

# Research on New Zealand dotterels during the 1994-95 season

J E Dowding  
Dowding Murphy Consultants  
PO Box 36-559  
Auckland

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# Summary

## STEWART ISLAND

There were problems obtaining suitable baits for the Table Hill cat-control operation this season. The Landcare-ACP baits supplied initially were late, in very poor condition on arrival, and were unsuited to the task. Dupont baits from last season were used for two changes, while awaiting a supply of new Dupont baits. Reliable supply of a suitable bait is pivotal to the whole programme, and is a problem that must be addressed urgently.

By the end of the season only one male-female pair of dotterels remained on Table Hill; they fledged two chicks. Other birds appear to be establishing on Table Hill and will probably breed there next season. There were no opportunities to carry out egg manipulations on Table Hill this season.

Annual flock counts showed that the population had risen to about 75 birds in late March 1995; during the season there were losses of banded adults but this was offset by high productivity overall.

It is recommended that the cat-control programme continue and that some survey work is undertaken to update our knowledge of dotterel breeding distribution on the island.

## NEST-CAGE TRIALS

Trials were undertaken in the North Island to test the possibility that mesh cages over nests may afford protection from cats to eggs and incubating adults. It proved surprisingly difficult to find a size of access hole that allowed dotterels easy passage to their nests but excluded cats. Dotterels entered cages over their nests and continued incubation, and no longer-term adverse effects were noted. No opportunities arose on Stewart Island this season to test nest cages. It is recommended that development of the cages continue in the North Island and that cages also be tested on Stewart Island during the 1995-96 season.

## CAPTIVE-REARING

Captive-rearing trials were undertaken in the North Island. Between early October and late December 1994, 40 eggs were collected from sites in North Auckland, Coromandel and Bay of Plenty and transferred to Otorohanga and Auckland Zoos for incubation and rearing. There were a number of early deaths (in shell, during hatching and in the week after hatching), possibly caused by sub-optimal incubation conditions. There is to be a meeting of those involved in the programme to discuss ways in which hatching and survival can be increased.

Thirteen birds survived and were released. Eight were released at Omaha Spit in early February 1995; all disappeared rapidly, with some killed by a stoat within a few days. Only two of these birds were known alive 12 weeks after release. Five birds were released at Wade River in mid-April; this release appeared more successful and three birds were still alive and at the release site after three weeks.

It is recommended that trials with North Island birds continue next season.

## Background

The NZ dotterel (*Charadrius obscurus*) is an endemic shorebird numbering about 1400 individuals. There are two populations, one breeding on the coast of the North Island and the other on hill-tops on Stewart Island; these have recently been recognised as different subspecies (Dowding 1994a). The southern NZ dotterel (*C. o. obscurus*) has declined rapidly in the past 40 years, with the major cause of the decline thought to be predation by feral cats (Dowding & Murphy 1993).

The recovery plan (Dowding 1993b) states that the highest priority should be given to reversing this decline. During the past three seasons, management has been confined to an experimental cat-control programme carried out on Table Hill; fishmeal-polymer baits containing 1080 have been deployed in a cordon of bait stations around the dotterel breeding area. The programme has had limited success so far (Dowding 1993a, 1994b), with the result that the total population of the southern subspecies had fallen to about 65 birds in April 1994 (Dowding 1994b). A significant gender bias now exists in the population (there are fewer males) and the effective population size is probably no more than 30.

The NZ dotterel recovery group (NZDRG) met in May 1994 and recommended (1) that other management options be considered for the Table Hill population and (2) that a captive-rearing plan be drafted and trials undertaken with North Island birds. These recommendations resulted in a report (Dowding 1994c) which discussed cat and rat control, egg manipulations, nest protection and other options on Stewart Island; it also contained a draft proposal for captive-rearing trials.

The present report describes the outcome of research and management of the southern subspecies during the 1994-95 season and makes recommendations for research and management tasks on Stewart Island during the 1995-96 season. It also describes preliminary trials in the North Island with predator exclosures over nests, and outlines the results of the captive-rearing trials undertaken at Otorohanga and Auckland Zoos, also using birds of the northern subspecies.

