HAND REARING NEW ZEALAND'S RAREST TERN, THE FAIRY TERN
(prepared by Martin Bell).

Introduction

The New Zealand fairy tern (*Sterna nereis*) is a sub-species of Fairy tern restricted to the Northern coasts of the North Island. Here, it is under considerable pressure from introduced mammalian predators, human interference and sanding over of nests. In 1997/98 a formal Recovery Group was formed by the Department of Conservation in order to coordinate recovery efforts.

Very little experience has been gained in New Zealand in the captive management of seabirds. Despite the potential that captive techniques have to offer in their conservation.

In 1986, 2 Fairy terns were successfully reared at Auckland Zoo and released back into the wild, but poor records were kept and the birds were released unbanded. Their fate was never determined.

In 1997, eleven years later, with no more than 25 birds remaining in the wild, the Zoo was approached by the Department of Conservation and asked to provide assistance in the form of incubating abandoned eggs prior to cross fostering.

In the 1997/1998 summer, Auckland Zoo received fairy tern eggs from South Head, Kaipara Harbour. All 3 eggs were from the same pair of birds, 2 from the first clutch and 1 from the second clutch. The eggs were taken to the zoo after being deserted by their parents. The eggs were expected to be cross-fostered back to Fairy terns before they hatched. However, despite everyone's best intentions, this was not to be.

The first of these eggs was hatched at the zoo because there was no foster nest available. The chick from this egg died at 17 days of age due to health related complications. The second egg was infertile. The third egg was cross-fostered to a wild pair of fairy terns once pipping began. This egg hatched but was not successfully reared by the foster parents.

The chick that died during hand rearing suffered from nutritional deficiencies that resulted in health related complications. We were quite sure that this problem could be overcome in the future if live fish was fed to chicks. The few records we did have on the successful rearing of the 1986 birds supported this hypothesis.

At the 1998 recovery group meeting, it was agreed that the zoo should first get incubation and hand-rearing experience with the common White-fronted tern (*Sterna striata*) in the 1998/99 season, but still be prepared to assist with any abandoned Fairy tern eggs or chicks should the need arise.

Four White-fronted tern eggs were incubated and two chicks hatched. The other two eggs were cross fostered back to wild white fronted terns before they hatched because we could see that they were going to exacerbate what was already going to be a very busy rearing period.

However, the focus of this report is on the 10 Fairy tern eggs that came to Auckland Zoo during that same season.

Materials and Methods

i) Source of eggs

Ten New Zealand Fairy tern eggs were taken to Auckland Zoo for incubation between 15 November 1998 and 6 January 1999.

The first Fairy tern egg (#1,clutch 1) arrived on 15 November 1998 from Mangawhai. This egg, (mother Green/metal and father unbanded) was abandoned. The egg was 4 days old.

The second and third eggs (#2 @ 3, clutch 2) also came from Mangawhai, on 15 November 1998 from a second nest (mother unbanded, father red/metal). Egg #2 was 3 days old. The eggs had been deserted.

The fourth egg, (#4, clutch 3) arrived from Papakanui (Northern Murawai) on 28 November 1998 (mother yellow/metal, father unknown). This egg, from a one-egg clutch, had also been deserted.

The fifth egg, (#5, clutch 4) arrived from Waipu on 28 November 1998. This egg had a large calcified deposit on the end. It was uplifted at approximately 1 week into incubation after being found deserted.

Two eggs arrived from Mangawhai (#6 & #7, clutch 5) on 28 November 1998. These eggs were from a second clutch (mother unbanded, father red/metal). The eggs were believed to be freshly laid.

Two eggs arrived from Papakanui (#8 & #9, clutch 6) on 18 December 1998 after being found deserted in windy, rainy weather. These eggs (mother white/metal, father unbanded) when candled, showed development consistent with 5 to 6 days of incubation and both were suspected of being dead in the shell.

The tenth egg (# 10, clutch 7) arrived from Waipu on 6 January 1999. This egg was from a 2-egg clutch. The sibling egg had hatched on 2 January 1999.

Table 1. Summary of egg origin.

