Establishment of shore plover *(Thinornis novaeseelandiae)* on Motuora Island

Part 1: Second release, September 1995

A. Davis and H. Aikman

Part 2: Third release, February 1996

H. Aikman

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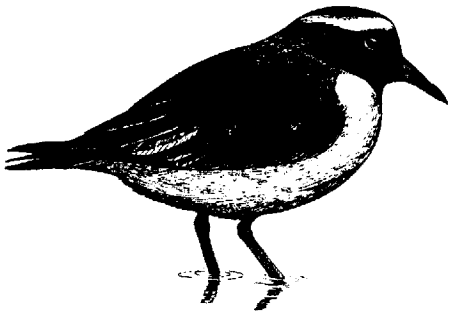

Part 1 Second release, September 1995

Abstract

Fifteen shore plover were transferred from captivity to Motuora Island in August 1995, held in aviaries on the island for a month, then released. Numbers of shore plover rapidly declined and, after 20 days, only four remained there. The two key problems in establishing shore plover on Motuora Island were predation by moreporks and dispersal of shore plover from the island. Habitat suitability and prey availability do not appear to be factors causing shore plover to leave Motuora Island. Encouraging site fidelity is seen as being the biggest obstacle to overcome, although it is recommended that the impact of morepork predation or harassment requires further research. A number of proposals to improve site fidelity to Motuora Island among shore plover are discussed, most significantly breeding or rearing birds in captivity on the island. Recommendations on the future of the shore plover programme on Motuora Island are made, including making further releases under different conditions, and following up the longer-term fate of released shore plover on the island and the mainland.

1. Introduction

This investigation reports the results of intensive monitoring of a second shore plover release on Motuora Island, and makes recommendations on future shore plover releases and the species management on the Island.

1.1 BACKGROUND

Shore plover *(Thinornis novaeseelandiae)* are an endangered species found as a single population numbering between 40 and 45 breeding pairs on Rangatira Island (also known as South-east Island), a small island in the Chatham Islands. Their population and behavioural ecology has been extensively researched by Davis (1987).

Concern for the species' long-term survival led to development of a recovery plan for shore plover that included, among a number of key management actions, the establishment of a second population using captive-bred stock (draft plan - Davis 1989; updated plan - Canterbury Conservancy, Department of Conservation 1993).

Davis (1987) listed a number of habitats that could be suitable for the (re)introduction of shore plover, and this list was carried forward into the recovery plan.

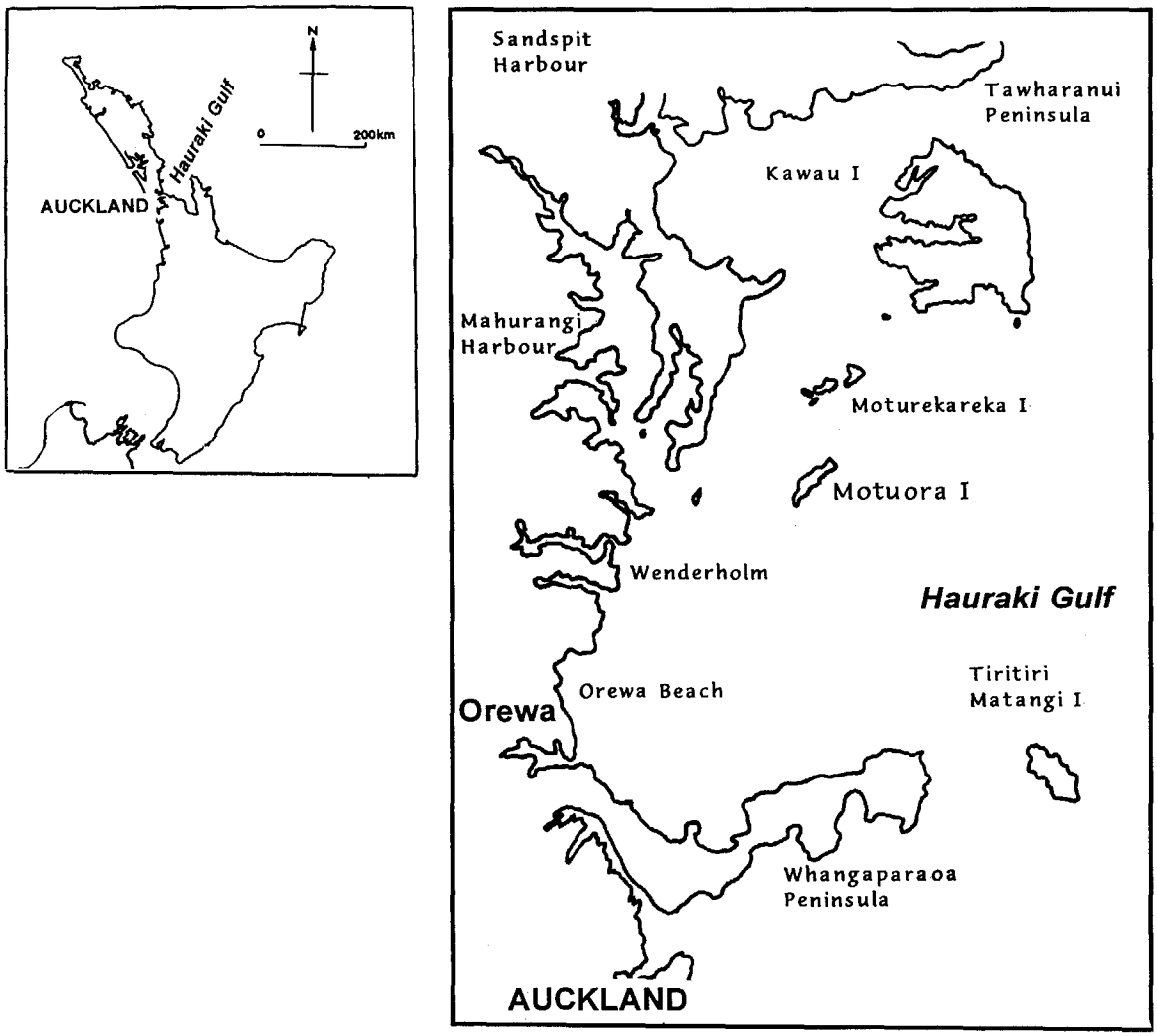

FIGURE 1: LOCATION OF MOTUORA ISLAND AND NEARBY MAINLAND COAST.

shore habitat, and the absence of mammalian predators. As shore plover had been recorded as widespread throughout the coastal areas of mainland New Zealand in the late 1880s, any habitat within the New Zealand region was considered.

Motuora Island, which is 5 km off the mouth of Mahurangi Harbour, on the east coast just north of Auckland (Fig. 1) was identified, along with Mana Island, off Porirua Harbour, as a priority location to attempt to reintroduce shore plover.

1.2 MOTUORA ISLAND AS A SITE FOR SHORE PLOVER ESTABLISHMENT

Davis (1994) provided a detailed assessment of the suitability of Motuora Island for the reintroduction of shore plover. The assessment concluded that Motuora Island would provide sufficient habitat to support a self-sustaining shore plover population, although there were concerns over the quality of chick-raising habitat and the ability of shore plover to remain on the island. Reasons given for

Motuora's suitability for shore plover included: the coastal habitat type of mixed rock platform and sandy shores; areas of pasture; secure conservation status as a recreation reserve; and, most importantly, the lack of rodents, mustelids and feral cats.

A trial release of 8 shore plover on Motuora Island in September 1994 was done to identify any problems with the transfer and release of birds and their subsequent survival. Intensive monitoring revealed an unexpected problem with morepork predation (Aikman 1995). Three shore plover were predated by harrier hawk while being held in the aviary on the island, while at least two shore plover flew to nearby mainland beaches. One bird was caught and returned to the island but soon disappeared again.

A second release of up to 20 shore plover was then proposed for August 1995 following the removal of morepork from Motuora island, as the presence of morepork was seen as the key impediment to shore plover establishing there. The Department of Conservation began removal of morepork in June 1995, and removed one pair before iwi requested that morepork not be removed from the island. The Department complied with this request and no more birds were removed. This left no time to reinstate the intensive morepork research that was originally proposed.

1.3 OBJECTIVES

The principal objective of this investigation was to fully understand the reasons for the success or failure of the second release of shore plover on to Motuora Island so as to assist planning for further shore plover releases.

Aspects to be examined included:

- the rate and cause of mortality among released shore plover;
- habitat use, activity budget, home range movement (including dispersal from Motuora Island), flock dynamics and breeding behaviour of shore plover;
- the distribution, density and behaviour of the following potential predators of shore plover:
    - morepork,
    - black-backed gull,
    - harrier hawk;
    - the response from shore plover to predators.

1.4 BIRDS TO BE RELEASED

All 15 of the shore plover for release were juvenile birds close to one year of age. All birds had been bred in captivity, 13 at the National Wildlife Centre and two at Peacock Springs in Christchurch. Twelve birds were reared by their parents and three were reared by hand.

The shore plover were divided into two groups and held in aviaries on Motuora Island for a month prior to their release. Only a small amount of aggression between captive birds was observed.

