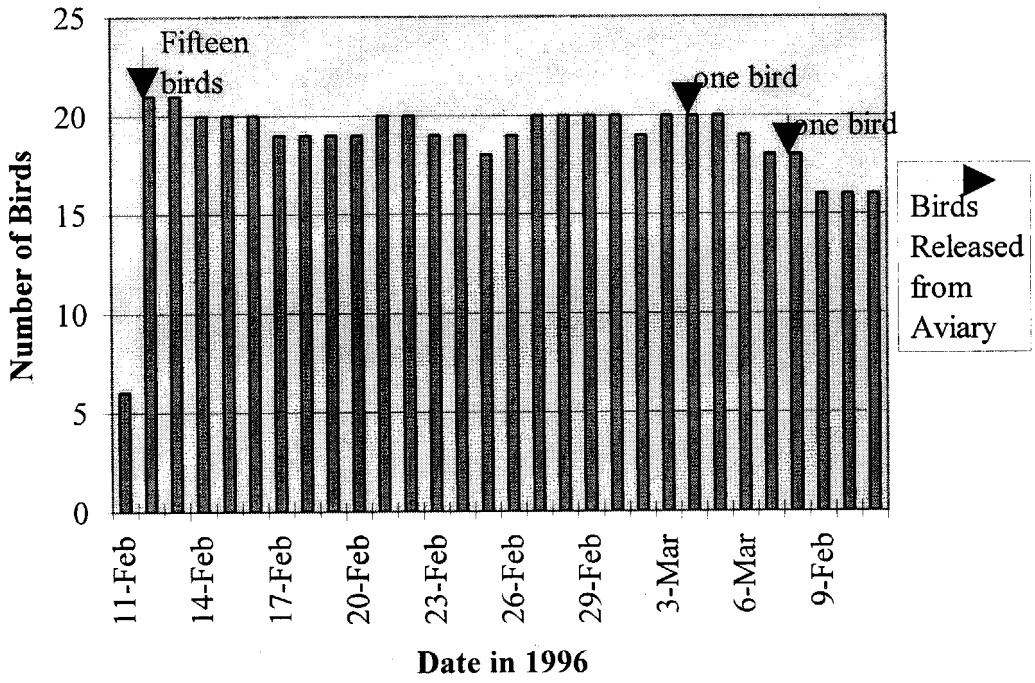

FIGURE 2: TOTAL NUMBER OF BIRDS AT LIBERTY ON MOTUORA ISLAND EACH DAY DURING THE FOUR WEEK MONITORING PERIOD.

3. Results

3.1 FATE OF RELEASED SHORE PLOVER

Four weeks after the release, 16 shore plover were alive and at liberty on Motuora Island (Fig. 2). Twelve of these were from this release and four were from the September 1995 release. The fate of 14 (87.5%) of the newly released birds is known; 12 remained on Motuora Island, one female died of starvation shortly after release, and one juvenile dispersed from the Island, flying to Manly Beach on the Whangaparaoa Peninsula (Fig. 1). Two juveniles disappeared from Motuora Island towards the end of the monitoring period, after their transmitters had fallen off. The fate of these birds is not known.

Two males from the September 1995 release disappeared from Motuora Island during the monitoring period. One was sighted on Orewa Beach, where it had been caught and returned to Motuora Island 16 weeks earlier. The fate of the other is not known. A record of individual bird sightings over the monitoring period is in the Appendices, Section 7.2.

One of the released birds (Female BW-GR) died four days after release. This bird had sustained a bill injury while in captivity but it was believed that she could forage well enough to survive in the wild. Observations of the bird in the few days after release raised some concerns, although it was seen catching prey. On the fourth day, this bird was seen coming into the camping ground and then hiding in the noisy generator shed. At this point it was caught and discovered to be extremely emaciated. The bird died in captivity that night. An autopsy at Auckland Zoo confirmed that starvation was the probable cause of death.

