

New Zealand fairy tern
(*Sterna nereis davisae*)
recovery plan, 2005-15

Katrina Hansen

THREATENED SPECIES RECOVERY PLAN 57

Published by
Science & Technical Publishing
Department of Conservation
PO Box 10420
The Terrace
Wellington 6143, New Zealand

Cover: Adult New Zealand fairy tern at Waipu Wildlife Refuge, 27 December 2004. *Photo: Katrina Hansen*

The General Manager Operations (Northern) of the Department of Conservation formally approved this plan in August 2006. A review of the plan is due after 10 years, in 2015, or sooner if new information or technology leads to a significant change in management direction. This plan will remain operative until a new plan has been prepared and approved, or become redundant if recovery is achieved and management effort enters a 'maintenance phase'.

Individual copies are printed, and are also available from the departmental website in pdf form. Titles are listed in our catalogue on the website, refer www.doc.govt.nz under *Publications*, then *Science and Research*.

© Copyright November 2006, New Zealand Department of Conservation

ISSN 1170-3806

ISBN 0-478-14130-0

This report was prepared for publication by Science & Technical Publishing; editing and layout by Ian Mackenzie. Publication was approved by the Chief Scientist (Research, Development & Improvement Division), Department of Conservation, Wellington, New Zealand.

In the interest of forest conservation, we support paperless electronic publishing. When printing, recycled paper is used wherever possible.

CONTENTS

Abstract	5
<hr/>	
1. Introduction	6
<hr/>	
2. Plan term and review date	6
<hr/>	
3. Context	7
<hr/>	
3.1 Overview of the species	7
3.1.1 Species ecology and biology	7
3.1.2 Status and species recovery principles	7
3.1.3 Past and present distribution	8
3.1.4 Agents of decline, and threats	8
3.1.5 Past and current management	8
3.1.6 Preferred option for recovery	9
3.2 Strategic directives	10
3.3 Cultural importance	10
3.4 Public awareness	10
4. Goals	11
<hr/>	
4.1 Long-term recovery goal	11
4.2 Goals for the term of this plan	11
4.2.1 Management	11
4.2.2 Community relations	11
4.2.3 Research	11
5. Implementation	12
<hr/>	
5.1 Management	12
5.1.1 Topic 1—Protection of the breeding population (Goal 1)	12
5.1.2 Topic 2—Maximise productivity (Goal 1)	12
5.1.3 Topic 3—Population parameters and dynamics (Goal 1)	13
5.1.4 Topic 4—Legal protection and maintenance of breeding and flock sites (Goal 1)	13
5.2 Community relations	14
5.2.1 Topic 5—Raise public awareness of the need for conservation, and increase community involvement (Goal 2)	14
5.2.2 Topic 6—Involvement of volunteers in the conservation of NZ fairy terns (Goal 3)	14
5.3 Research	15
5.3.1 Topic 7—Factors restraining recruitment and population growth (Goal 4)	15
5.3.2 Topic 8—Agent(s) of decline (Goal 4)	15
5.3.3 Topic 9—Assess impacts of current management regime (Goal 4)	16
5.3.4 Topic 10—Other research issues (Goal 5)	16

6.	Acknowledgements	18
7.	References	19
<hr/>		
Appendix 1		
<hr/>		
	Review of the NZ Fairy Tern Recovery Plan, 1997-2002	21
<hr/>		
Appendix 2		
<hr/>		
	Management actions for the protection of nesting NZ fairy terns	26
<hr/>		
Appendix 3		
<hr/>		
	Management protocols	27
	Recovery plans	31
	Threatened species recovery plans	32
<hr/>		

New Zealand fairy tern (*Sterna nereis davisae*) recovery plan, 2005–15

THREATENED SPECIES RECOVERY PLAN 57

Katrina Hansen

3 Harbour View Road, Whangarei 0110, Northland, New Zealand

ABSTRACT

The New Zealand fairy tern (*Sterna nereis davisae*) is New Zealand's rarest indigenous breeding bird. It is a morphologically distinct, geographically and genetically isolated, endemic subspecies of an Australasian species, which consists of two other recognised subspecies: *S. n. nereis* in Australia and *S. n. exsul* in New Caledonia. The population is estimated to number 35 to 40 individuals and now only breeds at four breeding sites in the North Island. It is threatened by introduced mammalian predators, disturbance and habitat modification. This plan presents a revised goal and the objectives required to continue recovery of the New Zealand fairy tern. Actions in this plan focus on the continued protection of the breeding pairs and their progeny *in situ*. Research is required on critical population demographics.

Keywords: New Zealand fairy tern, *Sterna nereis davisae*, recovery plan, species management, North Island, New Zealand

© Copyright November 2006, Department of Conservation. This paper may be cited as:
Hansen, K. 2006: New Zealand fairy tern (*Sterna nereis davisae*) recovery plan, 2005–15.
Threatened Species Recovery Plan 57. Department of Conservation, Wellington. 32 p.

1. Introduction

The New Zealand (NZ) fairy tern (*Sterna nereis davisae*) is New Zealand's rarest indigenous breeding bird. It is an endemic subspecies of an Australasian species, which consists of two other recognised subspecies: *S. n. nereis* in Australia and *S. n. exsul* in New Caledonia (Higgins & Davies 1996).

The Department of Conservation (DOC) has a current threat ranking for the New Zealand fairy tern of Nationally Critical (Hitchmough 2002), with the population estimated to number from 35 to 40 individuals. It was once more widespread throughout the North and South Islands (see Buller 1888; Oliver 1955), but now only breeds at four locations in the North Island. It is threatened by introduced mammalian predators, disturbance, and habitat modification of its breeding and roosting sites. Since 1997, between six and nine pairs have bred each season until 2005.

This is the second recovery plan for the NZ fairy tern. The first plan was approved in 1997 for a 5-year period (Parrish & Honnor 1997) and is reviewed in Appendix 1.

The current plan presents a revised goal and the objectives required to continue recovery of the fairy tern in New Zealand. This plan has had input from the NZ Fairy Tern Recovery Group, analysis of population demographics (Ferreira et al. 2005) and a technical review of the NZ fairy tern protection programme requested by the Biodiversity Recovery Unit, DOC (Taylor et al. 2004). The conservation achievements made under the previous plan towards recovery of the NZ fairy tern are reviewed and progress on the goal and objectives are assessed.

2. Plan term and review date

The term of the plan is 10 years, from August 2005 to August 2015. The review date is 31 August 2015.

3. Context

3.1 OVERVIEW OF THE SPECIES

3.1.1 Species ecology and biology

The NZ fairy tern nests on low-lying sand-spits, near sheltered estuaries along the coast of the northern North Island. They prefer open areas with sea-shell cover. Some pairs nest within 8–10 m of each other, while other pairs can be separated by several kilometres. Nesting occurs between October and January, with one or two eggs (1.67 on average) laid per clutch ($n = 120$) (Ferreira et al. 2005). Pairs will re-nest when clutches are lost, but can only raise the chicks from one clutch per season. The chicks remain with the parents for several months after fledging while they learn to fish for themselves. After breeding, the birds move from the breeding sites to flock sites on both the east and west coasts, particularly the Kaipara Harbour.

