

# **Report on the 2015 supplementary translocation of fairy prion (titiwainui) chicks from Takapouwera (Stephens Island) to Mana Island**

**Friends of Mana Island Inc.**

<b>Report title</b>	Report on the 2015 supplementary translocation of fairy prion (titiwainui) chicks from Takapouwera (Stephens Island) to Mana Island
<b>Confidentiality of information in this report</b>	
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<b>Report date</b>	2 March 2015
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<b>Project manager</b>	Brian Bell, Friends of Mana Island (FOMI) Committee
<b>Type of translocation</b>	Wild to wild translocation Supplementation (the species already exists at the release site)
<b>Species transferred</b>	Fairy prion <i>Pachyptila turtur</i> Threat status according to the NZ threat classification series 4 (Robertson et al. 2013): At Risk / Relict
<b>Release site</b>	Mana Island Scientific Reserve
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## 1. Summary

One-hundred fairy prion (*Pachyptila turtur*) or titiwainui chicks were transferred from Takapourewa (Stephens Island) to Mana Island in a single operation on 22 Jan 2015. This was the first transfer in a 2-year supplementary translocation project initiated by Friends of Mana Island Inc., sponsored by OMV New Zealand Ltd., and supported by Ngāti Koata, Ngāti Toa and Department of Conservation. The project objective is to augment a small population of fairy prions already breeding on Mana Island following initial translocations in 2002–04, in an effort to enhance the island’s ecological restoration.

A team arrived at the Takapourewa source colony on 18 Jan 2015 to inspect fairy prion burrows in order to obtain 100 chicks suitable to transfer on 22 Jan. A total of 1655 burrows was inspected on 18–20 Jan to find 392 accessible chicks, from which 120 that met pre-determined size criteria were selected using wing-length and weight criteria recommended following previous transfers of the species to Mana Island in 2002–04. From this larger pool of chicks, 100 were found to be suitable to transfer on 22 Jan. Chicks were of unknown sex and expected to be <12 days from fledging (wings 139–168 mm; weights >121 g). They were flown between source and release sites by helicopter.

On Mana Island, the fairy prion chicks were housed in artificial burrows on a sloping south-west facing cliff top approximately 78 metres above sea level. Entrance blockades prevented chicks leaving burrows prematurely. Removal of blockades proceeded on an individual basis—based on plumage development—when each chick was considered ready to fledge. A sound system broadcasting fairy prion calls played nightly while chicks were in residence. All chicks were hand-fed daily (via syringe and crop-tube) according to individual requirements, on a blend of tinned sardines in soy oil, water and a seabird vitamin/mineral supplement, until they fledged.

All 100 chicks were presumed to have fledged successfully from Mana Island. Fledging weights were comparable with those for parent-reared chicks on Takapourewa. Fledglings were lighter, but wing-lengths longer, than their counterparts hand-fed the same diet in the 2002–04 transfers, after spending relatively less time at the release site. Most chicks fledged on their first night out of the burrow.

Weather conditions were hot, calm and dry when most chicks fledged, and conditions at sea appeared favourable for all the new fledglings.

## 2. Introduction

### 2.1 Project background

Fairy prion (*Pachyptila turtur*) or titiwainui chicks were translocated from Takapourewa (Stephens Island) Nature Reserve across the Cook Strait to Mana Island Scientific Reserve in 2002–04 by the Friends of Mana Island (FOMI) and Department of Conservation (DOC), in an attempt to re-establish a breeding population there. Fairy prions are believed to have bred on Mana Island before humans arrived and their reintroduction, as recommended in Miskelly (1999) and Taylor (2000), will contribute to restoring a ‘seabird island’ community, by influencing vegetation, invertebrate and reptile communities (Miskelly, 1999; *Mana Island ecological restoration plan*).

Passive (acoustic) attraction alone was insufficient to attract adult fairy prions to Mana Island, with no birds detected between 1993 and 2003 (Miskelly & Taylor, 2004). The 2002–04 translocation project, designed as a research trial, was very successful with all 240 chicks fledging in good health after hand-feeding at the release site for 2–21 days (Miskelly & Gummer, 2013). Of the 45 (18.8%) translocated birds recovered as adults, 20 were recaptured on Mana Island as adults of 3–5 years old,

and 25 birds were known to have been attracted back to Takapourewa, which holds an estimated 1.8 million pairs of fairy prions.

