Protection of shorebirds at three Northland breeding sites—Mangawhai, Waipu, and Ruakaka

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ABSTRACT

Fencing and predator control put in place to protect the New Zealand fairy tern (*Sterna nereis davisae*) were assumed to have been of benefit to the chick-rearing success of New Zealand dotterels (*Charadrius obscurus aquilonius*) and variable oystercatchers (*Haematopus unicolor*) at Waipu and Mangawhai Wildlife Refuges. The benefits of predator control at Waipu and Mangawhai are not evident in current data, when compared with Ruakaka Wildlife Refuge where there is only fencing. The benefits of the fencing of nesting habitat at all three sites to breeding success were also not significant. However, it is likely that the current quality and quantity of the data collected are not adequate to answer these questions. The use of these management techniques at each site needs close examination to ascertain if changes in the way that the trapping programme is undertaken, the fencing is positioned, or the data are collected can further benefit breeding success of these species at these sites.

Keywords: variable oystercatcher, *Haematopus unicolor*, New Zealand dotterel, *Charadrius obscurus aquilonius*, predators, fencing, Northland, New Zealand

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1. Introduction

Predator control and temporary fencing are used as management tools in the protection of shorebirds, particularly the New Zealand dotterel (*Charadrius obscurus aquilonius*) and variable oystercatcher (*Haematopus unicolor*), breeding at various sites on the east coast of the North Island. Within the Whangarei Area, Northland Conservancy, these management actions are carried out under a programme to protect the critically endangered New Zealand fairy tern (*Sterna nereis davisae*) breeding at Mangawhai and Waipu Wildlife Refuges, and are extended to protect other shorebirds breeding at these sites and at Ruakaka Wildlife Refuge (Fig. 1). The effectiveness of these management actions has not been assessed specifically for the shorebirds at these sites, although other studies indicate that such work is effective (Dowding 1993). Previous analysis has shown that productivity is higher at managed sites than unmanaged sites (Cumming 1991; Dowding 2001). This current analysis was commissioned to assess whether specific actions, fencing and/or predator control, carried out at these Northland sites is effective. The proportion of the areas that are fenced to exclude the public range from small to large at the three sites, but disturbance of breeding shorebirds may still be very high at all sites.

Consequently, the issues of concern to management are whether the management tools being used are effective or can be made more effective.