2. Methods

2.1 SHORE PLOVER ON MOTUORA ISLAND

Shore plover released on Motuora Island were monitored, by field observations, ¡ncluding one-off observations, and 1 hour or more watches of birds, for their:

- presence/absence on Motuora Island,
- location on Motuora Island,
- location at other sites,
- habitat use,
- activity,
- make-up of any shore plover flocks, and
- behaviour (such as intraspecific interactions, breeding behaviour, predator response).

Presence/absence

Twice daily checks for the presence or absence of shore plover on Motuora island were done for a month following the birds' release. The first check of the day was made soon after dawn and the second check close to dusk to determine whether shore plover were disappearing at night or during the day. They were then checked for their presence on Motuora Island every few days until mid-February.

For the first three weeks following their release, intensive searches were done around Motuora Island for shore plover once they were detected to be missing. It was suspected that most of the transmitters attached to 10 of the shore plover would have fallen off or been removed by this time. From this time, the daily checks were used to detect any missing birds.

Activity budget, habitat use, and behaviour

Shore plover activity budgets and habitat use were determined by observing birds for around two hours spread over different individual birds, time of the tide, time of the day, and habitat types. These observation began 24 hours after the shore plover release and continued to mid February. The type of habitat used by shore plover was recorded as the substrate within 10 m of the bird and the type of micro-habitat within 0.5 m.

Any breeding or territorial behaviour was noted during the course of the investigation.

2.2 SHORE PLOVER ON THE MAINLAND AND OTHER ISLANDS

The presence of shore plover on sites away from Motuora was monitored by:

- searching along the coast of islands close to Motuora Island, and the mainland from Orewa (Fig. 1) to Mangawhai (about 60 km to the north), every week for a month once shore plover were known to have first left Motuora Island;
- after these surveys in the first month, requesting interested observers and researches working in coastal areas on the mainland coastal areas specified above to report any shore plover observations;
- requesting Ornithological Society of New Zealand observers and others to search for shore plover at wader roosts on the Kaipara Harbour (about 30 km west of Orewa); and
- field checking reported sightings to confirm the birds' presence, and attempting to capture birds and return them to Motuora Island

2.3 PREDATORS

Shore plover predators were identified, and the predators' distribution, density and behaviour were determined by:

- estimating the distribution of morepork on Motuora Island by listening for morepork calls for 1-2 hour periods for 15 nights from the time of the shore plover release until mid February;
- searching during the day for a total of 12 hours for morepork roosts and pellets around sites known to have morepork present;
- searching for a total of 10 hours for predated remains of shore plover;
- determining numbers of black-backed gulls present on Motuora Island by walking around the shoreline three times for the month following the shore plover release in mid September 1995, and once thereafter every month until early February; and
- recording harrier hawks observed on Motuora Island for the duration of the investigation (mid September to mid February).

3. Results

3.1 SHORE PLOVER MOVEMENTS

Presence/absence of shore plover on Motuora Island

Fifteen shore plover were transferred to Motuora Island from the National Wildlife Centre and Peacock Springs on 16 August 1995. They were held in two separate aviaries for four weeks, then, on 10 September 1995, all were released at the same time. Initially 14 birds had `back pack' transmitters attached by glue just prior to their release. The transmitters were used to assist in locating the shore plover, including any predated remains.

Problems were encountered in attaching the transmitters, including birds getting their bills caught under the attachment and the 'back packs' falling off. Fortunately the birds that got their bills caught did so before their release from the aviaries, enabling their transmitters to be removed. It was unclear as to why these problems were encountered, as a similar method of attachment and the same glue have been used on shore plover in the past, and are currently used for New Zealand dotterel, *Charadrius obscurus* (J. Dowding, pers. comm.). Transmitters were removed from the four birds that had difficulties with them, leaving 10 shore plover with transmitters at the time of the release.

Immediately on release the shore plover took flight, circling around a short distance out to sea. There was a lot of `excited' calling when they were in flight. The birds then settled in a number of small groups on the shore adjacent to and south-west of the aviaries. Shore plover from the two aviaries mixed together almost immediately after release, and no pattern was observed of birds continuing to associate with individuals held in the same aviary.

Figure 2 shows the changes in the number of shore plover on Motuora Island following their release from the aviaries until early February 1996. Within three days of their release, numbers had dropped rapidly to six birds. Numbers rose briefly to seven birds, then fluctuated between zero and four birds until early February when, with the capture and re-release of two birds which had dispersed to the mainland, numbers rose to six. The birds observed on Motuora Island between late September and mid February were the same four individuals (detailed in the Appendices, Section 7.1). Fluctuations in the number of shore plover for the first month following the September release were also due to repeat releases of birds captured on the mainland.

Individual shore plover were absent from Motuora Island for periods varying from one to nine days. When monitoring was less intensive after mid October 1995, birds were not sighted for periods of up to 18 days. Sightings of shore plover on nearby Moturekareka Island suggest birds were spending time on this island for at least some of the time. Some absences could be explained by the search effort for shore plover on Motuora Island which lessened after the first two months following the birds' release.

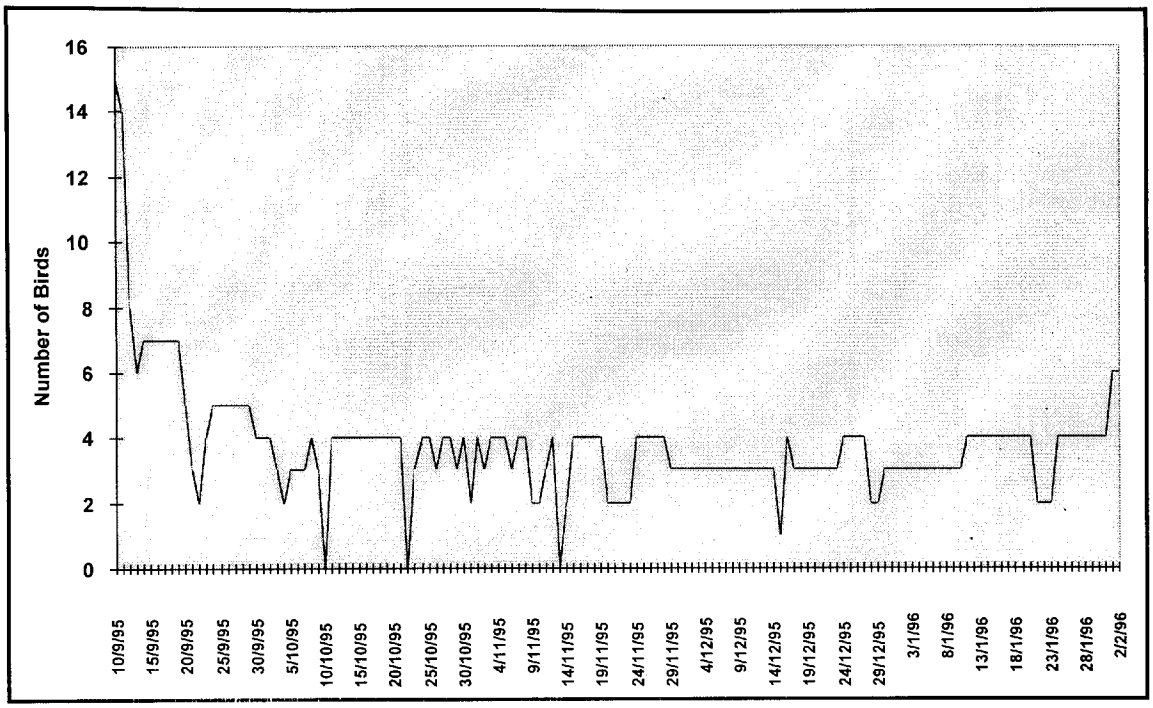

FIGURE 2: SHORE PLOVER PRESENCE ON MOTUORA ISLAND FOLLOWING THE SEPTEMBER 1995 RELEASE

Details of daily sightings of shore plover on Motuora island and elsewhere are recorded in the Appendices, Section 7.1.

Locations used by shore plover on Motuora Island

Shore plover showed a definite preference for certain locations on Motuora Island (Fig. 3). They predominantly used the south-west shore, which was also where shore plover moved to after the first release in August 1994 (Aikman 1995). The one shore plover from the first release that remained the longest on Motuora Island continued to use this area for the duration of its residency. The beach outside the aviaries (Home Bay South) was used extensively by the four shore plover present on Motuora Island, particularly when two birds captured on the mainland were held in the aviary from late November to early February.

There is no obvious explanation for shore plover choosing to occupy the south-west shores of Motuora Island. This part of the shore has a mix of substrate or habitat types, and a reasonable area above the high-tide mark. Other areas on the shore have a greater dominance of rock platform, sometimes with little area exposed above the high-tide mark. It may be that shore plover prefer to use that part of the shore which was close to their release site. The greater use made of the beach outside the aviary with two captive shore plover suggests that holding a bird in captivity could act as a drawcard for the wild birds. This is a management technique worth considering for future releases.