One juvenile (WR-WR) disappeared from Motuora Island two days after the release. Several members of the public reported sighting this bird six days later on Manly Beach on the Whangaparaoa Peninsula. The bird was caught and re-released on Motuora Island. It disappeared again a day later, only to be re-sighted at Manly Beach four days later. The bird was caught a second time and on this occasion was held in an aviary on Motuora Island for 11 days before re-release. It disappeared from Motuora Island that night and has since been re-sighted on Manly Beach.

3.2 LOCATION OF SHORE PLOVER ON MOTUORA ISLAND

The vast majority (98%) of shore plover sightings on Motuora Island were on the western side of the island from Scallop Bay clockwise through to Hole Bay (Fig-3),

Some birds began to explore around the back of the Island towards the end of the monitoring. Shore plover were sighted in Pohutukawa Bay and Rocky Bay, where they had not been sighted before. Birds were consistently seen in Scallop Bay and Snake Gully, which had only occasionally been used by shore plover after previous releases (Aikman 1995, Davis and Aikman 1997). Most sightings (66%) were at the south-west section of the island, from Home Bay South to Hole Bay (Fig. 4). This was the same area that birds used after the previous releases. No shore plover were seen in the north of the island, away from the coast.

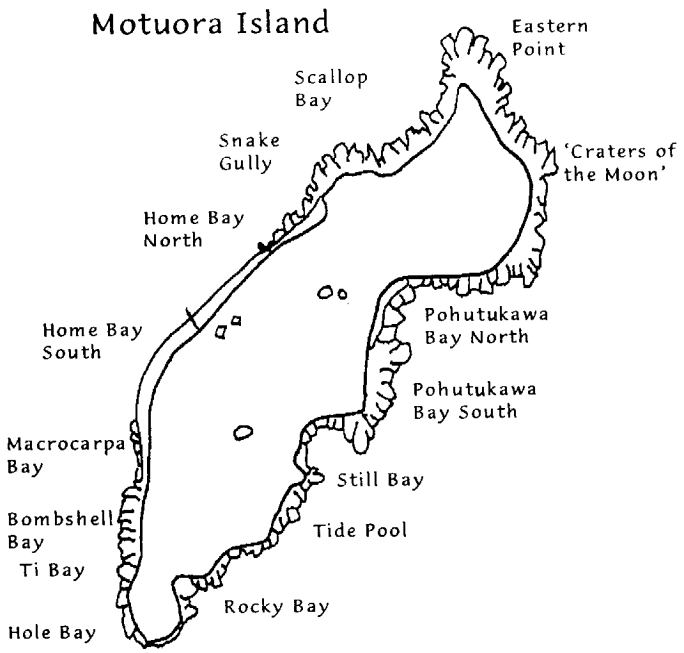

FIGURE 3: LOCATIONS ON MOTUORA ISLAND AVAILABLE TO SHORE PLOVER

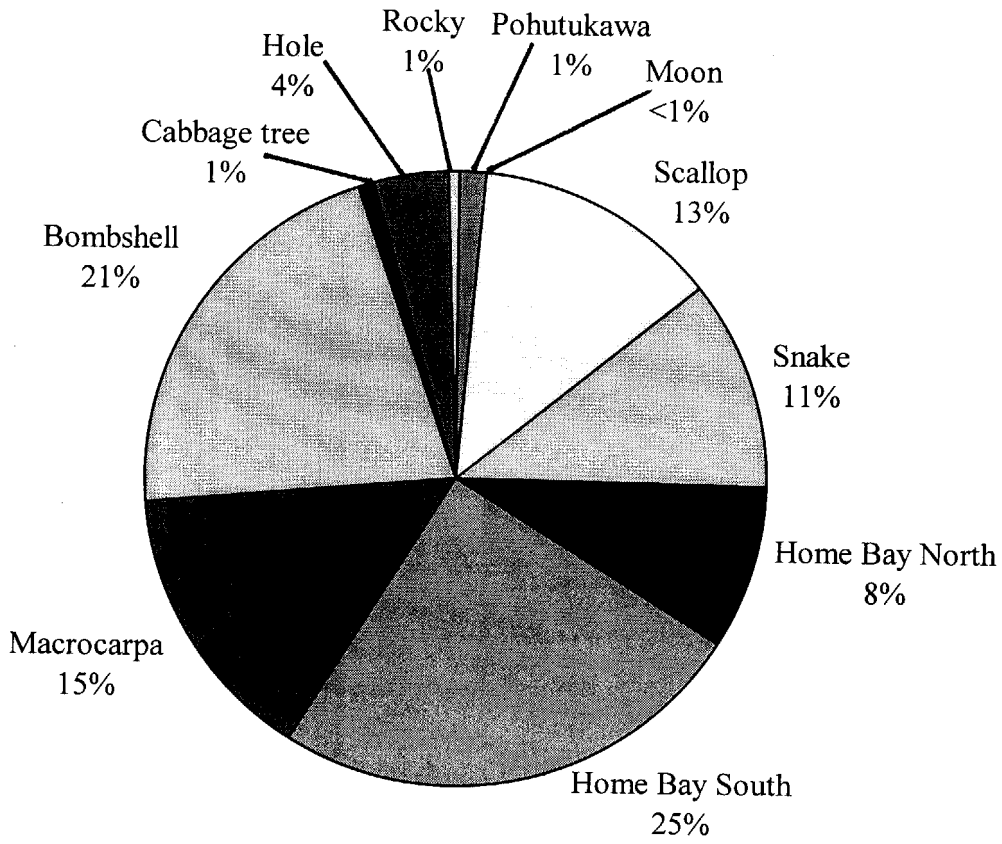

FIGURE 4: PROPORTION OF SHORE PLOVER SIGHTINGS AT DIFFERENT LOCATIONS ON MOTUORA ISLAND DURING THE 4 WEEKS AFTER THE FEBRUARY 1996 RELEASE. TOTAL NO. OF OBSERVATIONS, 980.

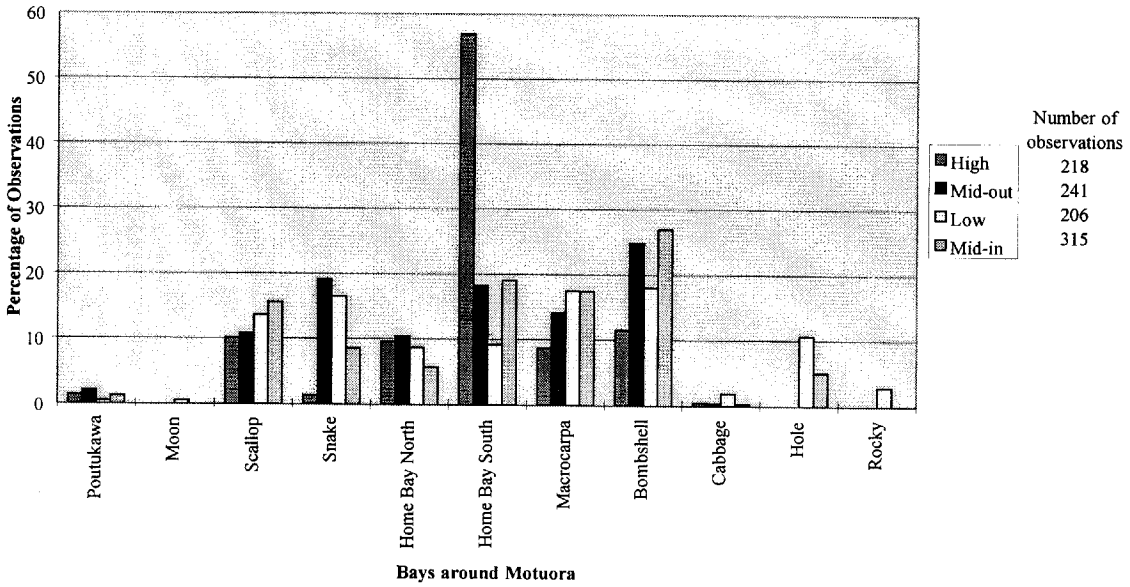

FIGURE 5: LOCATION OF SHORE PLOVER ON MOTUORA ISLAND AT DIFFERENT STATES OF THE TIDE.