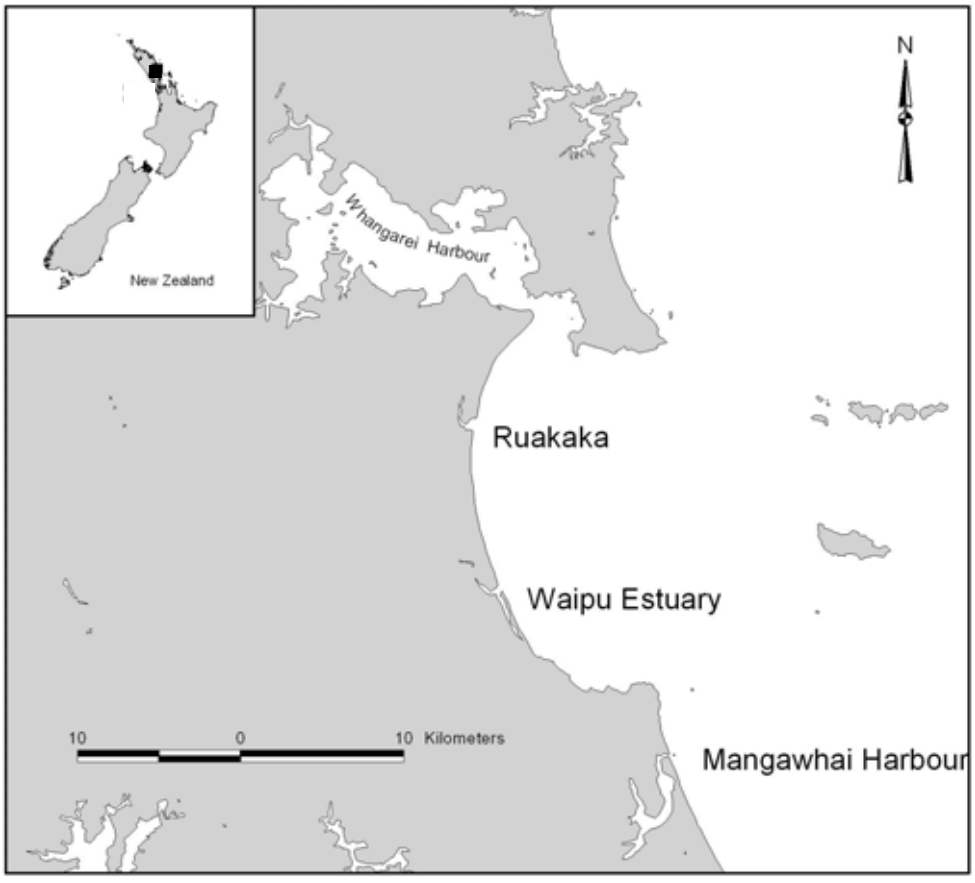

Figure 1. Location of management sites in Northland, New Zealand.

The specific questions to be answered were:

1. Are the predator-control programmes at Mangawhai and Waipu enabling higher fledging success of variable oystercatchers and New Zealand (NZ) dotterels, by habitat class (dune, open spit/beach), than at Ruakaka?
2. Is the timing of hatching of clutches with successful fledging linked with when the predator-control programme began or when specific predators were eliminated, or is it more influenced by other factors?
3. Is the fencing programme at Ruakaka providing benefit to the successful breeding of shorebirds (where breeding success is defined in terms of successful hatching and fledging of clutches, within and outside the fenced areas)?
4. What information, unpublished and published, exists on shorebirds of Mangawhai, Waipu and Ruakaka?

1.1 SITE INFORMATION

The Mangawhai Wildlife Refuge is c. 245 ha in area on a 3.5-km-long sand spit situated between the Mangawhai Harbour/Estuary and the ocean. The spit is lightly vegetated, predominately of spinifex (*Spinifex sericeus*) and pingao (*Desmoschoenus spiralis*), with extensive bare and mobile sand and shell areas. Breeding areas for shorebirds include open sandy areas, vegetated dunes and a lightly-vegetated shell-covered human-made area (bund wall).

The Waipu Wildlife Refuge is a 3.5-km-long and c. 200-m-wide sand spit located at the mouth of the Waipu River and adjacent to a small estuary. The sand spit covers c. 128 ha and has a low-lying sandy tip on the southern side of the river mouth, and stable dunes with a moderate vegetation cover of spinifex and low herbaceous and woody plants. It contains limited breeding areas for NZ dotterels and variable oystercatchers.

The Ruakaka Wildlife Refuge consists of low sand spits and vegetated dunes of spinifex and pingao on either side of the mouth of the Ruakaka River. The refuge covers c. 83 ha.

Temporary fencing is used at all three sites to fence off the main breeding areas for NZ dotterels and variable oystercatchers. Predator control for introduced mammalian predators and native aerial predators is carried out at Waipu and Mangawhai Wildlife Refuges (see Management techniques for details).

The amount of human disturbance at the three sites varies. Ruakaka has the highest level of disturbance, with residential properties adjoining the refuge on the south side of the river, and a campground on the western edge. The campground has c. 10 000 visitors over the summer holiday period (G. Acethorp, pers. comm.) and the level of disturbance is high, with people using the refuge for recreational activities and beach access. Generally, the beach and refuge are used during most of the daylight hours over summer with the peak from mid-morning to the evening (KH, pers. obs.).

