5.6 in the first decade (1985-1993) (9 counts) and averaged 7.5 over the second decade (1994-2003) (8 counts).

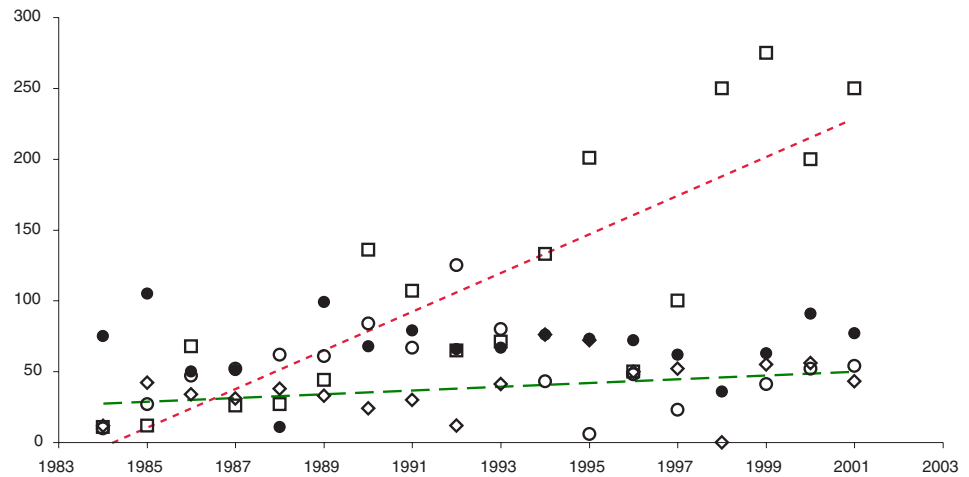
Winter counts over the study period ranged from 0 (5 occasions) to 10 (1997), averaging 4.3 (1985-2002) (17 counts) (Appendix 4, Figure 4b). Over the first decade (1985-1993) (9 counts) no more than 10 birds were recorded at any one count and averaged 3 birds. Over the second decade (1994-2002) (8 counts) numbers reached a maximum of 10 (1997) at any one count and averaged 5.7 birds.

Numbers remained very stable during both summer and winter at the estuary over the study period.

(5a) Summer



(5b) Winter



Figures 5a and b. Change in number of variable oystercatcher during the summer (a) and winter (b) season from 1984 to 2003 for the four key habitat units (Lines show statistically significant trends i.e.: $p \leq 0.05$)

Waiaua River estuary (including Opape Beach)

Summer counts over the study period ranged from 0 (2002) to 19 (2001), averaging 6.5 (1986-2003) (17 counts) (Appendix 4, Figure 4a). Numbers averaged 10 in the first decade (1986-1993) (8 counts) and 10 over the second decade (1994-2003) (9 counts).

Winter counts over the study period ranged from 0 (2001, 2002) to 33 (1998), averaging 9 (1985–2002) (17 counts) (Appendix 4, Figure 4b). Over the first decade (1985–1993) (9 counts) no more than 11 birds were recorded at any one count and averaged 8 birds. Over the second decade (1994–2002) (8 counts) numbers reached a maximum of 33 (1998) at any one count and averaged 10 birds.

Numbers remained static at the estuary over the study period for both summers and winters except for winter 1998 when numbers increased to 33 birds before dropping back to 9 the following winter.

Sites east of Waiaua River estuary

Between 1 and 6 variable oystercatchers were recorded at any of the sites east of Waiaua River estuary where counts took place during winter or summer (Appendix 4). The low numbers are likely to be a reflection of the few counts that took place at these sites during the study period and the fact that few of these sites is capable of supporting many variable oystercatchers anyway. Generally there was just the odd pair nesting, at widely spaced intervals, probably because territories need to be large on this stretch of coastline.

4.2.3 Pied stilt

Australasian pied stilt, Poaka (*Himantopus himantopus leucocephalus*) is one of five sub-species of pied or black-winged/white headed stilt. The sub-species are cosmopolitan extending from the Philippines, Indonesia, and the Bismark Archipelago to Australia and New Zealand (Heather and Robertson, 1996). It is thought they colonised New Zealand in the early 1800s. Pied stilts are widely distributed and breed throughout most of New Zealand and some of the outlying islands such as the Chatham's.

They usually breed near water, both coastal and inland, in loose colonies. Inland breeding birds move to the coast to over winter with the northern harbours holding the largest numbers while coastal breeding birds are usually sedentary (Sagar et al. 1999). The New Zealand population numbers about 30,000 birds (Heather and Robertson, 1996).

Bay of Plenty wide

Pied stilt numbers recorded over the study period at the 24 sites in the Bay of Plenty are shown in Appendix 5 with the average number per site over summer and winter (1984–2003) shown in Figures 6a and b. Pied stilt were well represented around the Bay of Plenty coastline during both winters and summer's, however numbers across the Bay of Plenty decreased over the period of the study, especially the winters.

Summer populations progressively increased from 125 birds in 1986 to a maximum of 494 birds by 1990 (Appendix 5) then declined to less than half that number by the late 1990s. Annually there appeared to be a contraction in their distribution after summer as birds congregate in flocks at fewer sites during the winter. Summer numbers averaged about 215 birds per year over the first decade (1984–1993) and 144 birds over the following decade (1994–2003). The summer average (1984–2003) was 181 birds or 0.6% of the national population (Table 3).

Winter numbers declined from 1677 (1985) to 415 (2002). Winter numbers averaged about 1049 birds per year through the first decade (1984–1993) and 675 birds in the following decade (1994–2003) (Appendix 5). The winter average (1984–2001) was 871 birds or 2.9% of the national population (Table 3).

The change in number of pied stilt during summer and winter seasons from 1984 to 2003 for the four key habitats (Tauranga Harbour; Maketu Estuary/Kaituna River mouth; Waihi Estuary/Pukehina Spit; and Ohiwa Harbour) are shown in Figures 7a and b with lines showing statistically significant trends i.e.: $p \leq 0.05$.

The change in number of pied stilt during summer and winter seasons from 1984 to 2003 for the four key habitats (Tauranga Harbour; Maketu Estuary/Kaituna River mouth; Waihi Estuary/Pukehina Spit; and Ohiwa Harbour) are shown in Figures 7a and b with lines showing statistically significant trends i.e.: $p \leq 0.05$). Decreases were statistically significant at Maketu Estuary (summer and winter).

Tauranga Harbour

The combined summer counts for sites counted (Table 1—Sites 1 to 7) belonging to Tauranga Harbour ranged from 4 (1988) to 48 (1997), averaging 18 (1984–2003) (18 counts) (Appendix 5). The average number of stilts at each harbour site during the summer (1984–2003) is shown in Figure 6a. Numbers averaged 13 in the first decade (1984–1993) (10 counts) and 23 over the second decade (1994–2003) (8 counts) (Appendix 5). No increase was significant at any of the Tauranga Harbour sites. Summer pied stilt counts were very low when compared to the winter counts for the harbour and this is probably a reflection of local birds away from the harbour at inland breeding sites.

The combined winter counts for all sites counted (Table 1—Sites 1 to 7) belonging to Tauranga Harbour range from 141 (1992) to 862 (1987), averaging 460 birds or 1.53% of the national population (1984–2001) (18 counts) (Table 3, Appendix 5). The average number of stilts at each harbour site during the winter (1984–2003) is shown in Figure 6b. Over the first decade (1984–1993) (10 counts) no more than 862 birds were recorded at any one count and averaged 470 birds (Appendix 5). Over the second decade (1994–2001) (8 counts) numbers declined reaching a maximum of 610 (2000) at any one count and averaged 382 birds (Appendix 5).

Maketu Estuary / Kaituna River mouth

Summer counts for pied stilt ranged from 4 (1999) to 200 (1990), averaging 78 (1984–2003) (19 counts) (Figure 6a, Appendix 5). Numbers averaged 102 over the first decade (1984–1993) (10 counts) then halved averaging 51 over the second decade (1994–2003) (9 counts) (Appendix 5).

Winter counts ranged from 12 (1990) to 477 (1984), averaging 149 (1984–2002) (19 counts) (Figure 6b and Appendix 5). Over the first decade (1984–1993) (10 counts) no more than 477 birds were recorded at any one count and averaged 192 birds. Over the second decade (1994–2002) (9 counts) numbers reached a maximum of 191 (1994) at any one count and averaged 102 birds as winter numbers declined at the estuary (Appendix 5).

The decrease in relative abundance over time (1984–2003) was statistically significant during summer ($P = 0.034$) and winter ($P = 0.005$) (Figures 7a and b, Tables 4a and b) at Maketu Estuary/Kaituna River mouth. The winter decline started around 1988. Prior to that time most of the stilts at the estuary inhabited a small c8 ha, isolated, shallow brackish lagoon, at the north-western end. The low lying wet fields, adjacent to this wetland, were also important nesting sites for stilts. However the Edgecumbe earthquake in 1986 damaged a stop bank and culvert system servicing the wetland and sometime later an adjoining landowner breached the stop bank on the estuary side, allowing the sea to flow directly back into the area. This spoiled the lagoon for stilts and other wading birds. The modifications had a major impact on shorebird usage at the estuary as the lagoon was the main feeding site for stilts and uncommon shorebirds.

Stilt numbers subsequently declined at the estuary and birds that remain go elsewhere to feed and roost, facing increased disturbances at the few roosts and nesting sites around the estuary. This impact has pushed stilts away from the estuary and reduced their numbers accordingly.

Waihi Estuary / Pukehina Spit

At Waihi Estuary/Pukehina Spit pied stilts were present in both the summer and winter seasons with summer numbers ranging from 2 birds (1997) to 100 birds (1990) with an average of 20 birds (19 counts) (Figure 6a, Appendix 5).

Winter counts ranged from 2 birds (1986, 2000) to 412 birds (1989) with an average of 120 birds (19 counts) (Figure 6b, Appendix 5). Over the winter of the first decade (1984–1993) the average number present was 144 birds (10 counts) but this reduced to 94 birds over the second decade (1994–2003) (9 counts) (Appendix 5).

The decrease in relative abundance over time (1984–2003) for winter seasons was not statistically significant (Table 3b) and there were too few birds to determine this for summer (Table 3a).

Otaramarakau / Pikowai / Hauone / Herepuru

At Otaramarakau, Pikowai, Hauone and Herepuru pied stilts were present in both the summer and winter seasons. Summer counts ranged from 2 birds (1999, 2000) to 14 birds (1996) with an average of 5 birds (14 counts) (Figure 6a, Appendix 5).

Winter numbers ranged from 2 birds (3 counts) to 20 birds (1989) with an average of 4 birds (17 counts) (Figure 6b, Appendix 5).

Numbers were very similar both summer and winter over both decades. This is surprising given that human disturbances by fishers and 4WD vehicles along this coastline have increased considerably over the last decade.

Matata Lagoon / Tarawera River mouth

Although the counts do not differentiate between Matata Lagoon and Tarawera River mouth most stilts were recorded at the lagoon. Summer counts ranged from 8 (1988, 1989) to 48 (1990), averaging 19 (1985–2003) (15 counts) (Figure 6a, Appendix 5). Numbers averaged 19 in the

first decade (1985-1993) (8 counts) then averaging 18 over the second decade (1994-2003) (7 counts).

Winter counts ranged from 2 (1988) to 250 (1989), averaging 59 (1985-2001) (17 counts) (Figure 6b, Appendix 5). Over the first decade (1985-1993) (9 counts) no more than 250 birds were recorded at any one count and averaged 86 birds (Appendix 5). Over the second decade (1994-2001) (8 counts) numbers reached a maximum of 58 (1994) at any one count and averaged 28 birds as winter numbers declined at the site (Appendix 5). It's unclear why there was a decline in numbers for the winter counts of the second decade (1994-2001).

On some occasions there were good numbers present as flocks and on other occasions there were only a few birds present. Why this occurred is unclear but it is possible that the decrease reflects human disturbances occurring at the time of counts, as the river mouth and lagoon margins are popular recreational areas. On the other hand, these declines could be caused by rainfall patterns, as when there was significant rainfall close to census time, observations show that many stilts are away feeding on wet pasture on the surrounding low lying farm land or at the nearby Awaiti wetland reserve. With the 17-18 May 2005 catastrophic flooding and infilling of the western lagoon at Matata Lagoon, it's likely that pied stilt numbers will decline further in the future.

Rangitaiki River mouth / Thornton Lagoon

At Rangitaiki River mouth/Thornton Lagoon there were only 6 summer counts when stilt were present. The summer numbers ranged from 1 (1989) to 39 (1991), averaging 4 (1985-2003) (15 counts) (Figure 6a, Appendix 5). Numbers averaged 6 in the first decade (1985-1993) (8 counts) then averaging 2 over the second decade (1994-2003) (7 counts) (Appendix 5).

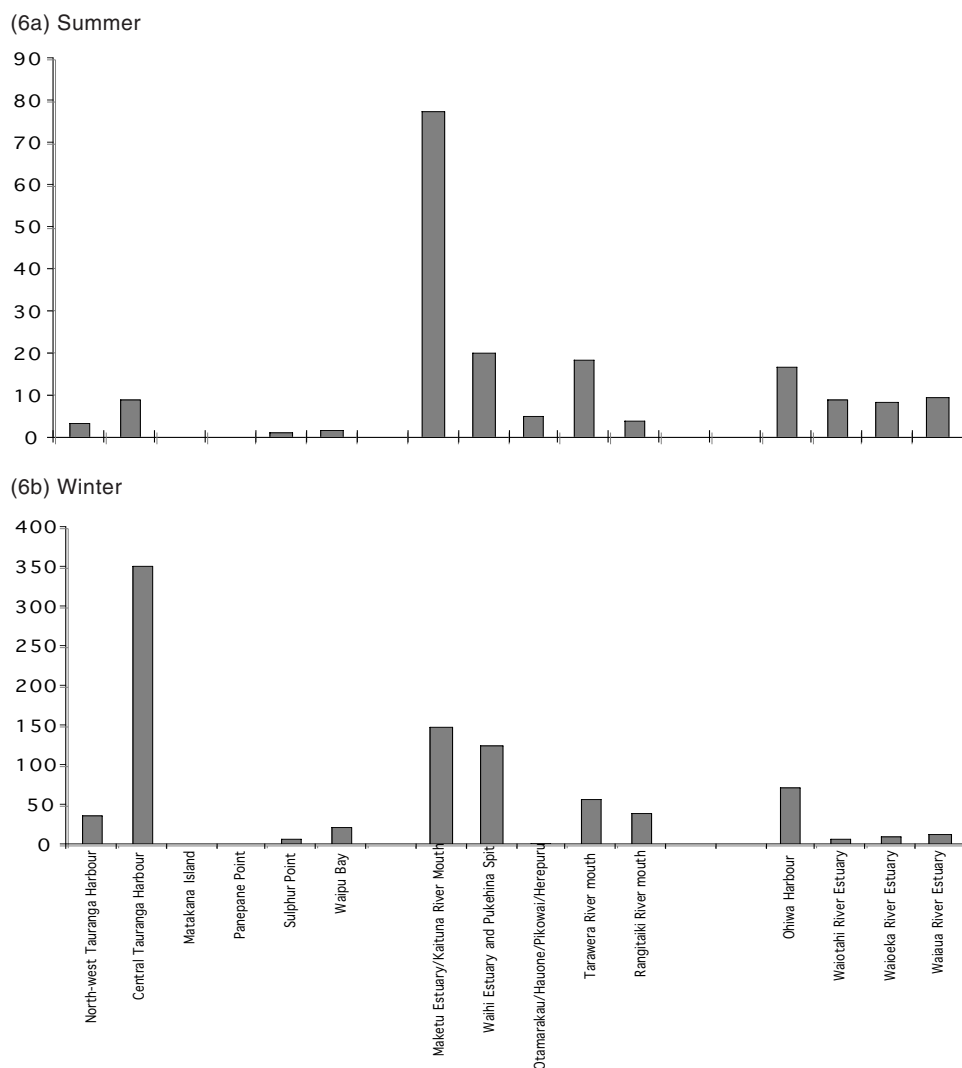
Winter counts ranged from 2 (1995) to 130 (1986), averaging 39 (1986-2002) (17 counts) (Figure 6b, Appendix 5). Over the first decade (1986-1993) (8 counts) no more than 130 birds were recorded at any one count and averaged 42 birds (Appendix 5). Over the second decade (1994-2002) (9 counts) numbers reached a maximum of 125 (1996) at any one count and averaged 34 birds as winter numbers declined at the site (Appendix 5).

Obiwa Harbour

Summer counts ranged from 4 (1988) to 79 (1990), averaging 17 (1984-2003) (18 counts) (Figure 6a, Appendix 5). Numbers averaged 26 in the first decade (1984-1993) (10 counts) then averaging 6 over the second decade (1994-2003) (8 counts of which only 2 recorded birds) (Appendix 5).

Winter counts ranged from 18 (1989) to 250 (1985), averaging 74 (1984-2002) (19 counts) (Figure 6b, Appendix 5). Over the first decade (1984-1993) (10 counts) no more than 250 birds were recorded at any one count and averaged 94 birds (Appendix 5). Over the second decade (1994-2002) (9 counts) numbers reached a maximum of 120 (2002) at any one count and averaged 51 birds as winter numbers declined at the harbour (Appendix 5).

No statistically significant trends in relative abundance were found for stilts for this site although numbers were much higher for the winter counts than summer counts over the study period as breeding birds returned to the harbour to flock. It's unclear however why both summer and winter counts declined over the second decade (1994–2003).



Figures 6a and b. Average number of pied stilt for each site visited eight or more times (except for Matakana Island which was not visited). Sites are shown in east to west direction across the Bay of Plenty Region.

Eastern Bay of Plenty sites

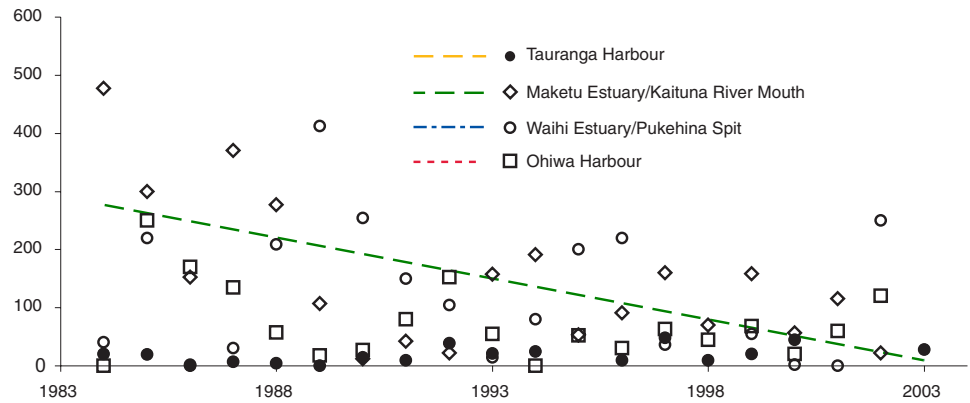
Waioatahi River estuary

At Waioatahi River estuary summer counts ranged between 1 (2001) to 30 birds (1986) over the study period (1984–2003) (Appendix 5). The average number of stilts at the estuary during the summer (1984–2003) is shown in Figure 6a. Over the first decade the average number of stilts on the estuary was 12 (9 counts) (1984–1993) and over the second decade (1994–2003) the average number on the estuary was 5 (9 counts) (1994–2003), a slight decrease in numbers over the study period (Appendix 5).

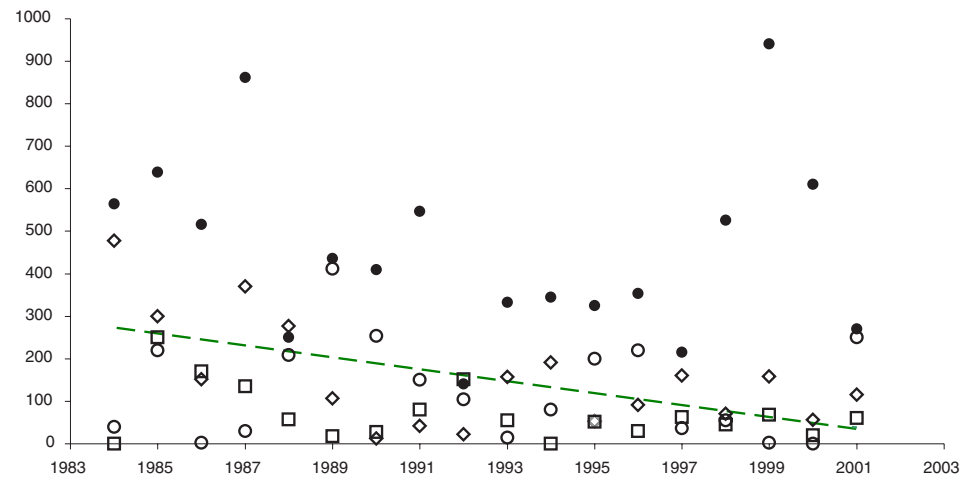
Winter counts ranged between 2 (4 counts) and 30 birds (1998) over the study period (Appendix 5). Over the first decade the average number of wintering stilts on the estuary was 8 (9 counts) (1985–1993) and over

the second decade (1994–2002) (8 counts) the average number on the estuary was 10 (Appendix 5). The average number of stilts at the estuary during the winter (1984–2003) is shown in Figure 6b.

(7a) Summer



(7b) Winter



Figures 7a and b. Change in number of pied stilt during the summer (a) and winter (b) season from 1984 to 2003 for the four key habitat units (Lines show statistically significant trends i.e.: $p \leq 0.05$)

Waioeka River estuary / Kukumoa

Summer counts ranged between 3 (1999) to 42 birds (1994) over the study period (Appendix 5). The average number of stilts at the estuary during the summer (1984–2003) is shown in Figure 6a. Over the first decade the average number of stilts on the estuary was 6 (9 counts) (1985–1993) and over the second decade (1994–2003) the average number on the estuary was 11 (8 counts) (1994–2003), an increase in numbers over the study period (Appendix 5).

Winter counts ranged between 3 (1999) and 65 birds (1991) over the study period (Appendix 5). The average number of stilts at the estuary during the winter (1984–2003) is shown in Figure 6b. Over the first decade the average number of wintering birds on the estuary was 15 (9 counts) (1985–1993) and over the second decade (1994–2002) (8 counts) the average number on the estuary was 5 (Appendix 5).

Waiaua River estuary

At Waiaua River estuary summer counts ranged between 1 (1986) to 25 birds (1988) over the study period (1985–2003) (17 counts) (Appendix 5). The average number of stilts at the estuary during the summer (1984–2003) is shown in Figure 6a. Over the first decade the average number of stilts on the estuary was 12 (8 counts) (1986–1993) and over the second decade (1994–2003) the average number on the estuary was 8 (9 counts) (Appendix 5).

Winter counts ranged between 2 (1999) and 35 birds (1998) over the study period (Appendix 5). The average number of stilts at the estuary during the winter (1984–2003) is shown in Figure 6b. Over the first decade the average number of wintering stilts on the estuary was 14 (9 counts) (1985–1993) and over the second decade (1994–2002) (8 counts) the average number on the estuary was 11 (Appendix 5).

Other Eastern Bay of Plenty sites

Relatively few birds were recorded east of Waiaua River estuary over the study period (Appendix 5) although very few counts took place. Motu River mouth had 7 records, six during summers, ranging from 2 to 6 birds, and one in winter (3 birds). Whangaparaoa Bay had 4 in summer (2–5 birds) and 3 in winter (5–12 birds) records. Hicks Bay had one summer record (1988) and Te Araroa had two summer records.

The lack of stilts recorded east of the Waiaua River estuary is a reflection of the limited number of counts that took place, especially over the last decade (1994–2003), and the small areas of habitat generally suitable for this species.

4.2.4 Northern New Zealand dotterel

There are two subspecies of the New Zealand dotterel, an endemic shorebird species (Dowding, 1994). They are the northern New Zealand dotterel (NNZD), tuturiwhatu (*Charadrius obscurus aquilonius*) that resides in the North Island but is very rarely seen south of northern Taranaki and Hawke's Bay and the southern New Zealand dotterel (*Charadrius obscurus obscurus*) that is found in the South Island and breeds only on Stewart Island.

The northern New Zealand dotterel is resident throughout the Bay of Plenty, where it breeds on sand spits, shell banks, beaches, dunes and near stream mouths and occasionally in paddocks along side coastal wetlands e.g Maketu Estuary. After breeding most birds stay close to their breeding grounds or in February will migrate a short distance to flocking sites at a nearby estuary and over winter there (Heather and Robertson, 1996).

Northern New Zealand dotterel has an acutely threatened status of "nationally vulnerable" (Hitchmough, 2002). A draft New Zealand Dotterel Recovery Plan (Dowding and Davies, 2004) guides its management with the support of the New Zealand Dotterel Recovery Group.

A census of the national population in October 2004 recorded a total of 1700 birds in New Zealand (Dowding, 2005). This total of 1700 birds has been used in this report to determine the 1% threshold for a site being nationally and therefore internationally significant for the species i.e. 17 birds.

Bay of Plenty wide

Historically, in the Bay of Plenty, northern New Zealand dotterel were found from Athenree to Hawai River mouth, east of Torere with an estimate minimum population of 57 birds from the North Island total of 1,114 birds (Edgar, 1969). Numbers contracted in the 1970s and in recent times few birds have been found east of Waiaua River estuary (P.L, pers.comm). Two pairs were recorded breeding on the Rurima Islands between 1967 and 1968 (Edgar, 1969) and dotterel were present in 1955 (Edgar, 1969) and in 1969 on Moutohora (Whale Island) (Mike Imber, pers.comm). More recently, in the 1980s and 1990s, 1 to 3 pairs breed on Moutohora most years (K.O., pers.obs).

An OSNZ census of northern New Zealand dotterel in the western Bay of Plenty (Bowentown Heads to Ohiwa Spit) in January 1978 recorded 69 birds (Edgar, 1978). In October/November 1983 Brian Chudleigh and P.L surveyed the whole of the Bay of Plenty region (Waihi Beach to Te Araroa). Their survey, covering the same area as this study, recorded 141 birds (c57 pairs, 14 non-breeders (sub-adults) and 13 chicks) (P.L., pers comm.).

By the mid 1990s birds started to spread back into these areas as active management by DOC, Royal Forest and Bird Protection Society (RFBPS) and others started at Matakana Island, Maketu Spit, Ohope Spit, Ohiwa Spit and Waiaua River estuary. The progeny from these managed sites dispersed widely, north to the Coromandel Peninsula, east to the East Coast, and down to Mahia Peninsula. Matakana Island is recognised as holding the largest number of breeding pairs in the country. Tauranga Harbour, Maketu Estuary and Ohiwa Harbour are the key post breeding flocking site for the species in the Bay of Plenty.

The northern New Zealand dotterel numbers recorded over the study period in the Bay of Plenty Region at the 24 sites are shown in Appendix 6. The average number at each site during summer and winter (1984–2003) are shown in Figures 8a and b. Northern New Zealand dotterel were well represented around the Bay of Plenty coastline during both winters and summers (Figures 8a and b). The summer numbers increased substantially over the study period. In the winter numbers dropped in the second decade (1992–2002). The summer population in the Bay of Plenty progressively increased from 41 birds in 1984 to a maximum of 134 birds by 2003 (Appendix 6). This was substantially less than the 180 birds recorded in the study area during the national dotterel census in October 2004 (Dowding, 2005) however some sites in the eastern Bay of Plenty were not visited very often during this study.

Summer numbers averaged about 90 birds per year through the first decade (1984–1993) and increased to average 112 birds in the following decade (1994–2003) (Appendix 6). The summer average (1984–2003) of 101 birds was 5.9% of the national population (Table 3).

Winter numbers increased from 99 (1984) to 155 (1989) then for some reason declined to 101 birds in 2002 (Appendix 6). Winter numbers averaged about 124 birds per year through the first decade (1984–1993) and 77 birds in the following decade (1994–2003) (Appendix 6). The winter average (1984–2003) of 102 birds was 6% of the national population (Table 3).

The decrease in winter numbers over the survey period could be a reflection of natural fluctuations in numbers regionally as birds migrate to a few post-breeding flocking sites or out of the region, although it may have been also influenced by the loss of the important flocking site at Sulphur Point in Tauranga Harbour. This decrease in numbers is in complete contrast to the 2004 census results for Bay of Plenty Conservancy that showed an increase as a result of the dotterel protection programme operating on Matakana Island. Perhaps this reduction also reflects sub adults migrating away from Bay of Plenty breeding areas to Coromandel Peninsula during the last decade, where numerous banded birds have been recorded at places such as Opoutere.

Since November 1992, when predators were controlled and breeding pairs raised more young on Matakana Island (Figure 9a), additional dotterel have been recruited into the regional population (Willis et al. 2003, Murray, 2003, Palmer, 2004). The January 1978 OSNZ census recorded 69 dotterels (Edgar, 1978) from the Bay of Plenty Conservancy (Waihi Beach to Ohiwa Spit) compared to the more recent November 1996 count data covering the same area which recorded a total of 96 birds. This shows a 28% increase in numbers over two decades. The 1996 count compares favourably with the 110 birds counted over the same area during the more intensive national census carried out at the same time (Heaphy, 2004).

The Bay of Plenty wide census undertaken in November 2004 duplicated the Bay of Plenty sector of the previous 1996 national census. The census recorded 180 birds, 145 between Waihi Beach and Ohiwa Spit (an increase of 32% from the previous census 8 years earlier) and a further 35 between Waiotahi River estuary and Cape Runaway near East Cape.

The Bay of Plenty results from this census indicate that overall there has been a 32% increase in number (Dowding, 2005), largely due to greater numbers on Matakana Island, at Maketu Estuary, Pukehina Spit, and at Totara Street (on vacant industrial land) near Port Tauranga. There has been a slight reduction in numbers at a few mainland sites, probably as a result of predator pressures at unmanaged breeding sites, while at Ohiwa Harbour and in the eastern Bay of Plenty numbers have remained about the same (John Heaphy, pers. comm.).