Egg #	Clutch #	Parent ID	Date of arrival	Origin	Age on arrival
1	1	♂unbanded ♀green/metal	15/11/98	Mangawahi	4 days
2 & 3	2	♂red/metal ♀unbanded	15/11/98	Mangawhai	Egg2 3 days old
4	3	♂unknown ♀yell/metal	28/11/98	Papakanui	approx. 17 days
5	4	??	28/11/98	Waipu	approx. 7 days
6 & 7	5	♂red/metal ♀unbanded	28/11/98	Mangawhai	Freshly laid
8 & 9	6	♂unbanded ♀white/metal	18/12/98	Papakanui	5 to 6 days developed

10	7		6/01/99	Waipu	Dead in shell on arrival

ii) Artificial Incubation

On arrival at the zoo, the eggs were weighed and measured and their volume and density calculated for incubation purposes. The eggs were then candled to determine their status. The eggs' density loss and weight loss was recorded each day and plotted on a graph.

All eggs were incubated in an 'AB Newlife 75' incubator in the horizontal position on wooden rollers. The target dry bulb temperature was 37.2°C to 37.5°C until pipping, with an average humidity of 60%. Humidity was controlled automatically by the incubator. The eggs were manually turned 4 times a day. This was to prevent jarring of the eggs.

The actual temperature range for all 10 eggs was between 36.7°C and 38.1°C (mean = 37.40°C) from the time they were put in the incubator until they hatched. The temperature was not reduced for hatching the eggs and there were no notable problems as a result.

ii) Chick rearing

Two eggs were successfully hatched from 2 separate clutches; one from Papakanui (egg # 4) and one from Waipu (egg # 5)

Egg #4 (Zoo ID # 980127)

This chick hatched in the 'AB' incubator at 37.7°C and a humidity of 56%. The shell was removed for weighing and its thickness was measured.

Shell weight = 0.91gms
Shell thickness = 0.19mm/0.19mm/0.20mm

Later that day, the chick was moved to a still air 'Brinsea' incubator at a reduced temperature (temp 37.1°C) with ambient room humidity. This was to make the chick more comfortable. It was placed in a shallow plastic bowl lined with paper tissues. A fibreglass model tern, complete with a speaker and soft internal lining made of sock material, was placed over the chick and bowl. Taped tern calls were played at this point through the model parent. Calls were played intermittently.

The chick was given its first feed 24 hours after hatching. Its first feed consisted of one small (5mm) Mosquito fish (*Gambusia affinis*). The temperature was reduced to 36.2°C and dropped to 31.0°C by the end of the second day.

The chick was removed from the incubator to a set of electronic scales and weighed before and after each feed. Food was offered with tweezers every hour to an hour and a half. A variety of small (5mm to 10mm) marine fish were offered which included; sprats, flounder, shrimps and bullies. Mosquito fish were also fed to the chick.

At day 2, the nesting bowl was removed and replaced with an ice-cream container with one side removed so the chick could wander out from under the model parent at will.
The chick was moved to a brooder at day 7. The brooder was a plastic tub (850mm x 600mm x 300mm deep). River sand was used as a substrate and seashells were scattered on the surface. The model parent was suspended above the brooder for the chick to shelter under. It was interesting to note that the chick still had its egg tooth at day 7. The temperature of the brooder room was pre-set at 25.°C so the chick would not chill. No other heat source was provided. The chick continued to be weighed before and after each feed on the electronic scales. Food quantity increased as the chick grew.
At day 20, live sprats were being left in shallow dishes of salt water to encourage the chick to feed itself. However, food continued to be offered to the chick with tweezers.
On day 27 (31/12/98) the bird was moved outside into a mosquito proof tent aviary. (The mosquito proof tents were used because mosquitoes around the zoo were known to carry a form of avian malaria that has been observed in New Zealand dotterels). By this stage, the bird was fully feathered and capable of flying. Blood was taken from the wing vein (0.15ml) for DNA analysis. The bird was banded with white over yellow left leg and metal right (#C-44002). It was mixed with 2 similar aged White-fronted terns and two juvenile New Zealand dotterels. The white fronted terns and dotterels were transferred to a separate tent on 4 January (4 days later) to allow more room for the Fairy tern. The Fairy tern was 31 days old at this stage and the younger Fairy tern had been introduced 3 days before.