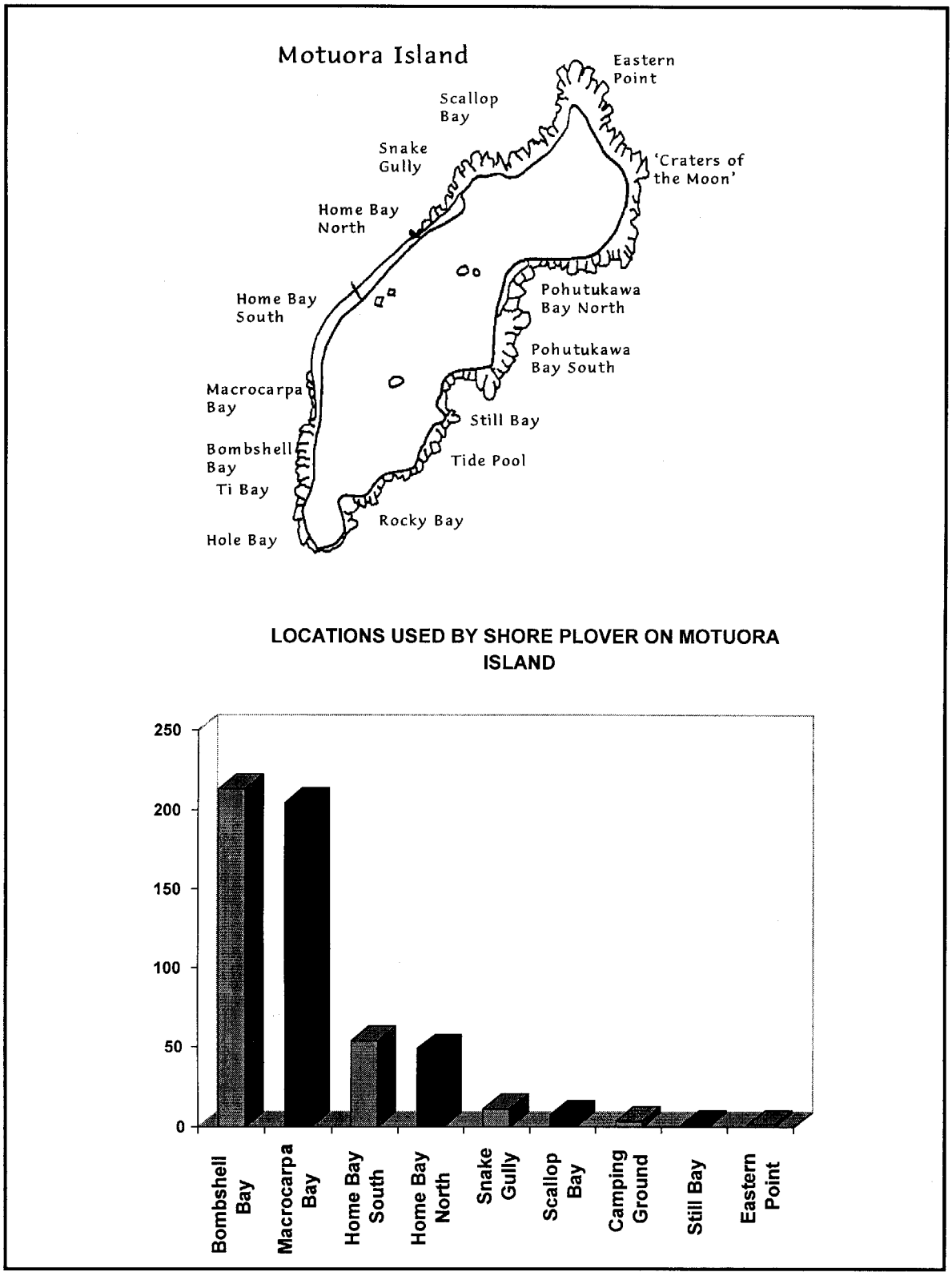

FIGURE 3: LOCATIONS ON MOTUORA ISLAND USED BY SHORE PLOVER - SEPTEMBER 1995 TO FEBRUARY 1996. NUMBER OF OBSERVATIONS, 604.

Dispersal of shore plover from Motuora

Some dispersal of shore plover from Motuora Island following their release from captivity was expected, given the results of the first release. At least two of the five shore plover released in August 1994 were sighted on the mainland (Aikman 1995). However, the dispersal of more than one-third of the released shore plover (six birds) from Motuora Island does present problems in establishing the species on the island.

Searches for shore plover on the mainland and other islands were done from September to early February. There was a greater search effort in the first six weeks following the release. Shore plover may have been overlooked during a search, but repeat visits to locations where they had previously been sighted or to locations commonly used by other wader species were likely to lead eventually to a shore plover sighting.

A variety of locations including mainland sites from Pakiri Beach, 30 km to the north, beyond Tawharanui Peninsula (Fig. 1), to Orewa Beach in the south, and sites on other islands were visited by shore plover which left Motuora Island (Table 1).

TABLE 1: MOVEMENT OF SHORE PLOVER FROM MOTUORA ISLAND FOLLOWING THE SEPTEMBER 1995 RELEASE

No. of days on Motuora before departure	Location bird sighted after leaving Motuora	Method of return to Motuora	Time held in aviary when returned	Continued presence on Motuora
1	Waiwera	Captured	Nil	Yes
1	Pakiri	Captured	Nil	No (7 days)
3	Moturekareka	Flew back	-	Yes
3	Moturekareka	Flew back	-	Yes
8	Beehive	Did not return	-	No
11	Orewa	Captured	2.5 months	Yes
22	Orewa	Captured	2.5 months	Yes
35	Orewa	Captured	Died	No

Some shore plover were captured and returned to Motuora island, where they were either released immediately or were held in captivity for up to 10 weeks. Other birds returned independently and continued to come and go from the island, while others were sighted on one occasion off Motuora Island and never seen again. No particular pattern of dispersal was detected, either in the locations shore plover moved to and from, or in relation to the length of time they were held in captivity after capture and returned to Motuora Island. However, it appears that Moturekareka Island is regularly used by shore plover on Motuora Island, and should probably be regarded as part of the Motuora habitat area. The largely predator-free status and rocky shores of Moturekareka Island make it a suitable habitat for shore plover, although small in area.

Shore plover on Rangatira Island are sedentary, with only a few records of dispersal to nearby Pitt Island (Davis 1987). Historical records are insufficient to draw any conclusions as to the dispersal behaviour of shore plover, and it is not known whether the sedentary behaviour is typical of the species, or has evolved in the Rangatira Island population. Davis (1987) recorded juveniles disappearing in the spring following their first winter rather than when they first became independent. This pattern of disappearance among juveniles is related to shortage of habitat on Rangatira Island, where breeding pairs reclaim territories at the start of the breeding season. Such a pattern of dispersal of young shore plover in the spring rather than the autumn may occur in other locations. An autumn release of shore plover on Motuora Island may therefore be more successful in holding birds there.

Shore plover released on Motuora Island were first-year birds, and birds on Rangatira Island do not breed until the beginning of their third year. Many studies on birds, including waders, have found that juveniles or pre-breeders are more likely to wander than birds of breeding age. Release of adult or breeding aged birds may have greater success in holding shore plover on Motuora Island.

However, the most successful way to promote site fidelity to Motuora Island among shore plover is likely to be achieved through rearing or breeding shore plover there. Many studies have shown that birds develop an attachment to their natal territory, often returning when they reach breeding age. It could also be expected that birds would be faithful to sites at which they have previously bred.

3.2 ACTIVITY BUDGETS

Observations of shore plover on Motuora Island showed that they spent most of their time feeding (69% of the total time observed), followed by roosting (18% of the total time observed) (Table 2). By comparison, juveniles (birds aged from fledging to the start of the following breeding season) on Rangatira Island spent 83% of their time feeding (Davis 1987). The coarse assessments of prey abundance suggest that there is plentiful potential food for shore plover on Motuora Island, although much of the feeding habitat is unavailable for six hours over a 12-hour period (Section 3.4).

TABLE 2: TIME (%) SHORE PLOVER SPENT ON DIFFERENT ACTIVITIES ON MOTUORA ISLAND - SEPTEMBER 1995 TO FEBRUARY 1996. NO. OF OBSERVATIONS, 1466.