Northern New Zealand dotterel were most frequently recorded at the larger harbours and estuaries in the western Bay of Plenty (Figures 8a and b). Tauranga Harbour and Ohiwa Harbour support the highest numbers followed by Maketu Estuary/Kaituna River mouth and then Waihi Estuary/Pukehina Spit (Appendix 6).

The change in number of northern New Zealand dotterel during summer and winter seasons from 1984 to 2003 for the four key habitats (Tauranga Harbour; Maketu Estuary/Kaituna River mouth; Waihi Estuary/Pukehina Spit; and Ohiwa Harbour) are shown in Figures 9a and b with lines showing statistically significant trends i.e. $p \leq 0.05$). At Tauranga Harbour increases were statistically significant for summer when we analysed only those counts (1992, 1993, 1994, 1996, 1997, 1998, 1999, 2000 and 2003) which included Matakana Island (Figure 9a, Table 4a). At Maketu Estuary decreases were statistically significant in both summer and winter (Figures 9a and b; Tables 4a and b).

Tauranga Harbour

The majority of dotterel at the harbour over the summer breed on Matakana Island (Figure 8 a), so it's likely that most of these birds would have been missed during the twice yearly harbour counts. This is because breeding pairs remain close to nests on the ocean beach and there were constraints on island access and manpower limitations. Nine summer counts of dotterel from Matakana Island, 1992, 1993, 1994, 1996, 1997, 1998, 1999, 2000 and 2003 (Wills, 1997, Murray, 2003, Palmer, 2004) were therefore included to provide a more accurate account of dotterel numbers at the harbour (Figure 9a). However we limited analysis for this species to Tauranga Harbour itself.

The combined summer counts for sites counted (Table 1—Sites 1 to 7) belonging to Tauranga Harbour (including Matakana Island), ranged from 8 (1984) to 83 (2000, 2003), averaging 45 (1984–2003) (20 counts) or 2.6% of the national population (Appendix 6, Table 3). The average number of dotterel at each harbour site during the summer (1984–2003) is shown in Figure 8a. Numbers averaged 26 in the first decade (1984–1993) (10 counts) and 64 over the second decade (1994–2003) (10 counts) (Appendix 6).

The increase over the second decade is largely a reflection of the productivity of the Matakana Island population as breeding pairs increased from 15 pairs (Wills, 1993) to 43 pairs (Palmer, 2004) with fledgling success increasing substantially over those years. By summer 1996 dotterel had largely stopped roosting at Sulphur Point port reclamation (P.L., pers. comm.). This is supported by the data (Appendix 6). However 4–6 pairs have managed to breed there most years, although there is very little habitat left (John Heaphy, pers.comm).

The combined winter counts for sites counted (Table 1—Sites 1 to 7) belonging to Tauranga Harbour (including Matakana Island) ranged from 3 (1998) to 48 (1989), averaging 24 (1984–2002) (18 counts) (Appendix 6). The average number of dotterel at each harbour site during the winter (1984–2003) is shown in Figure 8b. Over the first decade (1984–1993) (10 counts) no more than 48 birds were recorded at any one count and averaged 30 birds (Appendix 6). Over the second decade (1994–2001) (8 counts) numbers decreased reaching a maximum of 33 (1997) at any one count and averaged 16 birds (Appendix 6).

The winter counts for the 4 years from 1998 to 2001 were very low (3–9 birds), less than half the usual counts, and probably reflected some count difficulties rather than reduced numbers present on the harbour in those years so for this reason and the fact that Matakana Island birds were never counted, the winter trend was not analysed (Table 4b). The average number of dotterel from all sites within the harbour during the winter (1984–2003) was 24 birds or 1.4% of the national total (Table 3, Appendix 6).

Decreases over time (1984–2003) occurred for both summer and winter seasons at Panepane Point roost and for both summer and winter seasons at Sulphur Point roost. The decline in numbers for both summer and winter seasons over the study period (1984–2003) at these two sites has

been caused by coastal erosion and human disturbances at Panepane Point and major port development at Sulphur Point. These impacts have forced birds away from these key roost sites to other roosting and nesting sites around the harbour and on Matakana Island.

Maketu Estuary / Kaituna River mouth

Summer counts ranged from 5 (1994, 1999) to 20 (1986, 1987, 1989, 2001), averaging 13 (1984–2003) (19 counts) (Figure 8a, Appendix 6). Numbers averaged 17 in the first decade (1984–1993) (10 counts) then halved, averaging 9 over the second decade (1994–2003) (9 counts) (Appendix 6).

Winter counts ranged from 5 (2001) to 30 (1986), averaging 16 or 0.94% of the national population (Table 3, notes 1) (1984–2002) (19 counts) (Figure 8b, Appendix 6). Over the first decade (1984–1993) (10 counts) no more than 30 birds were recorded at any one count and averaged 23 birds (Appendix 6). Over the second decade (1994–2002) (9 counts) numbers reached a maximum of 16 (2002) at any one count and averaged 7 birds as winter numbers declined at the estuary (Appendix 6).

Decreases in relative abundance over time (1984–2002) were statistically significant for both summer ($P = 0.003$) and winter ($P = 0.001$) (Figures 9a and b, Tables 4a and b). The decline started in about 1993 when the exposed end of Maketu Spit, the main nesting and roosting site for native shorebirds including dotterel eroded into the sea. With the loss of this open sand spit area and increased human disturbances in the estuary, shorebirds were forced to shift elsewhere to other breeding sites beyond the estuary where they were less likely to be detected. The spit has now stabilised and the numbers of nesting dotterel's have again increased there in recent years. However, recent counts are likely to have under counted breeding birds occupying the spit because of its inaccessibility.

Waihi Estuary / Pukehina Spit

At Waihi Estuary/Pukehina Spit birds were present in both summer and winter seasons with summer numbers ranging from 1 bird (3 counts) to 8 birds (1985) with an average of 2 birds (19 counts) (Figure 8a, Appendix 6).

Winter counts ranged from 2 birds (1986, 1989, 1993, 1994) to 20 birds (1995) with an average of 8 birds (19 counts) (Figure 8b, Appendix 6). Over the winter of the first decade (1984–1993) the average number present was 9 birds (10 counts) but this reduced to 7 birds over the second decade (1994–2003) (9 counts).

Decreases in relative abundance over time (1984–2003) for both the summer and winter seasons were not statistically significantly ($p=0.113$ summer, $p=0.982$ winter) (Tables 4a and b).

The data reflects the fact that dotterel numbers generally decline over the summer seasons when only a few breeding pairs are present. Over the winter counts of the last decade dotterel numbers on some counts dropped at Waihi Estuary and increased at nearby Maketu Estuary and visa versa. Additional observations undertaken at Maketu Estuary and Waihi Estuary over the study period show that there is a frequent movement

of shorebirds (dotterels, godwits, knots, oystercatchers, etc.) between the two estuaries on a regular basis (P.L and Tim Barnard, pers. comm.). On that basis alone, these two estuaries, in terms of shorebird usage, should be considered as one entity i.e. ecosystem.

Otaramarakau / Pikowai / Hauone / Herepuru

At Otaramarakau, Pikowai, Hauone and Herepuru birds were present in both summer and winter seasons. Summer counts ranged from 3 (1999, 2000) to 17 birds (1997), with an average of 9 (13 counts) (Figure 8a, Appendix 6).

Winter numbers ranged from 1 bird (3 counts) to 8 birds (1999) with an average of 2 birds (17 counts) (Figure 8b, Appendix 6).

The data shows that dotterel numbers increased over the summer period when breeding pairs were present and declined over the winter when birds moved away to join post-breeding flocks. Observations suggest that some breeding birds along the coast between Otaramarakau to Herepuru join the autumn post-breeding flock at Maketu Estuary (P.L, pers.comm).

Numbers were similar in both decades despite the fact that human disturbances by fishers and 4WD vehicles along this coastline have increased substantially over the last decade.

Matata Lagoon / Tarawera River mouth

At Tarawera River mouth / Matata Lagoon only a few birds were present in both summer and winter seasons (Figures 8a and b) with a maximum of 4 birds (summer 1985) (Appendix 6). Numbers declined in the second decade (1994-2003) (Appendix 6). The decline is likely to have been caused by increased human disturbances occurring at the river mouth which is a popular fishing spot.

Rangitaiki River mouth / Thornton Lagoon

At Rangitaiki River mouth / Thornton Lagoon only a few birds were present in both the summer and winter seasons (Figures 8a and b) with a maximum of 6 birds (winter 1990) (Appendix 6). The dotterels occurring there are likely to have come from Moutohora (Whale Island) or the Rurima Islands, where 2-3 pairs annually breed, as there has never been a breeding pair or a nest found along this stretch of coastline (P. L, pers. comm).

Obiwa Harbour

Summer counts ranged from 8 (1998) to 32 (2001), averaging 17 birds (1984-2003) (19 counts) or 1% of the national population (Figure 8a, Appendix 6, Table 3). Numbers averaged 17 in the first decade (1984-1993) (10 counts) then 16 over the second decade (1994-2003) (9 counts) (Appendix 6).

Winter counts ranged from 15 birds (1997) to 76 (2002), averaging 43 (1984-2002) (19 counts) or 2.5% of the national population (Figure 8b, Appendix 6, Table 3). Over the first decade (1984-1993) (10 counts) no more than 75 birds were recorded at any one count and averaged 49 birds (Appendix 6). Over the second decade (1994-2002) (9 counts) numbers

reached a maximum of 76 (2002) at any one count and averaged 35 birds as winter numbers declined at the estuary (Appendix 6). The information collected from this study indicates that Ohiwa Harbour is one of three key post-breeding flocking sites for the species in the Bay of Plenty Region. The other sites are Tauranga Harbour and Maketu Estuary.

Decreases in relative abundance over time (1984–2002) were not statistically significant for the winter seasons ($P = 0.288$) at the harbour (Table 4b).

There was a large increase in birds from 32 birds (November 2001) to 76 birds (May 2002), the largest count recorded at the harbour (Appendix 6). As the 2002 count was done earlier than usual that year (on 5 May), instead of in June, it's likely that the post-breeding flock had additional dotterel in it than the numbers usually recorded there later in June. The reason was that the May post-breeding flock had not begun to break up and disperse at that time.

Eastern Bay of Plenty sites

Waiotahi River estuary

Summer counts at the estuary ranged between 0 (2 counts) to 12 birds (2002) over the study period (Appendix 6). Over the first decade the average number of dotterel was 6 (9 counts) (1984–1993) and over the second decade (1994–2003) the average number was 4 (9 counts) (1994–2003), a slight decrease in numbers over the study period (Appendix 6). The average number of dotterel at the estuary during the summer (1984–2003) is shown in Figure 8a.

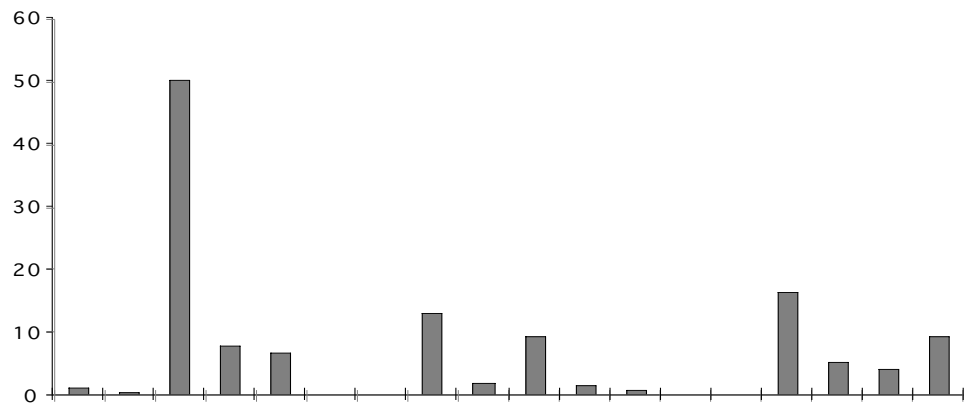
Winter counts ranged between 0 (3 counts) and 10 birds (1988, 1992) over the study period (Appendix 6). Over the first decade the average number of wintering dotterel was 5 (9 counts) (1985–1993) and over the second decade (1994–2002) (8 counts) the average number was 4 (Appendix 6). The average number of dotterel at the estuary during the winter (1984–2003) is shown in Figure 8b.

Waioeke River estuary

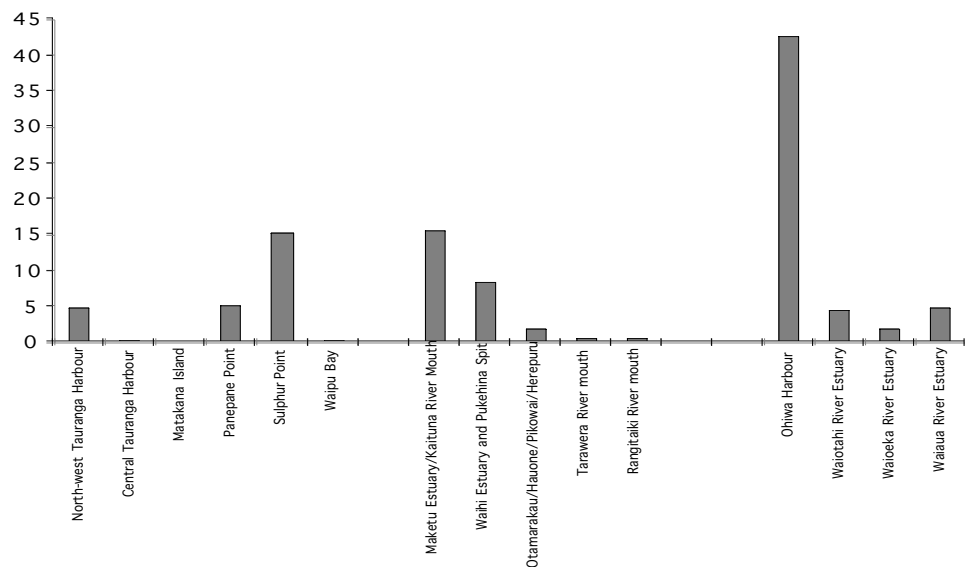
Summer counts at the estuary ranged from 0 (4 counts) to 10 birds (1994) over the study period (Appendix 6). Over the first decade the average number of dotterel on the estuary was 3 (9 counts) (1985–1993) and over the second decade (1994–2003) the average number on the estuary was 6 (8 counts) (1994–2003), an increase in numbers over the study period (Appendix 6). The average number of dotterel at the estuary during the summer (1984–2003) is shown in Figure 8a.

Winter counts ranged between 0 (6 counts) and 6 birds (1997) over the study period (Appendix 6). Over the first decade the average number of wintering dotterel on the estuary was 1 (9 counts) (1985–1993) and over the second decade (1994–2002) (8 counts) the average number was 3 (Appendix 6). The average number of dotterel at the estuary during the winter (1984–2003) is shown in Figure 8b.

(8a) Summer



(8b) Winter



Figures 8a and b. Average number of northern New Zealand dotterel for each site visited eight or more times (except for Matakana Island which was not visited in the winter). Sites are shown in east to west direction across the Bay of Plenty Region. Summer

Waiua River estuary

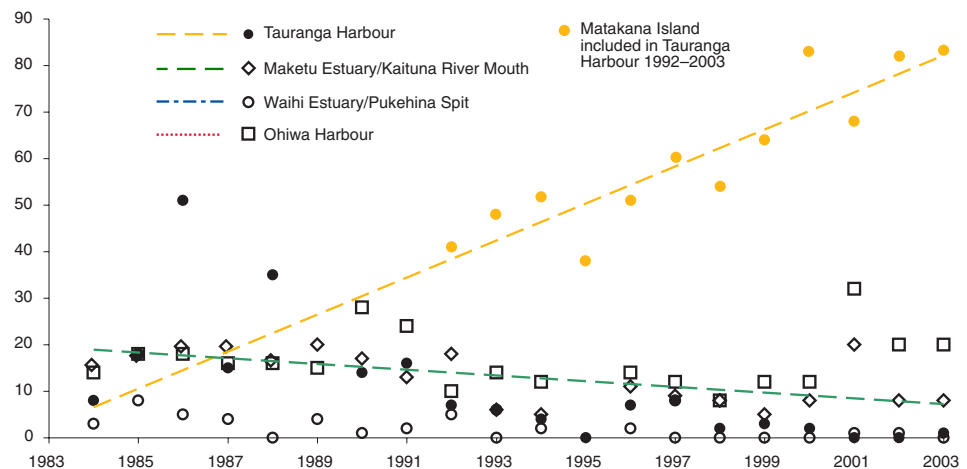
Summer counts at the estuary ranged between 4 (1994, 2003) to 14 birds (1986, 1999) over the study period (Appendix 6). Over the first decade the average number of dotterel on the estuary was 10 (8 counts) (1986-1993) and over the second decade (1994-2003) the average number was 9 (9 counts), very similar numbers over the study period (Appendix 6). The average number of dotterel at the estuary during the summer (1984-2003) is shown in Figure 8a.

Winter counts ranged between 0 (1987, 1989, 2002) and 13 birds (1997) over the study period (Appendix 6). Over the first decade the average number of wintering dotterel on the estuary was 4 (9 counts) (1985-1993) and over the second decade (1994-2002) (8 counts) the average number was 6 (Appendix 6). The average number of dotterel at the estuary during the winter (1984-2003) is shown in Figure 8b.

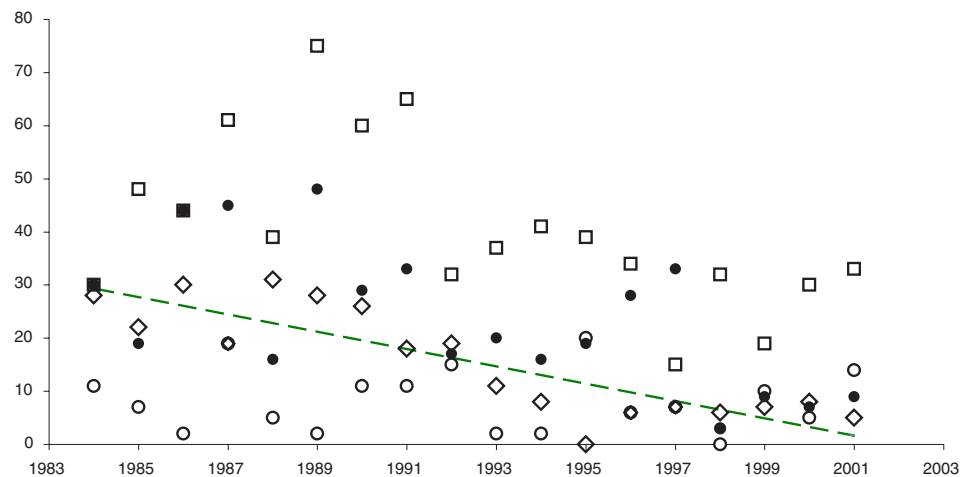
The Waiua River estuary sandpit is a northern New Zealand dotterel conservation site. DOC and locals protect and manage between 2 and 7 breeding pairs each year by undertaking predator control, reducing disturbances and educating the public (Andy Glaser, pers. comm.). Dotterels

have been monitored during each breeding season since the 1994-95 breeding season with between 1 and 9 juveniles fledging annually. There has been a decline in annual productivity in recent years, possibly due to a change in the estuary formation caused by sea erosion.

(9a) Summer



(9b) Winter



Figures 9a and b. Change in number of northern New Zealand dotterel during the summer (a) and winter (b) season from 1984 to 2003 for the four key habitat units (Lines show statistically significant trends i.e.: $p \leq 0.05$). Note that although all data is shown for Tauranga Harbour in summer, only those counts which included Matakana Island were subjected to regression analysis. This includes 1992, 1993, 1994, 1996, 1997, 1998, 1999, 2000 and 2003.

Motu River estuary to Te Araroa

Very few birds were recorded east of Waiau River estuary over the study period (Appendix 6). This is a reflection of the lack of counts that took place, especially over the last decade (1994-2003), and the limited amount of habitat generally suitable for this species in the area. Dotterels were recorded at Motu River estuary (3 birds) (summer 1989) (10 counts); Whangaparaoa Bay (1-8 birds) (summer) (8 counts) and 2-5 birds (winter counts) (6 counts); Hicks Bay (4 birds) (summer 1988) (2 counts); and Te Araroa (2 birds) (summer 1988) (2 counts) respectively. There were no dotterel recorded at Hawaii or Raukokore River mouths.

Very few nesting pairs have been observed in this part of the region with only the occasional nest found at Motu River mouth, Whangaparaoa Beach and Hicks Bay over the last 20 years (P.L. pers. comm.).

4.2.5 Banded dotterel

Banded dotterel, Tuturiwhata (*Charadrius bicinctus bicinctus*) breeds mainly on the braided river beds of the east coast of both the North and South Islands, New Zealand. The estimated national total is 50,000 birds of which 30,000 migrate to Australia during the non breeding period while the rest remain in New Zealand (Heather and Robertson, 1996). Banded dotterel are a chronically threatened species with a “gradual decline” threat status (Hitchmough, 2002).

Local banded dotterel once bred in good numbers from Matakana Island to East Cape but numbers have declined substantially over the last 25 years (P.L, pers.comm.) although birds migrate to the Bay of Plenty to winter over.

Today pairs breed along the Bay of Plenty coast at sandy beaches and river mouths, inland on Mount Tarawera, at Sulphur Bay, Lake Rotorua and further south on the sub-alpine herb fields of the Rangipo Desert in Tongariro National Park (Pierce, 1999). Tauranga and Ohiwa Harbours are notable flocking sites for wintering dotterels including birds that have breed around the North Island, especially coastal Bay of Plenty, Hawke’s Bay and Volcanic Plateau but also Southern North Island, Marlborough and Canterbury (Heather & Robertson, 1996, Pierce, 1999).

Bay of Plenty wide

The Bay of Plenty banded dotterel numbers recorded over the study period (1984–2003) at the 24 sites are shown in Appendix 7 and the average number at each site over summer and winter is shown in Figures 10a and b. Banded dotterel were well represented around the Bay of Plenty coastline during winters and summers but numbers reduced over summers ($P = 0.005$) (Table 4a) compared to winters ($P = 0.46$) (Table 4b). This reduction could reflect the fact that during November (early summer) when counts were taken, breeding pairs were largely absent from the harbours and estuaries at coastal and inland nesting grounds both locally and in the South Island (Pierce,1999) so fewer dotterel would have been present at this time (Table 3).

After 1993 few summer counts took place in the eastern Bay of Plenty (east of Waiaua River estuary) so subsequently this is likely to have reduced regional numbers by about 10% overall (based on the comprehensive 1988 summer survey of the eastern Bay of Plenty undertaken by Ray Pierce as part of this study) (Appendix 7).

The change in number of banded dotterel during summer and winter seasons from 1984 to 2003 for the four key habitats (Tauranga Harbour; Maketu Estuary/Kaituna River mouth; Waihi Estuary/Pukehina Spit; and Ohiwa Harbour) are shown in Figures 11a and b with lines showing statistically significant trends i.e.: $p \leq 0.05$. There was a statistically significant decrease of banded dotterel at Ohiwa Harbour (Figure 11b, Table 4b).

Bay of Plenty held a winter average of 775 birds or 3.9% of the national population (Table 3).

Tauranga Harbour

Historically, records show pairs breeding on open ground between Hull Road and the railway line at Mount Maunganui (October 1972) and around Mount Maunganui amongst the bark in the log marshalling yards at the wharves and on unoccupied ground of the oil company (1981). More recently, in 1992 and 1996 respectively, 2 pairs bred in the paddocks at Newton Road, and 2 pairs on nearby industrial land at Mount Maunganui (P.L. pers. comm).

Densem recorded 10 pairs on Matakana Island in 1967 (C.S.N 1963–1970, *Notornis* 19, Supp: 47) and at least 9 pairs bred there in spring 1982 (P.L. pers.obs.). Wills (1995) reports that historically up to 40 pairs nested in the Orchard Road area of Matakana Island but breeding is largely absent today. At Sulphur Point in Tauranga Harbour 6 pairs bred in November 1976, c10 pairs in November 1989 and 3 pairs in November 1997 (P.L. pers.obs).

At Tauranga Harbour the combined summer counts from sites counted (Table 1—Sites 1 to 7) ranged between 3 (1994) to 40 birds (1984) over the study period and averaged 12 birds (Appendix 7). The average number of dotterel at each harbour site during summer (1984–2003) is shown in Figure 10a.

In 1995, 1998, 1999, 2000 and 2003 no dotterel were recorded in summer at the harbour. Over the first decade the average number of dotterel on the harbour was 18 (10 counts) (1984–1993) and over the second decade 4 (8 counts) (1994–2003). The reduction in numbers is largely a reflection that only 3 of the 10 counts between 1994 and 2003 recorded birds. This was either a result of fewer numbers present or no birds being recorded during the counts. At this time of the year (November) breeding pairs have not returned to the harbour from inland or coastal nesting grounds so numbers are generally lower. Summer counts also decreased due to a decline in breeding pairs associated with developing Sulphur Point reclamation.

Decreases in relative abundance over time (1984–2003) were statistically significant for banded dotterel at Sulphur Point for the summer ($P = 0.001$) (Table 4a). The counts show that this decline was complete by summer 1997 (Appendix 7). The decline is very likely to have been caused by the loss of the Sulphur Point shorebird roost site, after its conversion into a large scale commercial port facility on reclaimed land, during this period. The roost was the principal roost for shorebirds in the southern half of the harbour. Today it is largely vacated by most shorebirds including banded dotterel although South Island pied oystercatcher and variable oystercatcher have habituated to the site, roosting on the roofs of storage buildings at high tide.

The combined winter counts from sites counted (Table 1—Sites 1 to 7) belonging to Tauranga Harbour ranged from 0 (1998, 1999) to 743 birds (1994) over the study period and averaged 346 birds or 1.73% of the national population (Table 3, Appendix 7). Over the first decade the average number of wintering dotterel on the harbour was 338 (10 counts) (1984–1993) and over the second decade (1994–2001) the average number was 366, a slight increase in numbers but from fewer counts (8 counts)

(Appendix 7). The average number of dotterel at each harbour site during the winter (1984–2003) is shown in Figure 10b. Winter counts were always higher than summer counts as breeding birds returned to the harbour in late summer, after the summer counts, to increase the winter population. Wintering birds very often frequent Tauranga Airport, adjacent to Waipu Bay, as its grassed runways offer favourable feeding areas.

A decrease in relative abundance over time (1984–2003) was statistically significant for dotterels for the winter seasons at NW Tauranga Harbour ($P = 0.032$ winter) (Table 4b). It's difficult to determine why this happened although the loss of the Bowentown Shellbanks from sea erosion (caused by storms) in the early 1990s could have been a factor. This forced roosting birds to shift a short distance to the adjacent Bowentown Beach but this loss only lasted a couple of years.

The summer decline noted for banded dotterel at Sulphur Point was also apparent at the same site for winter flocks, although not statistically significant ($P = 0.246$) (Table 4b). The last count of 450 birds was recorded in winter 1996 (Appendix 7). It is interesting to note, that there was also a winter increase in abundance over time (1984–2003) for dotterels at Waipu Bay, although not statistically significant. This is not surprising as dotterels and other shorebird species that were displaced from the heavily modified Sulphur Point port reclamation now roost at the Waipu Bay roosts (Tauranga Airport, Aerodrome Bay and Maheka Point), which are the nearest, available natural roosts.

Tauranga Airport has become a very important winter feeding area for banded dotterel and is now the best place to get an accurate count of winter numbers at the harbour (P.L, pers. comm). The Tauranga Airport Authority and DOC has become increasingly aware and concerned about aircraft movements and public safety caused by the increased numbers of roosting shorebirds displaced from Sulphur Point now using the Airport. The Authority has found it necessary to undertake control of the numbers of some shorebird species on occasions to reduce this impact.

Maketu Estuary / Kaituna River mouth

Summer counts ranged from 0 (8 counts) to 80 (2001), averaging 5 (1984–2003) (19 counts) (Figure 10a, Appendix 7). Summer numbers ranged from 1 to 4 birds except for 80 recorded in 2001. This one off count was very high but reflects that the estuary count was undertaken in January (2002) not November (2001) as normally occurs. This was a post-breeding flock count and numbers were much higher than we would have expected had the count taken place in November (P.L, pers. comm.).

Numbers average 1 in the first decade (1984–1993) (10 counts) then increased, averaging 10 birds, largely due to the 80 birds recorded in 2001, over the second decade (1994–2003) (9 counts) (Appendix 7). Breeding was first observed at the estuary in October 1978 and October 1983 when three pairs were observed nesting (P.L pers.comm).

Winter counts ranged from 0 (1999) to 178 (1993), averaging 51 (1984–2002) (19 counts) (Figure 10b, Appendix 7). Over the first decade (1984–1993) (10 counts) the maximum count was of 178 birds at any one count and

averaged 46 birds (Appendix 7). Over the second decade (1994–2002) (9 counts) numbers reached a maximum of 142 (1994) at any one count and averaged 56 birds as numbers increased slightly at the estuary (Appendix 7). The data shows that the estuary is an important post-breeding flocking site for the species.

As expected summer numbers were lower than winter numbers and stayed fairly constant over the survey period. Increases in abundance over time (1984–2003) were not statistically significant for winter seasons at the Estuary ($p=0.647$ winter) (Table 4b) and there were too few birds in summer to determine this (Table 4a).

Waibi Estuary / Pukebina Spit

There was only one summer count of 1 bird in 1984 over the whole survey period (1984–2003) (19 counts) (Appendix 7).

Winter counts ranged from 0 (on 11 counts) to 86 (1987), averaging 11 (1984–2002) (19 counts) (Figure 10b, Appendix 7). Over the first decade (1984–1993) (10 counts) no more than 86 birds were recorded at any one count and averaged 9 birds (Appendix 7). Over the second decade (1994–2002) (9 counts) numbers reached a maximum of 66 (1997) at any one count and averaged 12 birds as numbers remained relatively constant at the estuary (Appendix 7).