It continued to be hand fed but feeds were reduced to 2 hourly. Live fish was provided in a number of dishes to encourage natural feeding behaviour. By this stage, the number of fish being eaten was reduced but the fish size had increased.
The bird was quite independent by 40 days of age but soon started to beg for hand feeding again in the presence of the younger chick. It raised the question whether we missed the window of opportunity to release this bird by waiting for the younger one to catch up in development so they could be released together. (The problem was ultimately compounded by a delay in the release of both birds due to unsettled weather).
On day 40, a small transmitter (weighing 1.5gms) was fitted to the tail. This was removed at 52 days due to concerns that it was inhibiting the birds flight. On day 54, the bird was weighed and its wing, head/bill and tarsus were measured.

Weight = 59gms
Wing = 19.1mm
Head & Bill = 59.92mm
Tarsus = 14.33mm

On day 54 (27/01/99) it was taken to Mangawhai and released with the younger Fairy tern.

Egg #5 (Zoo ID # 980133)

This chick hatched in the 'AB' incubator at 37.5°C and a humidity of 63%. The shell was removed and weighed and its thickness measured.

Shell weight = 0.89gms
Shell thickness = 0.30mm/0.22mm and 0.21mm

The next day, the chick was moved to a Brinsea still air incubator set at 29.°C. This bird was treated in the same manner as the first tern. The temperature was increased slightly on the second day for the bird's comfort, ranging between 30.0°C and 31.8°C.

The chick was given its first feed 30 hours after hatching. Like the first bird, it was removed from the incubator for feeding and weighing.

The chick was moved to the brooder at day 7. The model parent was suspended above the chick and taped calls were played intermittently. The room temperature was set at 25.°C. No other heat source was provided. By day 17, the air conditioning was turned off to harden both tern chicks up in preparation for going outside. This chick did not have access to live fish in pools until it went outside and was solely hand fed to this point.

The chick was moved outside into the mosquito tent aviary to join the other older Fairy tern at 21 days of age (2 days after the older chick, which was 29 days old at this point). It continued to be hand fed as well as have access to pools with live fish.

The bird was banded at 34 days of age with lime green over red on left and metal right (#C44003). It was released at Mangawhai with the older bird on 27 January 1999 (46 days old). Prior to its release, measurements were taken.

Tarsus = 15.31mm
Wing = 190mm
Head @ Bill = 61.78mm
Weight = 66gms

Results

i) Incubation

Egg #1 was laid 4 days prior to its collection and was clear when candled. This egg proved to be infertile when removed from the incubator at day 11.
Egg #2 was laid 3 days prior to its collection and was also clear when candled. This egg was removed from the incubator at day 10, showing no signs of embryo development. Egg #3 was picked up from

the nest, freshly laid (the second egg of clutch 2). The egg was accidentally damaged 2 days after arriving at the zoo and the crack was sealed with nail varnish. This egg appeared to be fertile but it did not develop. It was removed from the incubator at day 8. This egg may have been chilled for too long prior to being uplifted for the zoo, or bacteria may have entered the egg through the crack in the shell.

Egg #4 (ARKS #980127) arrived with a well-developed embryo and hatched unassisted, 7 days after arriving at the zoo.

Egg #5 (ARKS #980133) arrived at the zoo one week into incubation after being found abandoned. This egg hatched 17 days later.

Egg #6 and #7 were picked up from the same nest. When candled, egg #6 looked infertile or freshly laid. It remained in the incubator for 17 days but was removed as a dead in shell. First signs of development were noticed 5 days after artificial incubation began. Egg #7 was estimated to be fresh when it was uplifted from the nest. However, the embryo developed normally but died in the shell after internally pipping at 21 days. The yolk sac had not been drawn into the body.

Egg #8 and #9 were picked up from an abandoned nest. When candled, egg #8 showed embryo development consistent with 5 to 6 days of incubation. The egg remained in the incubator for 11 days before being removed. The embryo had not developed further so it was likely that it had already perished before it was removed from the nest. When candled, egg #9 showed a very early dead embryo. It was artificially incubated for a further 11 days before being removed.