All shore plover present on Motuora Island mixed together soon after the release. No obvious patterns of association emerged. There did not seem to be any difference between locations chosen by juveniles and adult birds. Some individual birds developed preferences for particular areas, while other birds moved between areas.

The main influence on the location at which birds were found appeared to be tide (Fig. 5). At high tide a group of 10-13 birds frequently gathered to roost in Home Bay South in front of the aviaries. At low and mid tides, birds would spread out to Scallop Bay, Snake Bay, Macrocarpa Bay, Bombshell Bay and Hole Bay, where large rock platforms are exposed. Birds were seen in Rocky Bay only at low tide.

3.3 GROUP COMPOSITION

The pairs that had been established in captivity did not remain together after their release. Birds were usually found in groups, the composition of which changed frequently (Fig.6). A mean group size of 3.99 (N=980) was observed.

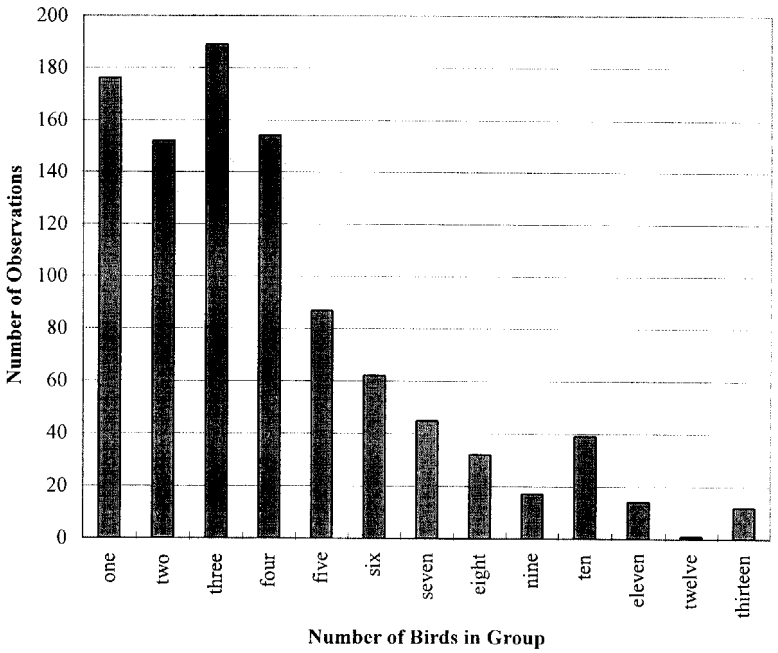

FIGURE G: SIZE OF GROUPS OF SHORE PLOVER OBSERVED ON MOTUORA ISLAND DURING THE FIRST 4 WEEKS AFTER RELEASE. TOTAL NO. OF OBSERVATIONS, 980.

3.4 ACTIVITIES

There was no difference observed between the activity budgets of juvenile from that of adult shore plover (Fig. 7). All birds spent a large proportion of their time feeding. Roosting was the next most frequent activity.