Otaramarae to Whakatane River estuary

Along the coast between Otaramarae to Herepuru in the summer dotterels were a regular visitor breeding at several stream mouths where numbers ranged from 2 to 24 birds (13 counts) (Figure 10a, Appendix 7). Birds were absent, except on 2 occasions (from 72 counts) at Tarawera River mouth/Matata Lagoon, Rangitaiki River mouth/Thornton Lagoon and Whakatane River estuary (Appendix 7).

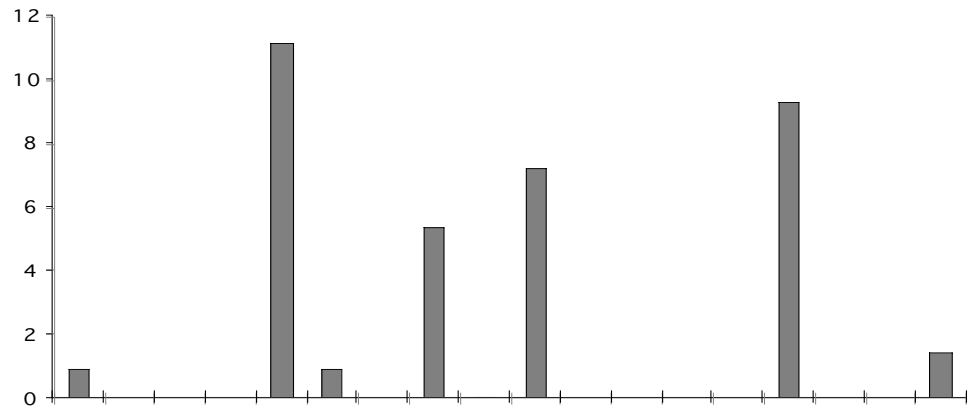
Breeding was recorded at Otamarakau (4 pairs in 1983, 1986 and 1987, 6 pairs in 1988, and 2 pairs in 1990), Herepuru (4 pairs in 1983 and 1987, 6 pairs in 1988 and 3 pairs in 1990) and 1 pair with chicks at Pikowai in 1990 (P.L. pers.comm). In the 1980s several pairs also bred at the Tarawera and Rangitaiki River mouths. Today very few pairs breed along the Otaramarae to Whakatane coast because too many human disturbances are taking place (P.L, pers. comm).

There were only two winter records (17 counts) of birds over the study period, along the coast between Otaramarae to Herepuru (Appendix 7).

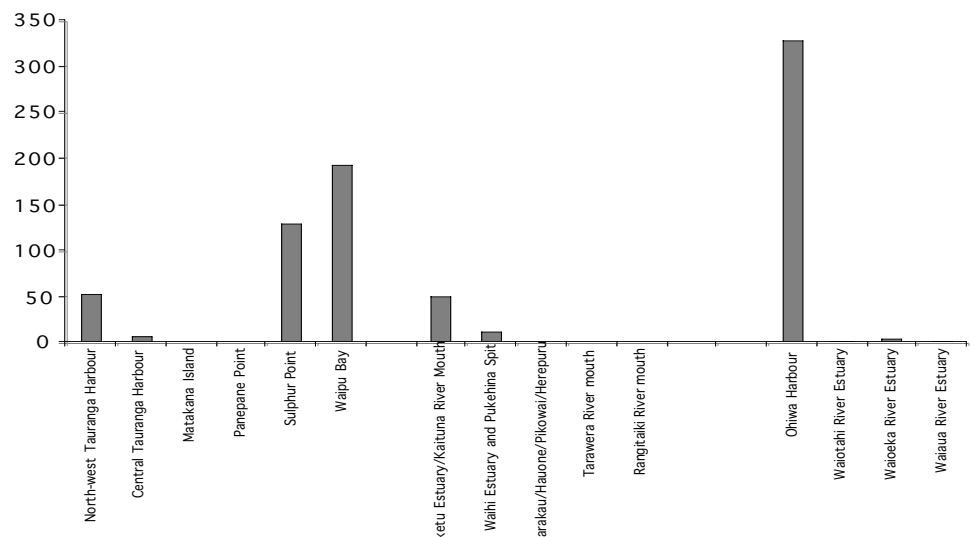
Obiwa Harbour

Summer counts ranged between 0 (7 occasions) to 50 (2001) over the study period (1984–2003) and averaged 9 birds (Appendix 7, Figure 10a). Over the first decade the average number of dotterel on the harbour was 12 (10 counts) (1984–1993) and over the second decade (1994–2003) the average number on the harbour was 7 (9 counts) a slight reduction in numbers (Appendix 7). During November (early summer) when counts took place, breeding pairs were largely absent from the harbour at coastal or inland nesting grounds (Pierce, 1999) so numbers are naturally lower at the harbour at this time.

(10a) Summer



(10b) Winter



Figures 10a and b. Average number of banded dotterel for each site visited eight or more times (except for Matakana Island which was not visited) from 1984 to 2003. Sites are shown in east to west direction across the Bay of Plenty Region.

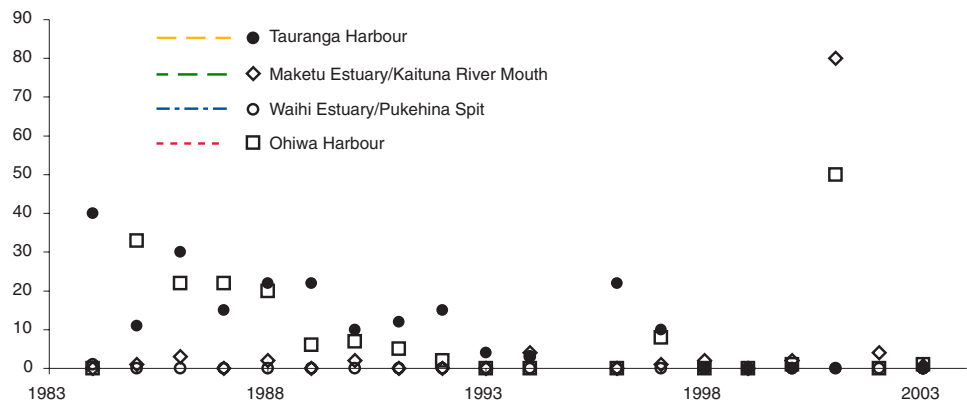
In 1988 and 1989 10 pairs bred on Ohope Spit and these were intensively managed in association with northern New Zealand dotterels by RFBPS and DOC but that ceased in about 1990, when coastal erosion of the spit occurred, reducing breeding pairs to 2 (P.L pers.comm). This is the main reason why summer numbers subsequently reduced at the harbour.

Winter counts ranged between 75 (2000) and 676 birds (1988) and averaged 316 birds or 1.58% of the national population over the study period (1984-2003) (Figure 10b, Table 3, Appendix 7). Over the first decade the average number of wintering dotterel on the harbour was 407 (10 counts) (1984-1993) and over the second decade (1994-2002) the average number on the harbour was 244 (9 counts) a substantial decline in numbers (Appendix 7).

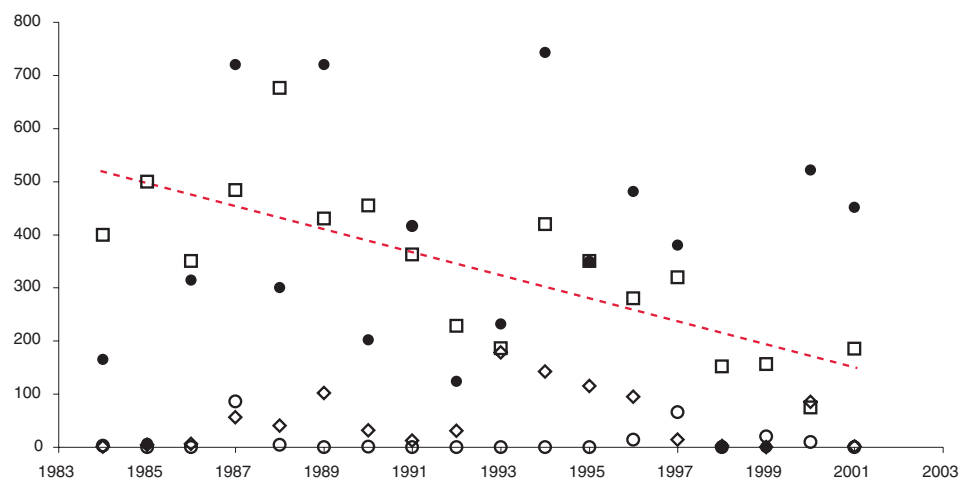
Winter counts were always higher than summer counts as breeding birds return to the harbour in late summer from inland nesting grounds increasing the winter population.

A decrease in relative abundance over time (1984-2002) was statistically significant for dotterels for the winter seasons at the harbour ($P=0.001$) (Table 4b, Figure 11b) but there were too few birds in summer to determine any statistical trend with the majority of breeding pairs away from the harbour nesting.

(11a) Summer



(11b) Winter



Figures 11a and b. Change in number of banded dotterel during the summer (a) and winter (b) season from 1984 to 2003 for the four key habitat units (Lines show statistically significant trends ie: $p \leq 0.05$)

Eastern Bay of Plenty sites

Waiotahi River estuary has only 2 winter records, 4 birds in 1985 and 17 birds in 1991 (Appendix 7). On five occasions Waioeka River estuary /Kukumoa had a small group of wintering birds. These were present in 1985 (16), 1990 (15), 1991 (13), 1996 (28) and 1998 (4) (Appendix 7).

Waiaua River estuary regularly has a few dotterels during both summer and winter, but no more than 7 (summer 2001) have been recorded there at any one time during this study (Appendix 7). East of Waiaua River estuary, there were very few records over the last decade (1994–2003) as few counts were done due to difficulty in getting people to count these isolated areas.

A total of 105 birds were recorded in summer 1988 from the eastern Bay of Plenty (Appendix 7) when Ray Pierce undertook a very comprehensive survey (P.L pers.comm.) but as part of this study, however since that year no more than 6 birds have been recorded in summer from the same sites.

In winter 1989 20 birds were recorded at Te Araroa, while at Whangaparaoa Bay 8, 17 and 17 birds were recorded during the winters of 1990, 1991 and 1993 respectively (Appendix 7). Between 1983 and 1985 dotterel were found nesting at Torere, Omaio, Motu River mouth, Hawaii River mouth, Raukokore River mouth, Whangaparaoa Bay, Hicks Bay and Te Araroa and other locations between these sites (P.L pers.comm).

4.2.6 Wrybill

The wrybill, Ngutuparore (*Anarhynchus frontalis*) is a small, shorebird endemic to New Zealand. It breeds on the braided rivers of Canterbury and inland Otago during the summer. Most of the population migrates north to the larger harbours in the North Island to winter. It has a strange shaped bill, the lower portion curved to the right near the tip, allowing it to forage under stones for invertebrates and on tidal flats where it scythes the surface for small crustaceans.

Nationally the species numbered about 5000 birds in 1994 (Heather & Robertson, 1996) however the species appears to have declined further as a 2001 survey on their winter feeding grounds revealed that there had been a 20% drop over 7 years in the population to 4,100 birds (Keey, 2005). The species is an acutely threatened species and has a “nationally vulnerable” status (Hitchmough, 2002).

Bay of Plenty wide

Bay of Plenty wrybill numbers recorded over the study period at the 24 sites are shown in Appendix 8. The average number per site over summer and winter (1984–2003) is shown in Figures 12a and b.

Wrybill were poorly represented in the Bay of Plenty. Very few birds were observed during the summer counts at any site throughout the study area. The majority of the records were from winter counts on Tauranga Harbour with a few birds recorded at Maketu Estuary / Kaituna River mouth, Waihi Estuary / Pukehina Spit and Ohiwa Harbour but in very low numbers (Appendix 8). Bay of Plenty’s wrybill population averaged 73 birds (1984–2003) or 1.8% of the national population with most birds being recorded at Tauranga Harbour (Table 3). There were no birds recorded at any site east of Ohiwa Harbour although wrybill are known to turn up in small numbers almost anywhere along the coast during autumn and winter, e.g, a bird at Tarawera River mouth in March 1975 (P.L, pers. comm.).

The change in numbers of wrybill during summer and winter seasons from 1984 to 2003 for the four key habitats (Tauranga Harbour; Maketu Estuary / Kaituna River mouth; Waihi Estuary / Pukehina Spit; and Ohiwa Harbour) are shown in Figures 13a and b with lines showing statistically significant trends i.e: $p \leq 0.05$). The decrease at Tauranga Harbour was statistically significant (Figure 13b, Table 4b).

Tauranga Harbour

Previous Tauranga Harbour counts prior to this study were c. 40 birds at Matahui Point in July 1982, 4 records from Sulphur Point, of 190 birds on 24 July 1982, 136 birds on 10 April 1981 (P.L pers.comm.), c. 100 bird on 17 May 1982 (Graeme Taylor, pers.comm) and 101 birds on 29 January 1983 (P.L, pers.comm).

The combined summer counts from sites counted (Table 1—Sites 1 to 7) belonging to Tauranga Harbour ranged between 0 (on 11 counts) and 6 birds (1989) over the study period (Appendix 8). Over the first decade the average number of wrybill on the harbour was 2 (10 counts) (1984–1993) and the maximum number was 6 (1989) (Appendix 8). Over

the second decade (1994–2003) there was just one record of a bird in 1997 (Appendix 8). An additional bird was recorded on Matakana Island in early December 1994 (Wills, 1995).

The November summer counts were unlikely to pick up wrybill at the harbour as these birds usually arrive in January. For example 162 and 120 birds were recorded in two separate counts in January 1980 and on 31 March 1986 respectively (P.L, pers.comm) when numbers were higher at the harbour. In the summer, breeding pairs are inland at nesting grounds in the South Island, however the reduced numbers recorded in the second decade show a general trend in decreased abundance.

Winter counts were always higher than summer counts as breeding birds return to the harbour in late summer from South Island breeding grounds to over winter (Figure 12b). They start returning in late December, peak in late January, then leave again in late June or July.

The combined winter counts from sites counted (Table 1—Sites 1 to 7) belonging to Tauranga Harbour ranged between 0 (on 2 counts) to 101 birds (1989) over the study period and averaged 49 birds (Figure 12b) (Appendix 8). Over the first decade the average number of wintering wrybill on the harbour was 71 (10 counts) (1984–1993) and over the second decade (1994–2001) the average number on the harbour was 22 (8 counts) a decline in numbers (Appendix 8). A decrease in relative abundance of wrybill over time (1984–2001) for winter were statistically significant for the harbour as a whole ($p < 0.01$) (Table 13b, Table 4b).

There was a statistically significant decrease for Sulphur Point as well ($p = 0.003$) (Table 4b).

The highest numbers at Sulphur Point were recorded in the first decade averaging 40 birds (1984–1993) (Appendix 8). This was a period when harbour dredging for the Sulphur Point port development took place. It's possible that this activity may have provided good feeding conditions for wrybill at the time (P.L, pers comm). However numbers have declined over the second decade to average 16 birds (Appendix 8).

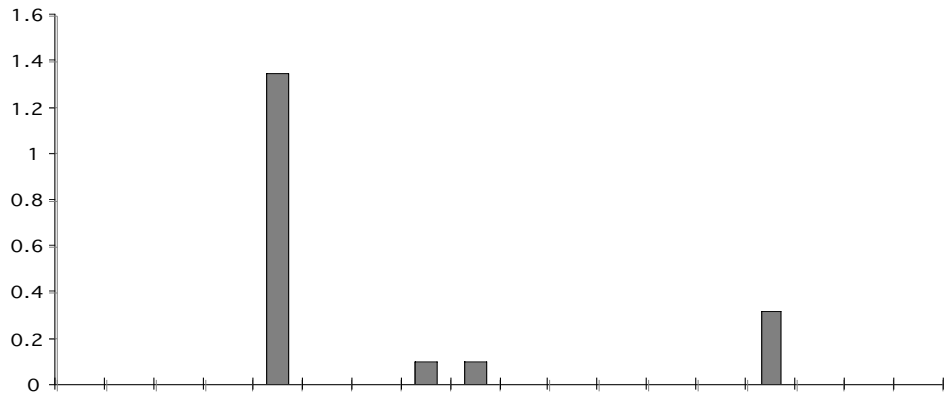
Numbers were low at other roosts in the harbour including Central Tauranga Harbour, Waipu Bay and Waimapu/Welcome Bay/Rangataua Bay over time (1984–2001) (Appendix 8).

This decline was exacerbated by the loss of the Sulphur Point shorebird roost at the time when it was developed into a large scale commercial port on reclaimed land, forcing birds to roost elsewhere in the harbour. This was the principal roost for most shorebirds in the southern half of the harbour and has been largely vacated by most species of shorebirds although South Island pied oystercatcher and variable oystercatcher, which have habituated to the site, now roost on the roofs of the storage sheds.

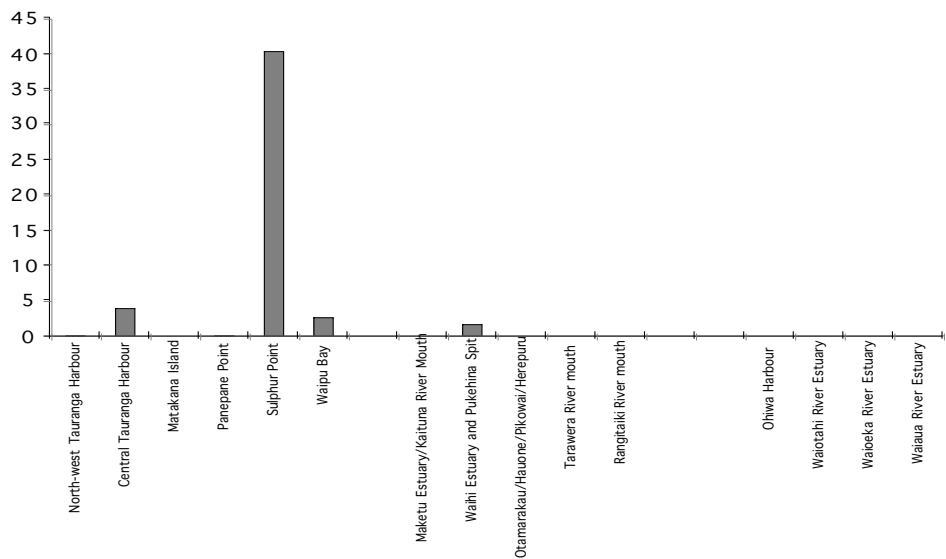
Maketu Estuary / Kaituna River mouth

Two wrybill were recorded at the estuary during the 2001 summer (Appendix 8, Figure 12a). This was the only record of wrybill present during the study period. Previously, 10 birds had been recorded in May 1981 and 17 birds in February 1982 P.L (pers. comm.).

(a) Summer



(b) Winter



Figures 12a and b. Average number of wrybill for each site visited eight or more times (except for Matakana Island which was not visited) from 1984 to 2003. Sites are shown in east to west direction across the Bay of Plenty Region.

Waihi Estuary / Pukehina Spit

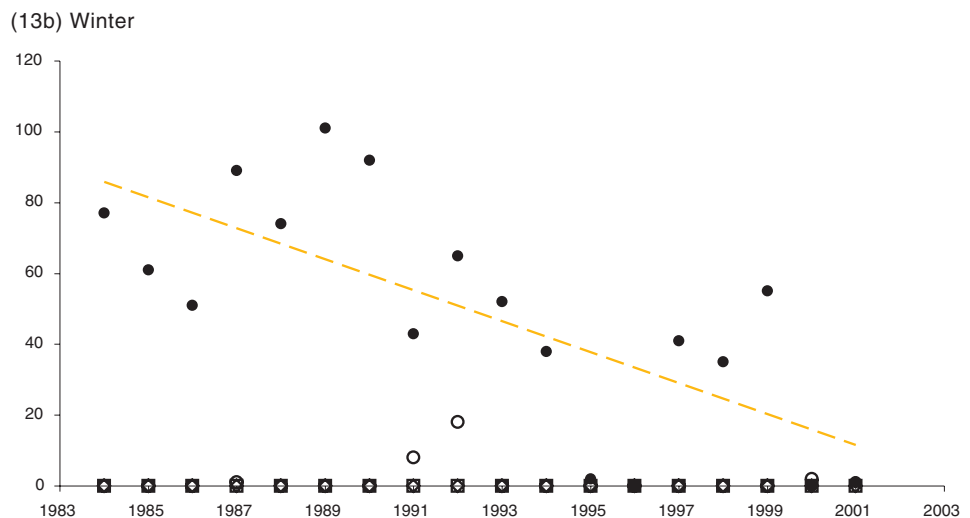
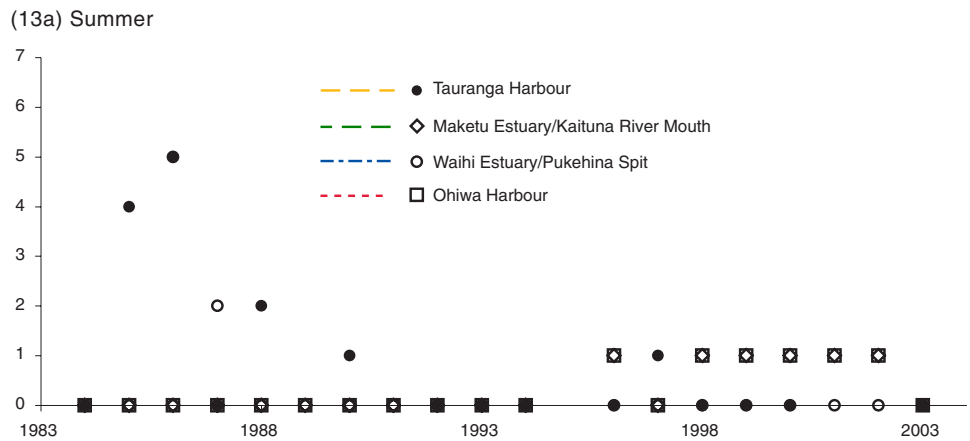
There was one summer record (2 birds in 1987) (Appendix 8, Figure 12a) and four winter records of 1 (1987), 8 (1991), 18 (1992) and 2 birds (2001) at the estuary (Appendix 8, Figure 12b).

Rangitaiki River mouth / Thornton Lagoon

Two birds were recorded at the river mouth outside of the study period in January 1983 (P.L, pers.comm).

Ohiwa Harbour

A single wrybill was recorded during the summers of 1996, 1998-2002 (Appendix 8, Figure 12a) and could have been the same individual? Two birds were recorded there on 6 November 1982 (P.L. pers. comm). No wintering birds were recorded on the harbour during any of the counts (1984-2003) although OSNZ counts outside of this study have recorded small numbers of wrybill present during winter (K.O pers.obs).



Figures 13a and b. Change in number of wrybill during the summer (a) and winter (b) season from 1984 to 2003 for the four key habitat units (Lines show statistically significant trends ie: $p \leq 0.05$)

4.2.7 Pacific golden plover

Pacific golden plover (*Pluvialis fulva*) a medium sized shorebird, breeds in the Arctic and sub-arctic tundra of Siberia and western Alaska during the northern summer and migrates south to India, Malaysia, Australasia and the Pacific Islands to avoid the northern winter. It summers throughout New Zealand including the Chatham Islands (Heather & Robertson, 1996). Most birds arrive in October and depart in April. The species very rarely winters in New Zealand although a single bird was found in June 1977 at Maketu Estuary (C.S.N, *Notornis* 24: 261). The estimated average national population is about 649 birds (Sagar et al. 1999).

Bay of Plenty wide

The Pacific golden plover numbers recorded in the Bay of Plenty region over the study period (1984–2003) at the 24 sites are shown in Appendix 9. The average number at each site over summer (1984–2003) is shown in Figure 14. The species was only recorded during the summer counts and was not recorded during the winter over the whole study period (Figure 14, Appendix 9). The annual summer numbers ranged between 12 (1984) to 110 birds (1990) and averaged 43 birds each year or 6.6% of the national population (Sagar et al. 1999) (Table 3, Appendix 9).

Key sites for summer flocks were Maketu Estuary / Kaituna River mouth and Ohiwa Harbour. Although the occasional flock was recorded at Tauranga Harbour and Waihi Estuary / Pukehina Spit we suspect they were probably there most summers but were just not found as they may have been away from the estuary on nearby farmland during the visits of observers.

Birds were absent in the eastern Bay of Plenty, except for 1 bird recorded in summer 1992 at Waioeka River estuary / Kukumoa.

The change in number of Pacific golden plover during summer seasons from 1984 to 2003 for the four key habitats (Tauranga Harbour; Maketu Estuary / Kaituna River mouth; Waihi Estuary / Pukehina Spit; and Ohiwa Harbour) are shown in Figure 15 with lines showing any statistically significant trends i.e: $p \leq 0.05$). However in general numbers during summer remain reasonably static and no significant trends, either increase or decrease, were found ($P = 0.488$) (Table 4a, Figure 15).

Tauranga Harbour

There were only 3 records from Tauranga Harbour over the study period (Appendix 9, Figure 14), 11 birds at the Sulphur Point roost in the summers of 1988 and 1989 and 4 birds during summer 2003 at the Te Maunga Sewage Works roost in Rangataua Bay. We believe that they are present on the harbour each summer but their roost(s) have never been found. Forty two birds (6.5% of the national population) were recorded on the harbour in March 1983 and birds have been also seen feeding over the tidal flats, off Matahui Point roost, during the flood tide (P.L, pers.comm.).

Outside of the study 4 birds were recorded in summer 2003 at Waimapu Estuary / Welcome Bay / Rangataua Bay (P.L pers. comm) and 5 birds at Te Maunga Sewage Works roost in January 2005 (Volcanic Plateau / Bay of Plenty regional roundup, Southern Bird, 2005).

Birds were absent from the harbour for all winter counts (Appendix 9).

Maketu Estuary / Kaituna River mouth

Summer flocks of plover were recorded at the estuary on 16 of the 19 counts (Appendix 9, Figure 14). Numbers ranged from 5 (1999) to 48 (1992) (7.4% of the national population) with the average number being 24 birds (1984-2003) (19 counts) or 3.7% of the national population (Table 3, Appendix 9). Over the first decade the average number of plover on the estuary was 28 (10 counts) (1984-1993) and over the second decade (1994-2003) the average number on the estuary was 19 (8 counts) a decline in numbers (Appendix 9).

Birds were not observed during counts at the estuary in the summers of 1984, 2002 and 2003 (Appendix 9) and in all winters when counts took place (Appendix 9), however it's likely that that they were present in all summers but were just not found during the counts. One of the plover's favourite foraging areas was the ploughed paddocks near the upper estuary where they can be difficult to observe. They also roost on the sandy point at the cattle yards at the nearby Kaituna River mouth.

Waihi Estuary / Pukehina Spit

Summer flocks of plover were recorded at the estuary on only 4 of the 19 counts (Appendix 9, Figure 14). Numbers ranged from 20 (2001) to 56 birds (1990) with the average number of 6 birds (1984–2003) (19 counts) (0.95% of the national population) (Table 3, notes 2) although on a count outside the study, 68 birds (10.5% of the national population) were recorded there in February 1987 (P.L. pers.comm). Over the first decade the average number of plover on the estuary was 8 (10 counts) (1984–1993) and over the second decade (1994–2003) the average number on the estuary was 5 (9 counts) a slight reduction in numbers (Appendix 9).

Their roosts were never found but they are likely to occupy the small, low lying, islands in the upper estuary over the high tide period where few disturbances takes place. Observations show that plovers shift regularly between Maketu Estuary / Kaituna River mouth and Waihi Estuary / Pukehina Spit which are only 2 kilometres apart (P.L and Tim Barnard, pers.comms.).

Birds were absent from the estuary for all winter counts (Appendix 9).

Ohiwa Harbour

Summer flocks of plover were recorded at the harbour on every one of the 19 counts (Appendix 9, Figure 14). Numbers ranged from 4 (1994) to 18 (1986, 2002, 2003) with the average number of 12 birds (1984–2003) (19 counts) being 1.8% of the national population (Table 3). Over the first decade the average number of plover on the harbour was 11 (10 counts) (1984–1993) and over the second decade (1994–2003) the average number on the harbour was 12 (8 counts) (Appendix 9). Birds were absent from the harbour for all winter counts (Appendix 9).

Eastern Bay of Plenty sites

There was only a single record of this species east of Ohiwa Harbour during the study. This was of a solitary bird at Waioeka River estuary / Kukumoa in summer 1992 (Appendix 9). On 2 separate occasions outside of the study, 4 birds were recorded at Whangaparaoa Bay in November 1985 and 4 birds at Waioeka River mouth in November 1998 (P.L., pers.obs).

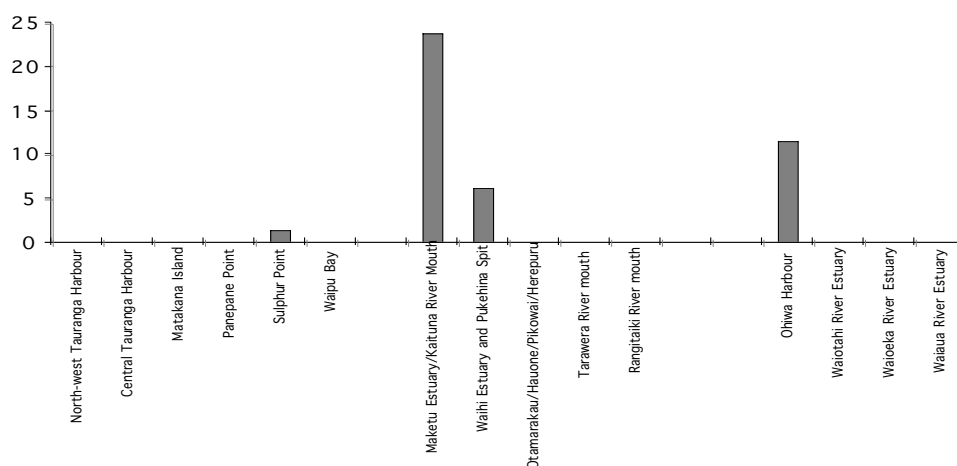
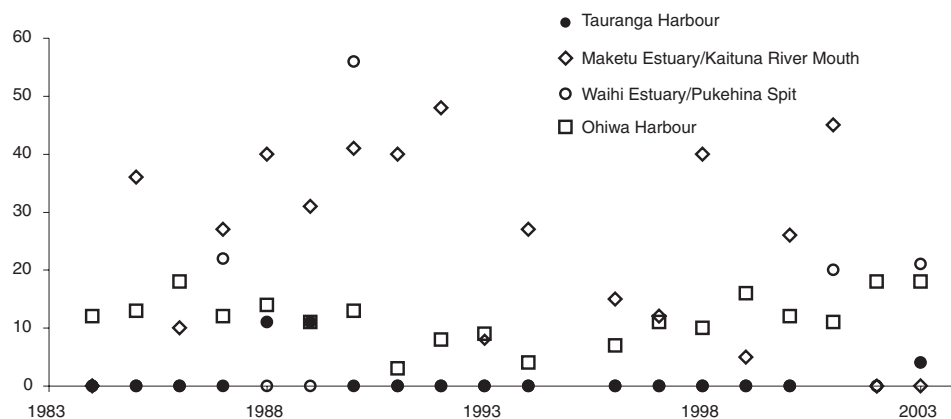


Figure 14. Average number of Pacific golden plover for each site visited eight or more times (except for Matakana Island which was not visited) from 1984 to 2003. Sites are shown in east to west direction across the Bay of Plenty Region. Note: only summer presence shown due to no birds recorded at any site for any winter sampling occasion.