Waipu has a lower level of disturbance, with only about a dozen residences adjoining the estuary and a lower level of visitation over the summer period (KH, pers. obs.). During summer and autumn a major visitor group comprises

overseas backpackers from a hostel at the end of Johnson Point Road and campers from the campground at the southern end of the refuge. Recreational use of the refuge includes collecting cockles from the estuary, fishing off the beach and general beach use. Some fishers use the refuge at night for fishing. Both Ruakaka and Waipu campground managers are supportive of DOC.

Mangawhai has the lowest level of disturbance for its size. The local community is generally very supportive of the shorebird protection programme and this assists in reducing the level of disturbance because locals talk to visitors about the shorebirds and report compliance incidents to the Department. The numbers of local visitors to the refuge outside of the holiday season is minimal. During the Christmas–New Year holiday period there are several thousand visitors to the refuge (KH, pers. obs.). Most people who access the spit come by boat, while others walk up the spit along the beach.

1.2 MANAGEMENT TECHNIQUES

Wardens were employed over the summer breeding season to monitor and protect the breeding shorebirds. Initial monitoring of the shorebirds' breeding attempts was started in mid September each season (1997–2003) by the project manager. Intensive monitoring occurred once the second warden was employed, generally mid October, and carried on until the end of January–mid February. Protection of the shorebirds involved trapping for introduced mammalian predators, controlling native aerial predators, fencing off the main nesting areas of NZ dotterels and variable oystercatchers (to reduce disturbance and trampling), other nest protection measures (such as moving nests threatened by high tides), and advocacy of the status of the shorebirds, their habitat and the regulations governing the wildlife refuges.

The temporary fences were erected during September or October each season, to coincide with the start of the shorebird breeding season and the increase of people on the beaches. The fences were maintained during the breeding season as needed. Only some of the NZ dotterels and variable oystercatchers nested within the fenced off areas. At Waipu and Mangawhai the fenced-off areas generally are where nests are concentrated, while the unfenced areas are where there are lower numbers of and more scattered nests. At Ruakaka, most nests are fenced, incorporating high and low density sites.

The trapping programme for introduced mammalian predators was started in 1996/97 at Mangawhai and in the 1997/98 season at Waipu. The predators targeted were: mustelids (*Mustela* spp.), cats (*Felis catus*), rats (*Rattus* spp.) and hedgehogs (*Erinaceus europaeus occidentalis*), using leg-hold (Victor 1.5) and kill (Fenn Mk6) traps. The predator-control programme was run for approximately 5.5 months (mid-August to end of January–early February) each summer to cover the shorebird breeding season. Trapping generally preceded the breeding season by 1 to 2 months, although in one season (1998) the first NZ dotterel nest was found 2 weeks before trapping started. The trap line ran along the southern boundary of the refuge at Mangawhai and consisted of a loop across the spit at Waipu, south of the concentration of nesting shorebirds at the northern end of the spit.

2. Methods

Data on NZ dotterel and variable oystercatcher breeding success and results from the predator-control programme were collated from the end-of-season reports (see unpublished literature in section 6) for seven seasons, 1997/98 to 2003/04. The data recorded for analysis were the number of: nests found for each species; nests in dunes; nests in open habitat; young successfully raised (fledged); young fledged from dunes; young fledged from open habitat; nests fenced; and young fledged from fenced nests (Table 1). As most chicks were not followed through from hatching to fledging, chicks that were seen at 3 weeks of age or older were deemed to be successfully raised and were assumed to have fledged (Cumming 1991). All young considered in the analysis as 'fledged/ successfully raised' were those recorded as approximately 3 weeks old or older (those seen at a younger age were not used in the analysis).

Only data for years with complete datasets were analysed. Although data were extracted from the reports for the 7 years of study, for some years insufficient detail was recorded to determine the number of young raised from dunes, open habitat or fenced areas. Consequently, these years were excluded from analysis (see Table 1).

The data from Waipu and Mangawhai, both sites with predator control, was reported separately when comparisons between each of these sites and Ruakaka differed in their interpretation of significance of trend. Otherwise comparisons are made with the data from the predator control sites combined. The results were compared using Chi-squared tests. In this paper each season's breeding success was defined as the total number of young of each species that was raised from the number of nests found at each site.