Feeding	69
Roosting	18
Walking/running	7
Flying	3
Preening	2
Interactions	1

3.3 BREEDING AND TERRITORIAL BEHAVIOUR

Flocking behaviour

Shore plover showed a strong tendency to stay together in a group or with another shore plover (Fig. 4). Eighty-eight percent of observations were of shore plover associating with at least one other shore plover. Often the groups

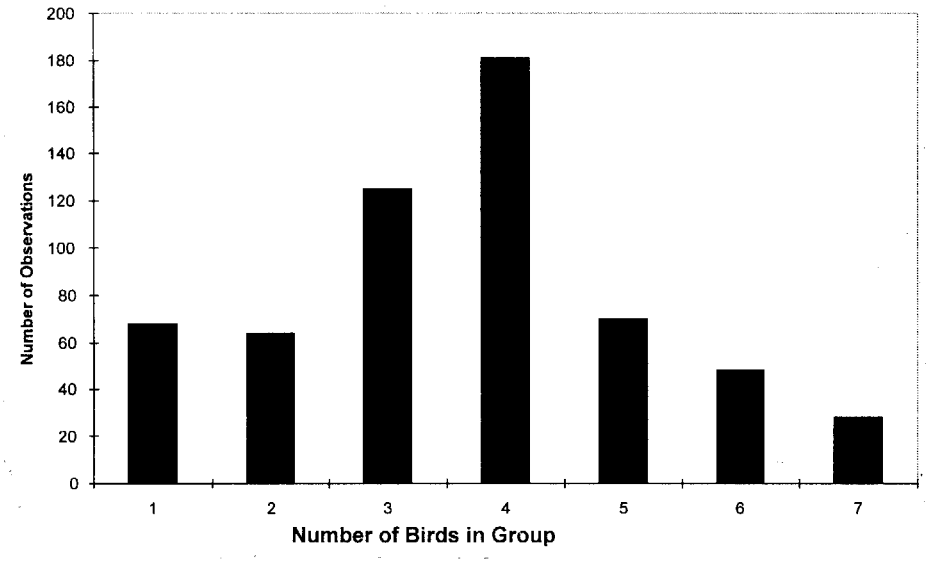

FIGURE 4: FLOCKING BEHAVIOUR AMONG SHORE PLOVER FOLLOWING THEIR RELEASE FROM CAPTIVITY ON MOTUORA ISLAND.
NO. OF OBSERVATIONS, 584.

or pairs of birds were `loose' associations with birds up to 30 m apart, but they were defined as a group because birds would keep in calling contact or would move in response to one leaving to follow another bird.

Observations of shore plover on the mainland showed that birds were rarely alone, either joining flocks of other waders, especially at high tide roosts, or other shore plover. Although they joined wader groups, they were seen being harassed by New Zealand dotterel (J. Dowding, pers.comm.).

Breeding behaviour

The only breeding behaviour observed was among the two birds recaptured in November from Orewa Beach and held in the aviaries on Motuora Island until early February. It was unclear whether these two birds formed a pair while at Orewa Beach or whether they were merely `keeping company'. However, once they were in the aviaries various aspects of breeding behaviour were observed, including nest building and courtship displays. No eggs were laid. The male bird in particular was very active in displaying to the female and showed strong territorial behaviour to shore plover visiting the aviary. The pair bond that began to form between the two birds while in the aviary was broken when they were released in early February.

It is not surprising that little breeding behaviour was observed. The shore plover were only a year old, which is one year younger than when birds on Rangatira Island first begin to breed. They were also released close to the start of the breeding season and were adapting to living in the wild. In addition, there was an uneven sex ratio, with one female to three males, throughout the breeding season. The birds held in the aviary over December January were unlikely to breed successfully given the lateness in the breeding season by the time they began building nests.

Territorial behaviour and aggression

No territorial behaviour was observed among the shore plover, except from the male bird held in the aviary over December January. Although constrained in the aviary, this bird displayed typical shore plover territorial behaviour: running about in an agitated fashion, holding his body in an upright stiff posture and calling frequently (see Davis 1987). Male birds free on Motuora Island responded to this bird by pacing outside the aviary and roosting on the aviary roof.

3.4 HABITAT AVAILABILITY AND USE

Habitat availability

The physical characteristics of Motuora Island have been described in detail by Davis (1994). The coastline is predominantly rocky, with sandy beaches on some stretches. The rocky coast includes extensive flat-profiled intertidal platforms, which in some places extend to the cliff edge but are mostly backed by boulders or narrow sandy beaches. Gravel beaches backing rock platforms are present, but are uncommon. The relative proportions of substrate available to shore plover as habitat are:

Rock platform	85%
Sand	11%
Boulders	4%
Shingle	1%

Motuora Island's shore differs from that of Rangatira Island in having a greater variety of substrate types. However, the dominant substrate on Rangatira Island, rock platforms, is also the dominant type on Motuora Island.

Although considerable area and a variety of substrate types are available for shore plover on Motuora Island, access depends on the state of the tide (Fig. 5, Table 3).

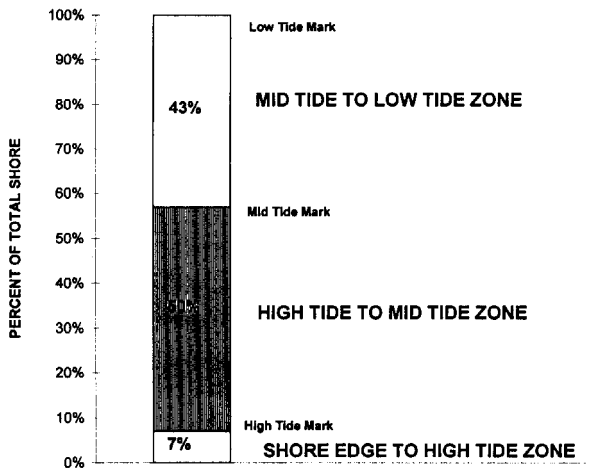

FIGURE 5: AVAILABILITY OF THE SHORE AREA AT DIFFERENT STAGES OF THE TIDAL CYCLE.

TABLE 3: HABITAT OR SUBSTRATE TYPES OF SHORE AREA (%) IN 3 TIDAL ZONES ON MOTUORA ISLAND

	Shore edge to high tide	High tide to mid tide	Mid tide to low tide
Percentage of total shore	7	50	43
Substrate types			
Rock platform	9	82	94
Sand	64	11	6
Boulders	18	7	-
Shingle	9	-	-

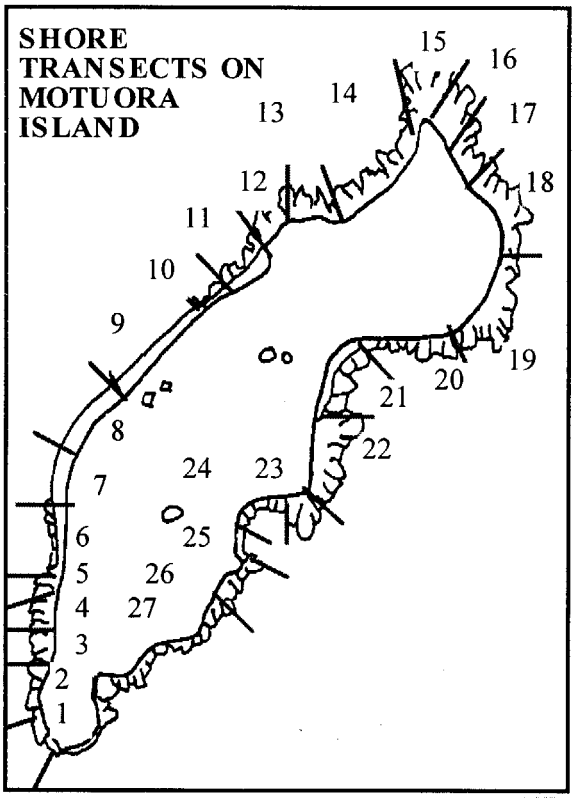

FIGURE G: LOCATION OF TRANSECTS TO MEASURE WIDTH OF TIDAL ZONES ON MOTUORA ISLAND.

For six hours of a tidal cycle, only 57% of the total habitat area on the shore is available to shore plover. At high tide the dominant substrate available is sand, while the dominant substrate of the lower two tidal zones is rock platform. The mid-tide to low-tide zone is dominated by wet algae-covered rock platform and shallow pools. These substrates support relatively rich and diverse invertebrate populations suitable as shore plover prey.

The location of transects to measure the area of shore exposed at different stages of the tide around Motuora Island is shown in Fig. G. The availability of shore habitat at different tidal states varies around the shore (Fig. 7). Only a few locations have no area above the high tide mark, while all locations have considerable areas exposed at mid and low tide.

Shore plover predominately used the shore between transects 3 and 8 (Bombshell Bay to Home Bay South) (see Section 3.1). These locations combined considerable areas above the high tide mark with large areas exposed between mid and low tide. Other locations which appeared to combine similar features were between transects 13 and 17 (Scallop Bay to Eastern Point), and transects 21 to 25 (Pohutukawa Bay to Still Bay). These locations are expected to provide the most suitable habitat for shore plover in the future.

The area of feeding habitat varies around the island and is likely to influence future spatial arrangements of shore plover territories.