Figure 15. Change in number of Pacific golden plover during the summer season from 1984 to 2003 for the four key habitat units (Lines show statistically significant trends ie: $p \leq 0.05$). Note no winter birds were recorded.



4.2.8 Spur-winged plover

Spur-winged plover (*Vanellus miles novaehollandiae*), one of two subspecies, is found in Australia, Tasmania and New Zealand. It was self-introduced to New Zealand in about 1932 and is now abundant and widespread throughout the North and South Islands and the Chatham Islands (Heather & Robertson, 1996).

It breeds in a variety of habitats, usually grassland or riverbed environments, and flocks after the breeding season, often congregating at estuaries and other coastal sites with short vegetation (Sagar et al. 1999). This species is regarded more of a terrestrial, pasture dweller rather than a coastal bird inhabitant; however the species is a common resident at harbours, estuaries and river mouths. Numbers recorded over the course of the study are probably not a complete indication of the real numbers in the region but they do reflect the seasonal numbers on the estuaries and give some guidance as to population trends over the study period.

Bay of Plenty wide

The first plovers recorded in the Bay of Plenty region were 6 birds at Maketu Estuary in May 1981 and the first breeding was noted there in September 1982 (P.L, per.comm).

The Bay of Plenty spur-winged plover numbers recorded over the study period at the 24 sites are shown in Appendix 10. The average number at each site over summer and winter (1984–2003) is shown in Figures 16a and b.

Spur-winged plover were well represented around the Bay of Plenty coastline during both winter and summer especially the winter's, with numbers increasing as the study progressed but this was not statistically significant ($P = 0.652$ winter) (Table 4b).

The average number of birds at each site during summer (1984–2003) is shown in Figure 16a.

The summer population in the Bay of Plenty progressively increased over the study period from 3 birds in 1984 to a maximum of 272 birds by 2000 (Appendix 10). This relationship although significant was very weak ($P=0.06$ summer) (Table 4a).

Summer numbers averaged about 40 birds each year through the first

decade (1984–1993 (10 counts) and then doubled averaging 96 birds each year in the following decade (1994–2003) (10 counts) (Appendix 10).

Winter counts for the Bay of Plenty ranged between 1 (1985) and 334 birds (1997) over the study period (Appendix 10). The average number of birds at each site during winter (1984–2003) is shown in Figure 16b. Over the first decade the average number of wintering plover was 82 (10 counts) (1984–1993) and over the second decade (1994–201) the average number was 183 (9 counts), more than a doubling of the population (Appendix 10). This increase in the overall population between 1984 and 2003 is likely to be due to the natural increase in the regional population over time as the population grew and expanded.

The change in number of spur-winged plover during summer and winter seasons from 1984 to 2003 for the four key habitats (Tauranga Harbour; Maketu Estuary/Kaituna River mouth; Waihi Estuary/Pukehina Spit; and Ohiwa Harbour) are shown in Figures 17a and b with lines showing any statistically significant trends i.e: $p \leq 0.05$). Although there was a general increase of plover numbers in the region this was not statistically significant for any of these key habitats.

Tauranga Harbour

The combined summer counts from sites counted (Table 1—Sites 1 to 7) belonging to Tauranga Harbour ranged from 3 (1987) to 41 (1997), averaging 8 birds each year over the study period (1984–2003) (Appendix 10). The average number of birds at each harbour site during summer (1984–2003) is shown in Figure 16a. Over the first decade the average number of plover was 4 (10 counts) (1984–1993) and over the second decade (1994–201) the average number was 13 (9 counts) a trebling of numbers.

The combined winter counts from sites counted (Table 1—Sites 1 to 7) belonging to Tauranga Harbour ranged from 2 (1999) to 105 (1996), averaging 16 birds each year over the study period (1984–2003) (Appendix 10). The average number of birds at each harbour site during winter (1984–2003) is shown in Figure 16b. Over the first decade the average number of wintering plover was 10 (10 counts) (1984–1993) and over the second decade (1994–201) the average number increased to 23 (9 counts), a twofold increase of the winter population.

Maketu Estuary / Kaituna River mouth

At Maketu Estuary/Kaituna River mouth summer counts ranged from 2 (1985, 1988, 1994) to 180 (2000), averaging 27 birds each year over the study period (1984–2003) (Figure 16a, Appendix 10). Over the first decade the average number of plover was 15 (10 counts) (1984–1993) and over the second decade (1994–201) the average number was 40 (9 counts) almost a trebling of the population. The estuary was regionally significant for spur-winged plover as it hosts the largest summer and winter concentrations in the Bay of Plenty (Figures 16a and b). The species probably favours the site because it has substantial areas of adjacent pasture land and there are less human disturbances allowing for daily movements of birds from inland fields to the river mouth and estuary, both summer and winter.

Winter counts ranged from 1 (1985) to 209 (1994), averaging 57 birds each year over the study period (1984–2003) (Figure 16b, Appendix 10). Over the first decade the average number of wintering plover was 26 (10 counts) (1984–1993) and over the second decade (1994–201) the average number was 91 (9 counts), more than a trebling of the population.

Increases in relative abundance over time (1984–2003) were not however statistically significant for spur-winged plover, both summer ($P = 0.087$) and winter ($P = 0.206$) seasons at the estuary (Tables 4a and b).

Waibi Estuary / Pukebina Spit

Spur-winged plover were rarely recorded at the estuary with only 6 of the 19 counts had birds (Figures 16a and b, Appendix 10).

Summer numbers ranged from 2 (1987) to 52 (2003) with the average number being 4 (1984–2003) (19 counts) (Figure 16a, Appendix 10). Over the first decade the average number of plover on the estuary was less than 1 bird (10 counts) (1984–1993) and over the second decade (1994–2003) the average number on the estuary was 7 (9 counts) an overall increase in numbers (Appendix 10).

Winter counts ranged from 3 (2000) to 27 (1996), averaging 2 birds each year over the study period (1984–2003) (Figure 16b, Appendix 10). Over the first decade the average number of wintering plover was less than 1 bird (10 counts) (1984–1993) and over the second decade (1994–201) the average number was 3 (9 counts) (Appendix 10).

Otamarakau / Pikowai / Hauone / Herepuru

Spur-winged plover were recorded along the Otamarakau to Herepuru coastline but generally in low numbers both summer and winter (Appendix 10, Figures 16a and b).

Summer numbers ranged from 2 (1989) to 18 (2000) with the average number being 5 (1987–2002) (14 counts) (Figure 16a, Appendix 10). Over the first decade the average number of plover was 5 bird (7 counts) (1987–1993) and over the second decade (1994–2002) the average number was 5 (7 counts) (Appendix 10).

Winter counts ranged from 3 (1997) to 11 (1996), averaging 2 birds each year over the study period (1985–2001) (17 counts) (Figure 16b, Appendix 10). Over the first decade there was only one count with birds (9 in 1991) (9 counts) (1984–1993) and over the second decade (1994–2001) the average number was 3 (8 counts) (Appendix 10).

Matata Lagoon / Tarawera River mouth

Plover were recorded in low numbers both summer and winter (Appendix 10, Figures 16a and b).

Summer numbers ranged from 1 (1990) to 7 (1991) with the average number being 1 (1987–2002) (14 counts) (Figure 16a, Appendix 10). During the first decade the first sighting was in 1990 with the average number of plover being 2 bird (8 counts) (1985–1993) and over the second decade (1994–2003) the average number was 1 (7 counts) (Appendix 10).

Winter counts ranged from 1 (1994) to 40 (1987), averaging 6 birds each year over the study period (1985–2001) (17 counts) (Figure 16b, Appendix 10). Over the first decade the average number was 8 birds (9 counts) (1985–1993) and over the second decade (1994–2003) the average number was 3 (8 counts) (Appendix 10).

Rangitaiki River mouth / Thornton Lagoon

Plovers were recorded in both summer and winter but there was only 1 summer count of 8 birds in 1993, over 15 counts (1985–2003) (Appendix 10, Figures 16a and b). It is unclear why there was only one summer record but it's likely that the few local birds would have been away nesting on paddocks during the summer period.

Winter counts ranged from 1 (1986, 1993) to 73 (1992), averaging 12 birds each year (Figure 16b) over the study period (1986–2002) (17 counts) and the numbers were similar between decades (Appendix 10). Over the first decade the average number was 11 birds (8 counts) (1986–1993) and over the second decade (1994–2002) the average number was 13 (9 counts) (Appendix 10). The winter counts show a build up in numbers into small flocks in some years, yet in other years there were very few birds present. Disturbances at this popular fishing site occurred less often during some winter count days than others so this may explain why there was an increase in numbers for those counts?

Ohiwa Harbour

Very few birds were recorded at the harbour and there were only 7 counts, both summer and winter, where birds were present out of 38 counts undertaken (1985–2003) (Appendix 10, Figures 16a and b). The first record of this species at the harbour was in 1990. Four summer counts had numbers ranging from 1 to 15 birds while the three winter counts had them ranging between 2 and 22 birds (Figures 16a and b, Appendix 10).

Eastern Bay of Plenty sites

Waiotahi River estuary

Plovers were recorded in both summer and winter (Appendix 10, Figures 16a and b).

Summer counts ranged from 1 (2003) to 20 (1998), averaging 3 birds each year over the study period (1985–2002) (18 counts) (Figure 16a) with only one count of 4 birds (1991) in the first decade (Appendix 10). Over the second decade (1994–2003) the average number each year was 6 (9 counts).

Winter counts ranged from 2 (1989) to 11 (1997), averaging 4 birds each year over the study period (1985–2002) (17 counts) with fewer birds in the first decade (Figure 16b, Appendix 10). Over the first decade (1985–1993) (9 counts) there were only 2 counts (1987, 1989) with 2 and 3 birds recorded respectively while over the second decade (1994–2002) the average number was 3 (9 counts). The winter counts show a build up in numbers in some years to form small flocks, yet in other years there were very few birds present.

Waioeka River estuary / Kukumoa (including Otara River)

Plovers were recorded in both summer and winter (Appendix 10, Figures 16a and b).

Summer numbers ranged from 1 (1985) to 46 (1994) with the average number being 12 (1987-2002) (17 counts) (Appendix 10, Figure 16a). Over the first decade the numbers ranged from 1 (1985) to 26 (1989) with the average number of plover being 9 birds (9 counts) (1985-1993) while over the second decade (1994-2003) (8 counts) the numbers ranged from 4 (2001) to 46 (1994) with the average number of birds on the estuary being 16 (8 counts) (Appendix 10).

Winter counts ranged from 4 (1989) to 60 (1988), averaging 19 birds each year over the study period (1985-2001) (17 counts) (Appendix 10, Figure 16b). Over the first decade the average number was 20 (9 counts) (1985-1993) and over the second decade (1994-2002) the average number was 16 (9 counts) (Appendix 10).

Waiaua River estuary (including Opape Beach)

Plovers were recorded in both summer and winter (Appendix 10, Figures 16a and b).

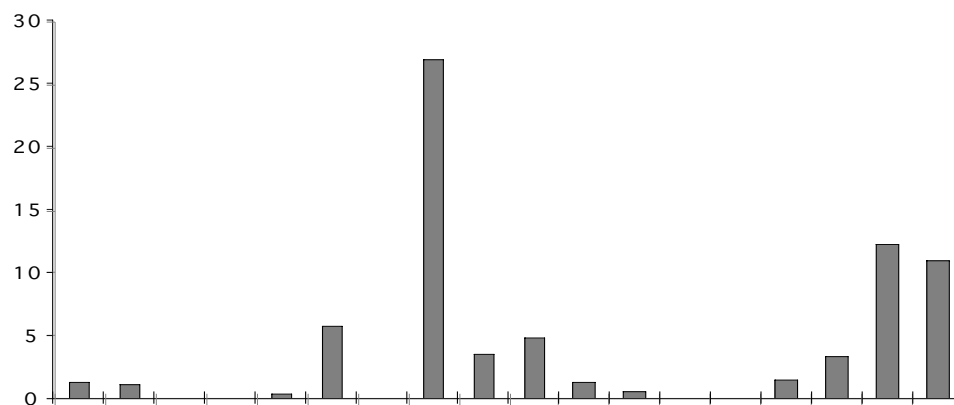
Summer numbers ranged from 2 (2000) to 63 (2003) with the average number being 11 (1986-2003) (17 counts) (Appendix 10, Figure 16a). Over the first decade the numbers ranged from 5 (1988) to 36 (1991) with the average number of plover being 7 birds (8 counts) (1986-1993) and over the second decade (1994-2003) (9 counts) the numbers ranged from 2 (2000) to 63 (2003) with the average number of birds being 15 (9 counts) (Appendix 10).

Winter counts ranged from 2 (2001) to 100 (1997), averaging 17 birds each year over the study period (1985-2002) (17 counts) (Appendix 10, Figure 16b). Over the first decade the average number was 4 (9 counts) (1985-1993) and over the second decade (1994-2002) (8 counts) the average number was 29 (Appendix 10). This winter increase was statistically significant over the study period ($P = 0.044$, $df_{1,15}$, $R^2 = 0.24$).

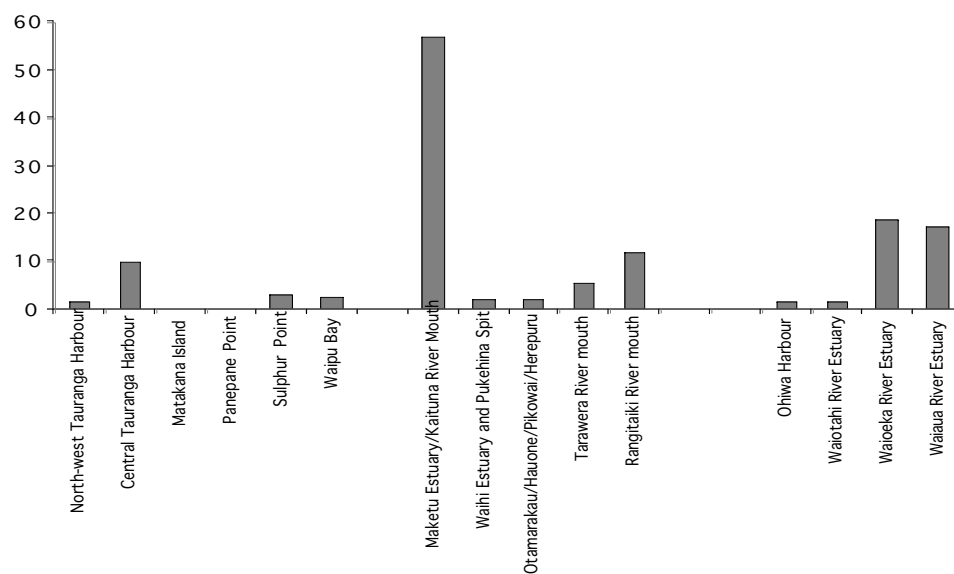
Motu River mouth

Plovers were present at the river mouth in both summer and winter although there were only 3 counts with birds (Appendix 10). These were of two summer counts of 5 birds each and one winter count of 7 birds, from 10 observations recorded.

(16a) Summer



(16b) Winter



Figures 16a and b. Average number of spur-winged plover for each site visited eight or more times (except for Matakana Island which was not visited) from 1984 to 2003. Sites are shown in east to west direction across the Bay of Plenty Region.

Whangaparaoa Bay

Plovers were present at the bay in both summer and winter (Appendix 10). Summer counts of 2 (1999) and 23 (1997) birds were recorded from 8 counts undertaken. There were two winter records of 1 bird in 1989 and 13 birds in 1993 from 6 winter counts undertaken.

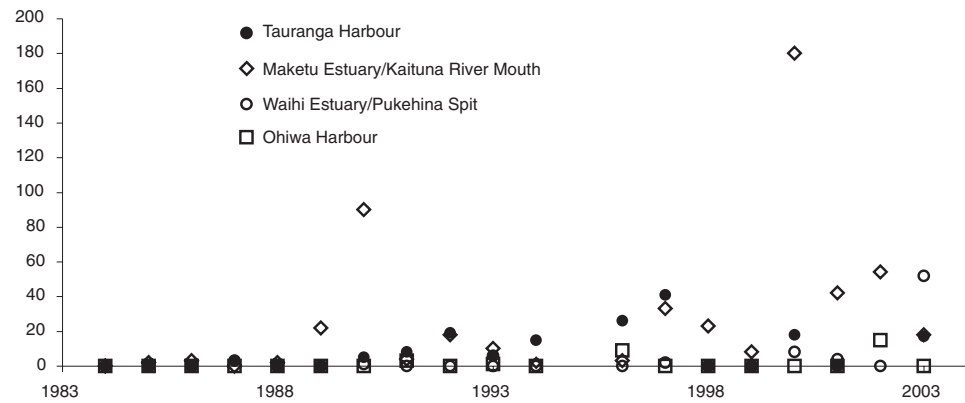
Hicks Bay

From just two observations, 4 birds were recorded in summer 1993 (Appendix 10).

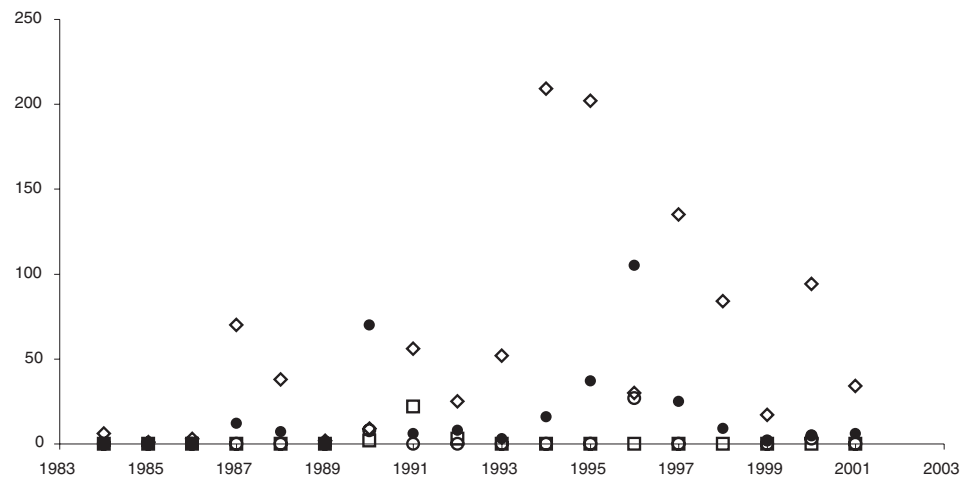
Te Araroa

From 3 observations, 4 birds were recorded in summer 1988 (Appendix 10).

(17a) Summer



(17b) Winter



Figures 17a and b. Change in number of spur-winged plover during the summer (a) and winter (b) season from 1984 to 2003 for the four key habitat units (Lines show statistically significant trends ie: $p \leq 0.05$)

4.2.9 Turnstone

Turnstones (*Arenaria interpres interpres*) breed in Siberia, Scandinavia, Greenland, Alaska and northern Canada. They migrate to New Zealand and Australia during the northern hemisphere winter (Heather & Robertson, 1996). During their southward migration they are known to use staging points in the Pacific and migrate through Australia (Sagar et al. 1999). The population in the East Asian - Australasian Flyway is estimated at 28,000 birds (Watkins, 1993).

The New Zealand population numbers between 5000 and 7000 birds, evenly divided between the North and South Islands with several hundred of these birds counted at the Chatham Islands and Auckland Islands (Heather & Robertson, 1996). The over wintering population in New Zealand numbers between 100 and 1800 birds reflecting the highly variable breeding success in the previous northern summer (Heather & Robertson, 1996).

Bay of Plenty wide

The Bay of Plenty turnstone numbers recorded at the 24 sites over the study period are shown in Appendix 11. The average numbers in the Bay of Plenty region over summer and winter counts (1984-2003) are shown in Figures 18a and b. Bay of Plenty annually averaged 176 birds or 2.51% of the national summer population (Table 3, Appendix 11).

Turnstones were represented in the Bay of Plenty at only six sites. They were Tauranga Harbour, Maketu Estuary/Kaituna River mouth, Waihi Estuary/Pukehina Spit, Rangitaiki River mouth/Thornton Lagoon, Ohiwa Harbour and Whangaparaoa Bay (Appendix 11, Figures 18a and b). The majority of the records were from summer counts at Tauranga Harbour and Maketu Estuary/Kaituna River mouth.

Summer and winter numbers decreased over time (1994–2003), this was statistically significant ($P= 0.032$ summer; $P= 0.011$ winter (Tables 4a and b)).

The change in number of turnstone during summer and winter seasons from 1984 to 2003 for the four key habitats (Tauranga Harbour; Maketu Estuary/Kaituna River mouth; Waihi Estuary/Pukehina Spit; and Ohiwa Harbour) are shown in Figures 19a and b with lines showing statistically significant trends i.e: $p \leq 0.05$). The decrease of turnstone at Tauranga Harbour (all records were from NW Tauranga Harbour) was statistically significant for both summer and winter (Figures 19a and b).

Tauranga Harbour

The average number of turnstone at each harbour site over summer and winter (1984–2003) are shown in Figures 18a and b.

The combined summer counts from sites counted (Table 1—Sites 1 to 7) belonging to Tauranga Harbour ranged from 70 (1996, 1998) to 330 (1988), averaging 172 birds each year over the study period (1984–2003) (Appendix 11, Figure 18a). This was 2.45% of the national population (Table 3, Appendix 11) and was most of the turnstone found in the region. It should be noted that all the turnstone counts from the harbour were from the north-west Tauranga Harbour roosts although Wills (1995) did record turnstones roosting on Matakana Island with godwits near Waikoura Point and on Tahunamanu Sandspit.

Over the first decade (1984–1993) the average number of turnstones on the harbour was 240 (10 counts) and over the second decade (1994–2001) the average number was 74 (7 counts) contracting by about two-thirds over the study period (Appendix 11). This decline may have been due to turnstones being unable to roost on the inundated Bowentown Shellbanks due to erosion. This may have forced them to use the Matakana Island ocean beach or Tahunamanu Island roosts instead. However ocean beach and Tahunamanu Island were not part of the study area and were rarely visited on other occasions due to manpower constraints, their isolation and access difficulties.

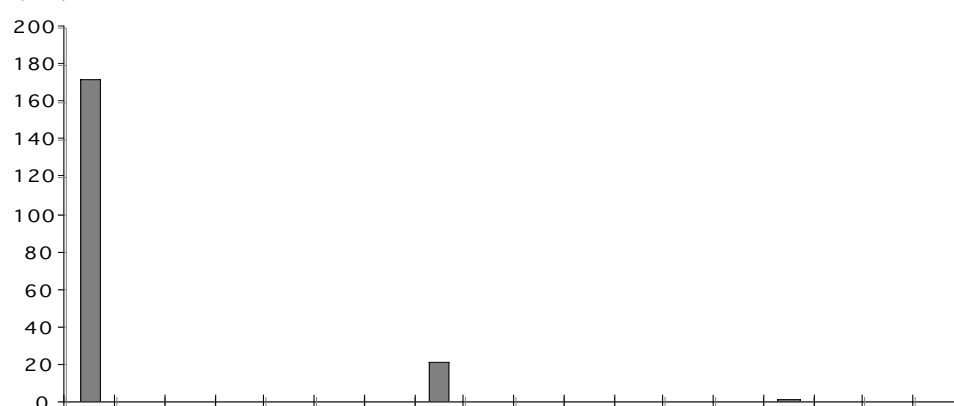
Numbers of both turnstones and godwits have been noted as swelling considerably in late March on Tauranga Harbour then a few days later most have left on their northward migration (P.L. pers. comm). On one occasion, in March 1984, outside of the study, c550 birds were recorded on Matakana Island's ocean beach (P.L, pers.comm).

At Tauranga Harbour the combined winter counts from sites counted (Table 1—Sites 1 to 7) ranged from 9 (1997) to 80 (1986), averaging 16 birds each year over the study period (1984–2003) (18 counts) (Appendix 11, Figure 18b). Over the first decade the average number of wintering

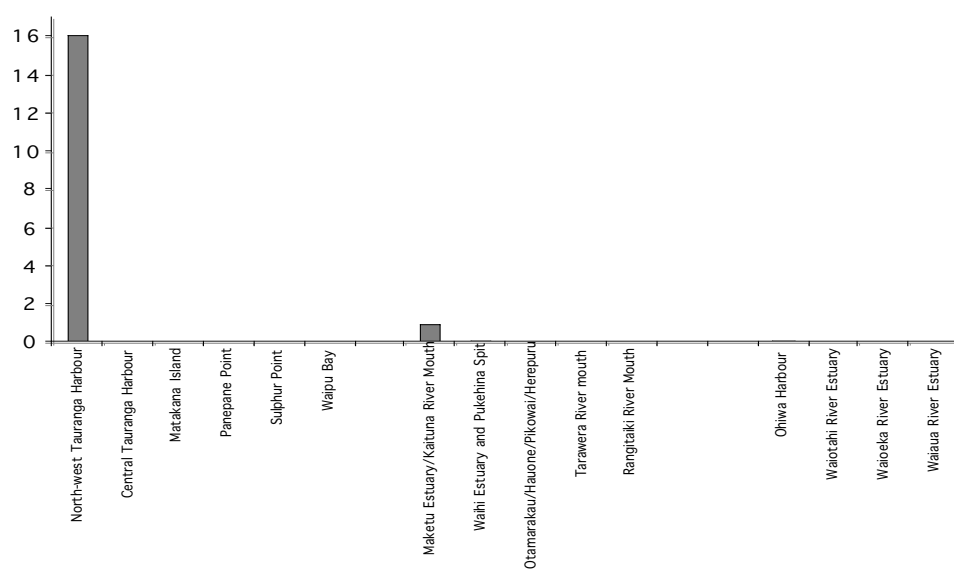
turnstones was 25 (10 counts) (1984-1993) but over the second decade (1994-2001) the average number was only 6 (8 counts), one quarter of the average over the first decade, a substantial decline (Appendix 11).

A decrease in relative abundance over time (1984-2003) was statistically significant for both the summer and winter seasons at north-west Tauranga Harbour ($P= 0.001$ summer; $P= 0.008$ winter) (Tables 4a and b, Figures 19a and b). The winter decline on the harbour may reflect the variable numbers of over wintering birds that occur during the New Zealand winters (Sagar et al. ,1999). The summer decline at north-west Tauranga Harbour might be explained by the fact that birds had to shift from the eroded Bowentown Shellbanks roost to use other roosts at the harbour such as Matakana Island's ocean beach or Tuhunamanu Island, which were both rarely visited due to manpower constraints, their isolation and access difficulties.

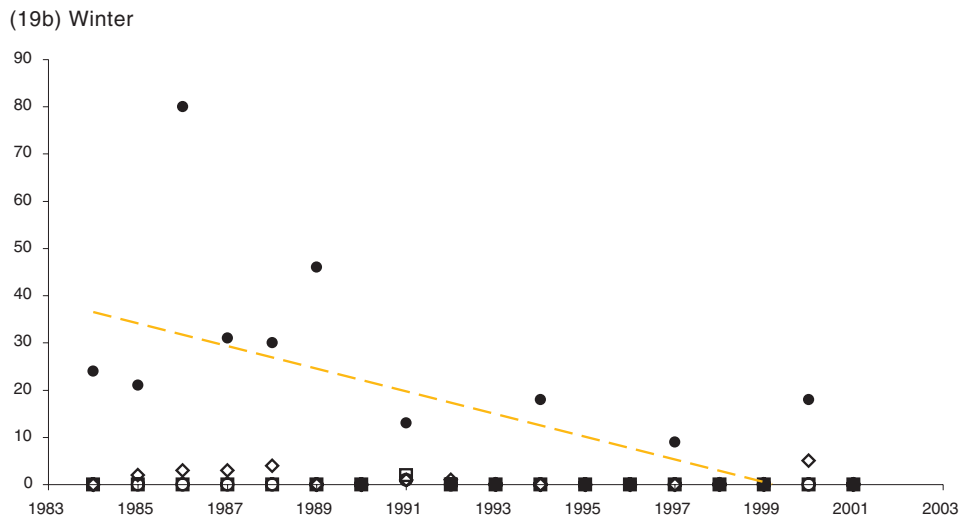
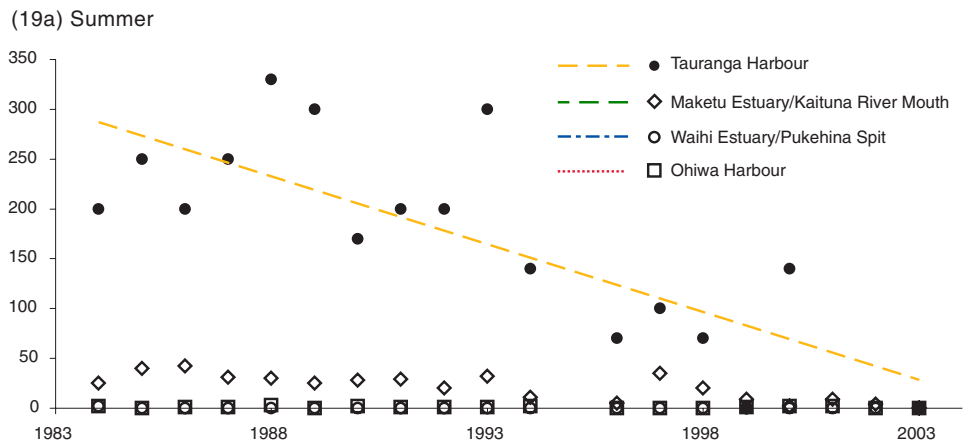
(18a) Summer



(18b) Winter



Figures 18a and b. Average number of turnstone for each site visited eight or more times (except for Matakana Island which was not visited) from 1984 to 2003. Sites are shown in east to west direction across the Bay of Plenty Region.