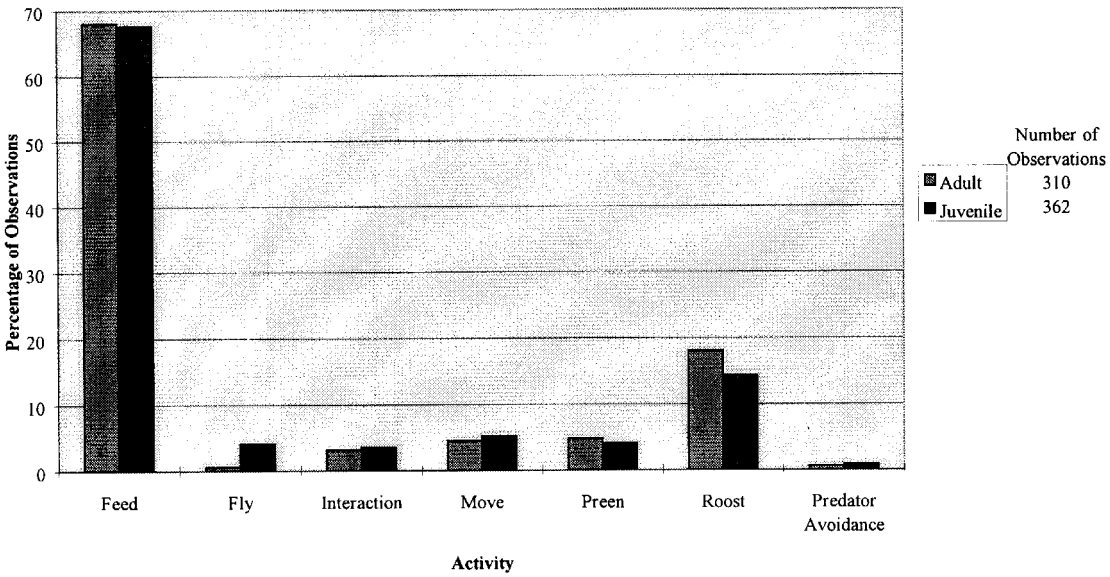

FIGURE 7: ACTIVITIES OF ADULT AND JUVENILE SHORE PLOVER ON MOTUORA ISLAND.

3.5 HABITAT USE

Sand was the major habitat type used by the shore plover on Motuora Island. In 79% of habitat observations, sand was present as a substrate within 10 m of the bird (Table 1). Rock platform was also an important habitat type, with boulder and pebble beaches being used occasionally. Shore plover were sighted in the camping ground and up on grass banks on several occasions, but pasture was not a frequently used habitat.

TABLE 1: HABITAT TYPES USED (%) BY SHORE PLOVER ON MOTUORA ISLAND IN THE FIRST 4 WEEKS AFTER THE FEBRUARY 1996 RELEASE.

	All activities	Feeding
Habitat type		
Sand	48	43
Sand/boulders	10	10
Sand/pebbles	3	3
Sand/grass bank	2	1
Sand/rock platform	16	22
Rock platform	16	19
Rock platform/boulders	2	2
Air	3	
No. of observations	671	456

TABLE 2: MICROHABITATS USED (%) BY SHORE PLOVER TO FEED ON MOTUORA ISLAND NO . OF OBSERVATIONS, 456.

Bare sand	36
Sand/wrack	28
Sand/surface film	5
Bare rock	7
Rock/algae	5
Rock/surface film	5
Rock/shellfish	2
Algae-surface film	8
Rock bank	1
Shell/pebbles	2
Grass/soil	1

Feeding

Sand was the major habitat type used by shore plover when feeding (Table 1). The micro-habitat within 0.5 m of the bird was recorded. Shore plover spent a considerable amount of time feeding on sand substrates, both among the wrack at the mean high-tide mark and from bare sand at the tide edge (Table 2).

Rock-platform also was an important feeding site for shore plover (Table 1). At low tide, birds moved to areas of rock-platform, feeding mostly on algae-covered rocks and low-lying areas of sand and silt adjacent to the rock platforms. Less frequently they fed on rock covered with shellfish or seaweed (Table 2).

Shore plover were seen attempting to eat a wide variety of prey. They were often seen pecking at open pipi shells on the beach, eating either the pipi itself or invertebrates feeding on the pipi. On different occasions, birds were seen attempting to catch or eat a butterfly, a wasp, a cricket and a beetle.

Roosting

When roosting, the shore plover were often very difficult to see. They frequently roosted completely out of sight, under the cover of overhanging banks or in a cave, or under vegetation. Alternatively birds were often hidden in locations with large amounts of beach wrack and driftwood, tucked in beside a large rock or log.

The following percentages of different roosting sites were used (total number of observations, 108):

Among wrack/driftwood	31
Open rock/sand	30
Beside log/rock	24
In lee of bank	12
On branch	2

Shore plover were often seen roosting in exactly the same spot on consecutive days. A group of 10-13 birds would form outside the aviaries, in Home Bay South, at high tide. During the heat of the day this group sometimes sheltered under the wharf or under a low spreading tree.