3. Results

Table 1 summarises the number of nests and chicks raised by location and fencing status during the monitoring programmes. On average, between 0.54 and 0.50 (n = 5 years) NZ dotterels were raised per nest at Mangawhai and Waipu, respectively, and 0.74 (n = 5 years) young per nest were raised at Ruakaka. Between 0.40 and 0.54 (n = 5 years) variable oystercatchers per nest were raised at all three sites. See also Figs 2 (Mangwhai) and 3 (Waipu).

3.1 EFFECT OF PREDATOR CONTROL ON NUMBER OF YOUNG RAISED

There was no significant difference in the number of NZ dotterels raised at Ruakaka, without predator control, compared with Mangawhai and Waipu (data pooled), both with predator control (χ^2 = 2.096, 1 d.f., P > 0.05). In contrast

TABLE 1. NEST AND FLEDGING COUNTS INDICATING SUCCESS AT MANGAWHAI, WAIPU AND RUAKAKA MANAGEMENT SITES.

	MANGAWHAI				WAIPU				RUAKAKA			
	NZ DOTTEREL		OYSTERCATCHER		NZ DOTTEREL		OYSTERCATCHER		NZ DOTTEREL		OYSTERCATCHER	
	n=7	n=5	n=7	n=5	n=7	n=5	n=7	n=5	n=7	n=5	n=7	n=5
	1997/98 –2003/04	1998/99 –2002/03	1997/98 –2003/04	1998/99 –2002/03	1997/98 –2003/04	1998/99 –2002/03	1997/98 –2003/04	1998/99 –2002/03	1997/98 –2003/04	1998/99 –2002/03	1997/98 –2003/04	1998/99 –2002/03
Nests												
Total	191	148	231	148	127	106	294	213	35	29	182	127
In dunes	99	75	107	71	55	45	121	88	10	9	64	45
In the open	92	72	124	77	73	61	173	125	25	20	118	82
Raised												
Total	109	80	100	62	66	53	187	116	26	24	73	57
In dunes	–	47	46	33	28	25	61	43	12	12	19	17
In the open	–	33	54	29	38	28	124	73	14	12	54	40
Nests: fenced	47	40	43	32	111	92	228	164	30	28	148	106
Raised: fenced	–	18	–	17	53	42	124	94	22	22	55	44

there were significantly more variable oystercatcher young raised at Ruakaka, than at Waipu (χ^2 = 11.361, 1 d.f., $P < 0.05$) but there was no significant difference in the numbers raised between Ruakaka and Mangawhai (χ^2 = 0.246, 1 d.f., $P > 0.05$).

The effects of predator control, and the lack of control, were also assessed using the habitat categories 'dune' and 'open spit/beach', using data from the 5 years of 1998/99 to 2002/03. In the dunes, significantly more NZ dotterels were raised at Ruakaka sites (without predator control) than at Mangawhai and Waipu (the two predator-control sites) (χ^2 = 6.914, 1 d.f., $P < 0.05$). However, there was no significant difference in the number of variable oystercatchers raised in the dunes at Ruakaka or Mangawhai and Waipu (χ^2 = 0.773, 1 d.f., $P > 0.05$). In the open spit/beach habitat, no significant difference was found in the numbers of NZ dotterels (χ^2 = 0.782, 1 d.f., $P > 0.05$) or variable oystercatchers (χ^2 = 0.034, 1 d.f., $P > 0.05$) raised from at Ruakaka or Mangawhai and Waipu.