The proportion of the population attempting to breed each year is low at an average of 43% (SE = 0.09) (Ferreira et al. 2005). The proportion of eggs hatching each season is also low, with an average of only 38% (SE = 0.04) (Ferreira et al. 2005). Chick survival to fledging is high at 63% (SE = 0.05), but recruitment into the breeding population is low with only 32.7% of the 55 birds banded between 1991 and 2003 attempting to breed to date. The factors limiting recruitment to the breeding population are currently unknown. Adult survival is high at 95%, and the average life-span is currently determined as at least six years. Demographic modelling currently predicts the population to be increasing at c. 1.5% (SE = 0.009) per annum (Ferreira et al. 2005).

3.1.2 Status and species recovery principles

The subspecific status of the NZ fairy tern is based on morphometric, geographic, and behavioural differences (Higgins & Davies 1996). Preliminary genetic analysis supported the subspecific status of the NZ fairy tern (Chambers & Coddington 1997; Chambers & Coleridge 1998); however, this work was based on only two samples of *S. n. davisae*. More recent detailed genetic studies (Brunton & Baling 2005) found that there is very restricted gene flow between the New Zealand and Australian populations with a migration rate (M) of 0.05, which is basically zero. They also found a distinct haplotype present only in the New Zealand birds.

The current threat ranking of the NZ fairy tern is Nationally Critical: a species with a very high risk of extinction (Hitchmough 2002). The population of NZ fairy terns numbers around 35–40 birds. The main threats to the population are known (habitat degradation, predation, disturbance, extreme weather) (Parrish & Honnor 1997) and management of these factors has resulted in the decline of the species being halted (Ferreira et al. 2005). However, management is still needed to secure the population. Priority research is needed to clarify the factors inhibiting recruitment into the breeding population, to determine the cause of unexplained losses of eggs and young chicks, and to assess the benefits or possible impacts of the intensive management regime.

3.1.3 Past and present distribution

The NZ fairy tern was once widespread around the coastline of the North Island and east coast and inland rivers of the South Island. The NZ fairy tern was described as ‘tolerably common’ by Buller (1888). However, prior to the 1950s, records of NZ fairy terns are probably inaccurate because of confusion which resulted from identifying eastern little terns (*S. albifrons*) as NZ fairy terns. After the 1950s little terns were recognised as visiting New Zealand, and records of NZ fairy terns became more accurate as the sites they used were surveyed regularly (Parrish & Honnor 1997; Ferreira et al. 2005). Birds were still recorded breeding near Levin, Tauranga, Manawatu, Blenheim, Rangitikei River and Hawke’s Bay during the 1930s to the 1950s (MacDonald 1953; Oliver 1955). Moon reported birds were still breeding in Whangarei Harbour in 1951 and along the Pakiri–Te Arai coast until the early 1970s (pers. comm. in Parrish & Honnor 1997). By 1983 the population had dropped from the 18 pairs of the 1950s to just three pairs breeding at three sites in Northland: Mangawhai, Waipu, and Papakanui Spit (Heather & Robertson 1996; Parrish & Honnor 1997). These three sites had remained the only breeding sites since that time, until a recent expansion of a breeding pair at Pakiri in 2003–04.

3.1.4 Agents of decline, and threats

The causes of decline of the NZ fairy tern have been attributed to a variety of factors that affect many of New Zealand’s endemic shorebirds, including:

- Habitat degradation (particularly dune stabilisation) related to the development of forestry, residential subdivisions, and farming (Jowett 1986; Cummings 1991)
- Loss of eggs and chicks to introduced mammalian predators, particularly rats (*Rattus* spp.), mustelids (*Mustela* spp.), cats (*Felix catus*), hedgehogs (*Erinaceus europaeus*) and native avian predators, particularly black-backed gulls (*Larus dominicanus*) and Australasian harriers (*Circus approximans*) (Dowding & Murphy 2001; Parrish & Honnor 1997)
- Disturbance by humans at the breeding sites
- Severe weather events

The population is also subject to a low level of recruitment of breeding adults and a high rate of infertility, although this has provided infertile pairs for nest manipulations to maximise productivity. The threats of predation, disturbance, and adverse weather events are minimised, as much as possible, by management, but the population may also be affected by inbreeding depression that affects small populations (Ferreira et al. 2005).

3.1.5 Past and current management

Management was initiated in 1983/84 by the then New Zealand Wildlife Service (Department of Internal Affairs), when the population had declined to three breeding pairs. The initial management regime consisted of wardens employed for irregular periods each breeding season at the three sites. DOC has continued the management of the NZ fairy tern, and a recovery group was established in 1991, which was formalised in 1997. Management actions were initiated (see Appendix 2). They included:

- Full-time wardens employed over the breeding season
- Trapping during the breeding season to remove mammalian predators and control of avian predators
- Fencing off nesting areas to reduce disturbance
- Moving eggs and chicks between nests, to maximise productivity
- Protecting nests from storm and wind damage, and tidal inundation
- Advocacy and compliance

Predator control was started in 1995 at Mangawhai, in 1997 at Waipu, and in 1998 at Papakanui. By 1999 all three sites had a full-time warden and trapper for at least five months over the breeding season. The Auckland Zoo has provided artificial incubation facilities and expertise since 1998, based on protocols developed with the recovery group.

The management which was intensified in 1991 with the initiation of the recovery group, and continued to the present has halted the decline of the species and reduced the risk of extinction from 52% to 39% (Ferreira et al. 2005). The increased productivity has resulted in a population increase of c. 1.5% (SE=0.009) per annum (Ferreira et al. 2005). A manual for wardens was developed to ensure continuity of effort and techniques (Honnor & Hansen 1998), and provided a basis for training wardens. Since 2003/04 the fairy terns have been breeding at four sites, with a pair of birds breeding at Pakiri. Some monitoring and trapping has been carried out at this site, at a minimal level, assisted by the local community and Ornithological Society of New Zealand (OSNZ) members.

Although some analysis of population demography was carried out (Ferreira et al. 2005) no assessment has been made of the affects of such intensive management. The effect of egg and chick manipulations and other interventions on such factors as egg viability, productivity, and pair stability needs to be analysed.

3.1.6 Preferred option for recovery

The preferred option for recovery is to continue with management to protect all known breeding pairs and nesting areas, including individuals at new sites, and maximise breeding productivity. The key recovery actions are as follows (Taylor et al. 2004): protection of nests and nesting pairs, controlling predators, colour-banding and DNA-sexing of all chicks, continuing flock counts and maintaining the sightings database, advocating protection of nest and flock sites from development, raising and continuing public awareness of NZ fairy tern. Full details and justification for these actions are described below in section 5: Implementation.

New techniques may also have the potential to greatly enhance recovery of the NZ fairy tern, if research and implementation is funded. These include more wardens to protect fairy terns at new sites, enhancing/improving breeding habitat, improvements to nest manipulations to increase productivity and better use of captive rearing facilities to enhance chick productivity.

3.2 STRATEGIC DIRECTIVES

This plan is consistent with the DOC Statement of Intent 2003–06, ‘Key Step 1: Protect and restore New Zealand’s natural heritage, Outcome 2: No human-induced extinctions of indigenous terrestrial, fresh-water, and marine species have occurred and, where practicable, representative populations of all indigenous species have long-term security in predominantly natural habitats within their natural range’ (DOC 2002: 25, 27). This plan is also consistent with the DOC Statement of Intent 2006–09, ‘2. Intermediate Outcomes, 3: ‘Managed threatened species have a lower risk of extinction’, resulting in a change in the threat classification status of managed ‘acutely threatened’ species or subspecies (DOC 2006: 39).

This plan also fulfils Goal Three of The New Zealand Biodiversity Strategy (Anon. 2000: 15): ‘Halt the decline in New Zealand’s indigenous biodiversity ... Maintain and restore viable populations of all indigenous species and subspecies across their natural range and maintain their genetic diversity.’