3.6 SPECIES INTERACTIONS

Moreporks (Ninox novaeseelandiae)

There was no evidence of predation of any shore plover after this release. Two juvenile birds disappeared after their transmitters fell off and have not been sighted on the mainland to date, so it is possible they have been predated. Morepork continued to be heard regularly in the area behind the house and camping ground. A morepork was heard one night calling at 8.30 p.m. from above Macrocarpa Bay. This was the first record of a bird being heard in this area since two moreporks were removed from there in July 1995. This area is frequently used by shore plover.

Black-backed gulls *(Larus dominicanus)*

Black-backed gulls on Motuora number in the high twenties (Davis and Aikman 1997). Shore plover were frequently seen near them and did not appear to be concerned by their presence.

Kingfishers *(Halcyon sancta)*

On 2 occasions kingfishers were observed diving at shore plover that were feeding on the beach. In both cases the shore plover flew to avoid the kingfisher before continuing to feed nearby. A group of resident shore plover were seen flying off when a kingfisher called near the group. On other occasions kingfishers and shore plover were seen close together with no interaction observed.

Harriers *(Circus approximans)*

Harriers were sighted only twice on Motuora Island during the monitoring period. Once, at 6.30 p.m., a bird was seen feeding on a dead penguin on the beach. On another occasion a bird was seen flying over the north of the island. There was no evidence of any interactions with shore plover.

Oystercatchers *(Haematopus unicolor)*

There was usually little interaction between the species, although there were occasions when the oystercatchers were seen chasing shore plover short distances. Two pairs of oystercatchers have a territory boundary directly in front of the shore plover aviaries. Both oystercatcher and shore plover frequently used this area at high tide. Chases were observed if shore plover were between the adult oystercatchers and their chick, or were in the middle of a territorial dispute between the oystercatcher pairs.

People

There were a large number of people on Motuora Island during the monitoring period. During the week after the release, 30 schoolchildren camped on the island for three nights, and there was a large number of day visitors during the weekends. This did not seem to disturb the shore plover unduly. Apart from moving a short distance away when directly approached, the shore plover did not leave the most visited locations on the island such as Home Bay.

3.7 HIGH TIDES AND STORMY WEATHER

During the second week following the release, Motuora Island experienced tides of 3.6 m, which were some of the highest tides of the year. Several of the bays that the shore plover often used, such as Snake Bay and Bombshell Bay, had virtually no beach remaining exposed at these high tides. The shore plover moved to adjacent bays at these high tides. They moved high up the beach, sometimes feeding up on rock or soil bank, or continued to feed in the sand at the tide-edge, flying out of the reach of large waves. Birds were observed roosting up banks and on the limbs of fallen trees during these very high tides.

During the night of 2 March 1996 extremely high winds were experienced on Motuora Island. No birds went missing during the storm and all the birds were found in the usual places the following day.

3.8 LEG INJURIES AND BAND PROBLEMS

The juvenile OB-RR, which was injured while having its transmitter attached, was held in the aviary for two weeks, then released. By this time the leg showed much improvement. The bird was no longer favouring the leg, and had only slight problems in spreading its toes normally. This bird showed no sign of difficulty in the two weeks after its release.

Resident female BG-RY developed a limp, which became steadily worse over a two-week period, to the point that she was not using her right leg at all. The bands did not seem to be causing any problems and there was no obvious injury. An attempt to catch the bird failed, but, after a week of not using the leg, it suddenly improved, with no further signs of trouble.

Male BR-YR lost his leg band 25 days after release. There was no sign of injury or distress.

Female BY-RW was observed limping one evening. The lower band on her right leg had opened and moved down, slightly restricting the movement of her foot. By the following morning the band was back in the correct position so no action was taken.

3.9 TRANSMITTERS

The transmitters stayed attached for an average of 12.6 days (7-19 days). The three older-type transmitters stayed attached a little longer than the newer type. The old type are larger, giving more surface area for gluing. They are also slightly curved underneath so they fit over the shore plovers' spine, making it possible to stick the bottom of the transmitter down firmly. Eight transmitters were retrieved once they fell off the birds.

4. Discussion

A number of factors may have contributed to the high survival and retention on Motuora Island of birds from the February release. It is difficult to determine which factors are the most important so future releases should attempt to include all of those which may have led to this successful outcome.