A small fairy prion population established on Mana Island as a result of the 2002-04 translocations, but has remained at six or fewer breeding pairs since 2008, in part due to the unexpected low level of recruitment of non-translocated birds there. Supplementary translocations to the site were recommended to achieve the establishment of a viable and growing fairy prion colony (Miskelly & Gummer, 2013).

Based on the results of the 2002–04 translocations, and because there is a small breeding population present to ‘anchor’ any translocated birds that return to Mana Island, we expect that translocations of a total of 200 chicks in 2015 and 2016 will result in about 30 additional adult birds recruiting to Mana Island 3–4 years later (Miskelly, 2014). Methodologies are based on the techniques used for the 2002–04 transfers, and are designed to maximise fledging and recruitment rates while minimising translocation costs (and the length of the time birds are hand-fed). The 2002–04 translocations revealed that the length of time that chicks were on Mana Island did not influence which of the two islands the birds recruited to as adults.

FOMI are leading the 2015–2016 project with assistance from DOC, Te Papa, Ngāti Koata, Ngāti Toa, and funding from OMV New Zealand Ltd.

For fairy prion biology, see Miskelly (2013): <http://nzbirdsonline.org.nz/species/fairy-prion>.

## 2.2 Conservation outcomes

The following are desired outcomes from short term (e.g. 3 years) through to long term (e.g. 30 years):

- To have translocated 200 fairy prion chicks (two cohorts of 100 each) by Feb 2016, with at least 190 fledging in healthy condition.
- To have at least 20 pairs of fairy prions breeding on Mana Island within 10 years.
- To have a growing population of fairy prions on Mana Island that exceeds 50 pairs and has demonstrable ecological benefits to other species on the island, within 30 years.

## 2.3 Operational targets

Initial success will be measured in terms of:

- Successful transfer and fledging rates—at least 95% of chicks transferred surviving to fledging;
- Appropriate fledging condition—chicks fledging at mean weights similar to those of chicks fledging from Mana Island in previous transfers and of parent-reared chicks fledging from Takapourewa;
- This transfer operation will later be considered successful if at least 10% of transferred birds return to the site (any time after 2 years following transfer) and start breeding (most likely 3+ years following transfer).

Note: Mortality exceeding 5% in any one year will necessitate refining components of the transfer process for subsequent transfers.

## 3. Personnel

Operation	Dates	Personnel
Translocation proposal and planning	Pre-transfer (2013 and 2014)	Brian Bell (Project Manager, FOMI Committee), Brian Paget (President, FOMI), Colin Miskelly (Curator of Vertebrates, Te Papa), Helen Gummer (FOMI Contractor, Seabird Translocations), Jeff Hall (DOC, Mana Island), Reina Solomon (FOMI Committee, Ngāti

<b>Operation</b>	<b>Dates</b>	<b>Personnel</b>
		Toa), Louisa Paul (Cultural Manager, Ngāti Koata), Paul McArthur (Conservation Partnerships Manager, DOC), Phil Clerke (Senior Ranger, DOC), Anneke Mace (Partnerships Ranger, DOC)
Fund-raising	Pre-transfer	Brian Paget
Artificial colony site selection, prototype double burrow installation	30 September 2013	Colin Miskelly, Helen Gummer, Brian Bell and Jeff Hall
Artificial burrow production	June 2014	Helen Gummer (design) and Barry Dent (construction)
Colony site preparation	June 2014	Led by Jeff Hall
Artificial burrow installation (Mana)	25–28 July 2014	Helen Gummer, David Cornick (FOMI volunteer), Barry Dent (FOMI volunteer), Sue Freitag (FOMI volunteer), Peter Gaze (OSNZ volunteer), Mark Tito (DOC), and Dale Shirtliff (FOMI Committee)
Source colony collection trip planning and food purchase	Pre-transfer (Jan 2015)	Colin Miskelly and Brian Bell
Source colony chick selection and collection (Takapourewa)	18–22 Jan 2015	Colin Miskelly, Brian Bell, Jason Christensen (FOMI Committee), Clinton Purches (DOC, Palmerston North), Anneke Mace (DOC, Wellington), and Lonae Paul and Hauora Paul (Ngāti Koata), assisted by resident DOC staff Polly Hall and Andre de Graaf
Transfer day public relations and catering	22 Jan	Brian Paget
Release site preparation, transfer day and post-transfer chick feeding (Mana)	20–26 Jan 2015	Helen Gummer, and volunteer Team 1a: David Cornick, Ros Batcheler (FOMI volunteer), Sue Chesterfield (FOMI Committee)
Transfer day and post-transfer chick feeding (Mana)	22–28 Jan 2015	Helen Gummer, and Team 1b: Gillian Candler (FOMI volunteer), Luke Rawnsley (FOMI volunteer), Fenella Fenton (DOC volunteer)
Chick feeding (Mana)	26 Jan to 1 Feb 2015	Helen Gummer, and Team 2a: Ali Hull (DOC volunteer) and Katie Cornish (volunteer), Brian Bell 26–28 Jan
Chick feeding (Mana)	28 Jan to 3 Feb 2015	Helen Gummer, and Team 2b: Ann Graeme (FOMI volunteer)
Volunteer catering (Mana)	22–28 Jan 2015	Linda Kirkmeester (FOMI Committee)
Logistics (Mana)	As required	Jeff Hall
Boat transport (Mana)	As required	Dave Wrightson (DOC) and Eliot Falconer (Knuckle Charters Ltd)