During the course of this season's programmes, the following authorities under the Wildlife Act 1953 were issued to the author by PSPD:

04 October 1994 - Collect and transfer up to 24 eggs (Auckland)  
05 October 1994 - Install cat-proof cages over nests (Auckland & Stewart Island)  
11 October 1994 - Transfer fertile eggs to female-female pairs (Stewart Island)  
23 December 1994 - Collect and transfer up to 8 eggs (Auckland & Bay of Plenty)  
03 February 1995 - Release up to 10 captive-reared juveniles (Omaha, North Auckland)  
17 March 1995 - Release up to 6 captive-reared juveniles (Wade River, Auckland)  
This document is intended to fulfil the reporting conditions required in those authorities.

# 1 Stewart Island

## 1.1 TIMETABLE OF FIELDWORK

Bait changes and bird monitoring were undertaken by John Dowding (QD), Mike Anderson (MA) and Pete Shaw (PS). The timetable of fieldwork was as follows:

05-07 Oct 1994 Table Hill cat-bait stations loaded, rat-bait stations installed (MA).  
10-14 Oct Birds checked, Table Hill (JD).  
27 Oct-08 Nov Birds monitored and banded on Table Hill, surveys of Blaikies Hill, Mt Rakeahua and Doughboy Hill (QD).  
10-12 Nov Bait change and birds noted, Table Hill (PS).  
29-30 Nov Bait change and birds noted, Table Hill (MA).  
11-22 Dec Birds monitored and banded on Table Hill; surveys of Blaikies Hill, Trig P, Mt Allen and Mt Rakeahua.  
16-18 Jan 1995 Baits changed 17-18 Dec (JD). Bait change, Table Hill (PS).  
25 Mar-03 Apr Annual monitoring of flocks, birds banded (QD).  
04-05 Apr Bait stations emptied, Table Hill (MA).

## 1.2 RESULTS

### *Baits*

In early July, David Morgan of Landcare Research (Christchurch) informed project manager Andy Roberts that they were not prepared to supply the Dupont baits used in the two previous seasons. The Landcare-ACP baits substituted at the start of the season arrived later than required and in very poor condition; the mix was moist, baits were shrink-wrapped and had been 11 days in transit. At least 30% were mouldy and/or badly clumped and were discarded immediately (A. Roberts, pers. comm.). Within three weeks in bait stations on Table Hill, these baits had absorbed a great deal of moisture and were covered in fungal and bacterial growth; in this state they were almost

certainly unpalatable to cats. Landcare Research subsequently supplied Dupont baits and these were used in later changes.

Ten Novacoil rat-bait stations (loaded with Talon) were installed on Table Hill in October 1994; these were at sites where rat sign had been most prevalent during the previous season. No bait takes had been recorded by mid-December, suggesting that rat density was low on Table Hill this season.

### ***Birds on Table Hill***

At the start of the season there were at least two male-female pairs in the Table Hill study area. One of the males (OWO-M) that has bred at the SW corner of Table Hill for at least the past three seasons had disappeared by 11 October. A damaged seventh right primary feather found near his territory on that date (a time when birds are not moulting primaries) may have been from this bird. His mate remained on Table Hill for at least two months.

A new pair formed this season and bred at the NE corner of Table Hill. Their two chicks were banded in mid-December at about 4 weeks of age; both fledged and were seen at the Mason Bay flock in late March. Both adults survived the season.

In early November a female-female pair was found incubating a 5-egg clutch. Two of the eggs had disappeared by mid-December and the remaining three were still being incubated. After 50 days of incubation these three eggs were removed and have now been added to the Auckland Institute & Museum collection.

Four new birds were banded on Table Hill in early November; these were part of a group of non-residents that visited the area on several occasions when the weather was fine. Some of these birds appeared to be pairing and becoming territorial, and may well establish and breed next season. Two of the newly-banded birds were probably males and both were still present in mid-December.