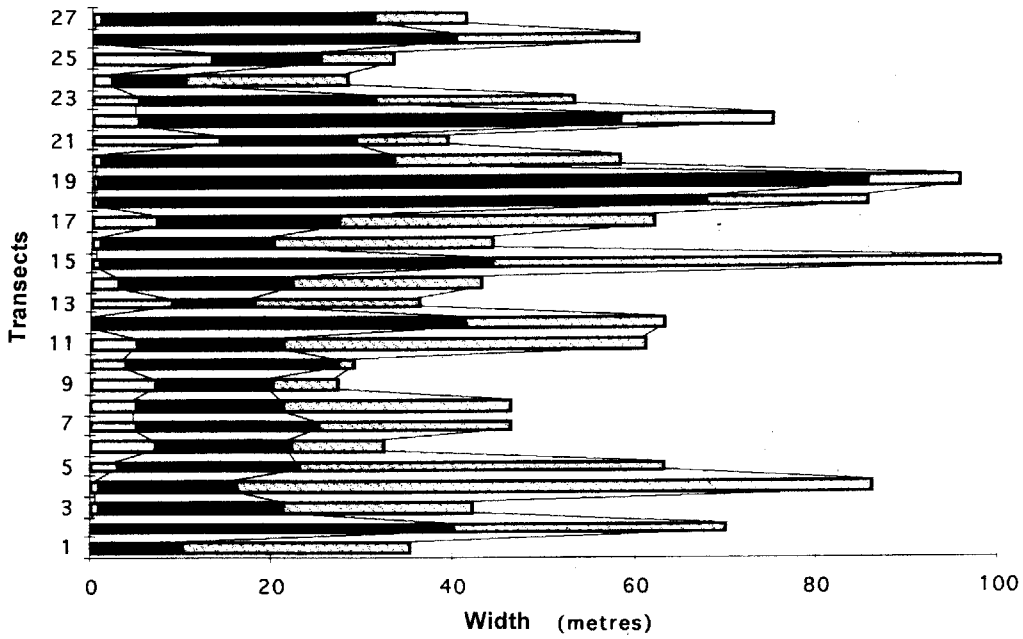

FIGURE 7: SHORE TRANSECTS AROUND MOTUORA ISLAND SHOWING THE DIFFERENT WIDTHS OF 3 TIDAL ZONES: SHORE MARGIN TO HIGH TIDE (LEFT); HIGH TIDE TO MID TIDE (CENTRE); MID TIDE TO LOW TIDE (RIGHT).

Territories would have variable areas to retreat from high tide waters, which could affect chick survival rate. During high tide, especially during spring tides or during large swells, a number of the platforms become completely inundated with water. Shore plover present in these areas would need to take refuge in sites above the high-tide mark. This could be a particular problem for chicks, which are less mobile than adult birds, and could cause breeding disruptions. On Rangatira Island, at times of extreme stormy weather when the rock platforms became inundated with breaking swells, shore plover moved on to land among the salt meadows of the `Clears' area to shelter. The pasture on top of Motuora may fulfil a similar function.

While chicks may drown or starve due to inundation by the sea, it is not thought that this will be a frequent occurrence. A loss of a brood, or failure to produce offspring for 1 season is unlikely to be a major problem in the long term for shore plover, which, given enough food, can readily re-nest, and are known to be relatively long-lived for a plover species.

Invertebrate prey, food availability and feeding habitat

Davis (1994) describes the shore invertebrate species, distribution and abundance on the shore of Motuora Island. Amphipods (sand hoppers) were found to be abundant among seaweed wrack piled up at the mean high tide mark on sandy beaches around the island. The amount and distribution of wrack varies through the year, but at least some piles were always found. The rock platforms provide a variety of habitat for invertebrates, including bare rock surfaces, sometimes with a covering of surface film water, various algae species *(Hormosira, Corallina,* filamentous green algae), and a mixture of shellfish species (oysters, *Nerita,* barnacles).

TABLE 4: INVERTEBRATES RECORDED ON THE SHORES OF MOTUORA ISLAND (FROM DAVIS 1994).

Invertebrate	Relative abundance
Nerita	Abundant
Barnacles	Common (at sea edge)
Oysters	Common
Ribbed Cellana	Common-Occasional
Amphipods	Locally abundant
Copepods	Occasional
Isopods	Occasional
Crabs	Occasional
Oyster borer (variable size)	Occasional
Polychaete	Occasional
Chitons	Occasional

Invertebrates recorded on these shore habitats are listed in Table 4. Isopods, copepods, amphipods, and polychaete worms have been recorded as shore plover prey (Davis 1987). During the investigation by Davis (1994) all were observed but only amphipods were locally abundant in shallow pools and among algae beds covered by a shallow surface film of water. They were within the size range of prey taken by shore plover.

Habitat use

Shore plover on Motuora Island showed a definite preference for habitats with sand, although rock platform in association with sand was also important (Table 5). Roosting mostly occurred on sand, while feeding occurred in habitats with a mix of sand and rock platform and habitats with sand alone in fairly equal proportions. Rock platform alone was used to a lesser degree. Shingle, boulders and pasture habitat were not used to any great extent by shore plover.

Within the broad habitat types, shore plover fed in a variety of microhabitats (Table 6). Sand-based microhabitats were used in nearly equal proportions to rock-based microhabitats. Bare sand was the single most important microhabitat used by shore plover for feeding, accounting for 37% of

TABLE 5: HABITAT TYPES USED (%) BY SHORE PLOVER ON MOTUORA ISLAND.

	General	Roosting	Feeding
Habitat type			
Sand	40	52	39
Rock platform/sand	38	40	39
Rock platform	19	8	22
Pasture	1		
Air	3		
No. of observations	1466	263	1009

observations. Wrack on sand and algae on rock platform were also important feeding sites.

Amphipods are the major prey available in sand and wrack, while a much greater variety of prey is available in rocky microhabitats, particularly algae. The high use of sand microhabitats for feeding may in part be a reflection of the length of time that sand is accessible over a tidal cycle (see Table 3).

The tide edge and the mean high tide mark were zones on the shore where shore plover concentrated their feeding (Fig. 8). It is likely that invertebrates preyed on by shore plover are more active where tidal water is washing about, and therefore more easily detected by shore plover. Wrack, which is mostly washed-up algae, is commonly heaped up at the mean high-tide mark, and is habitat for amphipods, a common prey species of shore plover.

Mainland habitat types and use by shore plover

The mainland coast and shores of other islands near to Motuora Island are a mix of boulder beaches, narrow rock platforms, sandy beaches and small estuaries or river mouths. Sightings of shore plover which left Motuora Island for the mainland following the September 1995 release were predominately of birds on sand habitats. There were a few sightings of birds on rock platforms. Most commonly the shore plover were located where rivers or small estuaries entered

TABLE 6: MICROHABITATS USED (%) BY SHORE PLOVER TO FEED ON MOTUORA ISLAND. NO. OF OBSERVATIONS, 1009.

Bare sand	37
Sand/wrack	17
Sand/surface film	2
Bare rock	9
Rock/algae	13
Rock/surface film	5
Rock/shellfish	3
Rock/algae-surface film	9
Rock/shellfish-surface film	5

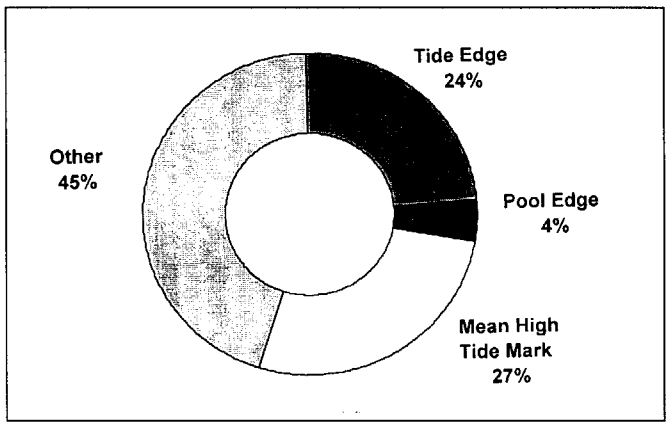

FIGURE 8: ZONES ON THE SHORE USED BY SHORE PLOVER FOR FEEDING, MOTUORA ISLAND. NO. OF OBSERVATIONS, 1009.

the sea. These sites were where waders commonly roosted, including New Zealand dotterel *(Charadrius obscurus),* variable oystercatchers *(Haematopus unicolor),* and migratory waders such as South Island pied oystercatchers (*H. finschi)* and godwits *(Limosa* spp.*).*

Two birds from the 1994 shore plover release were sighted soon afterwards using sandy beaches on the mainland, while a bird was sighted on the Kaipara Harbour several months later. This bird was among a large flock of waders at Jordan's Roost. A second sighting of a shore plover at Jordan's Roost was made in January 1996 (S. Davies, pers. comm.).

Although shore plover exclusively use rocky platform and salt meadow/ tussockland habitats on Rangatira Island (Davis 1987), historical records indicate a wide range of habitats were used in New Zealand by shore plover in the past, including shingle beaches, estuaries, and rocky coast. However, the degree to which shore plover used sandy beaches on the mainland was not expected.

3.5 POTENTIAL POPULATION SIZE AND TERRITORY ARRANGEMENT ON MOTUORA ISLAND

Davis (1994) gave a rough estimate of around 15 pairs of shore plover that could be supported by the present habitat on Motuora Island. It was thought that 15 pairs could sustain a self-supporting population, without the requirement for further releases to bolster population numbers. However, Davis (1994) recommended that there be further investigation of the potential shore plover population size, including a more detailed look at prey availability, and area and quality of chick-raising habitat. A closer examination of habitat availability and quality on Motuora island, and the observation that shore plover use nearby Moturekareka Island leads to the conclusion that this estimate is likely to be a minimum. While Moturekareka Island appears to have limited suitable habitat for breeding territories, it does provide feeding habitat. The records of birds moving freely between Motuora and Moturekareka Islands suggests that the islands should be considered together when estimating potential population size.