3.3 CULTURAL IMPORTANCE

Iwi call the NZ fairy tern, ‘tara-iti’. A working relationship between the Department and local iwi (Ngatiwai, Ngati Whatua, Te Uri o Hau) has been developed, including discussions on the taking of blood and feather samples.

Some of the communities where NZ fairy terns remain now value the species as an important part of their area, and are concerned for the species’ protection.

3.4 PUBLIC AWARENESS

Generally, there is minimal public awareness about the NZ fairy tern, in spite of regular media articles during each breeding season and several TV stories over the past decade. Public awareness is facilitated by wardens talking to people on the beaches, including members of the local communities, and writing regularly in local newspapers. Public knowledge of the NZ fairy tern is greater in the Northland–Auckland region where it breeds.

This species is considered to be of high importance by many ornithologists, and many Auckland and Northland OSNZ members give their time to assist with protection, monitoring, advocacy, and carrying out censuses, greatly enhancing the efforts by the Department.

The Auckland Zoo also plays an important role in conserving NZ fairy terns through advocacy and providing artificial incubation facilities and expertise.

4. Goals

4.1 LONG-TERM RECOVERY GOAL

Increase the number of NZ fairy terns to 100 by 2021. Then to increase the numbers of NZ fairy terns to at least 250 birds and the population to one capable of long-term survival, with minimal levels of protection maintaining the population at key coastal sites (Taylor et al. 2004).

4.2 GOALS FOR THE TERM OF THIS PLAN

4.2.1 Management

Goal 1—Actively manage and protect all NZ fairy tern nests to achieve maximum levels of productivity (1-2 chicks per pair per annum) and to protect breeding adult birds so that the total NZ fairy tern population increases by at least 1.5% per annum over the 10-year period of this plan. Manage at least five breeding sites if expansion of the population continues and birds move to new sites.

4.2.2 Community relations

Goal 2—Continue to raise public awareness through accurate and regular media stories every season. Increase active public support for the protection of the NZ fairy tern, so that community and iwi become more involved in nest protection and monitor birds at additional sites above those that the Department manages.

Goal 3—Continue and improve coordination and support to OSNZ volunteers so they remain involved and feel valued as part of the NZ fairy tern protection programme.

4.2.3 Research

Goal 4—Carry out essential research to: investigate factors limiting recruitment of adults into the breeding population; investigate the causes of unexplained loss of eggs and young chicks (desertion, death of embryos); and assess the possible impacts compared with the benefits of the current management regime as analysed by Ferreira et al (2005).

Goal 5—Research that will assist in management of the population should be carried out where possible, including: clarifying the taxonomic status of the NZ fairy tern; determining genetic variation and assessment of possible effects of inbreeding within the population; parental recognition of chicks; parental care post-fledging; movement of adults and juveniles post-breeding; improvements to nest manipulations; and captive rearing techniques.

5. Implementation

5.1 MANAGEMENT

5.1.1 Topic 1—Protection of the breeding population (Goal 1)

Issue: NZ fairy terns are vulnerable to predation by introduced mammalian predators, tidal inundation and adverse weather events, disturbance from humans and habitat degradation. These factors need to be managed to maintain and increase the population. If management is stopped the population will decline.

Objective 1: Protect all known breeding pairs and nesting areas, including pairs found breeding at new sites. Current protection and monitoring management actions (see Appendix 2) at the existing breeding sites are continued and increased to cover at least five sites as the population expands.

ACTIONS	ACCOUNTABILITY	PRIORITY
1.1 Use nest protection measures to safeguard nests from disturbance and weather/tides—including fencing, sandbagging and nest relocation	Programme managers (Biodiversity/NZ fairy tern protection)	Essential
1.2 Continue predator control at breeding sites—trap mammalian predators, control avian predators as required, record predator sign and monitor effectiveness of the predator control	Programme managers	Essential
1.3 Carry out compliance of the laws and regulations of the various reserves and protected status of the NZ fairy tern (under the Wildlife Act 1953)	Programme managers	High

5.1.2 Topic 2—Maximise productivity (Goal 1)

Issue: The NZ fairy tern has a high proportion of infertile eggs (c. 33%). As they are critically endangered and have a short life-span (average 6–7 years) it is vital to their survival and recovery that the maximum number of chicks is produced each breeding season, to compensate for these population fluctuations and the natural events (storms and high tides) that they are vulnerable to.

Objective 2: Maximise productivity so that the equivalent of one chick per breeding pair is reared each season. Eggs and chicks will be manipulated so that as many pairs as possible have an opportunity to rear chicks in the wild. This may involve cross-fostering eggs or young chicks to some pairs to increase productivity.

ACTIONS	ACCOUNTABILITY	PRIORITY
2.1 Candle all eggs to determine fertility—this information will be used in management decisions for manipulating eggs (see protocols, Appendix 3)	Programme managers (Biodiversity/NZ fairy tern protection)	Essential
2.2 Rescue abandoned eggs—for artificial incubation with assistance of Auckland Zoo (following existing protocols, Appendix 3)	Programme managers	Essential
2.3 Nest manipulation—cross-foster eggs and chicks to maximise productivity, in conjunction with Auckland Zoo (following existing protocols, Appendix 3)	Programme managers	Essential
2.4 Continue reviewing results of the breeding season at the end of each season and up-date protocols and operational manual as required	Recovery group, programme managers	High

5.1.3 Topic 3—Population parameters and dynamics (Goal 1)

Issue: Population monitoring is needed to determine increases in the population resulting from the effectiveness of management. Flock sites are monitored for the presence of NZ fairy terns and band sightings are recorded. This information provides an estimate of population size. Monitoring is also needed to detect movement of birds to new areas and subsequent breeding. Chicks are individually colour-banded prior to fledging, and to date approximately 90% of the population is banded. This has allowed information to be gained on the biology of the species, including survival, longevity, age at first breeding, and breeding history.

Objective 3: Population parameters are measured and population dynamics monitored.

ACTIONS	ACCOUNTABILITY	PRIORITY
3.1 Continue to individually colour-band all chicks prior to fledging	Programme managers (Biodiversity/NZ fairy tern protection)	Essential
3.2 Continue post-breeding monitoring through counts of birds at autumn flock sites and recording bands sighted	Programme managers	Essential
3.3 Maintain breeding and sightings database to allow analysis of recovery trends	Recovery group leader	Essential
3.4 Sex NZ fairy tern chicks by DNA testing, using feather samples	Programme managers	Essential
3.5 Actively survey/seek records from potential roost sites that are not regularly checked by current activity	Programme managers	High

5.1.4 Topic 4—Legal protection and maintenance of breeding and flock sites (Goal 1)

Issue: Breeding and flock sites are under continual threat of degradation and disturbance from increasing recreational pressures, coastal sub-divisions, and other land/resource uses (e.g. sand extraction). NZ fairy tern habitat is particularly under threat at the breeding sites during the summer period. Breeding and flock sites are by nature, dynamic landscapes and natural progression is for the sand-spits/mudflats to stabilise and become more vegetated. Management of these habitats is needed to retain them as dynamic sites for NZ fairy terns, rather than becoming stable and vegetated.

Objective 4: Ensure adequate legal protection and, as far as practicable, maintain suitable breeding and flock-site habitat for NZ fairy terns, and protect them from adverse human impacts.