<b>Operation</b>	<b>Dates</b>	<b>Personnel</b>
Helicopter transport (Takapourewa)	18 and 22 Jan 2015	Precision Helicopters Ltd
Biosecurity	As required	David Moss (DOC, Wellington)
Health & Safety Plan development	2014–15	Mana Island: Helen Gummer and Dale Shirtliff (FOMI Committee) Takapourewa: Colin Miskelly (Te Papa) and Helen Gummer
Invited guests at the arrival of the chicks on Mana Island	22 Jan 2015	Community Trust of Wellington (Ross Graham, Kate Hiatt), DOC Ministerial party (Associate Minister of Conservation Hon. Nicky Wagner, David Wagner, Kath Bell, Aprille Gillon, Beryl Bright, Mike Bridge), DOC (Paul McArthur, Di Batchelor), DomPost (Olivia Wannan), Grant Thornton (Peter Sherwin), Ngāti Toa (Hohepa Potini, Te Raukura Raven, Riria Te Kahurangi, Moana Solomon, Paranihia Potini), OMV NZ Ltd (Heather Horton, Grant Fairbairn), PCC Mayor's Office (Nick Leggett, Emily Leggett, Madi Masaga-Pita), Whitby News (Geoff Mowday, Claire Mowday), Wellington Regional Council (Jenny Brash)

## 4. Methods

### 4.1 Selection/collection trip to Takapourewa

A team of seven personnel (refer Section 3. Personnel) travelled to Takapourewa on 18 Jan 2015 for the following objectives:

- To determine availability of fairy prion chicks on Takapourewa for transfer to Mana Island on 22 Jan 2015;
- To locate as many short (arm-length) occupied fairy prion burrows as required to provide 120 chicks that met pre-determined criteria for transfer;
- To weigh and measure all chicks found, selecting and metal banding those likely to be suitable for transfer subject to confirmation on the transfer day (in practice, many very small or well-developed chicks were assessed by eye and returned to their burrows without being measured or weighed);
- To mark burrows of the 120 suitable chicks (with bamboo wands marked with plastic tape) to enable easy collection on the transfer day
- To prepare 60 translocation boxes (each with an internal partition allowing two birds to be held per box);
- To collect up as many as possible of the 120 marked chicks on the transfer day, and from these to select the 100 chicks most suitable for transfer
- To place the 100 selected chicks in transfer boxes marked with their band number, weight and wing-length, and store them adjacent to the helicopter landing area ready for the flight to Mana Island;
- To return any surplus chicks to their natal burrows, and remove marker wands once the 100 selected chicks reached Mana Island (this last task was completed by the resident DOC rangers on Takapourewa).

#### **4.1.1 Finding and selecting chicks**

Following discussion with the resident DOC rangers on Takapourewa, we focussed search effort on the dam paddock – i.e. the same site where most of the 2002–04 translocated fairy prion chicks came from. This site held a high density of robust burrows at an accessible site where there was low risk of damaging burrows as the team moved around. Taupata growth on the south side of the valley since 2004 reduced the area that could be searched without undue damage to vegetation and burrows (which are more robust when protected by grass roots), and so most search effort was made among rank grass on the north side of the valley.