4.1 SURVIVAL

There was good survival of released birds in the four weeks after their release. The one bird known to have died had a previous injury making her unable to forage adequately. In retrospect, this bird should not have been released. All the other birds appeared to adapt well to living in the wild.

There was no evidence of predation during the first two weeks of monitoring, when most birds had transmitters attached. Morepork were heard regularly on the island. It seems likely that changes in morepork feeding patterns at this time of year were the reason no shore plover were taken following this release. It is also possible that the newly released shore plover learnt avoidance techniques from the birds that had remained from the September 1995 release. For example, shore plover were frequently sighted roosting under cover following this release. It will be important to monitor the shore plover closely in September 1996 to determine whether predation becomes an important factor again.

4.2 DISPERSAL

Most of the shore plover released in February 1996 remained on Motuora Island. However, one juvenile (WR-WR) repeatedly left the island. This bird returned to Manly Beach on three occasions, demonstrating the ability to fly and navigate well. A male (OB-YB) from the 1995 release also returned to the site from which he had been caught, on Orewa Beach. It is possible that these birds will chose to return to Motuora Island when they find no other shore plover on their respective mainland beaches.

The two juveniles that disappeared towards the end of the monitoring period seem likely to have dispersed from the island, although there have been no sightings of them away from there to date. More adults have remained on Motuora Island than juveniles, although the difference is small. Adult birds, being ready to breed, may be less inclined to wander. Young birds may leave the island but return to breed. However, they face a high risk of predation during time they spend on the mainland. A mixture of ages may be important in creating normal social dynamics.

The presence of the six birds remaining from the 1995 release on Motuora Island was likely to have been important in encouraging the new birds to remain. The

1995 release birds had become accustomed to roosting near the aviary during December 1995 and January 1996, when a pair of shore plover was held in an aviary. This habit continued after the release of the pair and through the monitoring period, when one bird was held in the aviary for most of the time. The presence of birds in the aviary seems to have been an important factor in encouraging shore plover to establish on Motuora Island. It is not yet known if birds will stay now that there are none being held in the aviary.

The time of year chosen for this release may have been an important factor in encouraging birds to remain. On the first two occasions, juveniles were released just before their first breeding season in the hope that these captive-bred birds would not be fixed on a particular breeding location and that, finding vacant territory, they would settle on the island to breed. This did not occur. On Rangatira Island more juveniles disperse at the beginning of the breeding season than at the end (Davis 1987). For this reason released juveniles may be less inclined to disperse in February, which is at the end of the breeding season.

4.3 TRANSMITTERS

Given the success of the 1996 release to date, transmitters may not be needed for future transfers to Motuora Island. They are not generally required to locate birds that are alive on the island. They are helpful in determining whether birds have left but have not usually assisted in locating birds on the mainland. However, transmitters are essential for detecting incidents of predation.

If transmitters are to be used, the following changes in the method of attachment are required:

Test the use of a different type of adhesive.

Discuss with Sirtrack the possibility of shaping the transmitters to fit the curve of the shore plovers' back.

Cut a longer piece of cloth under the transmitter to increase surface area for attachment down the bird's back. A wider piece is not recommended because it may interfere with wing movement.

5. Recommendations

The following recommendations should be implemented:

1. Continue to monitor birds, at a low level through to September 1996, and then more intensively from September to the end of January 1997 to cover the breeding season and the period during which morepork predation has taken place in previous years.
2. Monitor shore plover sightings on the mainland.
3. Develop and adopt performance measures, to be assessed in September 1996, which evaluate the success of the releases on Motuora Island to date.
4. If the September assessment shows that the current success has continued, with no major new information coming to light, the release should be repeated in 1997. Successful factors to be repeated are:
    - February release time,
    - mixture of adult and juvenile birds (ideally a 50/50 mix) released,
    - holding birds in aviaries for a short period before release,
    - holding a bird in the aviary for a period to encourage the released birds to remain near the site.
5. Transmitters should only be used for future releases on Motuora Island if there have been significant shore plover losses over a short-period. If they are to be used, there need to be changes in the method of attachment.

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