### ***Birds at other sites***

A new pair on Mt Rakeahua had three small chicks in early November; one was seen, almost flying, in mid-December. The male is banded and is known to have survived the season.

The female of the Doughboy Hill pair was lost last season. The surviving male has paired (with a female who was one of a female-female pair on Table Hill) and this pair bred on Doughboy Hill. Both birds survived the season.

No birds were found during visits to Blaikies Hill in late October and mid-December. The male of the pair breeding on Mt Allen appears to have been lost during the season. There were no birds around Trig P (SE of Blaikies Hill) in mid-December and the habitat was largely unsuitable; there is tussock and low scrub but little of the open terrain favoured by dotterels elsewhere on the island.

TABLE 1. AUTUMN FLOCK COUNTS AND POPULATION ESTIMATES, 1993-1995

FLOCK	1993	1994	1995
Awarua Bay	15	10	10
Mason Bay	49	42	54
Cooks Arm	4	3	3
wandering juveniles and unpaired adults (estimated)	6	10	8
Totals	74	65	75

### *Annual census*

Autumn flock counts and estimates of total population size are shown in Table 1.

There were at least 12 juveniles in the Mason Bay flock in late March, indicating high productivity in the population as a whole. However, eight banded birds were not accounted for during the survey; three (and possibly four) of these were males. The size of the Cooks Arm flock has again been estimated; past counts and sightings of banded birds late in the breeding season suggest that a total of three is unlikely to be out by more than one.

## 1.3 DISCUSSION AND RECOMMENDATIONS

### *Baits*

Survival and productivity of birds on Table Hill continues to be poor and it is clear that the cat-control programme is not sufficiently effective at present. The fact that we were initially refused Dupont baits this season was unexpected, given that the Department paid a considerable sum towards the development and testing of these baits. The timing of this event meant that we had no choice but to use Landcare-ACP baits. These arrived late, so that once again baiting was begun a month later than planned; they arrived in poor condition and were clearly not suited to the damp conditions on Table Hill. Preliminary trials conducted in Australia suggest they are not particularly attractive to feral cats either (L. Staples, pers. comm.). I suggest that as presently formulated they should not be used in subalpine regions of Stewart Island (or areas with a similar climate) in future.

If effective localised control of feral cats is to be achieved on Table Hill (and possibly other similar sites on Stewart Island), the Department must find a bait that is (a) attractive to a high proportion of feral cats, (b) survives damp conditions for a reasonable period, and (c) is reliably available for the foreseeable future. The baits must then be installed *before* dotterel breeding begins (this has only happened once in the past three seasons). A prototype cat bait currently being developed and tested in Australia by Applied Biotechnologies, Melbourne, may provide another option. This bait will be field-tested under New Zealand conditions during the next four months to determine whether it is more or less attractive to cats than the baits currently being used.

### ***Future management on Table Hill***

It is not clear how many pairs of NZ dotterels will be attempting to breed on Table Hill during the 1995-96 season; only one remained at the end of last season but it seems likely that several others will have established by then. I suggest that bait stations be loaded in late August or early September with the best baits available at the time (note that Dupont baits are now available commercially from Bait-Tek Inc., Beaumont, Texas, but would need to be loaded in New Zealand). I will visit Table Hill in October 1995, and a decision can be made then on whether to continue baiting throughout the season.

Because of the small number of birds breeding in the area this season, there were no opportunities to conduct egg manipulations. However, consideration can be given to a small number of intra-specific transfers of fertile eggs to female-female nests (pages 5-6, Dowding 1994c) during 1995-96 if circumstances permit.

Informal discussions with PSPD and TSU staff suggest that a permit is unlikely to be issued to allow cross-fostering attempts with banded dotterels (page 10, Dowding 1994c), without a trial in the North Island first. Such a trial would take 3-4 years and in that time I suspect that the situation on Stewart Island will have been resolved one way or the other. The combination of improved cat control and protection of individual nests may have caused the population to rise; if not, and the decline continues, captive-rearing will almost certainly be necessary by then. In either case, cross-fostering to banded dotterels would be superfluous.