ACTIONS	ACCOUNTABILITY	PRIORITY
4.1 Advocate for protection of all known and potential habitat from the adverse effects of development. Undertake statutory advocacy where proposed activities are likely to cause adverse impacts on NZ fairy terns	Programme managers (Biodiversity), Recovery group leader, community relations staff	Essential
4.2 Review, and improve, the legal status of breeding and flocking habitat, using DOC legal advice	Programme managers, recovery group leader	High
4.3 Carry out weed and vegetation control, as required	Programme managers	High

5.2 COMMUNITY RELATIONS

5.2.1 Topic 5—Raise public awareness of the need for conservation, and increase community involvement (Goal 2)

Issue: Community support of the Department's efforts to protect NZ fairy tern is vital. There are regular articles in local media, and a degree of recognition of NZ fairy terns from the local communities. There is limited involvement in the conservation of NZ fairy terns from the communities, but if the species is to expand into more sites, then community involvement and sponsorship will become more important.

Objective 5: Raise the awareness of NZ fairy terns, and encourage local community involvement in their conservation. Encourage iwi to be involved with NZ fairy tern conservation through consultation and involvement in the management of NZ fairy terns. Follow-up opportunities for sponsorship and funding that arise.

ACTIONS	ACCOUNTABILITY	PRIORITY
5.1 Increase involvement of the media with the recovery programme—to assist in raising public awareness of NZ fairy terns and their habitat	Programme managers (Biodiversity/NZ fairy tern protection), community relations staff	High
5.2 Use media to increase emphasis on NZ fairy tern management as an important part of wider coastal management and shorebird protection	Programme managers, community relations staff	High
5.3 Maintain/improve signage that advocates protection and provides information of NZ fairy tern and their habitat	Programme managers	High
5.4 Identify opportunities for community and iwi to be involved in NZ fairy tern conservation	Programme managers	High
5.5 Follow-up opportunities for sponsorship and funding that arise	Programme managers	High

5.2.2 Topic 6—Involvement of volunteers in the conservation of NZ fairy terns (Goal 3)

Issue: Volunteers play a very important role in the NZ fairy tern recovery programme by assisting wardens with nest monitoring, obtaining sightings of banded birds, helping on formal surveys such as flock counts, and helping with the captive incubation/rearing programme. The contribution of the OSNZ volunteers is vital to provide the level of monitoring needed for the recovery of the NZ fairy tern.

Objective 6: Provide volunteers with logistic support as they are an essential part of the recovery programme.

ACTIONS	ACCOUNTABILITY	PRIORITY
6.1 Increase support to existing volunteers	Programme managers (Biodiversity/NZ fairy tern protection), community relations staff	High

5.3 RESEARCH

5.3.1 Topic 7—Factors restraining recruitment and population growth (Goal 4)

Issue: The proportion of the population attempting to breed each season is low at 43%. If the proportion of adults that breed each season can be increased then the population should increase at a greater rate. Some of the factors that may be influencing the number of adults breeding and recruitment of new pairs into the breeding population include: availability of nesting habitat, territorial behaviour of breeding pairs, and food supply.

Research is needed to determine whether there is any association between food supply and the number of pairs breeding, or recruitment of new pairs into the breeding population. This could be investigated through literature searches and surveys of prey items and availability.

An experimental approach is needed using models, habitat enhancement and other site manipulations to determine if more pairs can be induced to breed at each main breeding area. Observations are needed of birds during the pre-breeding period (June–October) to determine how NZ fairy tern behaviour might contribute to nest-site selection, and whether or not birds are being excluded by the aggressive behaviour of fairy terns or by other species.

Objective 7: Investigate why so few pairs of NZ fairy terns are breeding.

ACTIONS	ACCOUNTABILITY	PRIORITY
7.1 Investigate factors restricting numbers of breeding pairs and recruitment of new pairs using various experimental approaches	Conservancy advisory scientist, recovery group leader	Essential

5.3.2 Topic 8—Agent(s) of decline (Goal 4)

Issue: Predation is one of the main threats to NZ fairy terns. The suite of predators that most threaten all shorebirds has been identified as: mustelids, hedgehogs, rats, cats and black-backed gulls (Cumming 1991; Dowding & Murphy 2001). These predators are controlled under the NZ fairy tern predator control programme, and loss caused by predation has decreased from 32% to 12% since predator control was initiated (Taylor et al. 2004). However, eggs and chicks still disappear without trace and, in many instances, predation by some unidentified predator is suspected. These predators can't be specifically targeted until they are identified.

Objective 8: Identify causes of loss of eggs/chicks due to unknown agents and develop appropriate methods to target their control.

ACTIONS	ACCOUNTABILITY	PRIORITY
8.1 Continue video surveillance, increase number of video set-ups to video several nests per site/season	Recovery group leader, programme managers (Biodiversity assets)	Essential
8.2 Review protocols for wardens and ensure that they are skilled in predator sign recognition and maintain tracking tunnels	Recovery group leader, programme managers	High
8.3 Review and trial other methods for determining chick loss. Trial chick transmitters and use to determine location, cause and timing of loss/death	Conservancy advisory scientist, recovery group leader, programme managers	High

5.3.3 Topic 9—Assess impacts of current management regime (Goal 4)

Issue: Intensive manipulation of eggs has been carried out for many years, and although the benefits of this management have been assessed (Ferreira et al. 2005), no assessment has been made of the effect on survival of transferred eggs or chicks or the long-term impact on the breeding birds. Such intensive manipulations may effect survival of chicks or the life-span of birds used for many cross-fostering attempts.

Objective 9: Determine whether any effects of the current management regime are detrimental to the point of outweighing benefits.

ACTIONS	ACCOUNTABILITY	PRIORITY
9.1 Assess impacts of current management regime: effects of transfers on survival of eggs/chicks; long-term breeding potential and survivorship of adults	Conservancy advisory scientist, recovery group leader	Essential
9.2 Review success of nest manipulation and relocation techniques	Conservancy advisory scientist, recovery group leader	Essential

5.3.4 Topic 10—Other research issues (Goal 5)

[To be started within the term of this plan and completed if possible, as funding/research students are available.]

Clarify the taxonomic status of the NZ fairy tern

Issue: The NZ fairy tern is currently described as a subspecies (Mathews & Iredale 1913), based on morphological, geographical and behavioural differences (Higgins & Davies 1996). Although recent DNA results have substantiated some aspects of the genetic status (Brunton & Baling 2005; Chambers & Coddington 1997; Chambers & Coleridge 1998), the taxonomic status should be clarified further because the issue is raised regularly.

Action: Further taxonomic review incorporating morphology and behavioural studies should be conducted to clarify the status of the NZ fairy tern.

Genetic relatedness and DNA variability of the NZ fairy tern—assessment of possible effects of inbreeding within the population

Issue: The population could be suffering from inbreeding depression and this may be the cause of the high levels of egg infertility. Some genetic variability may be being maintained within the NZ fairy tern population by breeding site separation.

We may be able to reduce inbreeding, or may be doing this now, through egg or chick manipulation between sites. Assessing the genetic variability within the population will show how inbred the population is, whether some individuals have more genetic variability than other members of the population, and whether birds breeding at the different harbours carry unique markers for their sites.

Action: Assess the DNA relationships of the existing population to determine family relationships of the extant birds and the extent of genetic variability present in the population. The potential for inbreeding depression to be contributing to egg infertility levels needs to be investigated, through literature searches.

Parent–chick recognition and potential for chick manipulation

Issue: The level of parent–chick recognition in NZ fairy terns is unknown. This information is needed to assist with manipulations of chicks, particularly to determine to what age chicks can be transferred.