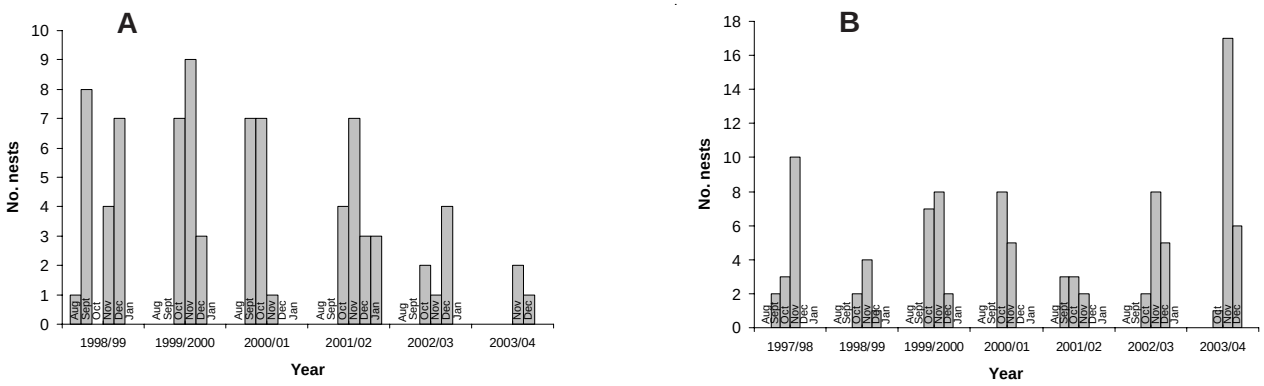

Figure 2. Number of NZ dotterel nests (**A**) and variable oystercatcher nests (**B**) that successfully fledged young at Mangawhai.

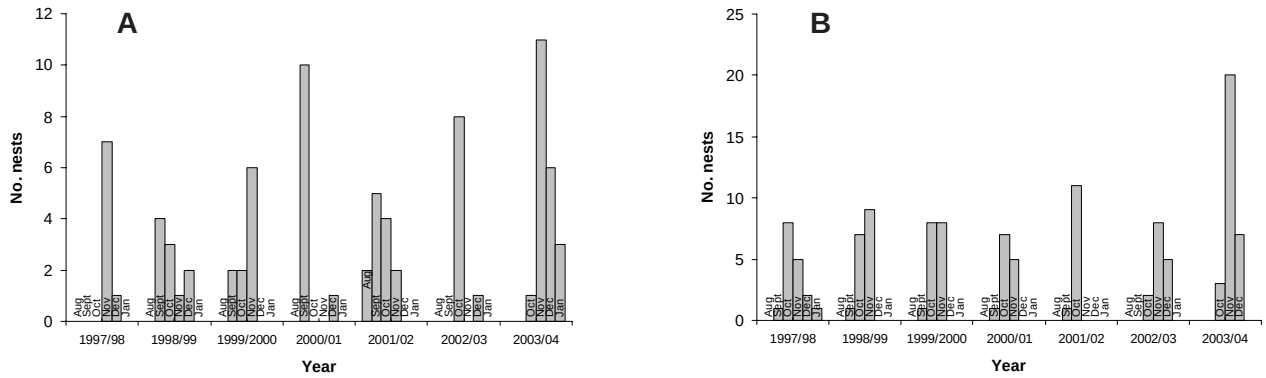

Figure 3. Number of NZ dotterel nests (**A**) and variable oystercatcher nests (**B**) that successfully fledged young at Waipu.

3.2 INFLUENCES ON THE TIMING OF HATCHING OF CLUTCHES THAT SUCCESSFULLY FLEDGE YOUNG

The earliest commencement date for any predator control was 12 August 2003 at Mangawhai, and the latest was 15 September 1997 at Waipu. The earliest recorded laying date was a NZ dotterel nest on 12 August 1998 at Mangawhai, approximately 2 weeks before the trapping programme started there. The fate of this nest was unknown, but another NZ dotterel nest laid during that August was successful. The earliest recorded laying date for variable oystercatchers was 5 October 2000 at Waipu. However, the recorded hatching dates of some variable oystercatcher nests indicated that they were laid in September.