Team members worked in groups of two, with one person responsible for recording search effort and burrow contents (including whether the burrow was too deep to record its contents). Any chicks extracted that appeared to be of the desired size class were placed in a carry bag and taken to a central processing area for weighing and measuring. All measurements were undertaken by Colin Miskelly, who also banded those chicks considered suitable for transfer. Each banded chick was returned to its burrow, which was marked with a bamboo wand with a flag bearing the band number of the chick.

We aimed to select chicks that would have wings 142–162 mm in length on the day they were moved to Mana Island (i.e. birds that were approx. 2–8 days from fledging), and that should have weights exceeding 115 g. As fairy prion wings grow at an average of 3.3 mm per day in the last week before they depart, our selection criteria changed slightly each day, from 129–149 mm on 18 Jan to 135–155 mm on 20 Jan (the day that we completed searching for chicks).

All 120 burrows containing marked chicks were GPSed, to facilitate their re-location on transfer day, and also the return of chicks that did not make the final selection (taking care to return each such chick to its original burrow).

#### **4.1.2 Translocation cartons**

We used cardboard pet boxes of dimensions 380 x 205 x 350 mm high (including handle) or 260 mm high with handle taped down to save space on the helicopter. These were modified by taping about six layers of newspaper covered with non-slip rubber matting to the base (floor), and inserting a diagonal divider to separate each box into two compartments. All 60 boxes were used to carry the birds to the final assessment site on the day of transfer, and 50 of the boxes were used to move the 100 chicks selected to Mana Island.

#### **4.1.3 Collecting and transferring chicks**

Gathering and processing the chicks on transfer day took about 4 hours (0730 to 1130 hrs). Boxes containing two chicks each were carried by hand to a quad bike that was used to ferry batches of birds to ‘The Palace’ (workshop), where two rooms had been prepared for processing and holding the birds. Each bird was given a quick health check (i.e. checking for injury, poor plumage condition, excessive parasite load, or lack of alertness), its band number checked, its wing measured, and it was weighed. Birds in good health, that exceeded 120 g, and with wing-lengths between 142 and 162 mm were returned to their boxes, their data recorded on the box lid above their compartment, and each box (with two birds therein) placed in a cool, shaded ‘quiet room’.

Birds that did not meet all selection criteria were held aside until all chicks had been gathered up, to ensure that we selected the best 100 chicks from those available. Surplus chicks were returned to their natal burrows once final selection was complete. The carry handles on the 50 boxes containing birds to be transferred were taped down, to facilitate stacking in the helicopter.

The BK helicopter arrived at 1245 hrs, and shut down while all birds, personnel and luggage were loaded. All 50 boxes were stacked into the rear cargo compartment. We did not attempt to squeeze any additional cargo into the compartment, to maximise air movement around the boxes. The flight to Mana Island took about 40 minutes, arriving there about 1350 hrs.

## **4.2 Preparation of new Mana Island artificial colony site**

### **4.2.1 Artificial burrow installation**

Most burrows used to accommodate fairy prion chicks in the 2002–04 transfers were 17 years old in 2014; some had collapsed, filled with debris or were difficult to access under vegetation. Others had been taken over by fluttering shearwaters, diving petrels, fairy prions (from the original transfers) and white-faced storm petrels.

New artificial burrows were installed on a section of steep grassy slope at the southern end of the currently active fairy prion burrows on Mana Island, just north of the sooty shearwater colony (site coordinates: NE corner—S 41005.548/E 174046.283; NW corner—S41005.548/E174046.276; SW corner—S41005.558/E174046.277; SE corner—S41005.557/E174046.284).

Two of the first prototype nesting boxes (double chambers, see below) were constructed and installed on site in October 2012. A second prototype was installed in the winter of 2013. After minor modifications, nest boxes were constructed in winter 2014 and stored in the DOC bio-security/quarantine facility before being taken to Mana Island (see Section 3: Personnel). We modified the sloping-ground box design used for other species that burrow into slopes in exposed cliff top habitat (Gummer & Adams, 2010; Gummer et al., 2014). Individual burrow dimensions were relatively smaller for fairy prions (Appendix 1). We considered that 50 double-compartment boxes would be more stable in the ground and require less labour and space during installation. It is also hoped that they will be easy and fast to inspect when monitoring for adult fairy prions in future years. Floors of all compartments were filled with beach gravel to provide drainage. The lids of each compartment open independently, so light cannot enter the adjacent box while the other is inspected.