Chick-raising habitat is limited, especially at times of high tides, and, because of this, birds would not be evenly spread around the shore. This could lead to a pattern of `cluster' territories, where shore plover pairs may form small nesting and chick-raising territories that are grouped around favourable breeding habitat, but spread out to feeding areas that could be some distance away. However, the amount and quality of feeding habitat, especially from observations that shore plover spend considerable time feeding on sandy beaches among wrack, is greater than initially estimated.

Davis (1994) also recommended that some pastureland be retained on Motuora Island to be available for shore plover during times of high seas and/or tides. This would require modification of the current revegetation plan. Shore plover were not observed on pasture, except on one occasion where a bird walked in the Camp Ground area on mown grass. However, with increasing numbers of

shore plover establishing on the island the birds may well begin to use pasture areas.

3.6 THREATS TO SHORE PLOVER - PREDATION AND DISTURBANCE

Moreporks *(Ninox novaeseelandiae)*

From a total of 37.5 hours of listening spread over 15 nights and six months we estimated that there are up to four pairs of moreporks resident on Motuora Island. A fifth pair was present, but was removed and released on the mainland in July 1995. The incidence of morepork calls or sightings for each observation period is shown in Table 7. On one occasion the entire island was covered by listeners during the same period. At other times, nights chosen for listening were generally calm, enabling morepork calls over most of the island to be heard from one or two vantage points. The listening periods were usually for a 1-2 hour period from dusk to midnight, but a few listening periods were done at dawn.

While the morepork pair behind the house on Motuora Island call at any time of the night, there is a greater frequency of calling in the earlier hours of the night (S. Watson, pers. comm.).

Searches were also made for morepork roosts in an attempt to pinpoint areas commonly used, and to provide further information on the numbers of morepork on Motuora Island. A roost site was known for the pair that were removed from the island in July 1995 (S. Watson, pers. comm.). A total of 12 hours' searching in late September did not locate a single roost. Many potential roost sites were on steep cliffs, or over dense kikuyu grass, which made it difficult to locate morepork faeces and regurgitated pellets.

The approximate locations of morepork territories on Motuora Island are shown in Fig. 9. Birds are fairly evenly distributed around the perimeter of the island, where most of the pines and native bush are found. The concentration of moreporks around the house and camping ground is likely to be due to the high number of morepork prey, such as sparrows and other small passerines, found near habitation.

Following the removal of a morepork pair in July 1995 no morepork were heard to call or were seen during the 14 hours of listening at the south-west end of Motuora Island. However, the remains of two predated shore plover subsequently found at this location suggest that morepork still use this part of the island for at least some of the time.

TABLE 7: MOREPORK RECORDS ON MOTUORA ISLAND, SEPTEMBER 1995 TO FEBRUARY 1996.

No. of birds heard/seen	No. of occasions
0	5
1	6
2	3
3	1

Morepork predation of the shore plover released in September 1995 was recorded on two occasions. Transmitters enabled the remains to be located. The only remains found were a small pile of feathers and, in one case, the bird's upper mandible. These were found in long grass on the banks above Macrocarpa Bay and Hole Bay. Although morepork were not observed killing the shore plover, the location and nature of the remains

strongly support them as the cause of the deaths. One of the predated birds is known to have disappeared at night, but the precise timing of the other's disappearance is unknown. Two shore plover that disappeared without transmitters attached have not been sighted in other locations. It is possible that these birds were predated by morepork, but no remains were discovered during 10 hours of searching in likely locations.

The birds predated in 1995 were found in the same areas as two shore plover predated by morepork out of five released in 1994. This was despite the morepork pair thought to be using this part of Motuora Island having been removed from the island before the second shore plover release. Shore plover from both the 1994 and 1995 releases used the shore on the south-west part of Motuora Island to the greatest extent (see Section 3.1).

The removal of the morepork pair that were located closest to where the shore plover spent most of their time may have lessened the predation pressure. This could explain the seemingly lower incidence of predation in the second than the first release. The higher number of shore plover released in 1995 may have increased the birds' ability to avoid predation.

Further investigation of morepork predation on shore plover may reveal a seasonal pattern. For example, predation pressure from moreporks may be greatest at the start of and during their breeding season when they are building up body reserves for breeding or have young to feed. Changes in availability of other prey species could also affect the predation pressure on shore plover.

The two incidences of morepork predation occurred three and 11 days after the release. The four shore plover that remained on Motuora Island six months after their release did so in the face of the ongoing presence of morepork on the island. This could indicate that the captive-reared birds were initially naive to the predation threat, but with time learned to avoid the danger.

Aikman (1995) raised the issue of morepork frightening or harassing the shore plover to the point where they leave Motuora Island. After the September 1995 release, a slightly greater number of shore plover disappearances occurred at night than during the day. However, as there is insufficient information for a conclusion to be reached as to the role of morepork harassment in shore plover dispersing from Motuora Island, this requires further investigation.

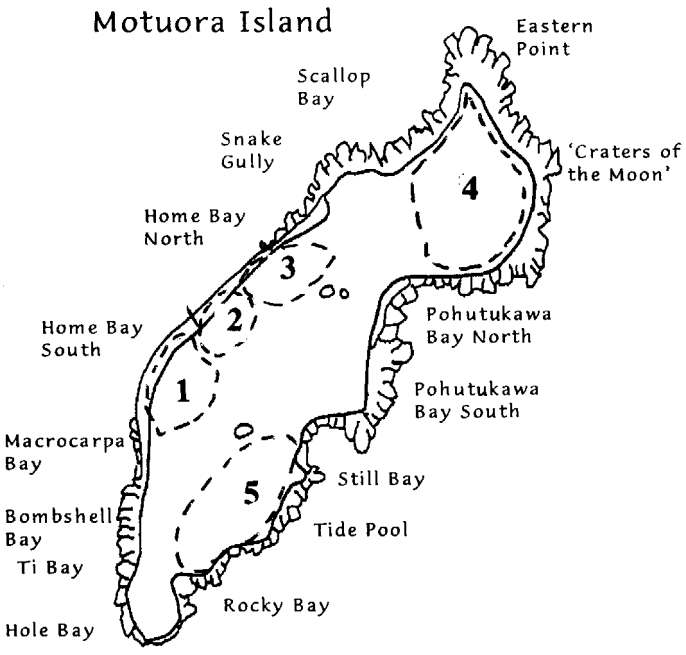

FIGURE 9: APPROXIMATE LOCATION OF MOREPORK TERRITORIES ON MOTUORA ISLAND

Harriers *(Circus approximans)*

Harriers were seen on 16 occasions over 11 different days flying over pasture areas on Motuora Island. It was thought that they would only visit the island from mid-afternoon onwards, using thermal air currents to move across from the mainland. However, they could be seen at any time of the day between 6.30 a.m. and 5.50 p.m. No interactions with shore plover were observed, nor did harriers visit the aviaries when shore plover were being held in captivity. It is likely that the shaded roof of the aviaries prevented harriers from sighting the captive birds.

Unless shore plover are in a vulnerable situation, such as in captivity without concealment from the air, or have nests or chicks, harriers are unlikely to harass or predate them.

Shore plover on Rangatira Island react to harriers flying over or landing in their territories by taking to flight, circling around their territories or by standing in an alert posture calling stridently (Davis 1987). There have been records of harriers predating shore plover on Rangatira Island.

Black-backed gulls *(Zarus dominicanus)*

Between 24 and 43 black-backed gulls were counted on Motuora Island each monthly survey between August 1995 and February 1996. The resident number is estimated to be in the high twenties. The majority of gulls were seen on the eastern side of the island. Gulls breed at the northern end of Scallop Bay and on scattered rock stacks and bluffs on the south-east end of the island (Fig. 10). Interactions were observed on a few occasions, on which black-backed gulls made a low swoop over feeding or roosting shore plover, but the shore plover appeared unconcerned with the presence of gulls. Although black-backed gulls have been observed to predate juvenile shore plover on Rangatira Island (pers.obs.) the low numbers of gulls on Motuora are unlikely to result in high predation pressure on young shore plover.