Figures 19a and b. Change in number of turnstone during the summer (a) and winter (b) season from 1984 to 2003 for the four key habitat units (Lines show statistically significant trends ie: $p \leq 0.05$)

Maketu Estuary / Kaituna River mouth

The average number of turnstone at the estuary over summer and winter counts (1984–2003) are shown in Figures 18a and b.

Summer counts ranged from 2 (2000) to 42 (1986), averaging 21 birds each year over the study period (1984–2003) (19 counts) (Appendix 11, Figure 18a). Over the first decade (1984–1993) the average number of turnstones was 30 (10 counts) and over the second decade (1994–2001) the average number was 11 (9 counts), a decline of about two-thirds over the study period (Appendix 11).

A decrease in relative abundance over time (1984–2003) was statistically significant for the summer seasons at the estuary ($P=0.001$) (Table 4a). It's unclear why this occurred, perhaps partly due to poor northern hemisphere breeding outcomes but also because at times we were unable to find their roosts as they often changed.

There were very few birds recorded during the winter counts. They ranged from 1 (1991, 1992) to 5 (2000), averaging 1 bird each year over the study period (1984–2003) (19 counts) (Appendix 11, Figure 18b). Over the first decade the average number of wintering turnstone was 1.4 (10 counts) (1984–1993) but over the second decade (1994–201) the average number was only 0.5 (9 counts) (Appendix 11).

Waihi Estuary / Pukebina Spit

Counts at the estuary, outside the study period, recorded 1 bird in January 1978 and 4 birds in December 1978 (P.L pers.comm).

Rangitaiki River mouth / Thornton Lagoon

Two birds were recorded during summer 1985 (Appendix 11).

Ohiwa Harbour

Turnstone numbers recorded at the harbour over summer and winter during the study period (1984–2003) are shown in Appendix 11. The average number at the estuary each year over summer and winter (1984–2003) is shown in Figures 18a and b.

Summer counts ranged from 1 to 3, averaging 1 over the study period (1984–2003) (19 counts) (Appendix 11, Figure 18a).

There was only one winter count of 2 birds in 1993 (Appendix 11, Figure 18b) from 19 counts (1984–2003).

Whangaparaoa Bay

One bird was recorded on 19 January 1983 outside the study period (Graeme Taylor, pers.comm).

4.2.10 Red knot

There are four or five subspecies of knot but it is the red or lesser knot, huahou (*Calidris canutus rogersi*) that comes from Chukotski Peninsula of eastern Siberia to Australasia including New Zealand (Heather & Robertson, 1996). At least three colour-banded birds from Sakhalin Island in the same region have been recovered in New Zealand in recent years. It is the second most common northern hemisphere Arctic shorebird found in New Zealand. The East Asian–Australasian Flyway population is estimated to be about 255,000 birds of which 153,000 migrate to Australia (Sagar et al. 1999). Each year between 51,000 and 67,400 come to New Zealand, with the estimated national summer population being about 59,000 of which about 10% winter over in New Zealand (Sagar et al. 1999).

Bay of Plenty wide

Knots were rare in the Bay of Plenty in the early 1970s with one of the early records being 15 birds recorded at Maketu Estuary in 1974. In January 1979 about 35 birds were recorded at Matahui Point on Tauranga Harbour. This was the largest number recorded at the time (P.L pers.comm.). It has been suggested that no Bay of Plenty harbour or estuary has ideal knot habitat as they seem to prefer the soft mud habitats of the Firth of Thames or Farewell Spit (P.L pers.comm.).

The Bay of Plenty red knot numbers recorded over the study period at the 24 sites are listed in Appendix 12. The average number per site over summer and winter (1984–2003) is shown in Figures 20a and b. In the Bay of Plenty during the summer, knots preferred Maketu Estuary ahead of Tauranga Harbour with a few birds found at Waihi Estuary, Ohiwa Harbour and Waioeka River estuary (Appendix 12, Figure 20a).

The species is more common and widespread during summers but is very rare or absent during winters.

Summer numbers averaged 133 birds or 0.22% of the national population over the study period 1984–2003 (19 counts) (Table 3, Appendix 12, Figure 20a). Over the first decade (1984–1993) (10 counts) numbers averaged 177 knots each year, then declined to average 85 birds over the second decade (1994–2003) (9 counts) (Appendix 12). It should be noted that knots arrive in the Bay of Plenty later than godwits and were often not all here when counts were carried out in November as the highest counts are often not recorded until after Christmas (P.L. pers.comm.).

Winter numbers averaged 3 birds over the Bay of Plenty over the study period 1984–2003 (19 counts) (Appendix 12, Figure 20b). Prior to 1990 there were five records of birds over wintering at Tauranga Harbour and Maketu Estuary. Since 1990 there have been no over wintering birds. Over the first decade (1984–1993) (10 counts) numbers averaged 5 knots each winter, however over the second decade (1994–2003) (9 counts) there were no knots recorded over wintering (Appendix 12).

The changes in numbers of red knot from 1984 to 2003 during summer seasons for the four key habitats (Tauranga Harbour; Maketu Estuary / Kaituna River mouth; Waihi Estuary / Pukehina Spit; and Ohiwa Harbour) are shown in Figure 21.

Tauranga Harbour

Knot numbers recorded at the harbour over summer and winter over the study period (1984–2003) are shown in Appendix 12. The average number at each harbour site visited over summer and winter (1984–2003) is shown in Figures 20a and b. The harbour holds the second largest population of knots in the study area.

The combined summer counts from sites counted (Table 1—Sites 1 to 7) belonging to Tauranga Harbour ranged from 2 (1994, 2000) to 201 (1992), averaging 28 or 0.05% of the national population over the study period 1984–2003 (18 counts) (Appendix 12, Table 3, Figure 20a). Over the first decade (1984–1993) (10 counts) numbers averaged 47 knots each year, then declined to average only 3 birds over the second decade (1994–2003) (8 counts) (Appendix 12).

The combined winter counts from sites counted (Table 1—Sites 1 to 7) belonging to Tauranga Harbour ranged from 1 (1985) to 16 (1984), averaging 2 over the study period 1984–2003 (18 counts) (Appendix 12, Figure 20b). Over the first decade (1984–1993) (10 counts) numbers averaged 3 knots each year, however in the second decade (1994–2003) (8 counts) there were no wintering knots recorded (Appendix 12).

Maketu Estuary / Kaituna River mouth

Knot numbers recorded at the estuary over summer and winter over the study period (1984–2003) are shown in Appendix 12. The average number at the estuary each year over summer and winter (1984–2003) is shown in Figures 20a and b. The estuary holds the largest population of knots in the region.

Summer counts ranged from 3 (1999) to 210 (1992), averaging 93 over the study period 1984-2003 (19 counts) (Appendix 12, Figure 20a). Over the first decade (1984-1993) (10 counts) numbers averaged 110 knots each year, then declined substantially (44%) to average only 73 birds over the second decade (1994-2003) (9 counts) (Appendix 12).

There were only two winter counts recorded over the study period (1984-2003) (18 counts) one was of 6 in 1986 and the other of 14 in 1988 (Appendix 12, Figure 20b).

Waibi Estuary / Pukebina Spit

The knot numbers recorded at the estuary over summer and winter over the study period (1984-2003) are shown in Appendix 12. The average number at the estuary each year over summer and winter (1984-2003) is shown in Figures 20a and b.

Summer counts ranged from 2 (1996) to 68 (1986), averaging 8 over the study period 1984-2003 (19 counts) (Appendix 12, Figure 20a). Over the first decade (1984-1993) (10 counts) numbers averaged 10 birds each year, then declined to average only 6 birds over the second decade (1994-2003) (9 counts) (Appendix 12).

There were no winter counts recorded over the study period (1984-2003) (19 counts) at the estuary (Appendix 12).

Obiwa Harbour

The knot numbers recorded at the harbour over summer and winter over the study period (1984-2003) are shown in Appendix 12. The average number at the harbour each year over summer and winter (1984-2003) is shown in Figures 20a and b.

Summer counts ranged from 2 (5 counts) to 26 (1992), averaging 5 over the study period 1984-2003 (19 counts) (Appendix 12, Figure 20a). Over the first decade (1984-1993) (10 counts) numbers averaged 9 knots each year, then declined to average only 1 bird over the second decade (1994-2003) (9 counts) (Appendix 12).

There were no winter counts recorded over the study period (1984-2003) (19 counts) at the estuary (Appendix 12, Figure 20b).

Waioeka River estuary / Kukumoa (incl Otara River)

There were only two summer records during the study period (1985-2003) (Appendix 12, Figure 20a). These were counts of 8 birds in summer 2001 and 3 birds in summer 2003. There were no birds recorded in the winter counts.

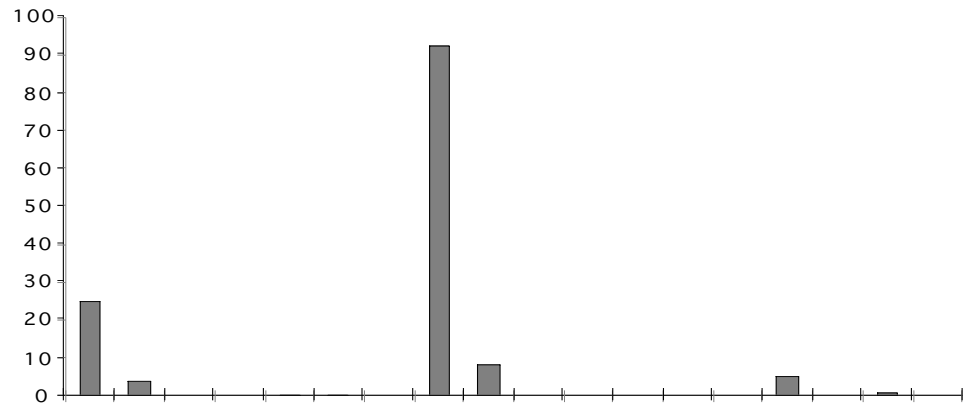
Waiaua River estuary (including Opape Beach)

One bird was recorded in summer 1990 (Appendix 12). This was the only record of this species at the estuary.

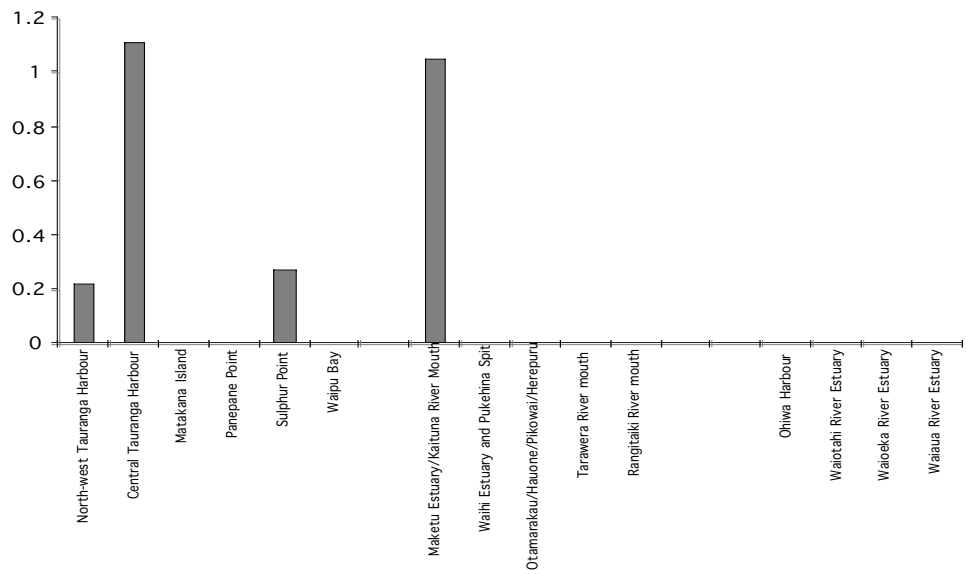
Te Araroa

Three birds were recorded in summer 1988 (Appendix 12). This was the only record of this species at the site.

(20a) Summer

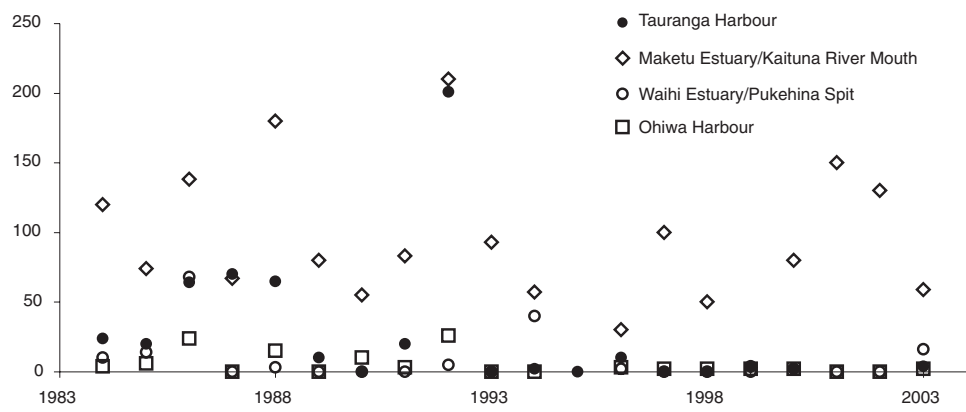


(20b) Winter



Figures 20a and b. Average number of red knot for each site visited eight or more times (except for Matakana Island which was not visited) from 1984 to 2003. Sites are shown in east to west direction across the Bay of Plenty Region.

Figure 21. Change in number of red knot during the summer season from 1984 to 2003 for the four key habitat units (Lines show statistically significant trends ie: $p \leq 0.05$). Note, no winter plot shown due to low numbers of birds recorded during winter season.



4.2.11 Bar-tailed godwit

Two sub-species of bar-tailed godwit are currently recognised. It is however the eastern bar-tailed godwit, kuaka (*Limosa lapponica baueri*), that is the dominant sub species in New Zealand (Turbott, 1990; Sagar et al. 1999) and the most common of the visiting Arctic shorebirds. It breeds from eastern Siberia across to northern Alaska and migrates south to south-eastern Asia, south-eastern Australia and New Zealand (Heather & Robertson, 1996).

Migrants usually arrive in New Zealand in late September with peak numbers reaching many of the estuaries in November and December. They leave to return to their northern hemisphere breeding grounds in late March. The New Zealand population is estimated to be 102,000 birds (Sagar et al. 1999). Between 10,000 and 17,000 of these birds stay over the southern winter rather than face the return migration. It is thought that these are young, non-breeding birds and a few aged birds.

There is strong evidence that the bar-tailed godwit from Alaska make the longest non-stop migration of all shorebird species with the southern migration crossing the Pacific Ocean from Alaska to New Zealand, a distance of 11,000 km, in seven days (Schuckard, 2002). During their northward migration to the breeding grounds, godwits follow the eastern coastline of Asia. The Yellow Sea, between Korea and China, is the final and most crucial staging area for this species on their northward migration (Barter et al. 2000).

Observations in August 2005 by Phil Battley of University of Otago at Matahui Point in Tauranga Harbour, recorded two wintering bar-tailed godwit that had been banded (colour-flagged tibias) in Victoria and South Australia (Southern Bird, 2005). So this indicates that some birds destined for New Zealand on their annual migration stop over briefly in Australia. Two godwit banded at Miranda and Taramaire in the Firth of Thames were recorded on Tauranga Harbour at the Matahui Point roost in 2005 (Phil Battley, pers.obs) so this clearly shows that some birds move around between harbours and estuaries during their stay in New Zealand.

This is especially so in October as birds move south to their chosen estuaries and March as they move north again. Numbers of both godwits and turnstones have been noted as swelling considerably in late March on Tauranga Harbour then a few days later most have left on their northward migration (P.L pers.obs).

Bay of Plenty wide

The Bay of Plenty godwit numbers recorded over the study period at the 24 sites are shown in Appendix 13 and the average number at each site over summer and winter (1984-2003) in Figures 22a and b.

The study showed that godwit favoured four key sites, all harbours and estuaries with substantial intertidal flats. Tauranga Harbour supported the highest numbers followed by Ohiwa Harbour, then Maketu Estuary / Kaituna River mouth and then Waihi Estuary / Pukehina Spit. Apart from these

sites all the other sites counted had very few birds with only a handful of birds recorded. In the eastern Bay of Plenty, Waiotahi River estuary, Waioeka River estuary and Waiua River estuary had the occasional visitor during the summer (Appendix 13).

Summer counts ranged from 4300 (2001) to 12,511 (2000), averaging 9,460 (9.3% of the national population) over the study period 1984–2003 (19 counts) (Table 3, Appendix 13, Figure 22a). Over the first decade (1984–1993) (10 counts) numbers averaged 9892 each year, then decreased to average 8979 birds over the second decade (1994–2003) (9 counts) a non significant decrease ($P=0.669$) (Table 4a) (Appendix 13).

There was a fluctuation in numbers over the study period (Appendix 13) which may mirror fluctuating breeding success at northern hemisphere breeding grounds due to a range of unknown factors.

The over wintering numbers of principally juveniles and non-breeders, with adults away at northern hemisphere breeding grounds, showed a reduction over time.

Winter counts ranged from 78 (2002) to 2018 (1989), averaging 1052 (1% of the national population) (Table 3) over the study period 1984–2003 (19 counts) (Appendix 13, Figure 22b). Over the first decade (1984–1993) (10 counts) numbers averaged 1218 each year, then decreased by about a third to average 866 birds over the second decade (1994–2003) (9 counts) but this was not significant ($P=0.104$) (Table 4b) (Appendix 13).

The change in number of bar-tailed godwit during summer and winter seasons from 1984 to 2003 for the four key habitats (Tauranga Harbour; Maketu Estuary/Kaituna River mouth; Waihi Estuary/Pukehina Spit; and Ohiwa Harbour) are shown in Figures 23a and b with lines showing statistically significant trends i.e: $p \leq 0.05$). There was a general non significant summer decrease across the region including north-west Tauranga Harbour and Sulphur Point, Tauranga Harbour (Table 4a) but statistically significant increases at Central Tauranga Harbour and Maketu Estuary/Kaituna River mouth sites (Table 4a, Figure 23a).

Tauranga Harbour

The godwit numbers recorded at the harbour over summer and winter over the study period (1984–2003) are shown in Appendix 13. The average number of godwit at the harbour over summer and winter (1984–2001) is shown in Figures 22a and b.

The combined summer counts from sites counted (Table 1—Sites 1 to 7) belonging to Tauranga Harbour ranged from 1950 (1998) to 7798 (2000), averaging 5065 (5% of the national population) (Table 3) each year (Appendix 13, Figure 22a). The harbour holds the largest summer population of godwit in the region.

Over the first decade summer numbers averaged 4922 birds per count (1984–1993) (10 counts) and over the second decade numbers increased to average 5274 (1994–2003) (7 counts) for fewer counts (Appendix 13). Increases in relative abundance over time (1984–2003) were statistically significant for the summer seasons at Central Tauranga Harbour ($P=0.001$)

(Table 4a). It's unclear why this was so as the loss of the Bowentown Shellbanks in north-west Tauranga Harbour, caused by sea erosion and inundation, was only temporarily for a year or two, but it did force godwit to roost at one of the central harbour roosts increasing the numbers there during that period.

A decrease in relative abundance over time (1984-2003) was statistically significant for the summer seasons at both north-west Tauranga Harbour ($P=0.014$) (Table 4a) and at Sulphur Point ($P=0.001$) (Table 4a). In the case of North-west Tauranga Harbour, this result may be a reflection of the loss of the Bowentown Shellbanks caused by erosion for a couple of years forcing godwit to roost at one of the central harbour roosts to which observers rarely went e.g. Matakana Island ocean beach or Tahunamanu Island.

Godwit numbers averaged 2178 birds at the Sulphur Point roost each summer count over the period 1984-1992 (9 counts), thereafter numbers declined to average 531 birds each count (1993-2003) (8 counts) (Appendix 13). It is very likely that development of the Sulphur Point reclamation area for large scale port development and its associated infrastructure and noise would have been key factors in driving large numbers of godwit and other shorebirds away to another roost.

Godwits were only recorded at Waimapu Estuary / Welcome Bay / Rangataua Bay roosts over two summers in 1997 and 2003. On both of these occasions no godwit were recorded at the nearby Sulphur Point roost (Appendix 13). These sites are very much secondary roosts and never held the numbers even collectively that Sulphur Point did nor are they fully usable on spring high tides.

The combined winter counts from sites counted (Table 1—Sites 1 to 7) belonging to Tauranga Harbour ranged from 310 (1992) to 1501 (1989), averaging 633 (1984-2003) (18 counts) with 450-550 being recorded in most years (Appendix 13, Figure 22b). The winter average of 633 birds accounted for twelve percent (12%) of the summer godwit numbers over wintering at the harbour.

Over the first decade winter numbers averaged 732 birds per count (1984-1993) (10 counts) and over the second decade numbers decreased to average 432 (1994-2003 (7 counts) for less counts (Appendix 13).

The three highest winter counts of 1000 (1991), 1285 (1984) and 1501 (1989) were over the first decade but during the second decade numbers were never higher than 874 and fell between 327 and 874. At north-west Tauranga Harbour the winter decline was statistically significant ($P=0.018$) (Table 4b) and was probably due to the unavailability of the Bowentown Shellbanks roost due to sea erosion forcing birds to other roosts in the Harbour.

Maketu Estuary / Kaituna River mouth

The summer and winter godwit numbers recorded at the estuary over the study period (1984-2003) are shown in Appendix 13. The average number of godwit at the estuary over summer and winter (1984-2001) is shown in Figures 22a and b.

Summer counts ranged from 127 (1986) to 1200 (2002), averaging 631 (1984–2003) (19 counts) (Appendix 13, Figure 22a). Over the first decade numbers averaged 556 birds per count (1984–1993) (10 counts) and over the second decade numbers increased to average 715 (1994–2003) (9 counts) (Appendix 13). Increases in relative abundance of godwit for the summer seasons was statistically significantly (1984–2003) ($P= 0.015$) (Table 4a, Figure 23a).

Winter counts ranged from 0 (1995) to 106 (1988), averaging 39 (1984–2002) (19 counts) (Appendix 13, Figure 22b). Over the first decade numbers averaged 44 birds per count (1984–1993) (10 counts) and over the second decade numbers decreased to average 34 (1994–2003) (9 counts) (Appendix 13).

Waibi Estuary / Pukebina Spit

The godwit numbers recorded at the estuary over summer and winter over the study period (1984–2003) are shown in Appendix 13. The average number of godwit at the estuary over summer and winter (1984–2003) is shown in Figures 22a and b.

Summer counts ranged from 0 (1999, 2002) to 800 (1993), averaging 441 (1984–2003) (19 counts) (Appendix 13, Figure 22a). Over the first decade numbers averaged 534 birds per count (1984–1993) (10 counts) and over the second decade numbers decreased to average 339 birds per count (1994–2003) (9 counts) (Appendix 13). Decreases in relative abundance of godwit for the summer seasons were not statistically significantly (1984–2003).

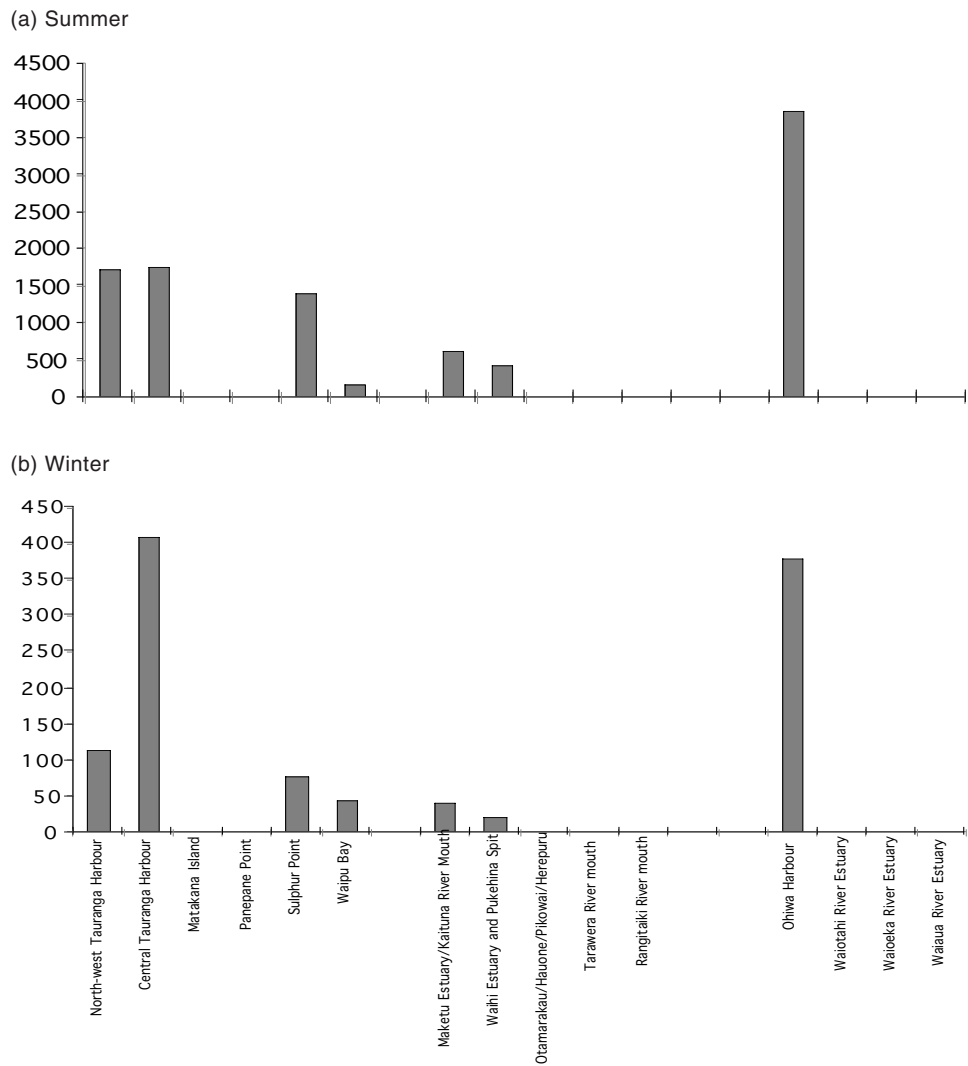
Winter counts ranged from 0 (1993, 1995, 1998, 2002) to 85 (1990), averaging 21 (1984–2002) (19 counts) (Appendix 13, Figure 22b). Over the first decade winter numbers averaged 29 birds per count (1984–1993) (10 counts) and over the second decade numbers decreased to average 12 birds per count (1994–2003) (9 counts) (Appendix 13).

Obiwa Harbour

The godwit numbers recorded at the harbour over summer and winter over the study period (1984–2003) are shown in Appendix 13. The average number of godwit at the harbour over summer and winter (1984–2001) is shown in Figures 22a and b.

Summer counts ranged from 2800 (1993, 1994) to 5000 (1988, 1997, 1998), averaging 3848 (3.8% of the national population) (Table 3; Figure 22a) over the first decade (1984–1993) (10 counts) and 3822 over the second decade (1994–2003) (9 counts) (Appendix 13). Numbers were relatively constant throughout the study period. This may reflect the ability of observers to count all godwit at the harbour as roosts are very accessible and no roost sites would be missed compared to Tauranga Harbour which has over 20 roosts which makes locating roosting shorebird flocks much more difficult.

Winter counts ranged from 60 (2002) to 700 (1988), averaging 379 (1984–2002) (19 counts) (Appendix 13, Figure 22b). The average numbers over the first decade were 413 (1984–1993) (10 counts), decreasing to average 341 over the second decade (1994–2002) (9 counts) (Appendix 13).