At Mangawhai, predators were caught throughout the trapping programme. During 5 of the 7 years most animals caught were hedgehogs and ship rats (*Rattus rattus*). Hedgehogs and ferrets (*Mustela putorius*) predominated in the other 2 years. At Waipu, predators were caught in all but 1 month of the trapping programme. The majority of animals caught were Norway rats (*Rattus norvegicus*).

Egg losses due to predation were recorded only in 1997/98 to 1999/2000 and 2003/04 at Mangawhai. Egg losses due to predation, or suspected predation, occurred during all years at Waipu and throughout the trapping period (Table 2). The number of egg losses that could be attributed to predation was small in relation to the number of clutches laid (Tables 1 & 2). It appears that other causes, such as disturbance and tidal inundation, are more important factors in egg loss (Table 3). Both NZ dotterels and variable oystercatchers have the ability to replace clutches each season so egg and clutch losses were potentially not as serious a problem as they first appeared. Analysis of the month in which successful clutches (i.e. with fledged young) were laid showed that successful clutches were laid over a number of months and suggests that predator densities were not high enough, or having a severe enough impact, to restrict breeding to any one period.

It was frequently not possible to relate predation events to any specific predator or predator group. However, major losses of NZ dotterel eggs occurred at

TABLE 2. NUMBER OF EGGS LOST TO PREDATION AT SITES WITH PREDATOR-CONTROL PROGRAMMES.

	MANGAWHAI		WAIPU	
	NZ DOTTEREL	OYSTERCATCHER	NZ DOTTEREL	OYSTERCATCHER
1997/98	5	1	4	5
1998/99	4	4	0	1
1999/2000	8	0	10	1
2000/01	0	0	27	5
2001/02	0	0	0	1
2002/03	0	0	6	0
2003/04	5	18	7	0
Total	22	23	54	13

Waipu in 2000/2001. This was thought to be due to rats because when traps were placed at these sites and Norway rats were removed, egg losses ceased. However, there were insufficient data to link removal of specific individual predators to nest or clutch failure in any instance.

3.3 IS FENCING AT RUAKAKA BENEFITING SUCCESSFUL BREEDING?

Breeding success is defined as the successful fledging of young. It appears that the fencing programme at Ruakaka has not provided a higher level of protection (Table 1). There were no significant differences in numbers of NZ dotterels ($\chi^2 = 1.720$, 1 d.f., $P > 0.05$) or variable oystercatchers ($\chi^2 = 1.624$, 1 d.f., $P > 0.05$) raised from within the fenced areas compared to the numbers raised outside of them.

A similar comparison at Waipu and Mangawhai (data pooled) also found that there was no significant difference in the number of NZ dotterels or variable oystercatchers raised from within or outside the fenced areas ($\chi^2 = 0.008$, 1 d.f., $P > 0.05$; $\chi^2 = 0.005$, 1 d.f., $P > 0.05$, respectively).

TABLE 3. THE FATE OF THE EARLIEST TWO NESTS AT EACH LOCATION DURING THE 7 STUDY YEARS AT SITES WITH PREDATOR-CONTROL PROGRAMMES.

NUMBER	MANGAWHAI		WAIPU	
OF NESTS	NZ DOTTEREL	OYSTERCATCHER	NZ DOTTEREL	OYSTERCATCHER
Found	14	14	14	14
That hatched	1	2	4	4
In which young were raised	0	1	2	2
Lost to predation	1	0	4	1
Lost to other causes	12	12	6	9