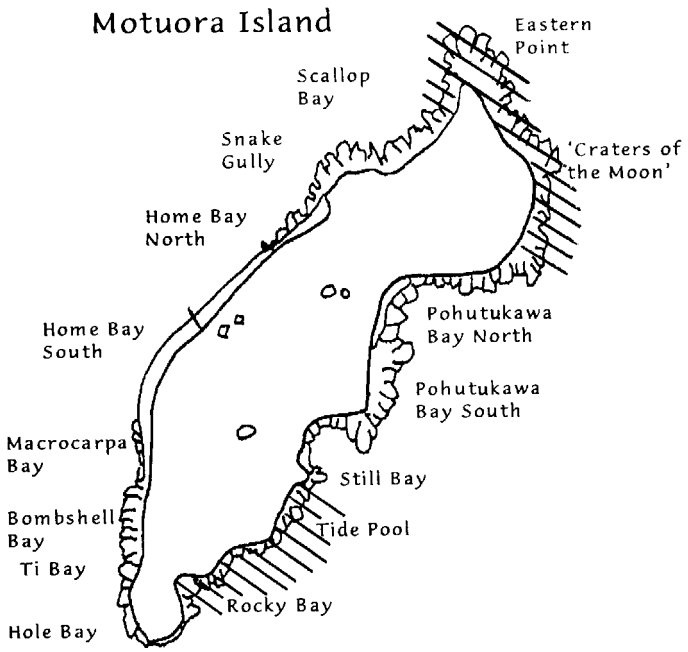

FIGURE 10: DISTRIBUTION OF BLACK-BACKED GULLS (HATCHED AREAS) AROUND MOTUORA ISLAND, AUGUST 1995 TO FEBRUARY 1996.

Oystercatchers

Seven pairs of variable oystercatchers *(Haematopus unicolor)* and at least one single bird were recorded on Motuora Island between September 1995 and February 1996. Four of the seven pairs were concentrated along the shore between Home Bay and Bombshell Bay, which is where the shore plover spent most of their time. The oystercatchers showed no noticeable response to shore plover when the plover were first released. However, when the oystercatchers began to breed in November/December they became very protective of their territories, chasing not only neighbouring oystercatchers, but also shore plover. For example, the pair which nested and raised a chick on the shore in front of the aviaries was commonly observed calling at or chasing shore plover short distances when they strayed close to the nest or chick. This did not appear to concern the shore plover, which continued to use the area in front of the aviary frequently.

On Rangatira Island, shore plover share the shore with the Chatham Island oystercatcher (*H. chathamensis),* and both species, despite showing some aggressive/defensive behaviour towards each other, continue to co-habit, and achieve successful breeding (pers. obs.). It is likely that shore plover and variable oystercatcher would also successfully share overlapping territories or home ranges on Motuora Island.

Other potential predators

Kingfishers *(Halcyon sancta)* and pukeko *(Porphyrio melanotus)* are present on Motuora Island and could possibly predate shore plover eggs and young chicks. On one occasion a kingfisher was observed diving at a shore plover. Neither species is present on Rangatira Island.

A greater potential threat is the accidental introduction of rodents or mustelids to Motuora Island. Rodents are most likely to be introduced in campers' gear, or off boats moored close to the shore. It is unlikely that mustelids or rodents would invade Motuora Island of their own accord as it is 5 km from the nearest land harbouring these predators.

People

Motuora Island receives its greatest numbers of visitors over the summer months. Visitors include people camping on the island or spending part of the day off boats and conservation volunteers working for the day or a weekend on the island. The low numbers of visitors at the time of the shore plover release meant that there was little disturbance to the birds. However, they were disturbed more frequently with the increase in visitors after Christmas. Nearly all day visitors land on the Home Bay beach close to the aviaries where shore plover were frequently present. The amount of disturbance received from people did not appear to discourage the shore plover from using this beach. A considerable effort was put into informing both campers and day visitors of the presence of shore plover and the need to avoid disturbing them (S. Watson, pers. comm.). This decreased the disturbance the shore plover experienced.

3.7 FATE OF RELEASED SHORE PLOVER

The fate of the shore plover released in September 1995 is shown in Table 8. Of the two birds found predated, one died three days after its release and the other after 11 days. The death of the bird that dispersed was due to an accident during its recapture.

TABLE 8: FATE OF SHORE PLOVER RELEASED IN SEPTEMBER 1995. SIGHTINGS OF BIRDS ON NEARBY MOTUREKAREKA ARE NOT REGARDED AS DISPERSAL AS BIRDS RETURNED TO MOTUORA ISLAND OF THEIR OWN ACCORD.

Dispersed, accidental death	1
Dispersed, last seen at other sites	1
Dispersed, recaptured, presumed dispersed again	1
Dispersed, recaptured, remained on Motuora Island	3
Predated on Motuora Island	2
Remained on Motuora Island	3
Presumed dispersed - transmitter attached when disappeared	2
Unknown	2
Total	15

The fate of two of the released shore plover is unknown. They were either predated by morepork on Motuora Island, with their remains not found, or they dispersed from the island. Birds with transmitters attached that could not be found on Motuora Island were assumed to have dispersed from the island. Birds that were not found after dispersing from Motuora Island may have been predated or perished soon after leaving, or they may have moved to locations that were not regularly searched or have been undetected in locations searched. It is unlikely that shore plover remained undetected on nearby mainland habitats because of the intensive search efforts to locate birds, especially over the first two months following their release. Two birds without transmitters disappeared and could have been predated by morepork or have dispersed. The problems encountered with transmitters remaining fixed to the shore plover presented difficulties in locating possible predated birds on Motuora Island as well as the mainland.

Further searches of nearby mainland sites, and other island and mainland locations in the Auckland region, may reveal missing shore plover.

Of the birds whose fates were known, more dispersed from Motuora Island than were predated. This suggests that limiting the incidence of dispersal rather than minimising or preventing morepork predation will be the problem to overcome in establishing shore plover on Motuora Island.

4. Summary and discussion

Of the 15 shore plover released on the 10 September 1995, only seven remained after five days, and four birds after 20 days. The same four shore plover stayed on Motuora until mid February 1996. Two shore plover captured on Orewa Beach in November 1995 were held in an aviary on Motuora Island until early February when they were released once again on the island. The decline of shore plover was due to dispersal to nearby mainland sites and islands, predation by morepork and unknown causes.

Shore plover showed a definite preference for using the western shore of Motuora Island, which was the location used most by those released in 1994. Shore plover also showed a preference for locations which had a mix of rock platform and sandy beach, and locations which were exclusively sandy beach. While shore plover on Rangatira Island use rock platform and salt meadow/ tussockland habitat, historic records show them using a wide range of coastal habitats, including estuaries and boulder/shingle coasts.

Motuora Island has an estimated 60 ha of shore habitat available for shore plover at low tide, but 50% of this area is covered by mid tide and 93% by high tide. Although, much of the habitat covered at mid tide is rock platform, which is an important feeding habitat for shore plover, it does not appear to greatly affect the ability of birds to obtain sufficient food in a 12 hour period. Habitat available at high tide is not evenly distributed around Motuora Island, and some locations have water washing up to the cliff edge at high tide. Even less habitat at high tide would be available for shore plover during spring tides or in storm conditions. An area or areas of mown grass or short-cropped pasture should be maintained on Motuora Island to provide a refuge for shore plover at these times.

Shore plover on Motuora Island spent much of their time feeding compared with other activities, which is similar to the time spent by juvenile shore plover on Rangatira Island.

Moreporks may be a threat to shore plover establishing on Motuora Island. Two birds were known to be predated, probably by moreporks. It is possible that a further two birds, whose fate was unknown, may also have been predated by morepork. Harassment by morepork (scaring shore plover off Motuora Island) could be occurring, but requires further investigation. Black-backed gulls and harrier hawks are not regarded as a threat to adult shore plover, unless harrier hawks have easy access to captive birds. Black-backed gulls may be a future threat to chicks.

Recreational use of Motuora Island is not directly threatening shore plover at present. It is important that visitors are made aware that shore plover are present and that they avoid disturbing the birds particularly during the breeding season. Fortunately, shore plover should have largely completed incubation of eggs and have large chicks by Christmas, when most visits occur. Problems could be encountered with late- nesting shore plover, where constant disturbance could result in egg failure or chick death. The greatest risk from visitors is not the people themselves, but the accidental introduction of rodents

in their luggage or from moored boats. Awareness of the risk of rodent introduction among users of the island, and implementation of measures to prevent this occurring are essential.

Minimising dispersal is regarded as the biggest challenge to establishing shore plover on Motuora Island, or any habitat into which they could be released. Factors that may be important to encouraging site fidelity and therefore decreasing the incidence of dispersal include:

- imprinting by young birds on their natal habitat (rearing or breeding on Motuora Island);
- releasing sufficient numbers of birds, a nearly equal sex ratio, mixed-aged birds, and a mix of breeders and non-breeders for normal social dynamics;
- holding birds in captivity for a period before release;
- holding shore plover `call birds' in captivity as an attractant for wild birds;
- ensuring that there are suitable habitats for the birds, including feeding, roosting and breeding habitats;
- possibly, reducing harassment by moreporks.

While shore plover are only rarely recorded dispersing from Rangatira Island, birds occasionally being sighted on the nearby Pitt Island coastline, this may not be a `typical' situation for shore plover. The population on Rangatira Island may have evolved sedentary behaviour because no benefit is to be gained by leaving the island, and settling in locations nearby may result in them being predated. Historical reports do not record shore plover migrating annually or showing any dispersal behaviour, but historical records of shore plover are scant.