### ***Breeding distribution***

Turn-over in the adult breeding population is rapid, and birds are known to have disappeared from some sites and been recruited at others in the past two-three years. Our knowledge of breeding distribution is therefore incomplete and I believe it is time to begin updating it. Knowing where birds have been recruited will help in deciding which areas (other than Table Hill) may be appropriate for cat control or other forms of management. Two areas in particular which both contain much suitable habitat have not been surveyed recently; the Anglem Ridge and Little Mt Anglem in the northern part of the island have not been checked since December 1991 and the southern half of the Tin Range has not been properly searched since December 1992. These areas could be surveyed in early October 1995, immediately before my first trip to Table Hill.

### ***Stoats***

The possible presence of stoats on Stewart Island gives much cause for concern, but at the time of writing had not been confirmed. However, stoats would clearly have a major impact on the small, critically-endangered dotterel population; it is therefore vital to know whether or not they are present in the subalpine breeding areas, as this will influence management decisions. To complement the trapping already undertaken in coastal/lowland areas of the island, I propose to run a Fenn-trap line on the flanks of Table Hill next season.



### *Captive-rearing*

The size of the flock at Mason Bay and the number of juveniles present indicate that there was good productivity overall during the 1994-95 season. There was also high productivity in 1992-93 and it seems likely that some of the chicks fledged this season were produced by newly-recruited two-year-old birds. This season's productivity suggests that a similar burst of recruitment and productivity may occur again in the 1996-97 season.

The state of the southern subspecies is clearly still precarious; however, because of (a) the high productivity seen this season, (b) recruitment during the past season and (c) the prospect of more efficient cat control in the near future, I do not believe that captive-rearing of Stewart Island birds is necessary during the 1995-96 season. However, it must be borne in mind that at least eight experienced birds (including at least three males) were probably lost this season and were replaced in the population by inexperienced, non-breeding birds.

### *Recommendations :*

- As currently formulated, Landcare-ACP cat baits should not be used in future operations in subalpine areas of Stewart Island.
- Bait stations on Table Hill should be loaded in late August 1995. Whether baiting is continued can be decided in October, depending on the number of pairs in the area.
- A brief survey should be conducted in early October to determine where birds have been recruited on the island and identify potential sites for cat control or other protection.
- A stoat kill-trapping line should be run on Table Hill during the season.
- Captive-rearing of the southern subspecies is not necessary during the 1995-96 season.

## 2 Nest-cage trials

A potential management technique on Stewart Island is the use of predator enclosures over nests (pages 6-7, Dowding 1994c); these would have holes in them of a size that allowed access to dotterels but excluded cats. In principle, they should protect eggs and sitting birds (particularly males at night) from cats and could be a very cost-effective technique at sites where cat control is not being undertaken. During the 1994-95 season, preliminary trials with nest cages were carried out in the North Island.

### 2.1 METHODS

Nest cages were constructed of 50 mm mesh Netlon 'Instant Trellis', joined with wire-netting clips. Prototype cages measured approximately 750 mm x 650 mm and were 425 mm high at the highest point. Access holes were cut

around the base of the cage, and the cage was pegged to the ground over the nest. A single hoop of fencing wire threaded through the mesh in the centre of the cage was used to provide extra rigidity to the structure. Trials with domestic cats were used to determine size of access holes.

A detailed description of cage materials and dimensions will be recorded at a later date, after further development and field-testing.

## 2.2 RESULTS

### *North Island*

Although cats and NZ dotterels are very different in size, it proved difficult to find a size of access hole that allowed dotterels easy passage but excluded cats. A hole 160 mm high and 65 mm wide allowed easy access for dotterels but also allowed entry to a small cat. Reducing the hole to 110 x 60 mm excluded cats, but dotterels clearly had considerable difficulty squeezing through a hole this size.