Action: A literature search should be carried out for information on transfer ages in related birds and trials developed.

Parental care of chicks after fledging

Issue: Juveniles stay with their parents after fledging for an undetermined period while being assisted over the initial foraging period, with on-going and frequent feeding. Information such as how long and how much fish juveniles are fed by parents and how long it takes for them to learn to feed for themselves is needed to replicate in the captive situation.

Action: Collect information on parental care of chicks post-fledging.

Movements post-breeding

Issue: Once through the post-fledging parental care period, juveniles appear to range independent of parents. Juveniles may use different roost sites than adults in the non-breeding period. Several known non-breeding roost sites are surveyed each year, but there are many birds that are not recorded regularly at these sites. Some birds are missing for up to 6 years in the period between fledging and returning to known flock/breeding sites. Determining the movement of juveniles and non-breeding adults may allow protection to be provided to other flocking sites.

Action: Determine movement of juveniles post-fledging. Trials will be needed with transmitter attachments and/or harnesses and to determine best practice methods and range for tracking.

Effects of bombing on fate/survival of eggs and chicks

Issue: There is speculation that the close proximity of the New Zealand Defence Force bombing range to the NZ fairy terns nesting area on South Head, Kaipara Harbour may be impacting upon the birds. Information on the effects on eggs/chick survival of bombing could be used to advocate and strengthen the protection for NZ fairy tern nesting habitat.

Action: A literature search needs to be carried out for evidence of adverse impacts on hatching or survival of chicks in populations nesting near to bombing ranges.

Techniques for captive rearing of NZ fairy tern chicks for release into the wild

Issue: Chicks from rescued eggs, or removed from first clutches, could be reared in captivity to maximise productivity each season, rather than continuing the transfer of eggs back to a nest *in situ* prior to hatching. However, the techniques for releasing captive-reared chicks so that they survive on release have not yet been perfected.

Action: If resources become available, then these techniques will need to be improved through trials and information from literature searches.

Objective 10: Start and, if possible, complete the following research projects.

ACTIONS	ACCOUNTABILITY	PRIORITY
10.1 Clarify the taxonomic status of the NZ fairy tern	Conservancy advisory scientist, recovery group leader	High
10.2 Determine the genetic relatedness and DNA variability of the NZ fairy tern to ascertain relationships between birds and to give an indication of inbreeding within the population	Conservancy advisory scientist, recovery group leader	High
10.3 Determine parent-chick recognition stages and the potential for chick manipulation	Conservancy advisory scientist, recovery group leader	High
10.4 Determine the extent of parental care of chicks after fledging	Conservancy advisory scientist, recovery group leader	High
10.5 Conduct research into the movements of adults and juveniles post-breeding, using most current and up-to-date best practice and technology. Likely to involve the use of transmitters	Conservancy advisory scientist, recovery group leader	High
10.6 Literature searches on effects of bombing on fate/survival of eggs and chicks	Conservancy advisory scientist, recovery group leader	High
10.7 Captive rearing of NZ fairy tern chicks for release into the wild	Conservancy advisory scientist, recovery group leader	High

6. Acknowledgements

Thankyou to all the members of the NZ Fairy Tern Recovery Group who contributed to the completion of this plan: Tony Beauchamp, Dianne Brunton, Andrew Nelson, Richard Parrish, Gwenda Pulham, Rosalie Stamp, Graeme Taylor, Audrey Williams, David Wilson and Thelma Wilson. Thankyou also to the other interested individuals for their involvement and comments on the plan including Gerard Pilon, Jeannie Preddey, Tony Habraken, Marlene Baling and Lynnell Greer; to the iwi, the DOC managers Keith Hawkins and Rolien Elliot, and members of the Conservation Board. The NZ Fairy Tern Recovery Group acknowledge the following contributions: Auckland Zoological Park for providing expertise and facilities for the captive incubation of NZ fairy terns; and Northland, Auckland, and South Auckland members of the Ornithological Society of New Zealand, who volunteered many hours of time to assist with the monitoring of NZ fairy tern. There are too many individuals to name, but without your contribution, recovery of the NZ fairy tern would be more difficult. Many iwi groups, local community, and Conservation Corps members also assist the programme—thank you all for your efforts.

7. References

- Anon. 2000. The New Zealand biodiversity strategy. February 2000. Our chance to turn the tide. Department of Conservation and Ministry for the Environment, Wellington. Or see the website: <http://www.biodiversity.govt.nz>
- Brunton, D.; Baling, M. 2005. Conservation genetics of the New Zealand fairy tern (*Sterna nereis davisae*). Unpublished report to the Department of Conservation, University of Auckland, Auckland.
- Buller, W.L. 1888. History of the birds of New Zealand. Wellington.
- Chambers, G.K.; Coddington, S.J. 1997. Molecular systematics of New Zealand fairy tern (*Sterna nereis davisae*) based on mitochondrial DNA sequences. Unpublished report, Institute for Molecular Systematics, School of Biological Sciences, Victoria University, Wellington. 9 p.
- Chambers, G.K.; Coleridge, S.J. 1998. Molecular systematics of New Zealand fairy tern (*Sterna nereis davisae*) based on mitochondrial DNA sequences. *Conservation Advisory Science Notes 182*. Department of Conservation, Wellington.
- Cumming, A. 1991. The New Zealand dotterel (tuturiwhatu) problems and management. Unpublished MSc thesis, University of Auckland, Auckland.
- DOC 2002. Department of Conservation Statement of Intent 2002–2006. Presented to the House of Representatives pursuant to section 38 of the Public Finance Act 1989. C.13 SI (03). Department of Conservation, Wellington. Annual updates may be viewed on the DOC website under *Publications*, then *Corporate*, then follow the links to *Statement of Intent*.
- DOC 2006. Department of Conservation Statement of Intent 2006–2009. Presented to the House of Representatives pursuant to section 38 of the Public Finance Act 1989. C.13 SI (06). Department of Conservation, Wellington.
- Dowding, J.; Murphy, E. 2001. The impact of predation by introduced mammals on endemic shorebirds in New Zealand: A conservation perspective. *Biological Conservation 99*: 47–64.
- Ferreira, S.M.; Hansen, K.M.; Parrish, G.R.; Pierce, R.J.; Pulham, G.A.; Taylor, S. 2005. Conservation of the critically endangered New Zealand fairy tern. *Biological Conservation 125*: 345–354.
- Heather, B.D.; Robertson, H.A. 1996. The field guide to the birds of New Zealand. Viking, Auckland. 432 p.
- Higgins, P.J.; Davies, S.J.J.F. (Eds) 1996. Handbook of Australian, New Zealand, and Antarctic birds. Vol. 3. Snipes to pigeons. Oxford University Press, Melbourne.
- Hitchmough, R. (Comp.) 2002. New Zealand Threat Classification System lists 2002. *Threatened species occasional paper 23*. Department of Conservation, Wellington.
- Honnor, L.; Hansen, K.M. 1998. New Zealand fairy tern operational manual. Unpublished report held by Northland Conservancy, Department of Conservation, Whangarei.
- Jowett, C. 1986. Report on the management of Papakanui spit, Mangawhai and Waipu wildlife refuges, with particular reference to fairy terns, over the 1985–86 summer. Unpublished report held by Northland Conservancy, Department of Conservation, Whangarei.
- MacDonald, N. 1953. Inquiry into the status of fairy tern in New Zealand. Interim report. *Notornis 5*: 84.
- Mathews, G.M.; Iredale, T. 1913. A reference list of the birds of New Zealand. *Ibis 110*: 245.
- Mitchell, A.S.; Chambers, G.K. 1998. Molecular systematics of New Zealand fairy tern *Sterna nereis davisae*. Unpublished report, Institute of Molecular Systematics, School of Biological Sciences, Victoria University, Wellington.
- Oliver, W.R.B. 1955. New Zealand birds. AH & AW Reed, Wellington.
- Parrish, G.R.; Honnor, L. 1997. New Zealand fairy tern (Tara-iti) *Sterna nereis davisae* recovery plan. *Threatened Species Recovery Plan 23*. Department of Conservation, Wellington.