While it has been shown that shore plover can survive for considerable periods on the mainland, such as the pair that settled on Orewa Beach, these birds have not yet attempted to breed. It is unlikely that shore plover would breed successfully on the mainland, or themselves survive nesting attempts because of the threat of predators and disturbance from dogs and people. However, it is possible that a site such as the isolated Te Muri Beach in Mahurangi West Regional Park or Papakowhai Spit on the Kaipara Harbour could support breeding shore plover, given intensive control of cats, mustelids and rats.

Further low-key monitoring of shore plover is required to determine the longer-term fate of those remaining on Motuora Island and those on the mainland. Research is also required to determine the impact of moreporks on shore plover, the availability of prey for shore plover, and the suitability of Motuora Islands' shore as chick-rearing habitat.

5. Recommendations

We recommend that the following actions are taken to establish a successful breeding population of shore plover on Motuora Island:

1. A minimum of 15 shore plover should be released at the end of the 1995-96 breeding season (February/March 1996).
2. This release should be a mixture of adult and juvenile birds released as one flock.
3. The birds should be held in the aviary for at least two weeks so that they adjust to a new location and overcome any stress from the transfer.
4. A monitoring programme should be put in place to closely follow the fate of all birds, and the interactions with the shore plover resident on Motuora Island.
5. Transmitters should be attached to a minimum of 70% of the shore plover, after a more successful method to secure them is found. This will assist in the detection of morepork predation of newly released birds.
6. The Shore Plover Recovery Group should meet one month after the February-March 1996 release to consider future options for shore plover management. Options will depend on the outcome of the third shore plover release, as well as results from the previous two releases.
7. If there continues to be significant dispersal of shore plover from Motuora Island, consideration should be given to captive rearing or breeding birds on the island, then their release. If, on the other hand, significant numbers of shore plover are known or suspected to have been predated by moreporks or significant numbers are disappearing from unknown causes, consideration must be given to either the removal of moreporks from Motuora Island or to discontinuing releases at this location.
8. A monitoring programme for numbers and location of morepork and black-backed gull on Motuora Island should be continued for at least another year after February-March 1996, provided that shore plover remain on the Island.
9. A register of informal sightings from the mainland should be maintained and volunteers invited to report sightings.
10. Assistance with mainland surveys for shore plover should be requested from the Ornithological Society of New Zealand (Auckland Branch) and the Mid North Branch of the Forest and Bird Protection Society.
11. Any shore plover found on the mainland should be captured and released immediately on return to Motuora Island for the first occurrence. Birds which disperse repeatedly should be left, with their movements monitored when possible.
12. An approach to Auckland University should be made requesting a student to look more closely at the prey availability and breeding behaviour of shore plover on Motuora Island.

13. Research to understand more precisely the impact of moreporks on shore plover should be considered, particularly if morepork are found to predate further shore plover or there are significant losses of shore plover.

14. Manawhenua of Motuora Island should be consulted over the future direction of the shore plover recovery programme on the island.

15. A public education programme should be initiated to inform people of the shore plover presence on Motuora Island, and the birds' vulnerability to disturbance and the accidental introduction of rodents.

16. Publicity on the shore plover programme on Motuora Island should be undertaken to increase the profile of the programme within DoC and with the public.

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7. Appendices

7.1 DAILY SIGHTINGS OF INDIVIDUAL SHORE PLOVER DURING THE MONTH OF INTENSIVE MONITORING AFTER RELEASE

Birds	10-Sep	11-Sep	12-Sep	13-Sep	14-Sep	15-Sep	16-Sep	17-Sep	18-Sep	19-Sep	20-Sep	21-Sep	22-Sep	23-Sep
OB-YR	*	0	Motur	0	*	*	*	*	*	*	*	*	*	*
OB-RY	*	*	0	0	0	0	Motur	*	*	*	0	0	0	Motur
WG-WG	*	*	*	*	*	*	*	*	*	*	*	*	*	*
OB-OB	*	0	0	0	Waiw	Caught	*	*	*	*	*	*	*	*
BG-RY	*	*	*	*	*	*	*	*	*	*	*	*	*	*
OB-YB	*	*	*	*	*	*	*	*	*	*	*	0	0	0
OB-GY	*	*	0	0	0	0	0	0	0	0	0	0	0	0
WB-GR	*	0	0	0	0	0	0	0	0	0	0	0	0	0
YR-BY	*	*	*	*	*	*	*	Beehive	0	0	0	0	0	0
WG-YB	*	*	*	*	*	*	*	*	*	*	Predated		-	-
WB-YR	*	*	Predated		-	-	-	-	-	-	-	-	-	-
YB-OG	*	*	*	*	0	*	0	0	0	0	0	0	0	0
YB-RY	*	*	0	0	*	0	0	0	0	0	0	0	0	0
OB-GR	*	0	*	0	0	0	0	0	0	0	0	0	0	0
YB-BR	*	*	*	0	0	0	0	0	0	0	0	0	0	0

Key

* = shore plover sighted on Motuora Island

0 = not sighted during thorough search around Motuora Island

Caught = captured on mainland and released on Motuora Island

Motur = Moturekareka Island

Waiw = Waiwera

24-Sep	25-Sep	26-Sep	27-Sep	28-Sep	29-Sep	30-Sep	1-Oct	2-Oct	3-Oct	4-Oct	5-Oct	6-Oct	7-Oct	8-Oct	9-Oct
*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
*	*	*	*	*	*	0	0	*	*	0	*	*	*	*	*
*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	0
*	*	*	0	0	0	0	0	0	0	0	0	*	*	*	*
*	*	*	*	*	*	*	*	0	0	0	0	0	0	0	Orewa
0	0	0	0	0	0	Orewa	0	0	0	0	0	0	0	0	Orewa
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pakiri	Caught	*	*	*	*	*	*	*	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
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0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

7.2 SHORE PLOVER SIGHTINGS ON MOTUORA ISLAND AND THE MAINLAND FROM 11 OCTOBER TO 11 FEBRUARY 1996

Date	OB-YR	OB-RY	WG-WG	OB-OB	BG-RY	OB-YB	OB-GY
11-Oct	*	*	*	*			
12-Oct	*	*	*	*			
13-Oct	*	*	*	*			
14-Oct	-	-	-	-	Orewa	Orewa	Orewa
15-Oct	*	*	*	*			
16-Oct	*	*	*	*			
18-Oct	*	*	*	*			
23-Oct	*	*	0	*			
24-Oct	*	*	*	*			
26-Oct	*	*	0	*			
29-Oct	*	*	0	*	Orewa	Orewa	
31-Oct	*	0	0	*			
2-Nov	*	*	0	*			
6-Nov	*	*	0	*			
9-Nov	*	*	0	0			
10-Nov	*	*	0	0			
11-Nov	*	*	0	*			
12-Nov	*	*	*	*			
14-Nov	*	0	*	0	Orewa	Orewa	
15-Nov	*	*	*	*	Aviary	Aviary	
16-Nov	*	0	*	0	Aviary	Aviary	
20-Nov	*	0	*	0	Aviary	Aviary	
24-Nov	*	*	*	*	Aviary	Aviary	
25-Nov	*	*	*	*	Aviary	Aviary	
29-Nov	*	0	*	*	Aviary	Aviary	
3-Dec	*	*	0	*	Aviary	Aviary	
15-Dec	0	*	0	0	Aviary	Aviary	
16-Dec	*	*	*	*	Aviary	Aviary	
17-Dec	*	*	*	*	Aviary	Aviary	
21-Dec	*	0	*	*	Aviary	Aviary	
22-Dec	*	*	*	*	Aviary	Aviary	
28-Dec	*	0	0	*	Aviary	Aviary	
30-Dec	*	0	*	*	Aviary	Aviary	
5-Jan	*	0	*	*	Aviary	Aviary	
6-Jan	*	*	*	*	Aviary	Aviary	
11-Jan	*	*	*	*	Aviary	Aviary	
17-Jan	*	*	*	*	Aviary	Aviary	
19-Jan	*	*	*	*	Aviary	Aviary	
21-Jan	*	*	0	0	Aviary	Aviary	
24-Jan	*	*	*	*	Aviary	Aviary	
26-Jan	*	*	*	*	Aviary	Aviary	
30-Jan	*	*	*	*	Aviary	Aviary	
31-Jan	*	*	*	*	Released	Released	
1-Feb	*	*	*	*	*	*	
2-Feb	*	*	*	*	*	*	
3-Feb	*	*	*	*	*	*	

Date	OB-YR	OB-RY	WG-WG	OB-OB	BG-RY	OB-YB	OB-GY
4-Feb	*	*	*	*	*	*	
5-Feb	*	*	*	*	*	*	
6-Feb	*	*	*	*	*	*	
7-Feb	*	*	*	*	*	*	
8-Feb	*	*	*	*	*	*	
9-Feb	*	*	*	*	*	*	
10-Feb	*	*	*	*	*	*	
11-Feb	*	*	*	*	*	*	

Key

* = bird sighted on Motuora Island

0 = bird not sighted in search of areas usually used by shore plover on Motuora Island

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