Prefabricated cages could usually be fitted over nests in 3-4 minutes. After I left the nest, one or both birds normally approached and inspected the cage within 5 minutes, then retreated. Time taken to return to the nest was highly variable, and was probably governed by weather conditions, state of incubation, and differences in individual behaviour. During these observations, I was surprised by how long birds sometimes took to return to *uncaged* nests; in one case on a dry mild day, I observed (by telescope from a concealed site more than 100 m away) a bird stay off its nest for 48 minutes. There were no obvious signs of disturbance and the bird, apparently unconcerned, spent most of this time about 20 m from the nest preening and resting. The eggs later hatched.

In the limited trials undertaken so far, cages appear to have had no long-term adverse effects on the nests involved. A nest at Wade River and another at Omaha were both used for trials (lasting 3-4 hours each) on three separate occasions and both subsequently hatched. A cage installed over another nest at Wade River was left in place for 48 hours then removed; the eggs later hatched.

### *Stewart Island*

No opportunities to test nest cages arose on Table Hill this season. The only fertile nest was present between my October and December visits, and the behaviour of the two birds with a 5-egg clutch was highly unusual. Unlike most Stewart Island dotterels, these would not go anywhere near their nest if I was in sight of it (even at a distance of 200 m or more); I could not therefore study their reaction to the cage or even tell if they were prepared to enter it.

## 2.3 DISCUSSION AND RECOMMENDATIONS

Although they are still very much at the development stage, I believe nest cages have considerable potential as a management tool on Stewart Island, as long as cats remain the major predator there. Cages will not exclude stoats however, if these are found to be present. NZ dotterels were clearly prepared to enter the prototype cages, but further work is required on the size and shape of access holes. Cats are lithe, supple and accustomed to moving in confined spaces, whereas dotterels are none of these.

Birds of the southern subspecies are 12% heavier on average than North Island birds (Dowding 1994a), and it may be necessary to use slightly larger access holes in cages on Stewart Island. This may not matter however, as most of the feral cats there will probably be larger than the domestic cats used in the North Island trials. It may be that feral cats will also be more wary and less willing to enter an unfamiliar structure or squeeze into a confined space. Some information on this may be obtained during a video-surveillance study of nest predators in the North Island planned for the 1995-96 and 1996-97 seasons.

### *Recommendations:*

- Development and testing of nest cages in the North Island should continue.
- Cages should be tested at selected sites on Stewart Island during the 1995-96 season.

# 3 Captive-rearing trials

If the Stewart Island population continues to decline in numbers, captive-rearing may be necessary to ensure the survival of the southern subspecies. Preparation of a contingency captive-rearing plan was suggested in the NZ dotterel recovery plan (Dowding 1993b), and a meeting of the NZDRG in May 1994 recommended that such a plan be drafted immediately. A proposal for a trial programme using North Island birds was subsequently drawn up (Dowding 1994c), and this programme was carried out during the 1994-95 season, with rearing undertaken by Otorohanga and Auckland Zoos.

## 3.1 METHODS

### *Egg collection*

Eggs were collected in two batches. The first batch, collected between 5 October and 17 November, consisted of whole clutches totalling 23 eggs taken from marked birds in the Omaha-Mangawhai study area (Dowding & Chamberlin 1991). The second batch, collected between 20 and 29 December, consisted of 17 eggs from a number of sites in North Auckland, Coromandel Peninsula and Matakana Island, Bay of Plenty. Details of collec-

tion sites, dates and numbers of eggs are given in Table 2. Eggs were transported in a portable incubator at an indicated temperature of **98.4-99.0°F (= 36.9-37.2°C)**.