Figures 22a and b. Average number of bar-tailed godwit for each site visited eight or more times (except for Matakana Island which was not visited) from 1984 to 2003. Sites are shown in east to west direction across the Bay of Plenty Region

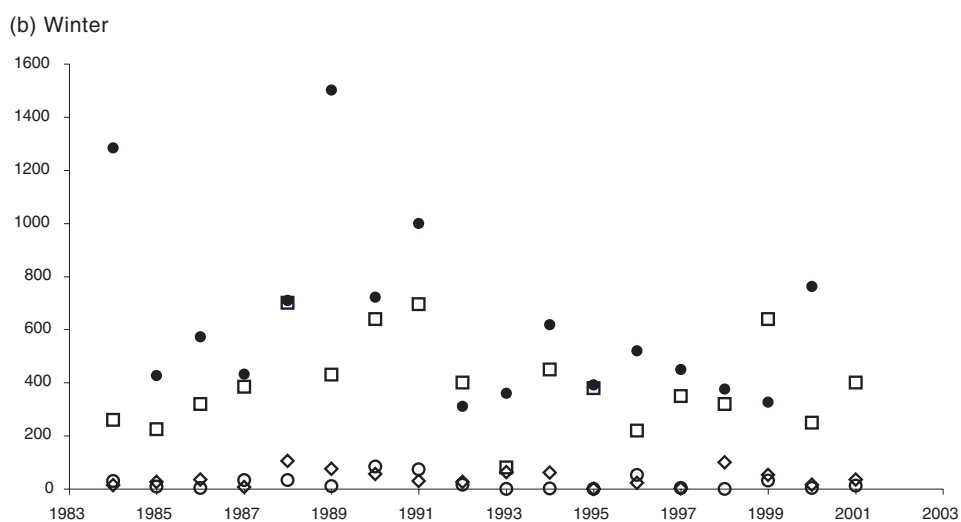
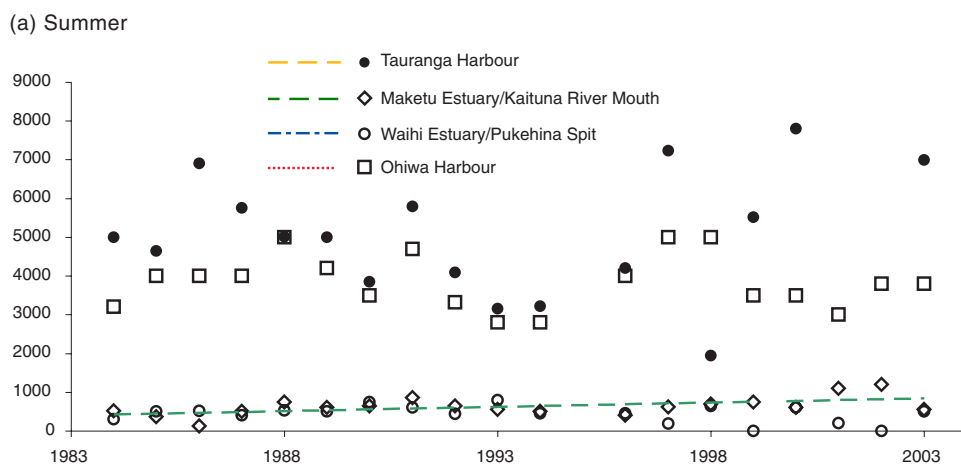
Eastern Bay of Plenty sites

Waiotahi River estuary to Te Araroa

The godwit numbers recorded in the eastern Bay of Plenty over summer and winter during the study period (1984-2003) are shown in Appendix 13.

There were no more than 20 godwit recorded during the summer at any one of the nine sites located east of Ohiwa Harbour (Appendix 13). The following sites had birds; Waiotahi River estuary (between 4 and 20 (from 18 counts), Waioeke River estuary/Kukumoa (between 3 and 8 (17 counts), Waiua River estuary (between 1 and 12 (17 counts), Whangaparaoa Bay (1 in 1997) (8 counts) and Te Araroa (3 in 1988) (2 counts) (Appendix 13).

Winter counts at the nine sites were rarely undertaken and usually only as far east as Waiua River estuary. There was just one winter count of 3 birds recorded at Waiotahi River estuary in 1990 (Appendix 13).



Figures 23a and b. Change in number of bar-tailed godwit during the summer (a) and winter (b) season from 1984 -2003 for the four key habitat units (Lines show statistically significant trends ie: $p \leq 0.05$)

4.2.12 Notes on other species

Apart from abundant Arctic and native species, many of the shorebird species found in the study area were seen infrequently at the various roost sites visited. Numbers were often below 10 birds at any one time. These species are all rare or uncommon migratory or vagrant species, most of which have their main non-breeding distribution in Australia, while a few are rarities belonging to other shorebird flyways. Many of these species had either not arrived or were not in full numbers by the November census as numbers of these species can often peak in late December.

In addition rare native species found in low numbers are also considered.

These “other species” are placed below into two separate groups the “rare and uncommon migrants” and the “rare native species”.

In the case of whimbrel, an uncommon migrant, many of the records are not distinguished between the two subspecies (Asiatic (*Numenius phaeopus variegata*) and American (*Numenius p. hudsonicus*)) that occur in New Zealand, so in this section they are listed as whimbrel species although most were probably Asiatic. This also applied for two records at Ohiwa Harbour where observers were unclear if they recorded Siberian

tattler (*Tringa brevipes*) or wandering tattler (*Tringa incana*), so they are listed as tattler spp.

Records have largely been collated from data obtained during the Bay of Plenty Region's twice yearly shorebird census work, from OSNZ data sheets and P.L. personal logbooks and from some Classified Summarised Notes (CSN) of Notornis for the Bay of Plenty. The scientific names for the species listed below can be found in the Species List in Appendix One. These species are listed by individual roost sites below and cover the period 1977 to 2005:

Rare and uncommon migrants recorded during study

North-west Tauranga Harbour

- Eastern curlew: One record; 1 bird in summer 1992.
- Whimbrel spp.: Two records; 1 bird in winter 1987; 1 bird in summer 2003.
- Siberian tattler: One record; 1 bird in summer 1989.

Central Tauranga Harbour

- Eastern curlew: One record; 1 bird in winter 1992.
- Whimbrel spp.: Four records; 1 bird in winter 1990, 1 in summer 1990, 1 in summer 1991 and 2 birds in summer 1997.
- Greenshank: Five records; single birds in the winters of 1984, 1985, 1986, 1987 and 1989. This individual was probably present on the harbour since 1977 when a single bird was recorded for the first time (P.L. pers.comm).

Panepane Point

- Eastern curlew: One record; 1 bird in winter 1998.

Waipu Bay

- Whimbrel sp.: One record; 1 bird in winter 1994.

Maketu Estuary / Kaituna River mouth

- Mongolian dotterel: Two records; 1 bird in winter 1989 and 1 in summer 1990.
- Sanderling: Two records; 1 in summer 1986, and 1 on 4 November 1989.
- Curlew sandpiper: Three records; 1 on 26 October 1987, 1 in summer 1988 and 4 in summer 1992.
- Sharp-tailed sandpiper: Twelve records; 7 in November 1984, 8 in November 1985; 9 in November 1986; 13 on 26th November 1987, 5 in summer 1988; 3 in summer 1989, 1 in November 1990, 7 in November 1991, 1 in November 1994, 3 in November 2001, 1 in summer 2002 and 1 in summer 2003.
- Pectoral sandpiper: Four records; 1 in November 1985, 1 in November 1988, 2 in November 1990 and 1 in November 1998.
- Red-necked stint: Sixteen records; 10 in November 1984, 6 on 30 November 1985, 2 in November 1986, 7 on 7 November 1987, 5 in winter 1988, 7 in November 1988, 5 in winter 1989, 6 in November 1989, 2 in November 1990, 2 in November 1991, 2 in November 1992,

1 in November 1993, 1 in November 1997; 5 in November 1998, 1 in November 2000 and 1 in November 2001.

- Eastern curlew: Eight records; 1 in summer 1991, 1 in summer 1992, 1 in summer 1994, 1 in summer 1996, 1 in winter 1998, 2 in summer 1998, 2 in summer 1999 and 1 in summer 2000.
- Whimbrel spp: Nineteen records; 4 in summer 1984, 1 in summer 1985, 3 in November 1986, 3 in June 1987, 4 in November 1987, 1 in winter 1988, 3 in November 1988, 1 in November 1989, 1 in summer 1990, 7 in summer 1991, 3 in winter 1992, 3 in summer 1992, 3 in summer 1993, 1 in winter 1993, 3 in summer 1994, 8 in November 1996, 1 in June 1997, 5 in November 1997 and 4 in November 1998.
- Hudsonian godwit: One record; 1 in November 2001.
- Siberian tattler: One record; 2 in November 1992.
- Marsh sandpiper: Two records; 1 in November 1988, 1 in November 1998.

Waibi Estuary / Pukebina Spit

- Eastern curlew: Two records; 1 in November 1992 and 1 in November 1993.
- Mongolian dotterel: One record; 1 in winter 1990.
- Sharp-tailed sandpiper: One record; 2 in summer 2003.
- Red-necked stint: One record; 4 in winter 1987.

Matata Lagoon / Tarawera River mouth

- Sharp-tailed sandpiper: One record; 1 in November 1990.

Obiwa Harbour (Obiwa Spit / Obope Spit)

- Eastern curlew: Six records; 1 in November 1984, 1 in November 1986, 1 in November 1992, 1 in summer 1997, 1 in November 1998, and 2 in summer 2000.
- Whimbrel spp.: Thirteen records; 5 in November 1984, 2 in November 1985, 4 in November 1986, 5 in November 1987, 5 in November 1988, 3 in November 1989; 2 in November 1990, 2 in November 1991, 1 in November 1994, 2 in June 1995, 2 in summer 2000; and 5 in summer 2002 and 4 in summer 2003.
- Mongolian dotterel: One record; 1 in summer 1999.
- Hudsonian godwit: One record; 1 on 24 November 1984.
- Tattler spp.: Two records; single birds in summer 1984 and winter 1986.

Whangaparaoa Bay (including Whangaparaoa River mouth)

- Large sand dotterel: One record; 1 in winter 1991.

Rare native species recorded during study

Central Tauranga Harbour

- Black stilt: Two records at Matahui Point roost; Two in winter 1986 and 1 in winter 1995.
- Hybrid black stilt × pied stilt: Four records; 2 in winter 1997 and 2 in winter 1998; 3 in winter 1999 and 1 in winter 2000. Each year several black stilt are recorded at the Matahui Point roost (P.L pers comm.).

Black Stilt have an acutely threatened status of “nationally critical” the highest threat category there is (Hitchmough, 2002). The records indicate that Tauranga Harbour is nationally significant as a black stilt wintering site regularly hosting 2 to 3 birds or about 4-6% on the national population of about 50 adults (Maloney & Murray, 2002).

Sulphur Point

- Black stilt (‘smudgy stilt’) (thought to be a juvenile black stilt): One record; 1 in summer 1992.

Waimapu Estuary / Welcome Bay / Rangataua Bay

- Black-fronted dotterel: One record; 1 in winter 1997.

Maketu Estuary / Kaituna River mouth

- Black-fronted dotterel: One record; 4 in winter 1997.

Otamarakau / Pikowai / Hauone / Herepuru

- Black-fronted dotterel: One record; 3 in winter 1992.

Matata Lagoon / Tarawera River mouth

- Black-fronted dotterel: Seven records: 5 in winter 1989, 3 in winter 1990, 4 in winter 1991, 1 in winter 1992, 4 in winter 1994, 2 in winter 1998 and 1 in winter 1999.

Rangitaiki River mouth / Thornton Lagoon

- Black-fronted dotterel: Two records; 1 in June 1991 and 8 in June 1993.

Waiaua River estuary (including Opape Beach)

- Hybrid black stilt × pied stilt: One record; 2 in winter 2002.

5. Discussion

5.1 VALIDITY OF DATA

Schukard, 2002, indicated that the counting of large flocks of birds can be difficult, especially for less experienced observers, with Prater (1979) finding that that most observers over-estimated small flocks and under-estimated larger ones. A study in the Dutch Waddensea (Rappolt et al.1985), established that the average counting error for shorebirds was 35% for birds in flocks, and 17% for flying birds. The effect of observer experience on the data presented in this paper is likely to be less given that European estuaries can be enormous in size by New Zealand standards, with individual roosts holding many tens of thousands of shorebirds (Schukard, 2002).

The largest numbers of birds in the study area reside at Tauranga Harbour. While this is a large harbour (c21, 800 ha) (Power et al. 1991) and birds disperse mainly between about seven principal spring tide roosts, these were generally accessible, thus allowing for reasonable accuracy in the counts. The next largest site, Ohiwa Harbour at c2800 ha (Bay of Plenty Regional Water Board, 1977) is relatively small, at one eighth of Tauranga Harbour's size. It has very few roosts which are all very accessible to observers. All the other sites are small in comparison and their roosts are largely accessible.

More than 100 people participated in the counts reported here, but less experienced observers were usually paired with more experienced ones in order to maintain a consistency in technique.

While it is accepted that there will be some variation in counts between observers, and even with the same observer doing repeat counts, we assumed that this did not affect the long-term trends in numbers reported here. It's likely that at Tauranga Harbour some roosting birds were missed at secondary roost sites not visited. However, the numbers missed are probably insignificant. Nevertheless, it would be useful to undertake a detailed assessment of the harbour, ideally by using aerial surveys, to determine if all roost sites have been found to date and to rank their importance.

5.2 SITES OF INTERNATIONAL IMPORTANCE

There are a number of world-wide conventions dealing with the protection of shorebirds and their habitats. They are: the Convention on Wetlands of International Importance especially as Waterbird Habitat (Ramsar Convention); the World Heritage Convention; Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES); the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention) and the Convention on Biological Diversity.

Of these, the Ramsar Convention (2000), to which New Zealand has been a signatory since 1971, is the most relevant to the conservation of shorebird habitats. The Ramsar Convention urges contracting parties to establish wetland inventories based on the best scientific information and, in particular, to identify those sites which are of international significance (Recommendation 4.2 Montreux 1990).

The Ramsar Convention Bureau has defined the following criteria:

A wetland should be considered **internationally** important if:

- it regularly supports 20,000 or more waterbirds (including shorebirds), or
- it regularly supports 1% of the individuals in a population of one species or subspecies of waterbird (including shorebird), or,
- it regularly supports populations of plant and/or animal species important for maintaining the biological diversity of a particular biogeographic region, or,
- it regularly supports plant and/or animal species at a critical stage in their life cycles, or provides refuge during adverse conditions.

It is the second of these four criteria that we specifically discuss below, although some of these other criteria, relating to plant or animal species, may also qualify sites but is beyond the scope of this report.

Various studies in recent years have improved our knowledge of the total number of migratory shorebirds that pass through the East Asian-Australasian Flyway (Watkins 1993; Bamford, 2001) (Table 2). The national population estimates for most migratory and native resident shorebirds in New Zealand were derived from OSNZ surveys conducted between 1984 and 1994 during which about 85% of the coastline was surveyed during spring (November) and winter (June) (Sagar et al.1999). In addition some species estimates are derived from Watkins (1993), Heather & Robertson (1996), Dowding (2005) and Keely, (2005).

These national and international results are important to make ongoing progress with the Shorebird Action Plan, a plan for the conservation of Migratory Shorebirds in the East Asian-Australasian Flyway. At present, although there are an estimated 400 sites of international importance for migratory shorebirds in the Flyway, only 29 are included in the network. The action plan for 2001–2005 sets a target of 100 sites included in the network by the end of 2005.

New Zealand, on the outer south-east corner of the Flyway map, has an average total of 139,000 migratory shorebirds in summer (Sagar et al. 1999). This is less than 3% of the estimated 5 million migratory shorebirds in the Flyway. Although this does not appear to be substantial, a few species depend on NZ shores in the non-breeding period, mainly those species breeding at the highest latitude.

Records from Tauranga Harbour indicate that the November count, used in New Zealand to establish the number of migratory species, may not reveal the maximum number that eventually migrate to New Zealand and that may be found inhabiting Tauranga Harbour. At Tauranga Harbour, some migratory shorebirds arrive in spring but do not increase to their

maximum numbers until the summer (P.L, pers.comm). Though it will not make a great difference in the international context, synchronization with the February summer census in Australia may well be justified to improve the population estimates in the non-breeding area of both Australia and New Zealand. Bar tailed godwit numbers and golden plover usually stabilised by November but the smaller Arctic migrants often did not peak till late December. Red knot numbers at Maketu Estuary sometimes peak even later (P.L pers.comm).

The results presented in this report provide valuable long term records and trends on the number of shorebirds using various sites at different times of the year in the Bay of Plenty Region of the North Island, New Zealand. With these data, it is now possible to identify those sites that are of national and international importance (Table 5).

Several of the Bay of Plenty sites regularly visited during this study have previously been investigated for possible listings and were identified as meeting specific criteria of the Convention of Wetlands of International Importance, especially as Waterbird Habitat (Ramsar Convention) (Owen, 1991; Cromarty & Scott, 1995). They are Tauranga Harbour, Maketu Estuary/Kaituna River mouth, Waihi Estuary/Pukehina Spit and Ohiwa Harbour. The data collected on various shorebird populations in the Bay of Plenty during this study clearly indicates that these sites qualify as being of international importance as Ramsar sites. This data supports and adds considerable weight to these four sites being registration under the Convention.

5.3 TAURANGA HARBOUR

Twenty-two shorebird species (9 native and 13 northern hemisphere), were recorded at the harbour over the 20 year study period compared to about 68 shorebird species for the whole of New Zealand and outlying islands (Turbott, 1990). Five of the twenty-two species were uncommon migrants recorded separately by P.L during the time of the study. These were the large sand dotterel (*Charadrius leschenaultii*), Mongolian dotterel (*Charadrius mongolus*), red-necked stint (*Calidris ruficollis*), black-tailed godwit (*Limosa limosa*), and Hudsonian godwit (*Limosa haemastica*).

The highest numbers of shorebirds were found at the harbour compared to any of the other sites studied in the Bay of Plenty Region. During the summer about 50% of all shorebirds in the study area are seen at Tauranga Harbour and about 50% in the winter. The November counts averaged 5310 shorebirds each count. A further increase is likely when additional migratory species arrive after November and the native species return from their breeding grounds but there is no data available to confirm this. Banded dotterel and wrybill arrive late December or January (P.L pers comm.) so additional birds are likely to be missing from counts. Of the migratory northern hemisphere shorebirds, about 14% stay behind in the winter. Of the native shorebirds that are present at the harbour during the winter, about 17% will not go to their summer breeding grounds.

TABLE 5. CURRENT ESTIMATES OF THE POPULATION SIZE OF KEY SHOREBIRD SPECIES WITHIN THE EAST ASIAN - AUSTRALASIAN FLYWAY COMPARED WITH THE NUMBER THAT VISIT NEW ZEALAND AND/OR THOSE THAT ARE RESIDENT WITHIN THE BAY OF PLENTY STUDY AREA (TABLE SHOWS THE SUM OF THE MEAN COUNTS AT ALL BAY OF PLENTY SITES VISITED BETWEEN 1984 AND 2003).

SPECIES	FLYWAY EST. (WATKINS 1993)	FLYWAY UPDATE (BAMFORD IN PRESS, 2001)	NZ EST. (SAGAR ET AL 1999, HEATHER & ROBERTSON, 1996, DOWDING, 2005 AND KEELY, 2005)	NZ EST. AS % OF FLYWAY	BAY OF PLENTY STUDY AREA, MEAN SUMMER NUMBERS	BAY OF PLENTY STUDY AREA, MEAN WINTER NUMBERS	% OF NZ POPN.	% OF FLYWAY
South Island pied oystercatcher			112,675		335	1320	0.3% summer 1.17% winter	
Variable oystercatcher			4,000		361	307	9% summer 7.7% winter	
Pied stilt	532,000		30,000		181	871	0.6% summer 2.9% winter	0.03% summer 0.16% winter
Northern NZ dotterel			1,700		101	102	5.9% summer 6% winter	
Banded dotterel	50,000 ¹		20,000 ²	40%	40	775	0.1% summer 3.9% winter	0.08% summer 1.55% winter
Wrybill			4,100			73	1.8% winter	
Pacific golden plover			649	?	43	0	6.6% summer	
Tumstone	28,000	31,000	7,000	25%	176	0	2.51% summer	0.56% summer
Red knot	225,000	220,000	59,000	23%	133	0	0.22% summer	0.06% summer ⁵
Bar-tailed godwit	330,000 ³	180,000 ⁴	102,000	31%	9,460	1,052	9.3% summer 1% winter	5.25% summer ⁵ 0.58% winter ⁵

¹ Breeding population in New Zealand

² Winter population in New Zealand

³ Both *L.l. menzibieri* and *L.l. baueri*

⁴ *L.l. baueri*

⁵ Percentage of flyway calculated using Bamford (2001)

Tauranga Harbour was one of four sites in the study area (Table 3) that qualified as an Internationally Important Site on the basis of the criteria that it regularly supports 1% of the individuals in a population of one species or subspecies of waterbird (=shorebird). In this regard it is nationally and internationally significant supporting more than 1% of the national population of the following species: bar-tailed godwit (5% summer), black stilt (4 to 6% winter), northern New Zealand dotterel (2.6% summer & 1.4% winter), turnstone (2.45% summer), banded dotterel (1.73% winter), wrybill (1.73% winter), variable oystercatcher (2.18% summer & 1.71% winter) and pied stilt (1.53% winter). It also holds 0.89% of the national population of South Island pied oystercatcher.

During the summer the harbour is notable for hosting the largest breeding population of northern New Zealand dotterel in New Zealand on Matakana Island, and a large post-breeding flock of northern New Zealand dotterel during the winter. The dotterel numbers have increased substantially in the Bay of Plenty over the study period largely due to the successful dotterel protection programme on Matakana Island.

5.4 OHIWA HARBOUR

Sixteen species of shorebird (7 native, 9 northern hemisphere) were recorded at the harbour during the study period, including the terek sandpiper (*Tringa terek*) recorded separately by P.L. The harbour held more than 1% of the national population of bar-tailed godwit (3.8% summer), variable oystercatcher (2.8% winter & 1.6% summer), northern New Zealand dotterel (2.5% winter & 1% summer), Pacific golden plover (1.8% summer) and banded dotterel (1.58% winter). The harbour was also notable for regularly hosting a large post-breeding flock of northern New Zealand dotterel in the autumn and small flocks of eastern curlew (*Numenius madagascariensis*) and whimbrel (*Numenius* spp.) in the summer.

5.5 MAKETU ESTUARY / KAITUNA RIVER MOUTH

The estuary was notable for the impressive number of rare and uncommon migratory northern hemisphere shorebird species it hosted. It is the Bay of Plenty “hot spot” with 24 shorebird species recorded from the estuary over the 20 years of census work (8 native and 16 Arctic) including 5 species recorded outside this study (P.L. pers. comm). These species were the large sand dotterel (*Charadrius leschenaultii*), grey plover (*Pluvialis squatarola*), terek sandpiper (*Tringa terek*), black-tailed godwit (*Limosa limosa*), and grey phalarope (*Phalaropus fulicarius*). This total of 24 species compares favourably to about 68 shorebird species recorded for the whole of New Zealand and outlying islands (Turbott, 1990).

Maketu Estuary/Kaituna River mouth held more than 1% of the national population of Pacific golden plover (3.7% summer) and just less than 1% of the northern New Zealand dotterel (0.94% winter).

The estuary is also regionally significant for spur-winged plover as it hosts the largest summer and winter concentrations in the Bay of Plenty.

5.6 WAIHI ESTUARY / PUKEHINA SPIT

Waihi Estuary hosted 7 native and 5 northern hemisphere migrants including the pectoral sandpiper (*Calidris melanotos*) recorded by P.L. The estuary held 0.95% of the national summer population of Pacific golden plover. The estuary is also notable for regularly hosting a wide variety of other rare and uncommon shorebird species, especially since detailed observations started a few years ago (Tim Barnard, pers.obs.).

5.7 SPECIES TRENDS

Data for this study extend over two decades and therefore allows for an assessment of long term trends of individual species. These are discussed below:

South Island pied oystercatcher was only recorded at the four largest wetlands, Tauranga Harbour, Ohiwa Harbour, Maketu Estuary / Kaituna River mouth and Waihi Estuary / Pukehina Spit (Appendix 4, Figures 2a and b). Both winter and summer numbers increased substantially over the study period at all 4 sites (Figures 3a and b, Appendix 4, Tables 4a and b). This trend was statistically significant, showing an increase in numbers over the study period ($P < 0.001$) (Tables 4a and b) and probably mirrors the substantial increase in numbers occurring nationally during that period (Sagar et al. 1999).

Variable oystercatcher were well represented around the Bay of Plenty coastline during both winter and summer (Appendix 4, Figures 4a and b) with numbers generally increasing over time (Tables 4a and b, Figures 5a and b) especially at the bigger harbours and estuaries. Increases were statistically significant at Tauranga Harbour, Ohiwa Harbour, and Maketu Estuary.

Pied stilt were well represented around the Bay of Plenty coastline during both winters and summers (Appendix 5, Figures 6a and b) especially the winters. However numbers across the Bay of Plenty declined over the study period both summer and winter (Tables 4a and b, Figures 7a and b). Numbers were higher for the winter counts than summer counts as breeding birds returned to the harbours and estuaries to flock (Appendix 5). It is unclear why both summer and winter counts declined over the second decade (1994–2003) although the loss of the brackish lagoon at Maketu Estuary in 1989, a significant habitat for stilt, would have had some influence on the trend over the later period (Figures 7a and b).

Northern New Zealand dotterel were generally well represented around the Bay of Plenty coastline during both winter and summer (Appendix 6, Figures 8a and b) with similar numbers present in both seasons. The summer population in the Bay of Plenty had patchy increases and decreases over the study period (Appendix 6, Table 4a.). Where increases occurred, this is due to the successful predator control operations taking place on Matakana Island to protect breeding dotterels (Figure 9a) and variable oystercatchers. In the winter there was a general decline across all sites

even though post-breeding flocks formed at Tauranga Harbour, Maketu Estuary/Kaituna River mouth and Ohiwa Harbour (Table 4b). There were statistically significant decreases at Maketu Estuary/Kaituna River mouth, both summer and winter (Figures 9a and b).

Banded dotterel were generally well represented around the Bay of Plenty coastline during winters and summers (Appendix 7, Figures 10a and b) but there was a general decrease in numbers both summers and winters over time (Tables 4a and b, Figures 11a and b). There was a statistically significant decrease at Ohiwa Harbour.

Wrybill were mainly recorded in the region during the winter but only at Tauranga Harbour, Maketu Estuary/Kaituna River mouth, Waihi Estuary/Pukehina Spit and Ohiwa Harbour (Appendix 8, Figure 12b). Most of the winter records are from counts on Tauranga Harbour (Figure 12b). There were very few birds observed during the summer counts (Appendix 8, Figure 12a). Numbers in the region remained relatively static over the first decade (1984-1993) but there was a decline in numbers over the last decade (1994-2003) especially during the winters (Table 4b, Figure 13b). This was statistically significant for Tauranga Harbour (Figure 13b, Table 4b) and within Tauranga Harbour, at Sulphur Point (Table 4b).

Pacific golden plover was only recorded during the summer counts and were not recorded during the winter at any site (Appendix 9, Figure 14). The summer numbers averaged 43 birds each year or 6.6% (Table 3) of the national population of 649 birds (Sagar et al. 1999). Numbers remained relatively constant over the period of the study (Figure 15). Key sites for summer flocks were Maketu Estuary/Kaituna River mouth and Ohiwa Harbour. Tauranga Harbour may also be an important site for a summer flock but until observers are able to locate any flocks we will never know.

Spur-winged plover were well represented around the Bay of Plenty coastline during both winters and summers, especially the winters (Appendix 10, Figure 16a and b). There was a general increase in numbers over the duration of the study period (Tables 4a and b). Maketu Estuary has the largest concentrations in the study area.

The turnstone is poorly represented around the Bay of Plenty coastline during both winters and summer's especially the winter's (Appendix 11, Figures 18a and b). Numbers remained relatively stable over the first decade of the study period (1983-1993) but there was a substantial decline over the last decade (1994-2003) (Appendix 11). There was a general decline in numbers for summers throughout the region (Tables 4a). There was a significant summer and winter decline for Tauranga Harbour (all counts were from north-west Tauranga Harbour) (Tables 4a and b, Figures 19a and b) and during the summer for Maketu Estuary/Kaituna River mouth (Tables 4a).

Red knot were largely present only during summers (Figure 20a) and numbers decreased across the region, especially over the second decade (1994-2003) compared to the first decade (1984-1993) (Appendix 12).

Bar-tailed godwit numbers fluctuated over the study period (Appendix 13, Figures 22a and b) but there appeared to be a general non-significant decrease across the region over time (Tables 4a and b) which may mirror

fluctuating breeding success at Northern Hemisphere breeding grounds. Significant summer decreases took place at two locations within Tauranga Harbour (north-west Tauranga Harbour and Sulphur Point) but there were increases at central Tauranga Harbour and Maketu Estuary / Kaituna River mouth (Table 4a). There was a general but non-significant decline of the over wintering population (principally juveniles and non-breeders) at all sites (Appendix 13, Table 4b).

6. Recommendations

6.1 REGISTRATION OF INTERNATIONALLY IMPORTANT WETLANDS FOR SHOREBIRDS

This study shows that four sites (Tauranga Harbour, Ohiwa Harbour, Maketu Estuary/Kaituna River mouth and Waihi Estuary/Pukehina Spit) are outstanding shorebird habitats and are nationally and internationally significant as sites for shorebirds meeting the criteria of the Ramsar Convention on Wetlands of International Importance, especially as Waterbird (including shorebirds) Habitat. In the case of Maketu Estuary/Kaituna River mouth and Waihi Estuary/Pukehina Spit these two sites should be considered as one entity as movement of shorebirds between sites makes them inseparable.

We **recommend** that priority be given to the development of cases to register these four sites as Wetlands of International Importance as Habitat for Waterbirds under the Ramsar Convention. Each case should be formally submitted by DOC or another party, with DOC's assistance, for consideration by the government.

6.2 EFFECTS OF REDUCTION IN COUNTS AND FUTURE COUNTS

The cessation of Bay of Plenty wide winter counts since 2001 is of concern. Without winter counts it is very difficult to determine long term trends in the distribution and numbers of our endemic and native shorebird species over time. This will have a considerable impact on our knowledge of wintering South Island pied oystercatcher, variable oystercatcher, pied stilt, northern New Zealand dotterel, banded dotterel, wrybill and other species. This study shows that at least two of these species, banded dotterel and wrybill, are in decline regionally, so it is essential that such data is collected in the future so that these long term trends can be monitored.

To achieve this we **recommend** that future shorebird surveys carried out by OSNZ or other parties largely concentrate their efforts on the four largest harbours and estuaries (Tauranga Harbour, Maketu Estuary/Kaituna River mouth, Waihi Estuary/Pukehina Spit and Ohiwa Harbour).

We further **recommend** that both winter and summer surveys should be carried out annually at these 4 key sites and that visits to the other (smaller) sites within the region should take place during summer as a minimum requirement.

6.3 IDENTIFYING ROOSTS

Numerous spring and neap tide roost sites were recorded in Tauranga Harbour during this study, however it's unclear whether all have been identified and which are the key ones supporting concentrations of roosting birds and which ones are under threat of development or disturbance. It would be useful to undertake a detailed assessment of the harbour, ideally by using aerial surveys, to determine if all roost sites have been found to date and to rank their importance.