- Taylor G.; Hansen, K.; Ferreira, S. 2004. Technical review of the New Zealand Fairy Tern Recovery Programme. Unpublished report of Biodiversity Recovery Unit, Department of Conservation, Wellington.
- Treadgold, S.J. 2000. Behavioural ecology of the New Zealand fairy tern (Tara-iti) *Sterna nereis davisae*: implications for management. Unpublished MSc thesis, Massey University, Palmerston North, New Zealand.

Appendix 1

REVIEW OF THE NZ FAIRY TERN RECOVERY PLAN, 1997 - 2002

The previous plan (Parrish & Honnor 1997) detailed goals and objectives to achieve recovery of the NZ fairy tern for five years from 1997 to 2002. These objectives are reviewed and the outcomes detailed below.

Long-term goal

- To increase the population of fairy tern, improve their conservation status from Category A (endangered) to Category B (threatened) and expand their breeding range back into parts of their former range.

Progress: The conservation status of NZ fairy tern has remained as endangered (Nationally Critical (Hitchmough 2002)) but they have expanded into former parts of their breeding range, Pakiri).

Short-term goals

- To prevent the extinction of the New Zealand subspecies

Progress: The extinction of the NZ fairy tern has been prevented in the short-term, with the risk of extinction within 50 years decreasing from 0.52 to 0.39 (Ferreira et al. 2005).

- To increase the breeding population by 25% by 2002

Progress: The breeding population did not increase by 25% by 2002, but remained static. However, the number of NZ fairy terns increased from an estimated 30 to an estimated 35-40.

Objectives

Six objectives set the direction for the five-year period 1997-2002.

Objective 1 *To protect all known breeding pairs and nesting areas, including individuals found at new sites by employing wardens to carry out the following duties*

- Fencing nest sites; monitoring breeding attempts (egg laying, hatching, and fledging); recording the details of egg and chick failures; monitoring tidal and weather conditions and implementing protection measures i.e. sand-bagging, nest relocation, holding in captivity; manipulation of eggs and chicks; recording notable fairy tern behaviour i.e. interaction between conspecifics and other species; assisting with the control of predators and recording predator incidents and presence of sign (e.g. tracks and scats); video surveillance of nesting attempts; advocacy and education; compliance and law enforcement.

Outcome: Wardens were employed to cover Waipoua, Mangawhai and Papakanui over the period of the plan and at Pakiri when a pair started nesting there in 2003, and continuing at all sites up to the release of this plan.

- Produce a Shorebird Manual detailing duties and to provide guidance in the

field.

Outcome: A Shorebird Protection Manual was written in 1998 (Honnor & Hansen 1998) and has been up-dated several times since that date.

- Continue video surveillance of nests.

Outcome: Video surveillance of nests was carried out at Mangawhai from 1995/96 until 2000/01, at Waipu in 1999/2000 and 2001/02, and was to be used at Papakanui in 1997/98 but was not continued with because of problems with the equipment. However, no data on predators or disappearance of eggs or young chicks has been recorded on video.

- Continue the predator control that was started at Mangawhai in 1996 and instigate predator control at Waipu and Papakanui.

Outcome: Predator control continued at Mangawhai from 1996, commenced at Waipu in 1997 and at Papakanui in 1998.

Objective 2 *Maximise chick productivity by manipulation*

- Candle all eggs at the earliest possible stage to determine fertility.

Outcome: All eggs were candled to determine fertility (apart from those eggs which disappeared through weather events or suspected predation prior to being candled). Eggs were generally candled between 7 and 12 days of age, but have been candled earlier at 3 days. Eggs were weighed when candled, if weather and other conditions, such as proximity to other nests, permitted.

- Move eggs between nests so that each pair is incubating at least one fertile egg. Weigh eggs when handled.

Outcome: Eggs were regularly moved between nests so each pair incubated at least one fertile egg. Eggs were not always weighed due to time required for the transfers and to reduce disturbance to the birds.

- Protect eggs and chicks in the nest from flooding by sandbagging or relocating the eggs or chicks to an elevated site. Otherwise hold eggs/chicks until the threat has passed. Use 'dummy' eggs to replace real eggs.

Outcome: Eggs and chicks were protected from flooding by sandbagging or relocation. 'Dummy' eggs were regularly used. No situation arose where eggs/chicks held over tidal threat and returned to nest—needs to be trialled in future.

- Mobile chicks threatened by flooding/tides/wind will be moved progressively to a safer, elevated site, or provided with shelter (e.g. driftwood).

Outcome: Mobile chicks were left to move on their own. Shelter was available naturally (e.g. driftwood on present on site) or artificially provided—e.g. half plastic drainage pipes put out for chicks at Papakanui to provide cover from potential predation from black-backed gulls (2001/02).

- Abandoned eggs/chicks will be fostered into the nest of another fairy tern.

Outcome: Abandoned eggs were regularly cross-fostered into other fairy tern nests, often via Auckland Zoo, until nests in situ became available. Pipping eggs or newly hatched chicks were transferred only a couple of times.

- Fostering of eggs/chicks to white-fronted terns will be considered if they can't be fostered to a fairy tern nest. Raising fairy terns in captivity will be

considered a last option.

Outcome: Trials with rearing white-fronted tern chicks as analogue species for NZ fairy tern were carried out at Auckland Zoo in 1998/99 with the decision being made that white-fronted terns were not suitable for cross-fostering of NZ fairy tern chicks.

Objective 3 *Measure the population parameters and monitor the population dynamics of NZ fairy tern*

- Continue banding chicks from all breeding sites.

Outcome: All chicks were banded from all breeding sites.

- Attempt to band adults in the population which are non-banded.

Outcome: Attempts were made to band non-banded adults: one adult was caught and banded (1999), several other attempts to catch a breeding adult were not successful. However, as of 2005 there appear to be only 2 non-banded birds remaining in the population and these older birds will soon disappear through old age.

- Establish a database for NZ fairy tern to record breeding attempts and histories and sightings of banded and un-banded birds.

Outcome: A breeding and sightings database has been set up in Access to record breeding histories and all sightings of banded and non-banded birds. The database is updated regularly (at least twice a year).

- Carry out a breeding census in late December. Current, former and potential breeding sites will be checked around the Northland Peninsula and the Kaipara harbour.

Outcome: A breeding census was carried out in December 1998 with no new breeding sites found. Because of the large number of people required to cover the large areas, the census wasn't repeated. However, several potential sites are visited as part of other surveys carried out by OSNZ and regular fairy tern monitoring.

- A post-breeding census will be carried out in late April at all current, former and potential flock sites. Surveys of known winter flock sites will be carried out from late March to May every year.

Outcome: A post-breeding census was carried out in April 1998. Regular winter monitoring has provided enough sightings to estimate the population size each year without carrying out a census. Surveying known winter flock sites annually between March and May will continue.