TABLE 2. ORIGIN AND COLLECTION DATES OF NZ DOTTEREL EGGS TAKEN INTO CAPTIVITY DURING THE 1994-95 SEASON

LOCATION	COLLECTION DATE	NUMBER OF EGGS	RECIPIENT INSTITUTION
Omaha Spit, North Auckland	05-10-94	3	Otorohanga
	19-10-94	5	Otorohanga
	25-10-94	3	Auckland
	17-11-94	3	Auckland
Te Arai Stream, North Auckland	05-10-94	4	Otorohanga
Pakiri River, North Auckland	17-11-94	5	Auckland
Tapora, Kaipara Harbour	29-12-94	3	Auckland
Matakana Island, Bay of Plenty	20-12-94	3	Otorohanga
	23-12-94	5	Auckland
Onemana, Coromandel	21-12-94	3	Otorohanga
Opoutere, Coromandel	21-12-94	2	Otorohanga
Whiritoa, Coromandel	21-12-94	1	Otorohanga

Incubation conditions used at Otorohanga and Auckland this season were similar - nominal temperature was **37.2°C** at both institutions and relative humidity was 40-60% at Otorohanga and 40-70% at Auckland.

### ***Releases***

Birds were transported to release sites in purpose-built transfer boxes; these boxes held six birds each, individually housed in compartments measuring 300 x 200 mm and 180 mm high. All birds were banded with individual colour combinations and weighed before release.

Transmitters used in the second release (manufactured by Sirtrack, Havelock North) were single-stage, pulsed at 40 ppm, weighed 2.0-2.5 g (between 1.2-1.8% of the weights of the birds carrying them) and had an expected life of 19-24 days. They were attached following a protocol similar to that used for shore plover (Hilary Aikman, *Use of glue-on transmitters for New Zealand shore plover*, unpublished report to DoC Ethics Committee). The transmitter body was attached to a piece of cotton voile with superglue and allowed to dry thoroughly. To fix the transmitter to the bird, feathers and down were carefully cut away to expose a patch of skin on the upper back; the cleared

patch was typically about 30 mm long (following the line of the spine) and about 15-20 mm wide. The patch of skin and the cotton voile (trimmed to the same size and shape) were coated with **Skin Bond®** rubber cement (Smith & Nephew, Auckland), which was then allowed to dry for 3-4 minutes. The transmitter package was pressed into place and the fringe of cotton was pressed down around the edges to ensure good contact. Transmitters were attached 1-2 hours before release and checked at release.

### 3.2 RESULTS

#### *Impact of clutch removal*

There were no apparent long-term effects of removing whole clutches. All donor pairs of batch 1 eggs remained paired and none left their territories. The five donor pairs at Omaha all re-laid within three weeks; the two pairs at Te Arai Stream had both re-laid within a month; whether the two pairs at Pakiri River re-nested could not be determined.

#### *Incubation and chick-rearing*

The outcome of incubation and chick-rearing this season, separated by institution and egg batch, is shown in Table 3.

TABLE 3. FATE OF NZ DOTTEREL EGGS TAKEN INTO CAPTIVITY, 1994-95 SEASON

	OTOROHANGA		AUCKLAND		TOTALS
	BATCH 1	BATCH 2	BATCH 1	BATCH 2	
Number of eggs	12	9	11	8	40
Infertile eggs	4	2	0	1	7
Died in shell	0	1	0	3	4
Died hatching	2	0	0	1	3
Hatched	6	6	11	3	26
Died early (<2 weeks)	0	0	7	2	9
Died late (>2 weeks)	1	2	1	0	4
Released	5	4	3	1	13

It is clear from the figures in Table 3 that there were a significant number of early deaths (i.e. in shell, during hatching, and among very young chicks). Some early chick deaths in batch 1 at Auckland may have been attributable to diet, which was modified for batch 2 chicks. Autopsy reports containing in-

formation on the causes of other deaths are not yet available. Of the 40 eggs taken into captivity, 13 birds were reared to release age.

### ***First release***

On 7 February 1995, eight captive-reared birds (five reared at Otorohanga and three at Auckland) were released at high water at Omaha Spit, in the presence of a flock of about 30 wild NZ dotterels. The average age of the released birds was 12 weeks; one was 8 weeks, the others were all between 10.5 and 16 weeks. Birds raised in the wild normally fly at 6-7 weeks. All could fly when released, but they were not particularly strong fliers. The eight birds did not stay together when released and only one joined the flock of wild birds; the others scattered around the spit (about 400 m long) and stood singly.