We **recommend** that aerial surveys of Tauranga Harbour be undertaken within the next year to determine if all the roost sites, both spring and neap, have been found to date. They need to be ranked as to their importance, mapped, photographed, described and any environmental and/or human factors restricting their long term sustainability and use be identified. Ideally, all the other high tide roosts in the region, outside of Tauranga Harbour, identified in this study need the same details recorded but are not so critical in terms of external pressures and time frames.

6.4 SHOREBIRD ROOST PROTECTION

We **recommend** that all the spring and neap tide shorebird roosts identified in this report be fully protected from development and human disturbances, ideally as reserves or within protection zones. The boundaries of all the key high tide roosts identified need better delineation to achieve this goal. Priority should be given to those in the western Bay of Plenty where development pressures are the greatest.

We further **recommend** that suitably sized buffers of undeveloped land be established around such sites in order to reduce human and other disturbances e.g people, vehicles, dogs. These buffers need to be of a minimum distance of two to three hundred metres.

6.5 LOW TIDE COUNTS

The data compiled into this report on shorebird distribution was collected during high tide periods. There was no data collected at low tide on any of these harbours and estuaries. This is a serious weakness when using the data to assess the relative importance of individual inter-tidal feeding areas, within a harbour or estuary, particularly when developments are proposed in or adjacent to these sites.

We **recommend** that detailed assessments of the shorebird feeding distribution at low water on the four larger harbours and estuaries take place to overcome this deficiency and to improve our understanding of shorebird usage within all parts of these important ecosystems.

6.6 NON SHOREBIRD USAGE OF STUDY AREA

It should be noted that counts of non-shorebird species (shags, herons, waterfowl, rails, gulls, terns and other seabirds), although recorded during the field work of this study, were specifically excluded from this paper.

We **recommend** that this information be utilised to more fully describe the relative merits (and conservation status) of the various harbours and estuaries or their component parts covered in the study.

Appendix 1

SPECIES LIST

COMMON NAME	SCIENTIFIC NAME	STATUS
South Island pied oystercatcher	<i>Haemotopus ostralegus finschi</i>	Endemic
Variable oystercatcher	<i>Haemotopus unicolor</i>	Endemic
Pied stilt	<i>Himantopus bimantopus</i>	Native
Black stilt	<i>Himantopus novaezelandiae</i>	Endemic
Black stilt/hybrid stilt	<i>Himantopus novaezelandiae</i> × <i>Himantopus bimantopus. leucocephalus</i>	Native
Northern New Zealand dotterel	<i>Charadrius obscurus aquilonius</i>	Endemic
Banded dotterel	<i>Charadrius bicinctus</i>	Endemic
Black-fronted dotterel	<i>Charadrius melanops</i>	Native
Large sand dotterel	<i>Charadrius leschenaultii</i>	Migrant
Mongolian dotterel	<i>Charadrius mongolus</i>	Migrant
Wrybill	<i>Anarhynchus frontalis</i>	Endemic
Pacific golden plover	<i>Pluvialis fulva</i>	Migrant
Grey plover	<i>Pluvialis squatarola</i>	Migrant
Spur-winged plover	<i>Vanellus miles</i>	Native
Turnstone	<i>Arenaria interpres</i>	Migrant
Red knot	<i>Calidris canutus</i>	Migrant
Sanderling	<i>Calidris alba</i>	Migrant
Curlew sandpiper	<i>Calidris ferruginea</i>	Migrant
Common sandpiper	<i>Calidris hypoleucos</i>	Migrant
Sharp-tailed sandpiper	<i>Calidris acuminata</i>	Migrant
Pectoral sandpiper	<i>Calidris melanotos</i>	Migrant
Red-necked stint	<i>Calidris ruficollis</i>	Migrant
Eastern curlew	<i>Numenius madagascariensis</i>	Migrant
Asiatic whimbrel	<i>Numenius phaeopus variegata</i>	Migrant
Whimbrel spp.	<i>Numenius phaeopus</i>	Migrant
Bar-tailed godwit	<i>Limosa lapponica</i>	Migrant
Black-tailed godwit	<i>Limosa limosa</i>	Migrant
Hudsonian godwit	<i>Limosa haemastica</i>	Migrant
Wandering tattler	<i>Tringa incana</i>	Migrant
Siberian tattler	<i>Tringa brevipes</i>	Migrant
Tattler sp.	<i>Tringa</i> sp.	Migrant
Greenshank	<i>Tringa nebularia</i>	Migrant
Marsh sandpiper	<i>Tringa stagnatilis</i>	Migrant
Terek sandpiper	<i>Tringa terek</i>	Migrant
Grey phalarope	<i>Phalopus fulicarius</i>	Migrant

Appendix 2

LIST AND BRIEF DESCRIPTION OF KNOWN BAY OF PLENTY SHOREBIRD ROOSTS

1. **North-west Tauranga Harbour (Bowentown Beach, Bowentown Airstrip, Bowentown shellbank, north-west Matakana Island and Tuapiro Point)**

Bowentown Beach

A few shorebirds roost on the beach when tidal conditions are suitable and human disturbances are low.

Bowentown Airstrip

The grass airstrip is used on occasions during spring tides when storms push shorebirds from the harbour. It is mainly used by South Island pied oystercatcher and pied stilts.

Bowentown shellbanks

The Bowentown Shellbanks are a group of three low-lying sandbanks covered with shell located between Tanners Point and Bowentown Heads at the northern end of Tauranga Harbour. When conditions are right they provide the principal high tide roost site for shorebirds, shags, terns and gulls at the northern end of the harbour. It is a principal high tide roost site for shorebirds and is also a nesting site for coastal birds including Caspian terns, red billed and southern black-backed gulls and variable oystercatcher. It is available during neap tides but can become flooded during spring tides, when shorebirds are then forced to fly to nearby Waikoura Point, north-west Matakana Island to roost. It was influenced by periodic erosion and accretion over the study period.

North-west Matakana Island

North-west Matakana Island roost is the large, sandy ocean beach at Waikoura Point at the northern end of Matakana Island. The high tide roost was been prone to both erosion and accretion during the study period. It is one of two principal shorebird roosts in the northern part of Tauranga Harbour and is available at all tides. Birds usually roost on the ocean beach and it's often used whenever the Bowentown Shellbanks are unavailable through storms or erosion. It is also a notable breeding site for northern New Zealand dotterel and variable oystercatcher. DOC has undertaken predator control operations there annually since October 1994 (Wills, 1995, Wills et al. 2003).

Tuapiro Point

This roost comprises of a small sandy beach at the end of the spit on the Tuapiro Point Recreation Reserve. It is largely used as a secondary, neap high tide roost when conditions are right. Unfortunately disturbance from people to roosting birds has become more prevalent today as the reserve is becoming well used by locals and visitors.

2. **Central Tauranga Harbour – part Southern Tauranga Harbour (Matahui Point/Pahoia/Omokoroa Peninsula/Tahunamanu Island and Spit/Te Hopai Island/Rangiwaia Island/Kuku Road/ Oikimoke Point/Oikimoke Road/central Waikareao Estuary**

Matahui Point

The roost is located on the eastern side of the Matahui Point peninsula close to its point where it adjoins the central part of Tauranga Harbour. The roost lies near the upper harbour watershed where the north-west waters discharge through the Bowentown channel and the south-east waters discharge through the Mount Maunganui channel to the open sea. Because it is located near the junction of the two major harbour arms it is thus one of the first shorebird feeding areas (inter-tidal flats) of the harbour to be exposed after high water and the last available for feeding on an incoming tide. The roost, a strip of sandy beach on the foreshore adjoining the shallow bay, is popular as a shorebird neap tide roost site and often holds thousands of shorebirds. It is not tenable as a spring tide roost because it becomes flooded by the tide. It is notable for regular visits from migrating black stilt. A number of banded bar-tailed godwit have recently been recorded here including an orange-flagged bird in summer 2004 from Victoria, Australia (Southern Bird, 2004).

Pahoia

This roost is located on the northern side of the Pahoia headland, adjacent to the boat ramp off Pahoia Beach Road, in the central part of the harbour. It is a secondary roost, and is used only occasionally.

Omokoroa Peninsula (Omokoroa Golf Course, Omokoroa Spit, Mangawhai Bay)

There are three shorebird roost sites found around the peninsula.

The first roost, found on the northern side of the Omokoroa Beach Peninsula at the Omokoroa Golf Course, is on a small sandy beach adjacent to the coastal walkway on the edge of the golf course. It can be used on all high tides but shorebirds are frequently disturbed by people using the nearby walkway, often walking their dogs.

The second roost is located on a low-lying sandspit adjacent to a local recreation reserve/rubbish tip on the eastern side of the peninsula. Its usage however has fluctuated widely over the years through frequent disturbances from people and dogs and now plays a diminishing role today.

Because of the frequent disturbances occurring at these first two roosts, shorebirds tend to use the third roost, the Tinopai Lodge sandbank roost, a raised sandbank, in Mangawhai Bay. This site, used since about 2000 can become untenable when tidal conditions are bad i.e, when spring high tides and strong winds occur and water levels are sufficiently high to force birds from the roost.

Tabunamanu Island and Spit

The Tahunamanu Island and associated spit site is a narrow, low lying sandy spit and adjoining small island that lies off on the southern side of Matakana Island near Opureora settlement, opposite Omokoroa Beach. It is a favoured shorebird roost site, often holding high numbers of shorebirds including bar-tailed godwit, red knot and turnstone (Wills, 1995). It was usually surveyed when tidal conditions were favourable to bird's i.e, on neap tides when winds were absent or light. It has become more frequently used by shorebirds as they are forced from other roosts in the central part of the harbour.

Te Hopai Island

Red knot, pied stilt and a whimbrel sp. were recorded roosting on the island in low lying saltmarsh and prostrate mangroves on one occasion in the past (Owen, 1993). However it's unclear how often the island is used by wading birds as it requires a boat to gain access. Further visits are needed to clarify its importance.

Rangiwaea Island

This is a small sandspit roost at the eastern end of island. It was very rarely visited due to difficulties with access but birds have been seen roosting there.

Kuku Road

This roost, at the end of Kuka Road, Te Puna on the beach, appears to be a neap tide roost. South Island pied oystercatcher and bar-tailed godwit have been observed roosting there when conditions were suitable (Owen, 1993).

Oikimoke Point/Oikimoke Road

The sandspit directly south of Oikimoke Point, Te Puna and the shoreline area closer to Oikimoke Road are two roosts supporting South Island pied oystercatcher, bar-tailed godwit, pied stilt, spur winged plover and other coastal bird species when tidal conditions are suitable (Owen, 1993). Further information is needed on the usage and importance of these two roosts.

Central Waikareao Estuary

Coastal birds including pied stilts and bar-tailed godwit will roost on the edge of the saltmarsh on the western side of the estuary when tidal conditions are right (neap tides) and human disturbances are low (Owen, 1993).

3. Matakana Island Ocean Beach

Between 1992 and 1998 on 6 occasions high tide counts were undertaken along the full length of the seaward and harbour sides of Matakana Island including the low-lying sandy Tuhunamanu Island. These were full counts undertaken by Dave Wills (DOC, Tauranga) while he was based on the island on northern New Zealand dotterel management work during the summers of 1992, 1993, 1994, 1995, 1996, 1997 and 1998. On these counts most roosting shorebirds (except for variable oystercatchers) were recorded at Waikoura Point, Panepane Point and on Tuhunamanu Island as the rest of the open ocean beach of Matakana has very limited space and was suffering from accelerated erosion making it largely unavailable

for roosting bird's. These 3 sites are really important as they provide some of the very few undisturbed roost sites close to the harbour.

4. Panepane Point

Panepane Point roost, located at the southern end of Matakana Island, adjoins the Mount Maunganui entrance to Tauranga Harbour. It is an extensive area of sandy beach and coastal dunes. It is an important shorebird roost, although during summer, considerable disturbances occur from surfers and fishers. It is a very notable breeding site for northern New Zealand dotterel and variable oystercatcher and has been part of the DOC protection programme since 1992. Due to access problems and time constraints counts were often done from an elevated spot on Mount Maunganui across the main harbour entrance using a spotting scope. Because of the distance involved it's likely that smaller shorebird species would have been missed during these counts.

In the 1990s an attempt was made to create an artificial shorebird roost at Panepane Point by extending the area of dunes to offset the Sulphur Point port development and encourage displaced shorebirds to the site to roost but the results were disappointing (K.O pers.comm).

5. Sulphur Point

This roost was located on the Sulphur Point reclamation in southern Tauranga Harbour, adjacent to Tauranga City. Originally when counts first started over twenty years ago the roost was part of the natural shoreline but was subsequently reclaimed and extensively developed as the major port area for Port of Tauranga Limited. This site was probably the most important shorebird roost in the harbour. In the early stages of port development substantial areas of the reclamation comprised of sand or grass providing ideal roosting but this is largely gone today as the port company has developed the site, making life very difficult for many thousands of roosting migrants (especially godwits) and native shorebirds.

Nesting shorebirds (northern New Zealand dotterel and variable oystercatcher) and white-fronted tern and red billed gull all habitually nested there but has largely been forced to go elsewhere since 1996. In the case of nesting northern New Zealand dotterel they are currently occupying the last area of open ground in the ports industrial area across the main channel at Totara Street. South Island pied oystercatcher, variable oystercatcher and gull species are now roosting on the roofs of the large cargo shed at the very end of Sulphur Point. Nesting white-fronted terns and roosting godwit flocks occupied the sand quarry site on the port reclamation up until recently however when that was developed further, godwit were forced to fly to Matahui Point or elsewhere to roost (John Heaphy, pers.comm).

6. Waipu Bay (Matapihi/Tauranga Airport/Aerodrome Bay)

Matapihi

The Matapihi roost is located on a small sand spit adjacent to Maheka Point on the western side of the Bay. It is the main neap tide roost for shorebirds feeding in the bay but is dependent on suitable tides and little wind for it to be used as a spring tide roost.

Tauranga Airport

Tauranga Airport is another roost that has become more important since about 1996 when shorebirds became displaced from the Sulphur Point roost. Many species of shorebirds roost on the mown grass areas alongside the main sealed runway and on the adjacent grass runways. It has become the main roost for banded dotterel on the harbour.

Aerodrome Bay

The roost at “Aerodrome Bay” is located on grass at the end of the airport runway near the Fertiliser Works.

7. Waimapu Estuary/Hairini/Welcome Bay/Rangataua Bay

Waimapu Estuary

The Waimapu Bay roost is found on Motupuhi (Rat Island) and rarely has more than a few oystercatchers and pied stilts.

Hairini

Shorebirds, especially pied stilts, roost on occasions in the corner of the bay where the road causeway to the city goes down the hill. This is usually only available over neap high tides.

Welcome Bay

The roosts at Welcome Bay are small areas of raised sandy beaches remaining exposed during neap high tides such as Tye Park foreshore. However these were rarely visited as they only held a few birds and these get frequently disturbed by people.

Rangataua Bay

Most roosting shorebirds observed in the Bay were recorded at the Te Maunga Sewage Works roosting on the grassy embankments of the oxidation ponds at the head of the Bay.

8. Maketu Estuary and Kaituna River mouth

There were five sites that shorebirds used as roosts around the estuary. These are located on the two sand spits at the estuary mouth (dependent on prevailing conditions), on the sandbank adjacent to the skateboard park next to the marae, on the sandy beach on the western side of the Kaituna River mouth and on the raised sandy area adjacent to the Motiti Island cattle yards a short distance upstream from the river mouth. The sandbank is, however, the key roost site for shorebirds at the estuary, although it gets flooded on spring tides.

For many years most shorebirds used a small island in the brackish lagoon at the north-west end of the estuary as their roost site until it was effectively destroyed through flooding by an adjoining landowner in about 1988. Subsequently the Edgecumbe earthquake damaged the lagoons flap gate valves and then the bund walls were breached. Now the sea has direct access which has largely ruined it for shorebirds. Some shorebird species such as pied stilt, banded dotterel, turnstone and golden plover

use the ploughed fields between this site and the river mouth over the high tide period as an attractive alternative roost site.

9. Waihi Estuary and Pukehina Spit

There are several roost sites at Waihi Estuary. They are located on Pukehina Spit, on several small low-lying islands and sandbanks found in the middle and upper reaches of the estuary and on the lawns of the holiday park camping ground. The roost located on the low lying dune system at the end of the Spit is used by nesting northern New Zealand dotterel and variable oystercatcher. It is one of the key roosts for the estuary as it is above spring high tide level whereas the islands and sandbanks tend to be flooded on most spring high tides.

10. Otaramarakau/Hauone/Pikowai/Herepuru

Counts along the coast between Otaramarakau and Matata were collectively pooled for reporting purposes. The sites where counts were collected from and where birds roosted were all stream mouths, apart from the Otaramarakau roost, which is located on a sandy spit adjacent to the mouth of the Waitahanui Stream lagoon. The Hauone, Pikowai and Herepuru sites are located at the mouths of the Hauone, Pikowai and Herepuru Streams respectively. None of these are true roosts but serve that purpose and variable oystercatcher, banded dotterel and northern New Zealand dotterel breed there and pied stilt and spur winged plover visit.

11. Matata Lagoon / Tarawera River mouth

The Matata Lagoon roost is located at the northern end of the southern lagoon within the Matata Lagoon Wildlife Refuge where an area of the lagoon bed is dry and exposed. This is a popular roost site for shorebirds and waterfowl. The sandy beach and dunes on each side of the Tarawera River mouth serve as shorebird roosts too when human disturbances are low.

12. Rangitaiki River mouth / Thornton Lagoon

The sandy beaches and adjacent low-lying dunes on each side of the Rangitaiki river mouth and seaward of the Thornton Lagoon provide important roost sites for shorebirds (oystercatcher, dotterel, etc) inhabiting the river mouth and surrounding coast. The site does get a lot of disturbances from 4WD vehicles and the public especially fishers.

13. Whakatane River estuary

There are no recognised high tide roosts at Whakatane River estuary but several low lying islands found within the estuary and nearby Piripai Spit on the western side of the river mouth provide some roosting space for variable oystercatcher and other shorebird species. Further work is needed to determine where birds roost in the estuary.

14. Maraetotara

The Maraetotara Stream mouth roost regularly supports small groups of roosting oystercatchers but is only available during neap high tide periods and is of limited value as human disturbances are considerable here.

15. Ohiwa Harbour

Ohiwa Harbour is an important shorebird habitat holding a number of high tide roost sites. The two principal spring tide roosts at the harbour are Ohope and Ohiwa Spits. Both have been recognised over the period of the study as providing essential roost sites for shorebirds using the harbour. Over the last twenty years both Ohope and Ohiwa Spits have faced problems associated with cyclic erosion and accretion and from increased human disturbances on roosting birds as the surrounding coastal areas become developed and heavily populated. For this reason both spits have been very important although increased human usage by fishers and walkers is of concern.

Other important roosts are Whangakopikopiko (Tern Island) Wildlife Refuge Reserve, Tunanui Stream mouth, Wainui Stream mouth, Uretara Island Scenic Reserve, Motuotu Island Nature Reserve and the unnamed island off Ohiwa Harbour Road (Owen, 1994). In the case of the mouths of Tunanui Stream and Wainui Stream, these are tidal flat roosts which are only available as neap tide roosts, due to spring tide flooding.

16. Waiotahi River estuary

The end of the sand spit on the western side of the estuary mouth is the principal roost site for shorebirds at the estuary where counts were taken during the study.

17. Waioeka River estuary / Kukumoa / Otara River

This area covers the eastern end of Waiotahi Beach, the western end of Hukuwai Beach and the Waioeka River estuary formed at the confluence of the Waioeka and Otara rivers (Opotiki Harbour) at the coast. Kukumoa is the swampy farmland adjacent to the western side of the estuary. Very few northern hemisphere migratory shorebirds visit the estuary but northern New Zealand dotterel, variable oystercatcher, pied stilt, banded dotterel, and spur-winged plover have all breed there or nearby. The estuary is subject to sudden change and erosion when the rivers are in flood and especially when north-east storms occur.

18. Waiaua River mouth (including Opape Beach)

The sand spit at the river mouth is an important roost and breeding area for shorebirds. Northern New Zealand dotterel, variable oystercatcher and spur-winged plover are resident and bred there while banded dotterel may breed there from time to time. White-fronted terns nest in large numbers in some years. Very few Arctic migratory shorebirds use the estuary. The sand spit is managed intensively by DOC as a northern New Zealand dotterel protected breeding site. Other local coastal breeding

species such as variable oystercatcher, banded dotterel and white-fronted tern benefit from this management activity. Nearby Opape Beach is used by variable oystercatchers as a roost.

19. Hawai River mouth

The river mouth provides a minor roost to a few shorebirds but was rarely visited during the study period. Species that have been recorded roosting there included 1 or 2 pairs of variable oystercatcher and one or two pairs of banded dotterel, which have breed there in the past.

20. Motu River mouth

The sand and stony ground of the river mouth and its beach are feeding and roosting areas for variable oystercatcher, pied stilt and banded dotterel. All three species occasionally breed there. In 1988 4 pairs of banded dotterel nested there and Northern New Zealand dotterel have bred there in the past (P.L. pers.comm).

21. Ruakokore River mouth

The river mouth provides a minor roost for shorebirds but was rarely visited during the study period. A few pairs of banded dotterel and variable oystercatcher breed there. In the past banded dotterel breed there (6 pairs in 1984) but very few do today (P.L pers.comm.).

22. Whangaparaoa Bay (including Whangaparaoa River mouth)

This roost is situated at the mouth of the Whangaparaoa River in Whangaparaoa Bay.

Variable oystercatcher and pied stilt usually nest near the river mouth and several pairs of banded dotterel breed along the beach. Northern New Zealand dotterel nested at the mouth of a small stream in the bay in the past (P. L, pers.comm).

23 Hicks Bay

A roost of minor significance is located at the mouth of a small tidal stream that flkows through the dunes into Hicks Bay. Here, a few pairs of variable oystercatcher and an occasional northern New Zealand dotterel and banded dotterel may roost here from time to time. In 1988, 10 pairs of banded dotterel bred there, but very few do today (P.L. pers. comm.).

24 Te Araroa

The beach near Te Araroa settlement is used as a high tide roost and breeding area by a few resident pairs of variable oystercatcher, pied stilt and spur-winged plover. A few pairs of banded dotterel breed along the coast, but in the past they used to nest there in good numbers (12-13 pairs in 1988) (P.L. pers. comm).

Appendix 3: South Island pied oystercatcher, 1984-2003

Place	Season	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
NW Tauranga Harbour	W	450	450	435	443	0	360	211	500	450	500	651	599	800	1000	886	415	500	600		
	S	74	53	76	70	6	17	85	20	110	220	203	203	320	78	107	130	132			137
Central Tauranga Harbour	W	0	0	7	0	58	2	100	233	150	102	347	373	341	831	500	810	1200	216		
	S	0	0	1	0	0	0	0	0	0	0	0	0	76	360	50	260	132			290
Matakana Island (whole island count)	W																				
	S																				
Panepane Point	W																				
	S																				
Sulphur Point (Tauranga)	W	0	15	0	0	60	0	0	142	148	0	0	203	325	131	503	200	136	100		
	S	0	34	0	0	0	0	18	48	39	0	99	0	52	4	190	100	150			220
Waipū Bay	W			0	159	0	45	90	0	29	280	380	0	0	14	0	82	12	30		
	S				23	0	0	0	0	0	0	0	0	0	27	0	0	0	0		
Waimapu Estuary/Welome Bay/Rangataua Bay	W				8										110		120	0			
	S				0										81		0	0			
Maketu Estuary and Kaituna River Mouth	W	0	1	0	0	3	0	0	0	0	0	114	190	124	156	0	140	140	185	250	
	S	0	0	0	0	0	0	0	0	0	0	76	0	40	61	66	2	23	0	130	12
Waīhi Estuary and Pukehina Spit	W	12	9	6	9	8	6	12	13	3	5	20	14	43	62	0	53	20	59	150	
	S	2	2	6	8	4	5	10	19	27	71	0	0	17	0	5	0	30	60	2	90
Otamarakau, Pīkōwai, Hauone, Herepuru	W	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Tarawera River Mouth and Matata Lagoon	W	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Rangitaiki River Mouth and Thornton Lagoon	W	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0		
	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Whakatane River Estuary	W																				
	S																				
Mararetotara	W																				
	S																				
Ohiwa Spit/Ohope Spit/Ohiwa Harbour	W	80	139	102	200	128	94	170	165	250	320	266	470	249	260	701	800	400	325	220	
	S	25	3	0	19	13	0	9	5	41	4	93	0	150	170	110	160	132	200	246	120
Waioatahi River Estuary	W																				
	S																				
Waiopeka River Estuary/Kukūmoa (incl. Otara River)	W	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Waiaua River Estuary (incl. Opape Beach)	W	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Hawai River Mouth	W																				
	S																				
Motu River Mouth	W																				
	S																				
Raukokore River Mouth	W																				
	S																				
Whangaparaoa Bay (incl. river mouth)	W																				
	S																				
Hicks Bay	W																				
	S																				
Tc Araroa	W																				
	S																				
Year		1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Total	W	542	614	550	914	257	507	583	1053	1032	1207	1778	1849	1882	2564	2590	2620	2408	1515	620	
	S	101	92	83	120	23	22	122	92	217	295	471	781	655	781	528	652	599	260	378	869
	W + S	643	706	633	1034	280	529	705	1145	1249	1502	2249	1849	2537	3345	3118	3272	3007	1775	998	869
	W	6	12	13	16	13	15	16	18	16	17	14	14	13	16	14	15	12	15	8	
	S	7	9	11	15	21	15	17	16	17	17	15	14	14	17	13	15	16	6	6	15
Number of sites visited	W + S	13	21	24	31	34	30	33	34	33	34	29	14	27	33	27	30	28	21	14	15

NB: Blank spacings for years means sites not surveyed

Appendix 4: Variable oystercatcher, 1984-2003

Place	Season	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
NW Tauranga Harbour	W	17	25	42	25	0	49	35	38	40	40	38	19	20	28	0	31	27	49		
	S	13	35	22	15	55	28	28	80	20	4	18	24	33	26	25	40				76
Central Tauranga Harbour	W	0	0	0	0	0	2	0	0	0	0	0	0	1	0	0	0	44	22		
	S	0	0	2	0	0	0	0	10	0	0	0	0	1	0	0	18	19			5
Matakana Island (whole island count)	W																				
	S									60	58	72		98	78			123			
Panepane Point	W							24	0	10	18	26	31	24	28	32	22	0	6		
	S			29	16	19		21	8	0								24			32
Sulphur Point	W	58	83	8	21	11	48	5	41	16	8	12	23	27	6	4	6	22	0		
	S	47	12	20	19	12	8	11	8	6	8	6	6	33	6	2	9	12			0
Waipau Bay	W			0	0	0	0	4	0	0	1	0	0	0	0	0	4	0	0		
	S			3	2	2	2	0	2	2	2	0		0	0	0	0	0	0		2
Waimapu Estuary/Welome Bay/Rangataua Bay	W																				
	S																				0
Maketu Estuary and Kaituna River Mouth	W	12	42	34	31	38	33	24	30	12	41	76	72	50	52	0	55	56	43	94	
	S	14	18	28	23	24	44	22	18	20	26	26	26	40	18	44	17	22	90	64	29
Waihi Estuary and Pukehina Spit	W	10	27	47	52	62	61	84	67	125	80	43	6	48	23	0	41	52	54	10	
	S	38	40	31	28	42	40	39	38	76	60	50	41	37	6	12	72	50	80	80	82
Otamarakau, Pukowai, Hauone, Herepuru	W			6	8	4	4	4	4	6	2	8	6	8	14	9	9	5	0		
	S			10	10	10	12	9	4	6	11	6	7	15	4	9	3				4
Tarawera River Mouth and Mataia Lagoon	W			3	2	2	2	2	2	4	4	2	4	2	0	4	2	3	0		
	S			2	0	0	2	4	1	2	6	6	6	6	4	0	2	0			4
Rangitaiki River Mouth and Thornton Lagoon	W			0	0	4	0	19	2	4	23	43	20	25	24	25	14	4	2	24	
	S			2	4	7	2	0	0	0	8	6		14	3	4	0	8			4
Whakatanu River Estuary	W																				
	S			7	6																0
Maratotara	W																				
	S					10															
Ohiwa Spit/Ohope Spit/Ohiwa Harbour	W	11	12	68	26	27	44	136	107	65	71	133	201	50	100	250	275	200	250	80	
	S	16	16	32	61	30	33	30	52	54	46	120	70	30	30	75	60	105	200	150	52
Waioatahi River Estuary	W			13	0	4	7	6	9	5	6	14	8	6	6	4	10	8			
	S			6	4	6	11	7	8	6	12	8	7	6	8	6	9	10	14	0	6
Waioeka River Estuary/Kukumooa (incl. Otara River)	W			2	0	0	6	4	2	4	10	7	7	8	10	6	8	0	0		
	S			0	4	2	4	11	8	6	8	9	9	9	7	9	6	8	8		4
Waiaua River Estuary (incl. Opape Beach)	W			8	4	10	9	9	11	6	4	9	11	13	7	8	33	9	0	0	
	S			12	18	6	8	17	4	6	11	8		12	10	7	13	9	19	0	11
Hawaii River Mouth	W																				
	S					0															
Motu River Mouth	W																				
	S					2	0	0	0	1	0				2	0					
Raukokore River Mouth	W																				
	S					0															
Whangaparaoa Bay (incl. river mouth)	W																				
	S					6	3	3	2		2				4						0
Hicks Bay	W																				
	S					0					4										
Te Araroa	W																				
	S					1															
Year		1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Total	W	108	244	211	230	168	264	369	316	301	319	413	410	276	301	367	486	413	434	208	
	S	128	125	193	203	236	204	203	241	275	264	337	361	361	257	183	184	455	381	294	311
W + S	W + S	236	369	404	433	404	468	572	557	576	583	750	770	771	558	550	670	868	815	502	311
Number of sites visited	W	6	12	13	16	13	15	16	18	16	17	14	14	13	16	14	15	12	15	8	
	S	7	9	11	15	21	15	17	16	17	17	15	14	14	17	13	15	16	6	6	15
W + S	W + S	13	21	24	31	34	30	33	34	33	34	29	28	27	33	27	30	28	21	14	15