Objective 4 *Review and improve the legal status of the breeding and flocking habitat of fairy tern, and protect all known and potential habitat from development*

- The legal status of all three breeding sites will be reviewed and steps taken to make changes if appropriate.
- Increase the legal status of Waikiri Creek flock site from Stewardship Area to higher level of protection, possibly Wildlife Refuge.

Outcome: There has been no progress on changing the legal status of the breeding sites and flock site at Waikiri Creek.

- Consultation with planning authorities to inform them of the location of NZ fairy tern sites and habitat protection requirements.
- The Department will object to planning applications which will affect known and potential breeding and flocking sites, and consider legal action to halt unauthorised modification of habitat.

Outcome: The Department has been involved with input to regional and planning authorities in regards to protecting NZ fairy tern habitat from modification, for example sand extraction consents at Mangawhai.

- New dog control legislation will be used to make flocking and nesting areas 'no dog' zones and advocacy measures will be used at every opportunity.

Outcome: Bylaws have been passed under the Dog Control Act (1996) to designate the east coast NZ fairy tern nesting areas 'closed' no dog areas.

Objective 5 ***Raise public awareness of the need for the conservation of fairy tern through the following actions***

- Continue media releases on the results of fairy tern breeding attempts and their population dynamics, and write articles on the New Zealand fairy tern.

Outcome: Media release and articles have been written on NZ fairy tern each season.

- Produce a pamphlet for New Zealand fairy tern.

Outcome: A NZ fairy tern pamphlet was produced in 2002.

- Erect further signage at Papakanui Spit and Waikiri Creek.

Outcome: Signage on NZ dotterels has been erected at Waikiri Creek, but no more NZ fairy tern signs have been erected at Waikiri Creek or Papakanui.

- Involve local people and give public presentations.

Outcome: People from local communities are regularly involved and public presentations are given each season.

- Instigate and support the production of a Fact Sheet for New Zealand fairy tern.

Outcome: A fact sheet on NZ fairy terns is located on the DOC Website; the pamphlet is available as a printed fact sheet.

- Investigate possible sponsorship of fairy tern recovery.

Outcome: No opportunities for sponsorship have been followed up because of lack of resources and staff time.

Objective 6 ***Formalise a Fairy Tern Recovery Group***

- The members will meet regularly to discuss and monitor progress of the recovery programme toward achieving the goals and objectives of the Recovery Plan.
- The Recovery Plan will be reviewed regularly to measure the effectiveness of the programme in terms of money spent and allow for changes to be made to the Plan to improve conservation efforts.

Outcomes: The NZ Fairy Tern Recovery Group was formalised in 1997 and holds a recovery group meeting every year following the breeding season.

Management protocols were developed to detail best practice methods for manipulations and this is discussed and up-dated following each breeding season.

A technical review was carried out on the programme in 2004 (Taylor et al. 2004) to assess effectiveness of the programme in terms of the money spent and details further actions for recovery of the NZ fairy terns.

Research topics

Eleven topics were identified for research (listed in priority order).

- Sexing of fairy terns
- Nest relocation
- Cause of predation
- Taxonomic status of New Zealand fairy tern
- Life expectancy
- Movement and migration
- Parent-chick recognition and parental care
- Hatching and rearing of tern chicks in captivity
- Nest protection cages
- Assessing plumage
- Habitat requirements

Research completed

- Sexing of fairy terns—started with collection of blood samples in 1999 (Treadgold 2000) and is on-going with chick feather samples taken each season.
- Nest relocation—only a few trials carried out, further work needed.
- Cause of predation—no further data has been collected since video monitoring of Caspian terns in 1996; extensive video monitoring of NZ fairy terns has not recorded any incidents of predation. Sign and evidence of predation is recorded but the cause of disappearance of eggs/chicks has not been identified.
- Taxonomic status—preliminary work was carried out by Chambers & Coddington (1997), Chambers & Coleridge (1998), Mitchell & Chambers (1998), and further studies undertaken in 2004-05 (Brunton & Baling 2005).
- Life expectancy—data analysed and written up: Ferreira et al. 2005.
- Movement and migration—no research carried out, only data collected during post-breeding monitoring. Trials with transmitter attachment carried out on a NZ fairy tern chick at Auckland Zoo in 1999, but were abandoned because of the adverse effect on the flight of the chick.
- Parent-chick recognition and parental care—no research carried out.
- Hatching and rearing of tern chicks in captivity—some trials carried out, further work needed to rear chicks that have behaviours to survive on release.
- Nest protection cages—no research carried out.
- Assessing plumage—some data collected and entered in database, no analysis done since 1997.
- Habitat requirements—some work done through M.Sc. thesis research (Treadgold 2000); further work needed to increase data collected.

Appendix 2

MANAGEMENT ACTIONS FOR THE PROTECTION OF NESTING NZ FAIRY TERNS

Wardens are employed to protect fairy tern nests. The main tasks are:

- Putting up temporary fences and signs around the nest sites to discourage people from approaching nests
- Patrolling the beaches to ensure no vehicles, motorbikes, horses, dogs or people approach the nests
- Monitoring egg laying, hatching and fledging of chicks
- Candling eggs to check for fertility
- Recording details about egg and chick failures
- Monitoring high tide and weather conditions to detect if nests are at risk of being lost to sea surges and storms
- Implementing protection measures such as sand-bagging and nest relocation and removing eggs or chicks from nests at risk
- Manipulating eggs and chicks to maximise productivity
- Recording fairy tern behaviour and interaction
- Predator control and looking for predator sign near nests
- Operating nest surveillance equipment
- Public awareness of the recovery programme
- Compliance and law enforcement (CLE)

Appendix 3

MANAGEMENT PROTOCOLS

[Reviewed and up-dated annually by the NZ Fairy Tern Recovery Group after each breeding season. Contact the Recovery Group Leader for an up-dated version¹]

Rescue intervention

If environmental conditions are deteriorating or abandonment is detected, then the following action is to be taken:

- Remove the complete clutch and place immediately into a portable incubator (must be at appropriate temperature).
- Where the option of placing out fake eggs exists, this should be done.
- Eggs are to be transported to Auckland Zoo immediately.
- Situation to be assessed by Recovery Group following safe incubation of eggs. Then cross-foster or return to parents at approximately 20 days into incubation.

Management intervention

The objective is to maximise productivity such that the majority of adult pairs will have an opportunity to rear chicks in the wild. This may involve cross-fostering eggs or chicks to some pairs to increase productivity. **Decisions will be made on a case-by-case basis.** If quick decisions need to be made, and not all Recovery Group members can be contacted, then the Recovery Group Leader and Project Managers will make judgement calls.

For all nests the following information should be recorded:

Need to know

- Fertility of the clutch on the ground—candle eggs at 10 days + 3.
- Pair(s) breeding history—known producers/good parents?
- Risks at the nest site—can these be managed? Unsafe sites are those prone to flooding or moving dunes or strong winds.

Given this information, potential donor and recipient nests for re-nesting and cross-fostering will be identified.

Recipient nests

- Should be within 50% of the incubation period (i.e. 23 days + 11 days) of the donor nest.
- When clutches are split (e.g. one egg transferred) the recipient nest egg and transferred egg should hatch within 4 days of each other.

¹ Contact the New Zealand Fairy Tern Recovery Group via any office of the Department, or write to the Manager, Threatened Species Section, Terrestrial Conservation Unit, Department of Conservation, PO Box 10420, The Terrace, Wellington 6143.

First nest attempts

From October to the first week of December.

All nests on the ground during this period will be assessed and the above information recorded. Each case will then be discussed and one of the following procedures will be undertaken, **if management is deemed necessary**.