4. Discussion

There are limited published data on the productivity of NZ dotterels and variable oystercatchers at unmanaged sites in northern New Zealand (Marchant & Higgins 1993). However, these limited data suggest that most losses occur at the egg and young chick stages, and that once young reach 3 weeks old they fledge (Cumming 1991). Cumming (1991) recorded a difference in NZ dotterel productivity, measured as number of fledged young per breeding pair. He found 0.62 fledglings per nest (SE = 0.21) for sites he considered less human disturbed, and 0.31 (SE = 0.22) at more disturbed sites. However, because of the lack of control of disturbance at each type of site and the study's short duration, the differences were not significant. Wills et al. (2003) also found that chick survival was not significantly greater in managed sites than unmanaged sites on Matakana Island, even though the number of chicks fledging increased per nest from 0.26 to 1.04 over an 8-year period after management began. Syddell (1999) looked at breeding at the unprotected Karikari and Puwheke beaches, Karikari Peninsula, Northland, in 1998/99. She found that the fledging rates were 0.02 (n = 21) and 0 (n = 6) per nest (0.09 and 0 fledglings per breeding pair) for NZ dotterels, and 0.1 (n = 15) and 0.2 (n = 3) per nest (0.42 and 0.66 per breeding pair) for variable oystercatchers, for Karikari and Puwheke beaches, respectively. Fleming (1990) found that a pair of variable oystercatchers at Waikanae fledged 16 young in 11 of 18 breeding seasons and at least 21 clutches (≤ 0.52 young per nest).

The productivity reported at Ruakaka, Waipu and Mangawhai in this study ranged from similar to or up to 4–5 times higher than that found at most of the above-mentioned unprotected sites. However, despite the apparent success of management, some of the results of this study are unexpected. This may be due to a number of factors including: different effort and personnel skills over the years, the lack of detailed knowledge of nests' success, difficulty monitoring chicks and small sample sizes.

It was expected that the habitat types that NZ dotterels and variable oystercatchers used for breeding would result in similar productivity for each species at each site. However, the comparisons of both dune and open spit/beach habitats found significantly more NZ dotterels raised from the dunes at Ruakaka than at Mangawhai and Waipu, but there was no difference between locations in the numbers raised from the open habitat. This would indicate that at Ruakaka the dunes are conferring some benefit to the NZ dotterels nesting over those nesting on the spit/beach. More work is needed to understand this difference. Nests in the open at Ruakaka may be more affected by disturbance, even though both habitat types are fenced off. Keller (1989) found that clutch losses of greater crested grebes (*Podiceps cristatus*) were significantly greater from areas with more frequent disturbance than in undisturbed areas. More effort may be needed to protect the birds nesting in open habitat and reduce disturbance at Ruakaka.

There was no significant difference in the number of variable oystercatchers raised in both dune and open spit/beach habitats in comparisons between

Ruakaka and the pooled data of Mangawhai and Waipu. The reasons for the difference between NZ dotterels and variable oystercatchers at Ruakaka is unknown and requires a greater scrutiny of observer effort and investigations into the timing of breeding and location of nests at Ruakaka.

The predator-control programme at Mangawhai and Waipu would have been expected to have resulted in higher breeding success by NZ dotterels and variable oystercatchers at these sites than at Ruakaka (without predator control). However, significantly more variable oystercatchers were raised at Ruakaka. Several factors may have contributed to this unexpected result. Less effort was put into monitoring at Ruakaka, as the principal focus was monitoring NZ fairy terns breeding at Mangawhai and Waipu. Consequently, undetected shorebird nests could have been laid but lost to predation or other causes at Ruakaka, resulting in a higher perceived breeding success than actually occurred.

The commencement of the mammalian predator-control programme at Mangawhai and Waipu appears to be early enough to provide protection for many of the early shorebird nests. Only a few nests were lost to predation, while most were lost owing to other causes, such as tidal inundation, or their fate was unknown. Some early nests may not have been detected because the monitoring of nests and chicks was less intensive earlier in the season (wardens were employed only for the latter part). However, even if there are earlier nests, their monitoring may not be feasible owing to cost (disproportionately high for a limited number of nests). Both NZ dotterels and variable oystercatchers are known to lay up to three clutches after loss (Hansen 1998; Syddell 1999) and these later nests would be protected by the then existing predator control.