NB: Blank spacings for years means sites not surveyed

Appendix 5: Pied stilt, 1984-2003

Place	Season	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
NW Tauranga Harbour	W	19	184	60	80	50	5	7	40	20	15	57	0	90	8	49	0	0	0	0	0
	S	16	2	0	0	0	0	5	4	0	21	0	0	0	8	0	0	0	0	0	0
Central Tauranga Harbour	W	530	430	450	650	200	393	363	478	100	270	268	314	264	115	447	270	540	252		
	S	4	12	0	0	0	0	9	3	24	0	22		0	10	9	6	43			10
Matakana Island (whole island count)	W																				
	S																				
Panepane Point	W																				
	S																				
Sulphur Point	W	15	25	6	0	0	38	0	0	21	0	0	11	0	0	30	0	10	0	0	0
	S	0	5	0	5	4	0	0	1	0	0	2		0	0	0	0	2			0
Waipou Bay	W				17	0	0	39	2	0	48	20	0		42	0	145	0	18		0
	S				2	0	0	0	1	15	0	0		1	0	0	0	0			0
Waiapu Estuary/Welome Bay/Rangataua Bay	W				115				27	0					50		0	60			18
	S				0				0						38		14	0			
Maketu Estuary and Kaituna River Mouth	W	477	300	152	370	277	107	12	42	22	157	191	53	91	160	70	158	56	115	22	22
	S	140	100	53	138	120	67	200	75	62	66	10		124	85	28	4	20	150	15	22
Waihi Estuary and Pukehina Spit	W	40	220	2	30	209	412	254	150	104	14	80	200	220	36	0	55	2	0	250	
	S	20	3	16	30	4	0	100	0	0	0	8		60	2	20	0	20	80	0	16
Otamarakau, Pukowai, Hauone, Herepuru	W		6	0	0	2	20	0	5	0	0	0	6	12	5	2	0	0	2		0
	S				8	6	0	4	8	3	4	8		14	9	6	2	2			0
Tarawera River Mouth and Mataira Lagoon	W		230	20	45	2	250	92	78	13	40	58	5	40	22	31	0	20	50		0
	S		11		9	8	8	48	27	26	18	20		34	13	26	10	21			0
Rangitaiki River Mouth and Thornton Lagoon	W			130	26	3	20	30	97	0	31	87	2	125	8	45	6	45	0	10	0
	S		0		5	0	1	0	39	0	1	0		0	0	0	10	2			0
Whakataene River Estuary	W				0				0		0										
	S				0				0	3											
Maratotara	W				0																
	S				0																
Ohiwa Spit/Ohope Spit/Ohiwa Harbour	W	0	230	170	135	57	18	27	80	152	55	0	52	30	63	45	68	20	60	120	
	S	0	0	25	56	4	33	79	50	6	7	0		25	23	0	0	0	0	0	0
Waioatahi River Estuary	W		12	12	15	2	8	0	16	4	2	9	2	11	11	30	2		4	7	
	S		0	30	12	22	4	15	21	6	0	12		6	4	4	17	0	1	0	0
Waioeka River Estuary/Kukumooa (incl. Otara River)	W		10	0	25	0	4	0	65	8	22	4	11	7	7	0	3		0	6	
	S		0	0	0	18	7	14	0	7	11	42		18	0	11	3	7	4	6	
Waiaua River Estuary (incl. Opape Beach)	W		10	12	22	14	24	9	15	10	11	23	19	5	16	35	2		0	0	
	S		1	1	21	25	11	17	4	8	9	7		8	20	8	14	4	3	0	6
Hawaii River Mouth	W																				
	S				0																
Motu River Mouth	W								0		3										
	S				6	6	0			6	2				5	4					
Raukokore River Mouth	W																				
	S				0																
Whangaparaoa Bay (incl. river mouth)	W																				
	S				4	0	0	3	0			0			5	2				0	
Hicks Bay	W																				
	S					10					0										
Te Araroa	W						0														
	S					15					6										
Year		1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Total	W	1081	1677	1014	1530	816	1311	838	1101	454	668	797	675	895	543	784	709	753	501	415	78
	S	180	133	125	286	246	137	494	233	166	145	131		298	214	116	82	121	238	15	78
W + S	W + S	1261	1810	1139	1816	1062	1448	1332	1334	620	813	928	675	1193	757	900	791	874	739	430	78
Number of sites visited	W	6	12	13	16	13	15	16	18	16	17	14	14	14	13	16	14	15	12	15	8
	S	7	9	11	15	21	15	17	16	17	17	15	17	14	17	13	15	16	5	6	15
W + S	W + S	13	21	24	31	34	30	33	34	33	34	29	14	14	27	33	27	30	28	20	14

NB: Blank spacings for years means sites not surveyed

Appendix 6: Northern New Zealand dotterel, 1984-2003

Place	Season	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	
NW Tauranga Harbour	W	11	4	6	8	0	18	1	21	0	0	0	0	6	11	1	0	0	0	0	0	
	S	2	2	1	3	1	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Central Tauranga Harbour	W	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
	S	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0
Matakana Island (whole island count)	W																					0
	S									34	42	48	38	44	52	52	61	81	68	82	82	82
Panepane Pt	W							16	0	0	0	0	3	10	18	2	8	0	0	0	0	0
	S			25	4	20		14	0	0												0
Sulphur Point	W	19	15	38	37	16	30	12	11	17	20	16	16	12	4	0	1	7	1	1	1	0
	S	6	16	25	8	14	6	0	5	7	6	4	7	7	8	2	3	0	0	0	0	0
Waipou Bay	W																					0
	S																					0
Waimapu Estuary/Welome Bay/Rangataua Bay	W																					0
	S																					0
Maketu Estuary and Kaituna River Mouth	W	28	22	30	19	31	28	26	18	19	11	8	0	6	6	7	6	7	8	5	16	16
	S	16	18	20	20	17	20	17	13	18	6	5	5	11	9	8	5	8	20	8	20	8
Waihi Estuary and Pukehina Spit	W	11	7	2	19	5	2	11	11	15	2	2	20	6	7	0	10	5	14	0	0	0
	S	3	8	5	4	0	4	1	2	5	0	2	2	2	0	0	0	0	0	1	1	0
Otamarakau, Pukowai, Hauone, Herepuru	W																					0
	S																					4
Tarawera River Mouth and Mataia Lagoon	W																					4
	S																					0
Rangitaiki River Mouth and Thornton Lagoon	W																					2
	S																					0
Whakatanu River Estuary	W																					2
	S																					0
Maratotara	W																					0
	S																					0
Ohiwa Spit/Ohope Spit/Ohiwa Harbour	W	30	48	44	61	39	75	60	65	32	37	41	39	34	15	32	19	30	33	76	76	
	S	14	18	18	16	16	15	28	24	10	14	12	12	14	12	8	12	12	32	20	20	20
Waioatahi River Estuary	W																					7
	S																					4
Waioeka River Estuary/Kukumooa (incl. Otara River)	W																					10
	S																					1
Waiaua River Estuary (incl. Opape Beach)	W																					0
	S																					4
Hawaii River Mouth	W																					5
	S																					4
Motu River Estuary	W																					0
	S																					0
Raukokore River Mouth	W																					0
	S																					0
Whangaparaoa Bay (incl. river mouth)	W																					4
	S																					3
Hicks Bay	W																					0
	S																					0
Te Araroa	W																					0
	S																					0
Year	W	99	101	124	154	119	155	151	137	106	90	85	91	85	87	57	63	50	77	101	101	101
	S	41	70	114	87	112	98	81	98	81	98	101	104	38	116	130	111	125	128	131	134	134
Total	W + S	140	171	238	241	231	253	249	218	204	191	189	129	201	217	155	174	175	205	234	234	234
	W	6	12	13	16	13	15	16	18	16	17	14	14	14	13	16	14	15	12	15	8	8
Number of sites visited	S	7	9	11	15	21	15	17	16	17	17	15	1	14	17	13	15	16	7	7	7	16
	W + S	13	21	24	31	34	30	33	34	33	34	29	15	27	33	27	30	28	22	15	15	16

NB: Blank spacings for years means sites not surveyed.

Appendix 7: Banded dotterel, 1984-2003

Place	Season	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
NW Tauranga Harbour	W	145	6	21	230	0	220	106	96	0	0	42	1	31	40	0	0	0	0	0	0
	S	0	3	0	5	2	0	0	0	2	0	1	0	0	0	0	0	0	0	0	0
Central Tauranga Harbour	W	0	0	0	0	10	0	44	0	0	0	1	0	0	0	0	0	0	35	19	0
	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Matakana Island (whole island count)	W	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Panepane Point	W	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sulphur Point	W	200	0	43	490	90	500	0	70	53	100	348	0	450	0	0	0	0	0	0	0
	S	40	8	30	10	20	20	10	12	10	4	2	18	6	6	0	0	0	0	0	0
Waipua Bay	W	0	250	0	200	0	200	0	52	250	71	352	348	340	0	0	0	487	432	0	0
	S	0	0	0	0	0	0	0	0	3	0	0	0	4	4	0	0	0	0	0	0
Waimapu Estuary/Welome Bay/Rangataua Bay	W	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Maketu Estuary and Kaituna River Mouth	W	1	4	6	56	40	102	32	12	31	178	142	115	95	14	3	0	85	2	50	0
	S	0	1	3	0	2	0	2	0	0	0	4	0	0	0	1	2	0	2	80	4
Waihi Estuary and Pukehina Spit	W	3	0	0	86	4	0	1	0	0	0	0	0	14	66	0	20	10	0	0	0
	S	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Otamarakau, Pukowai, Hauone, Herepuru	W	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	S	0	0	0	16	24	7	12	7	0	6	4	0	0	0	0	0	1	1	0	0
Tarawera River Mouth and Mataia Lagoon	W	0	0	0	0	1	0	0	5	0	0	0	0	0	0	0	0	0	0	0	2
	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rangitaiki River Mouth and Thornton Lagoon	W	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Whakatane River Estuary	W	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Maratotara	W	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ohiwa Spit/Ohope Spit/Ohiwa Harbour	W	400	500	350	484	676	430	455	363	228	186	420	350	280	320	152	156	75	185	260	0
	S	0	33	22	22	20	6	7	5	2	0	0	0	0	8	0	0	0	1	50	0
Waioatahi River Estuary	W	0	4	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0
	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Waioeka River Estuary/Kukumooa (incl. Otara River)	W	16	0	0	0	0	0	15	13	0	0	0	0	28	0	4	0	0	0	0	0
	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Waiaua River Estuary (incl. Opape Beach)	W	1	0	0	0	1	1	1	2	5	2	0	0	1	6	0	0	0	0	0	0
	S	0	0	2	0	2	0	1	0	1	0	0	0	0	2	3	0	0	0	7	0
Hawaii River Mouth	W	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Motu River Mouth	W	0	0	0	0	0	0	0	1	1	6	0	0	0	0	0	0	0	0	0	0
	S	0	0	0	0	0	0	0	0	2	3	0	0	0	2	3	0	0	0	0	0
Raukokore River Mouth	W	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Whangaparaoa Bay (incl. river mouth)	W	0	0	0	0	0	0	8	17	0	17	0	0	0	0	0	0	0	0	0	0
	S	0	0	0	0	0	0	6	3	0	0	0	0	0	3	0	1	0	0	0	0
Hicks Bay	W	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Te Araroa	W	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Year	W	749	531	670	1346	1022	1273	714	846	389	621	1305	814	899	786	159	177	693	688	310	0
	S	41	45	55	55	173	43	35	24	20	18	11	29	29	33	12	3	6	137	4	10
Total	W + S	790	576	725	1401	1195	1316	749	870	409	639	1316	814	928	819	171	180	699	775	314	10
	W	6	12	13	16	13	15	16	18	16	17	14	14	13	16	14	15	12	15	8	0
Number of sites visited	S	7	9	11	15	21	15	17	16	17	17	15	17	14	17	13	15	16	6	6	15
	W + S	13	21	24	31	34	30	33	34	33	34	29	14	27	33	27	30	28	21	14	15

NB: Blank spacings for years means sites not surveyed

Appendix 8: Wrybill, 1984-2003

Place	Season	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
NW Tauranga Harbour	W	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Central Tauranga Harbour	W	25	10	0	0	0	0	39	0	0	0	0	0	0	0	0	0	0	0	0	0
	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Matakana Island (whole island count)	W																				
	S																				
Panepane Point	W												2								
	S																				
Sulphur Point	W	52	51	49	67	74	101	45	43	65	52	38	0	0	0	35	55	0	0	0	0
	S	0	4	5	0	2	6	1	5	0	0	0	0	0	0	0	0	0	0	0	0
Waipu Bay	W			0	22	0	0	8	0	0	0	0	0	0	8	0	0	0	0	1	0
	S																				
Waimapu Estuary/Welome Bay/Rangataua Bay	W														41						
	S														1						
Maketu Estuary and Kaituna River Mouth	W	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
Waihi Estuary and Pukehina Spit	W				1	0	0	0	8	18	0	0	0	0	0	0	0	0	0	2	0
	S	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Otamarakau, Pikowai, Hauone, Herepuru	W																				
	S																				
Tarawera River Mouth and Mataia Lagoon	W																				
	S																				
Rangitaiki River Mouth and Thornton Lagoon	W																				
	S																				
Whakatane River Estuary	W																				
	S			0						0											
Maratotara	W																				
	S																				
Ohiwa Spit/Ohope Spit/Ohiwa Harbour	W	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	S	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	0
Waioatahi River Estuary	W																				
	S																				
Waioeka River Estuary/Kukumooa (incl. Otara River)	W	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Waiaua River Estuary (incl. Opape Beach)	W	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hawai River Mouth	W																				
	S																				
Motu River Mouth	W																				
	S																				
Raukokore River Mouth	W																				
	S																				
Whangaparaoa Bay (incl. river mouth)	W																				
	S																				
Hicks Bay	W																				
	S																				
Te Araroa	W																				
	S																				
Year		1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Total	W	77	61	51	90	74	101	92	51	83	52	38	2	0	49	35	55	0	3	0	0
	S	0	4	5	2	2	6	1	5	0	0	0	0	1	1	1	1	1	3	1	0
W + S	W	77	65	56	92	76	107	93	56	83	52	38	2	1	50	36	56	1	6	1	0
	S	6	12	13	16	13	15	16	18	16	17	14	14	13	16	14	15	12	15	8	0
Number of sites visited	W	7	9	11	15	21	15	17	16	17	17	15	14	14	17	13	15	16	6	6	15
	S	13	21	24	31	34	30	33	34	33	34	29	14	27	33	27	30	28	21	14	15

NB: Blank spacings for years means sites not surveyed

Appendix 9: Pacific golden plover, 1984-2003

Place	Season	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
NW Tauranga Harbour	W	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Central Tauranga Harbour	W	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Matakana Island (whole island count)	W																				
	S																				
Panepane Point	W																				
	S																				
Sulphur Point	W	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	S	0	0	0	0	11	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Waipū Bay	W																				
	S																				
Waimapu Estuary/Welome Bay/Rangataua Bay	W																				
	S																				4
Maketu Estuary and Kaituna River Mouth	W	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	S	0	36	10	27	40	31	41	40	48	8	27	15	12	40	5	26	45	0	0	0
Waihi Estuary and Pukehina Spit	W																				
	S	0	0	0	22	0	0	56	0	0	0	0	0	0	0	0	0	0	20	0	21
Otamarakau, Pīkōwai, Hauone, Herepuru	W																				
	S																				
Tarawera River Mouth and Mataia Lagoon	W	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rangitaiki River Mouth and Thornton Lagoon	W																				
	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Whakatane River Estuary	W																				
	S																				
Maratotara	W																				
	S																				
Ohiwa Spit/Ohope Spit/Ohiwa Harbour	W	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	S	12	13	18	12	14	11	13	3	8	9	4	7	11	10	16	12	11	18	18	18
Wāitohi River Estuary	W																				
	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wāioeka River Estuary/Kukumooa (incl. Otara River)	W																				
	S	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Wāiaua River Estuary (incl. Opape Beach)	W	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	S																				
Hawai River Mouth	W																				
	S																				
Motu River Mouth	W																				
	S																				
Raukokore River Mouth	W																				
	S																				
Whangaparaoa Bay (incl. river mouth)	W																				
	S																				
Hicks Bay	W																				
	S																				
Te Araroa	W																				
	S																				
Year		1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Total	W	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	S	12	49	28	61	65	53	110	43	57	17	31	22	23	50	21	38	76	18	43	
W + S		12	49	28	61	65	53	110	43	57	17	31	22	23	50	21	38	76	18	43	
W		6	12	13	16	13	15	16	18	16	17	14	14	13	16	14	15	12	15	8	
S		7	9	11	15	21	15	17	16	17	17	15	14	14	17	13	15	16	6	15	
W + S		13	21	24	31	34	30	33	34	33	34	29	14	27	33	27	30	28	21	14	15

NB: Blank spacings for years means sites not surveyed

Appendix 10: Spur-winged plover, 1984-2003

Place	Season	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
NW Tauranga Harbour	W	0	0	0	0	7	0	8	3	0	3	2	0	4	1	0	0	0	0	0	0
	S	0	0	0	0	0	0	2	8	4	0	0	0	2	0	0	0	0	0	0	0
Central Tauranga Harbour	W	0	0	0	0	0	0	62	0	0	0	11	1	101	0	6	0	0	0	0	0
	S	0	0	0	0	0	0	3	0	5	0	4		0	0	0	0	0	0	0	7
Matakana Island (whole island count)	W																				
	S																				
Panepane Point	W																				
	S																				
Sulphur Point	W	0	0	0	6	0	0	0	0	5	0	0	32	0	8	0	2	0	0	0	0
	S	0	0	0	0	0	0	0	0	0	0	0	0	2	4	0	0	0	0	0	0
Waipū Bay	W																				
	S																				
Wāmapu Estuary/Welome Bay/Rangataua Bay	W																				
	S																				
Maketu Estuary and Kaituna River Mouth	W	6	1	3	70	38	2	9	56	25	52	209	202	30	135	84	17	94	34	14	14
	S	0	2	3	0	2	22	90	4	18	10	2	0	3	33	23	8	180	42	54	18
Wāihī Estuary and Pukehina Spit	W																				
	S	0	0	0	2	0	0	1	0	0	0	0	0	27	0	0	0	3	0	0	0
Otamarakau, Pīkōwai, Hauone, Herepuru	W																				
	S																				
Tarawera River Mouth and Mataia Lagoon	W																				
	S																				
Rangitaiki River Mouth and Thornton Lagoon	W																				
	S																				
Whakatane River Estuary	W																				
	S																				
Maratotara	W																				
Ohiwa Spit/Ohope Spit/Ohiwa Harbour	W	0	0	0	0	0	0	2	22	3	0	0	0	0	0	0	0	0	0	0	0
	S	0	0	0	0	0	0	0	3	0	1	0	0	9	0	0	0	0	0	0	15
Wāitohi River Estuary	W																				
	S																				
Wāioeka River Estuary/Kukumooa (incl. Otara River)	W	0	0	0	40	60	4	12	18	9	35	15	19	17	30	22	12	0	27	0	0
	S	1	0	0	6	26	10	11	25	0	46	14	13	14	13	8	0	30	4	0	14
Wāiaua River Estuary (incl. Opape Beach)	W	0	0	0	0	3	0	8	0	0	24	14	7	24	100	50	50	2	2	13	0
	S	0	0	0	0	5	0	6	36	7	0	21		33	0	15	0	2	0	0	63
Hawai River Mouth	W																				
Motu River Mouth	W																				
Raukokore River Mouth	W																				
Whangaparaoa Bay (incl. river mouth)	W																				
Hicks Bay	W																				
Te Araroa	W																				
Year	S																				
Total	W	6	1	4	167	113	19	118	129	124	135	274	273	261	334	170	85	152	69	27	0
	S	0	3	3	5	22	50	126	73	73	48	92	97	97	117	74	14	272	62	69	165
W + S	W	6	4	7	172	135	69	244	202	197	183	366	273	358	451	244	99	424	131	96	165
	S	0	12	13	16	13	15	16	18	16	17	14	14	13	16	14	15	12	15	8	0
Number of sites visited	W	7	9	11	15	21	15	17	16	17	17	15	14	14	17	13	15	16	6	6	15
	S	13	21	24	31	34	30	33	34	33	34	29	14	27	33	27	30	28	21	14	15

NB: Blank spacings for years means sites not surveyed

Appendix 11: Turnstone, 1984-2003

Place	Season	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
NW Tauranga Harbour	W	24	21	80	31	30	46	0	13	0	0	18	0	0	9	0	0	18	0	0	0
	S	200	250	200	250	350	300	170	200	200	300	140	0	70	100	70	0	140	0	0	0
Central Tauranga Harbour	W	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Matakana Island (whole island count)	W																				
	S																				
Panepane Point	W																				
	S																				
Sulphur Point	W	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Waipou Bay	W	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Waimapu Estuary/Welome Bay/Rangataua Bay	W																				
	S																				
Maketu Estuary and Kaituna River Mouth	W	0	2	3	3	4	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0
	S	25	40	42	31	30	25	28	29	20	32	11	0	5	35	20	9	2	9	4	0
Waihi Estuary and Pukehina Spit	W	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	S	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Otamarakau, Pukowai, Hauone, Herepuru	W	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tarawera River Mouth and Mataia Lagoon	W	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rangitaiki River Mouth and Thornton Lagoon	W	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Whakatane River Estuary	W																				
	S																				
Mararetotara	W																				
	S																				
Ohiwa Spit/Ohope Spit/Ohiwa Harbour	W	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
	S	2	0	1	1	3	0	2	1	1	1	2	0	0	0	0	1	2	0	0	0
Waioatahi River Estuary	W	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Waioeka River Estuary/Kukumooa (incl. Otara River)	W	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Waiaua River Estuary (incl. Opape Beach)	W	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hawai River Mouth	W																				
	S																				
Motu River Mouth	W																				
	S																				
Raukokore River Mouth	W																				
	S																				
Whangaparaoa Bay (incl. river mouth)	W																				
	S											2									
Hicks Bay	W																				
	S																				
Te Araroa	W																				
	S																				
Year		1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Total	W	24	23	83	34	34	46	0	17	1	0	18	0	0	9	0	0	23	0	0	0
	S	229	292	243	282	363	325	200	230	221	333	155	0	75	135	90	10	144	11	4	0
W + S	W + S	253	315	326	316	397	371	200	247	222	333	173	0	75	144	90	10	167	11	4	0
W	W	6	12	13	16	13	15	16	18	16	17	14	14	13	16	14	15	12	15	8	0
S	S	7	9	11	15	21	15	17	16	17	17	15	14	14	17	13	15	16	6	6	15
W + S	W + S	13	21	24	31	34	30	33	34	33	34	29	14	27	33	27	30	28	21	14	15

NB: Blank spacings for years means sites not surveyed

Appendix 12: Red knot, 1984-2003

Place	Season	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
NW Tauranga Harbour	W	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	S	20	10	30	70	65	10	0	20	200	0	0	0	0	0	0	0	0	0	0	0
Central Tauranga Harbour	W	16	1	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	S	0	10	33	0	0	0	0	0	1	0	2	0	10	0	0	4	2	0	0	0
Matakana Island (whole island count)	W																				
	S																				
Panepane Point	W																				
	S																				
Sulphur Point	W	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	S	4	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Waipou Bay	W																				
	S																				
Waimapu Estuary/Welome Bay/Rangataua Bay	W																				
	S																				
Maketu Estuary and Kaituna River Mouth	W	0	0	6	0	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	S	120	74	138	67	180	80	55	83	210	93	57	0	30	100	50	3	80	150	130	59
Waihi Estuary and Pukehina Spit	W																				
	S	10	14	68	0	3	0	0	0	5	0	40	0	2	0	0	0	0	0	0	16
Otamarakau, Pukowai, Hauone, Herepuru	W																				
	S																				
Tarawera River Mouth and Mataia Lagoon	W																				
	S																				
Rangitaiki River Mouth and Thornton Lagoon	W																				
	S																				
Whakatane River Estuary	W																				
	S																				
Maratotara	W																				
	S																				
Ohiwa Spit/Ohope Spit/Ohiwa Harbour	W	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	S	4	6	24	0	15	0	10	3	26	0	0	0	3	2	2	2	2	0	0	2
Waiotahi River Estuary	W																				
	S																				
Waioteka River Estuary/Kukumooa (incl. Otara River)	W	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Waiata River Estuary (incl. Opape Beach)	W	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	S																				
Hawaii River Mouth	W																				
	S																				
Motu River Mouth	W																				
	S																				
Raukokore River Mouth	W																				
	S																				
Whangaparaoa Bay (incl. river mouth)	W																				
	S																				
Hicks Bay	W																				
	S																				
Te Araroa	W																				
	S																				
Year		1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Total	W	16	1	6	0	14	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	S	158	114	294	137	266	90	66	106	442	93	99	45	106	45	102	52	9	84	158	84
W + S		174	115	300	137	280	102	66	106	442	93	99	0	45	102	52	9	84	158	130	84
Number of sites visited	W	6	12	13	16	13	15	16	18	16	17	14	14	13	16	14	15	12	15	8	8
	S	7	9	11	15	21	15	17	16	16	17	17	15	14	17	13	15	16	16	6	15
W + S		13	21	24	31	34	30	33	34	33	34	29	14	27	33	27	30	28	21	14	15

NB: Blank spacings for years means sites not surveyed

Appendix 13: Bar-tailed godwit, 1984-2003

Place	Season	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	
NW Tauranga Harbour	W	280	120	160	170	90	236	100	350	0	0	204	36	0	80	80	29	100	0			
	S	2500	3000	1400	3000	2000	3000	2200	1300	1200	1000	1025	1002	1002	3360	450	1419	900				670
Central Tauranga Harbour	W	1003	202	380	101	320	1055	500	150	200	315	250	355	520	270	85	200	662	792			
	S	0	145	2500	1	15	0	650	2900	395	1260	1400		2000	2800	0	4100	6148				5600
Matakana Island (whole island count)	W																					
	S																					
Panepane Point	W																					
	S																					
Sulphur Point	W	0	104	32	110	300	0	1	500	110	0	40	0	0	0	210	0	0	2			
	S	2500	1500	3000	2500	3000	2000	1000	1600	2500	0	800	1200	0	1500	0	750	0	0			0
Waipou Bay	W																					
	S																					
Waimapu Estuary/Welome Bay/Rangataua Bay	W																					
	S																					
Maketu Estuary and Kaituna River Mouth	W	14	27	36	7	106	76	56	29	26	63	62	0	23	2	100	52	16	36	18		
	S	520	362	127	506	750	600	640	860	640	550	500	410	617	700	750	610	1100	1200	550		
Waihi Estuary and Pukehina Spit	W	29	9	3	34	33	11	85	73	15	0	1	0	52	3	0	32	3	13	0		
	S	300	500	516	400	530	500	750	600	440	800	460	450	188	650	0	600	200	0	0		500
Otamarakau, Pukowai, Hauone, Herepuru	W																					
	S																					
Tarawera River Mouth and Mataia Lagoon	W																					
	S																					
Rangitaiki River Mouth and Thornton Lagoon	W																					
	S																					
Whakatanu River Estuary	W																					
	S																					
Maratotara	W																					
	S																					
Ohiwa Spit/Ohope Spit/Ohiwa Harbour	W	260	225	320	384	700	430	640	695	400	80	450	380	220	350	320	640	250	400	60		
	S	3200	4000	4000	4000	5000	4200	3500	4700	3320	2800	2800	4000	5000	5000	5000	3500	3000	3800			
Waioatahi River Estuary	W																					
	S	4	0	0	20	13	0	0	16	7	0	0	0	0	0	0	0	0	0	0	0	0
Waioeka River Estuary/Kukumooa (incl. Otara River)	W																					
	S																					
Waiaua River Estuary (incl. Opape Beach)	W																					
	S																					
Hawaii River Mouth	W																					
	S																					
Motu River Mouth	W																					
	S																					
Raukokore River Mouth	W																					
	S																					
Whangaparaoa Bay (incl. river mouth)	W																					
	S																					
Hicks Bay	W																					
	S																					
Te Araroa	W																					
	S																					
Year		1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	
Total	W	1586	687	932	857	1549	2018	1505	1797	751	503	1131	771	815	805	795	1051	1031	1323	78		
	S	9024	9509	11543	10689	11312	10304	8743	11976	8502	7322	6985	9066	13041	8300	9769	12511	4300	5000	11840		
W + S		10610	10196	12475	11546	12861	12322	10248	13773	9253	7825	8116	771	9881	13846	9095	10820	13542	5623	5078	11840	
Number of sites visited	W	6	12	13	16	13	15	16	18	16	17	14	14	13	16	14	15	12	15	8		
	S	7	9	11	15	21	15	17	16	17	17	15	14	14	17	13	15	16	6	6	15	
W + S		13	21	24	31	34	30	33	34	33	34	29	14	27	33	27	30	28	21	14		

NB: Blank spacings for years means sites not surveyed

Glossary

(After Heather & Robertson, 1996)

Endemic: natural range is in a certain country and nowhere else, e.g. Northern New Zealand dotterel and black stilt are found in New Zealand only.

Migrant: a species that moves annually and seasonally between breeding and non-breeding areas, either within New Zealand, e.g. wrybill, or to other countries, e.g. bar-tailed godwit. Includes species which reach New Zealand each year, even if in small numbers, e.g. sharp-tailed sandpiper

Native: birds that are naturally found in a country, e.g. South Island pied oystercatcher, or are self-introduced (e.g. spur-winged plover and black-fronted dotterel).

Vagrant: a wanderer; a bird having turned up unexpectedly in an unusual direction, having strayed there by mistake or, having been caught up in a severe storm, is blown well off course e.g. grey phalarope.

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