These birds disappeared quickly; only three of the eight were present the day after the release. On day 2, we found one bird alive and the remains of two others, surrounded by fresh stoat tracks. On day 3, none of the birds was at Omaha. Despite searches of the spit and adjacent estuary, and checks of suitable coastline to the north and south of the release site, none was seen alive again until 9 March when one returned to Omaha. This bird left Omaha again within a week and another returned; it was first seen there on 22 March and remained for at least a month.

### ***Second release***

On 13 April 1995, five birds were released at the sand-bar at the mouth of the Wade River, north of Auckland. In addition to being individually colour-banded, these birds were all fitted with radio-transmitters. At release, one bird was aged 12 weeks, the others were 13 weeks.

In this case, the behaviour of the birds was markedly different when released. All birds walked calmly away, did not fly, stayed in a group and integrated well with other dotterels present. None of the apparent panic and scattering behaviour seen at Omaha was evident. Several of the birds preened but did not appear to be trying to remove their transmitters; three of the birds started foraging soon after release. Another moved into the territory of a resident pair and was chased by the male; it took appropriate evasive action.

A week after release, all five birds were still alive and at the release site. Two of them appeared to have become more independent and mixed freely with wild dotterels, while three still tended to stay together in a group apart from other birds. On day 9, the remains of one bird were found on the sand-bar; these consisted of both wings, a leg and the transmitter. Another transmitter (but no remains) was found 20 m away; that bird has not been seen since and is assumed dead. The three remaining birds were still alive and at the release site three weeks after release.

In total, 5 (38%) of the 13 birds released were known or thought to be alive in the first week of May, 12 weeks after the first release and three weeks after the second (Table 4).

TABLE 4. FATE OF CAPTIVE-REARED BIRDS TO EARLY MAY 1995

	1ST RELEASE	2ND RELEASE	TOTALS
Known alive	1	3	4
Probably alive	1	0	1
Known dead	2	1	3
Probably dead	4	1	5

***Transmitters***

There was no evidence that transmitters caused the birds any problems; no bird was seen to peck at its transmitter at any time and they did not appear to impede flight at all. Two birds were re-trapped and their transmitters were removed after failing at 15 days; by this time new feathers were emerging in the cleared patch of skin and were lifting the skin cement (and hence the transmitter) off the skin. One transmitter was still in place after three weeks. Transmitter life was monitored and found to be considerably less than advised by the manufacturers. Expected life was quoted as 19.1-23.9 days (mid-point 21.5 days); of five transmitters used to the end of their lives, one failed between 11 and 15 days, one failed after 14 days, and three failed after 15 days. One transmitter was shed by a bird at 17 or 18 days and was lost as a direct result of failing early.

3.3 DISCUSSION AND RECOMMENDATIONS

***Impact of egg collection***

As anticipated, the removal of whole clutches had no noticeable effects on pair-bonds or maintenance of territories by donor birds. It therefore seems likely that if captive-rearing of the southern subspecies becomes necessary, whole clutches could be collected on Stewart Island without causing problems. In any further North Island trials, whole clutches can still be taken from sites threatened by inundation or known to have high rates of predation; single eggs can be taken from 3-egg clutches at other sites with little impact on productivity - NZ dotterels very rarely raise three chicks in the wild.

***Incubation and chick rearing***

Results from this season suggest that optimal incubation conditions for NZ dotterel eggs have not yet been found. Overall, 7 (18%) of the 40 eggs taken into captivity were listed as infertile, including 6 (29%) of 21 at Otorohanga. It seems unlikely that infertility in the wild is as high as this. In one case an entire clutch taken from a known fertile pair was apparently infertile. It therefore seems possible that some eggs may have suffered very early embryo death (which can be difficult to detect) rather than being infertile. Some captive-

rearing protocols for other shorebirds include changes in temperature and/or humidity during incubation (pages 20-22, Dowding 1994c); similar adjustments may improve hatching rates of NZ dotterel eggs. Auckland Zoo have already identified other minor changes to their incubation regime that they believe will improve hatching rates.