Only some of the potential predators of shorebird eggs and chicks (Wills et al. 2003) are controlled directly at Waipu and Mangawhai, while others like black-backed gulls (*Larus dominicanus*) are controlled only when nesting near NZ fairy tern nests. The lack of significant difference between fledging at predator-controlled and non-predator-controlled sites suggests that we are not controlling some of the important predators at controlled sites, or that predation is only one of many loss factors. It could be that egg and chick losses are likely from other causes even when mammalian predators are controlled. It should also be remembered that this programme is run as a consequence of NZ fairy tern management, and predator control is primarily manipulated to protect the nesting terns.

There was insufficient clarity in the data to link the lack of removal of specific predators to nest or clutch failure. However, predator control at sites with known predator problems was an effective tool in reducing egg losses.

The NZ dotterels and variable oystercatchers within fenced areas were expected to raise more young than those outside these areas, as fencing was expected to confer protection against human disturbance. However, there was no significant difference between the numbers of NZ dotterels and variable oystercatchers raised within fences and outside them at all three sites. The result at Ruakaka was unexpected and it is possible that the fenced areas are too small, and too much of each area is prone to disturbance from people walking along the margin of the fencing. Finney et al. (2005) found that when human

access through a golden plover (*Pluvialis apricaria*) breeding area was restricted to a footpath, the birds' flush distance was reduced from 200 m to 50 m. In addition, at Ruakaka, there is no protection from disturbance from factors such as stray dogs (T. Beauchamp, pers. comm.; KH, pers. obs.). At Waipu and Mangawhai the human disturbance factors may currently be so low that there is no real difference in interaction between outside and inside the fenced areas, or access to feeding areas.

The data collected by the wardens were of variable quality. In some years more observations and monitoring had been carried out, and there was no systematic indication of effort in the existing data. In most years it is likely that many nests were lost before they were detected. There are also substantial learning curves and experience issues for personnel. It is often difficult to monitor chicks to fledging owing to the open nature of the beach environment, the low vegetated dune habitats, and the defensive behaviour of the shorebirds.

5. Recommendations

The shorebird protection work reported here is funded by the NZ fairy tern programme. This programme is highly visible due to staff presence, fencing and signage. Monitoring shorebirds helps with predator management decisions affecting NZ fairy terns. The information gathered from monitoring NZ dotterel breeding success also feeds into the management of NZ dotterel in the Whangarei Area Office and to the NZ dotterel recovery group. The accuracy of the data is key to informing management, and we need to be sure that we are collecting adequate data of sufficient quality to provide for long-term Departmental needs.

The data and data quality needs of the Ruakaka, Waipu and Mangawhai shorebird programme must be reassessed to ensure that DOC gains maximum benefit from this work.

More effort should be put into monitoring NZ dotterel nests and chicks at all sites, to obtain more accurate information on fledging success and effectiveness of fencing. One way to facilitate this would be to develop standard data collection sheets, so the wardens have a prescribed method for data collection.

The programme is most visible at Ruakaka owing to the high visitor use, and a very high level of disturbance from people, along with dogs and cats, is seen at this site. A high level of advocacy is also undertaken here. The programme, as a result, may be achieving substantial advocacy benefits for shorebirds above the real benefits of protection, or it may be that the protection measures, fencing for instance, are giving a false sense of comfort to the people using the site without providing actual benefits for the shorebirds.

At Ruakaka, several areas require investigation. Public attitudes to and perceptions about DOC's management of shorebirds need to be determined, in terms of the success/lack of success of management there, and the factors that may be causing problems to the shorebirds. Visitor movements need to be

assessed, and minimum fencing distances and fencing methods to reduce disturbance also require study.

Information about the public perceptions of management may become critical at Waipu. This site is similar in size and habitat to Ruakaka but is more important as a shorebird breeding site. Residential subdivision of the rural areas surrounding Waipu Wildlife Refuge is expected to increase over the next few years. Information on shorebird fledging success and public perceptions will be necessary to assess the effectiveness of current management actions and to determine improvements to protection methods before greater human impacts occur at Waipu.

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