Egg #10 was the second egg of a clutch. The first egg had hatched in the wild on 2 January 1999. This egg was taken to the zoo because it had not hatched. It contained an early dead embryo and was put in an incubator for 2 days before confirming its death.

Table 2. Summary of incubation outcomes

Egg #	Clutch #	Origin	F/INF/DIS	Comments
1	1	Mangawhai	INF ?	
2	2	Mangawhai	INF ?	
3	2	Mangawhai	Early DIS	Cracked
4	3	Papakanui	F	Hatched (#980127)
5	4	Waipu	F	Hatched (#980133)
6	5	Mangawhai	Early DIS	
7	5	Mangawhai	Late DIS	Died pipping internally
8	6	Papakanui	DIS on arrival	5-6 days
9	6	Papakanui	DIS on arrival	"
10	7	Waipu	DIS on arrival	Early DIS.

ii) Chick rearing

Two chicks were successfully reared in the season. Both chicks were released at Mangawhai on 27 January 1999. The oldest chick was 54 days of age and the younger bird was 46 days of age.

Feeding the birds entirely on live fish and fresh (unfrozen) fish made rearing reasonably straightforward.

Discussion

Two eggs were successfully incubated and hatched. Two eggs were infertile and the remaining 6 fertile eggs either died at the nest or during incubation at the zoo. It is quite reasonable to assume that the embryos in most of the eggs were subjected to prolonged cooling before they were uplifted from the wild. This may well have weakened the embryos and contributed to their deaths. It is impossible to accurately determine the cause of their deaths.

The two chicks that hatched, were reared successfully on a variety of live fish or fresh refrigerated fish. No frozen fish was fed to either chick. Their weights were taken regularly and compared to known weights of wild chicks of the same age. The two captive reared chicks growth rates compared favourably with their wild counterparts.

The surrogate model parent was used with both chicks from the day they hatched. Both birds sheltered under the model when they were small but increasingly wandered away from the model as they got older. They were often seen sitting in overturned seashells. Both birds spent time with the 2 White-fronted terns and two New Zealand dotterels once in the outside tent aviary. This was necessary because of the limited space available. It benefited the terns by exposing them to other species they would encounter in the wild.

The birds gradually learned to catch live fish from the small pools provided, either by standing beside the pool and fishing or momentarily hovering above the pool and taking fish while on the wing.

It was always our intention to release the birds together because it was thought they might provide support for one another, but we may have compromised the survival of the older tern by waiting for the younger bird to physically and behaviourally catch up. The older bird might have been better released on its own at the time it was more independent. If we had kept the two terns separated, the older bird may not have started begging for hand feeds.

Fish collection took up a considerable number of man-hours. On average, one person was required each day to collect fish. Up to day 44, one Fairy tern had consumed 3500 assorted fish. (It was difficult to determine how many more fish were fed after 44 days because fish were shared *ad lib* among 2 fairy terns and 2 White-fronted terns).

One problem was keeping the marine fish alive once they were moved to the outside pools. Because the pools were small and shallow, the water temperature would very quickly rise to lethal temperatures and the fish would sometimes be dead within 15 minutes. This meant there was limited opportunities for them to catch live fish.

Conclusion

New Zealand fairy terns can be hand reared. However, the oldest chick was found dead after it was released. The most likely cause was starvation. This hypothesis is based on the fact that this bird became reliant again on hand feeds prior to its release following a period of independent feeding. The youngest chick has not been seen since it was released.

Although hand rearing of the New Zealand Fairy tern was successful they may not have been successfully conditioned for survival in the wild. Any future hand reared fairy terns may have a better chance of surviving in the wild if conditioned in an aviary at the release site prior to their release. This is often referred to as a "soft" release. The birds might benefit from learning to fish from a greater height and larger, deeper area, more like what they would experience in the wild. The length of time the birds need to stay in captivity is difficult to know and many more birds will need to be reared to determine this.

Hand rearing Fairy terns proved to be an expensive conservation option. However we now know that eggs can be successfully incubated and hatched in captivity, which provides an option for cross fostering. If the tern is destined for extinction in the wild, we now know that eggs can be successfully incubated and hatched in captivity and chicks can be reared which provides that "last resort" option of keeping them in captivity.