Results to date suggest that there is lower success with eggs taken very early in incubation (i.e. within 2-3 days of clutch completion). This may be due to enhanced susceptibility of very early embryos to damage during transfer, or it may be a reflection of sub-optimal incubation conditions over a long period. Clutches collected on Stewart Island are more likely to be of unknown age and it is therefore highly desirable that we are able to incubate successfully from any stage.

A meeting to discuss the results of this season's programme in detail will be held in the near future. This will focus particularly on incubation conditions, chick diet, and the reasons for egg and chick deaths; at the time of writing few autopsy reports are available. The meeting will be attended by those involved in the programme at Auckland Zoo, Eric Fox (Otorohanga), John Dowding (NZDRG), and possibly Shaun O'Connor (National Wildlife Centre). Following the meeting, I will circulate a brief report on the major conclusions reached.

### ***Releases***

The first release was clearly unsuccessful, with some birds taken by a stoat within a few days, and only two of eight thought to be alive after 12 weeks. Although sample sizes are small, the second release appeared far more successful - all birds remained at the release site and, at least initially, survival was considerably higher.

There are a number of factors that may have contributed to the relative success of the second release:

1. The birds were held together in a large aviary with other birds (mostly bar-tailed godwits) for some weeks before release; their behaviour in both intra- and inter-specific interactions may have been more highly developed. It was clear that they integrated with dotterels and other species much more quickly than the birds released at Omaha.
2. Predators (specifically one or more stoats) had a dramatic impact on the birds released at Omaha. The Wade River sand-bar is cut off at high water and there is evidence (high adult survival, higher productivity) that predator activity is lower there.
3. Release age may be important. The only two birds so far known to have survived the first release were two of the three oldest, aged 14 and 15 weeks at release, and all birds in the second release were 12 weeks or older. Three birds that disappeared in the first release were between 8 and 10.5 weeks. Sample sizes are too small to draw definite conclusions, but it may be prudent in future to release only birds aged 13-14 weeks or more.



### ***Transmitters***

Four of the six transmitters supplied were recovered and will be re-powered for use during the shore plover release planned for spring 1995. Sirtrack will be advised that none of the five transmitters used in these trials lasted more than 15 days, much less than their expected life of 19-24 days. It may be possible to rectify this situation during re-powering, but those involved in the shore plover release should bear in mind that the life of these units may be shorter than expected.

### ***Conclusions***

Although it is clear that rearing conditions for NZ dotterels have not yet been optimised, those involved with the programme this season are encouraged by the results to date. Some ways in which hatching rates can probably be improved have already been identified and both Otorohanga and Auckland Zoos have indicated that they are keen to continue their participation in the programme next season.

Increasing the survival of captive-reared birds after release presents different problems - they are clearly naive and very susceptible to predation. Initial survival can probably be improved by releasing at sites with low predator activity, but wherever they are released captive-reared dotterels will eventually encounter mammalian predators. Their chances of surviving those encounters should improve the longer they have been in the wild.

### ***Recommendations :***

- The programme should be repeated during the 1995-96 season, with a view to increasing hatching rates and releasing a greater number of birds.
- In future North Island trials, whole clutches can be taken from sites where inundation or predation are likely; single eggs can be taken from 3-egg clutches at other sites.
- Where appropriate, recommendations from the planned end-of-season meeting should be incorporated into next season's programme.
- Release sites where predators are known to be present regularly or at high density should be avoided.

### ***Outputs***

Research and management during the 1994-95 season resulted in the following outputs:

- A talk on the Stewart Island situation to Forest & Bird's Waikato Branch, March 1995
- A *Conservation Brief* article on the results of the season on Stewart Island, May 1995 issue of *Forest & Bird* magazine
- Verbal reports to the NZ dotterel recovery group meeting on 26 April 1995 on Stewart Island and the captive-rearing trials
- This report

In addition to the outputs listed above, there were a number of articles in national and local newspapers on the captive-rearing programmes at Otorohanga and Auckland.

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