Procedure: Remove complete clutch of fertile eggs from 'good breeders' so that they will abandon to re-nest.

Either: Directly cross-foster fertile eggs into recipient nest of 'infertile pair'.

Or: Transfer eggs to Auckland Zoo for temporary incubation in safe conditions. Cross-foster into recipient nest at approximately day 20.

First time breeders

Situation applies when neither parent has reared a chick (generally 2-3-year-old birds). Do not want to re-nest first-time breeders, but there is a probability that the parents will not be able to raise 2 chicks. There are several scenarios laid out below.

- If: First-time breeders produce a clutch of 2 fertile eggs
- And: There is a recipient nest containing infertile eggs available within 50% incubation period of the donor nest, or
- The recipient nest has 1 of 2 eggs infertile and is the same age as the donor egg
- The recipient pair, at first nest attempt, is unlikely to produce a second viable clutch if re-nested, as assessed by their breeding history or the lateness of the season
- Then: Remove 1 fertile egg and cross-foster to the recipient nest replacing their infertile egg.

Second and third nest attempts

Each case will be discussed and one of the following procedures undertaken if intervention is deemed appropriate.

Procedure: (In the case of 2 fertile eggs in nest).

- Take one fertile egg and replace with a fake. Place in portable incubator at appropriate temperature.
- Observe pair to confirm acceptance within 5 minutes, and providing birds resettle:
- Either: Transfer fertile egg directly to recipient nest.
- Or: If a recipient nest will be available: Transfer to Auckland Zoo for temporary incubation prior to cross-fostering at approx. day 20.

If the birds do not resettle:

- Replace the egg and wait to see if the birds will settle; if not:
- Remove the egg(s) and replace with fake egg(s).
- Take egg(s) to Auckland Zoo for temporary incubation prior to cross-fostering at approx. day 20.

Captive management

Auckland Zoo will continue to contribute to the programme. The Zoo can assist by:

- Providing support for rescued eggs and chicks in emergency situations.
- Providing incubation facilities and expertise for temporary holding of eggs prior to cross-fostering.
- Providing veterinary assistance as needed.

Captive rearing trial

The Recovery Group also has a secondary objective to improve knowledge on techniques for hand rearing and release. There is the potential for eggs to be available for captive rearing trials either from first-time breeders or second clutches where cross-fostering options are absent although these trials are dependent upon resources being available from the Department. With funding, the Auckland Zoo may be able to assist with:

- Hardening-off chicks to be released at post-breeding flock sites in March/April.
- Investigating/providing a flight aviary as a training arena for NZ fairy tern to learn appropriate fishing/diving behaviours.

There are opportunities for positive advocacy and media coverage associated with the Zoo programme and the shorebird display. Zoo staff who are involved are welcome to visit the field sites during the season.

Autopsy

All unhatched eggs, dead chicks, or adults are to go to Massey University Pathology Department for autopsy as soon as possible, if cause of death is unknown. Staff are to fill as much information as possible on the Wildlife Health sheets and send along with the specimen.

Unhatched eggs

- If eggs are candled as infertile, remove as soon as other egg in clutch has hatched.
- If egg was candled as a fertile/viable embryo, but does not appear to be going to hatch (longest between clutch mates hatch date is 4 days), then 3 days after the first chick hatched check the following:
 - If parents are still sitting and incubating egg, then leave with parents.
 - If pipping, obviously leave in the nest.
 - If parent leaves one egg, wait for one day and then remove for analysis.
 - If you are unsure if parent is incubating but they are moving off the nest a lot, wait until 4 days since the first chick hatched before removing.

Recovery plans

This is one of a series of recovery plans produced by the Department of Conservation (DOC). Recovery plans are statements of the Department's intentions for the conservation of a particular species of plant or animal, or group of species, plant or animal community for a defined period. Recovery plans focus on the goals and objectives of recovery management, guide the Department in its allocation of resources and are used to raise public awareness of the recovery process.

A recovery group has been established for the New Zealand fairy tern. This group consists of people with knowledge of the ecology and management needs of the species. The role of the recovery group is to achieve recovery of the species they represent through generation and provision of high quality technical advice. The recovery group prepared this plan in conjunction with people interested in or affected by this plan, or with an expert knowledge of the species. Drafts have been sent to relevant Conservation Boards for comment and to people or organisations with an interest in the conservation management of New Zealand fairy terns. Minor changes to the plan were made as a result of that consultation.

The recovery group will review progress in the implementation of this plan and will recommend to Department managers any changes in management that may be required. Comments and suggestions regarding conservation of New Zealand fairy terns are welcome, and should be directed to the New Zealand fairy tern recovery group via the Northland or Auckland Conservancies, or to the Manager, Biodiversity Recovery Unit, Department of Conservation, PO Box 10420, The Terrace, Wellington 6143.

The recovery planning process provides opportunities for further consultation between the Department, tangata whenua, and others, regarding management of this species. Those interested in being more involved in the management of New Zealand fairy terns, or in receiving information, should also contact the recovery group.

Threatened species recovery plans

NO.	SPECIES	YEAR APPROVED
56	<i>Dactylanthus taylorii</i> recovery plan, 2004-14	2005
55	New Zealand large galaxiid recovery plan, 2003-13	2004
54	Hihi/stitchbird (<i>Notiomystis cincta</i>) recovery plan	2004
53	New Zealand non-migratory galaxiid fishes	2004
52	Grassy plants of fertile sites	2004
51	Mudfish (<i>Neochanna</i> spp.)	2003
50	Kiwi (<i>Apteryx</i> sp.)	2003
49	<i>Powelliphanta</i> land snails	2003
48	North Island <i>Oligosoma</i> spp. skink	2002
47	Tuatara	2001
46	Chatham Island fantail, Chatham Island tomtit and Chatham Island warbler	2001
45	Forbes' parakeet and Chatham Island red-crowned parakeet	2001
44	New Zealand shore plover	2001
43	Chatham Island shag and Pitt Island shag	2001
42	Chatham Island mollymawk, northern royal albatross, Pacific mollymawk	2001
41	Chatham Island tui	2001
40	Black robin	2001
39	Parea	2001
38	Chatham Island oystercatcher	2001
37	Chatham petrel	2001
36	Chatham Island taiko	2001
35	Hoiho	2001
34	Pygmy button daisy	2001
33	<i>Hebe cupressoides</i>	2000
32*	Inland <i>Lepidium</i>	2000
31*	<i>Muehlenbeckia astonii</i>	2000
30*	North Island kokako	1999
29*	Weka	1999
28*	<i>Pittosporum patulum</i>	1999
27	<i>Cyclodina</i> skinks	1999
26	Coastal cresses	1999
25*	Threatened weta	1998
24*	Striped skink	1998
23*	Fairy tern	1997
22*	Blue duck	1997
21	Kakapo	1996
20	Stitchbird	1996
19*	Brown teal	1996
18*	Native frogs	1996
17*	New Zealand (Hooker's) sea lion	1995
16*	<i>Dactylanthus taylorii</i>	1995
15*	Bat (peka peka)	1995
14	Otago and grand skinks	1995

All *Threatened Species Recovery Plans* from No.25 (1998 and later) are available on the DOC website: www.doc.govt.nz > Publications > Science and Research > Biodiversity Recovery Unit.

* Out of print.

In-print issues are available free of charge from: Science & Technical Publishing, (Research Development & Improvement Division), Department of Conservation, PO Box 10420, The Terrace, Wellington 6143, New Zealand.