The Mana Island DOC ranger with OMV and FOMI volunteers delivered the boxes and beach gravel to the site prior to the installation trip. A team of 5–6 people (see Section 3: Personnel) took 2.5 days to install all 50 boxes in late July 2014. Burrow numbers were painted on (FP1–FP100) in a separate day trip. The prefix FP distinguishes the new burrows from the old burrows used in the 2002–04 transfers (referred to as AB1–AB105, although this AB prefix was not painted on the old burrow lids).

### **4.2.2 Sound system maintenance**

The sound system at the fairy prion colony site on Mana Island had not been operating effectively through 2014. The unit was sent to the DOC Electronics Unit earlier in 2014 for maintenance. At this time, the sound track was also edited by Graeme Taylor (DOC) to include more prominent fairy prion vocalisations, and to remove the fluttering shearwater calls. Two new speakers and cables were installed on 23 December 2014 at the site. The system was operating at full capacity before the fairy prion chicks arrived in Jan 2015.

### **4.2.3 Preparing artificial burrows to accommodate chicks**

Personnel arrived on Mana Island by DOC boat on the morning of 20 Jan to allow 2 days of preparation before the arrival of chicks (refer Section 3. Personnel).

All 100 numbered artificial burrows were checked to ensure they were safe to accommodate transferred chicks. Plastic mesh blockade gates were installed at every burrow entrance to ensure chicks could not exit burrows. Scrapes were made in the chamber floor sand at the back of each burrow, and were lined with a small amount of dry grass as nesting material. Sandbags were placed over the chamber roofs of a few burrows for insulation (i.e. for those burrows where the covering grass turfs had failed to establish).

### **4.2.4 Other preparations**



The Mana Island DOC ranger towed the FOMI caravan to a clearing above the artificial burrow site and tied it down with strops. It was cleaned and kitted out, and benches disinfected in preparation for chick-feeding. An awning was erected and hand-washing facilities set-up outside.

Three areas of shade were created (by pruning) beneath existing vegetation near the colony site to shelter the transfer boxes immediately on arrival on Mana Island.

Stick fences were erected at nearby old burrows AB1–30 in preparation for checks for potential use by exploring transferred chicks.

### 4.3 Arrival of chicks on Mana Island

Following arrival by helicopter on the Southern Track, the transfer boxes were carried by the visitors (see Section 7: Consultation and community relations) to the designated shaded areas where they were placed awaiting processing. Each box was opened and the welfare of all chicks assessed, and basic bio-security checks performed.

Once processing commenced, chicks were removed from transfer boxes and the information that had been written on the tops of each box compartment copied onto data sheets (band number, transfer day weight and wing-length). Band numbers were re-checked and the physical state of all birds was assessed to check for injuries that might have occurred during transit.

Chicks were given oral fluids—up to 10 ml of Hartmann’s Solution each—to compensate for any dehydration that occurred during transfer—before being carried to numbered burrows in individual carry boxes. No chicks were anticipated to require feeding (with sardine puree) on the transfer day as it had been communicated that there were no light-weight chicks selected for transfer.

All unoccupied burrows, including one known to be used by adult prions (burrow FP62), were left open, i.e. without blockades. As FP62 was ‘occupied’, one chick was placed in AB17, an artificial box installed at a natural fairy prion site adjacent to FP1. AB17 had less evidence of regular use than FP62.

### 4.4 Hand-feeding chicks

All hand-feeding methods and equipment used are detailed in Gummer et al. (2014): ‘Field guidelines for burrow-nesting petrel and shearwater translocations—a companion guide to the seabird translocation best practice documents’, unless otherwise stated.

#### 4.4.1 Target fledging condition

Chicks were hand-fed with the aim of reaching target fledging condition (weight and wing-length) similar to that achieved for Brunswick® sardine-fed chicks in the 2002–04 fairy prion translocations. As a minimum target, chick fledging weights needed to fall within known fledging weight ranges recorded for the species on Takapourewa (mean 106 g; range 86–132 g; n=30; Miskelly & Gummer, 2004).

#### 4.4.2 Diet and food delivery

Chicks were fed the standard diet of tinned Canadian sardines (89% fish in 11% soya oil), blended with fresh (boiled) water and Mazuri® Vita-zu™ seabird vitamin/mineral supplement (product code: Small 5M25). The recipe was 1 x 106 g tin sardines: 50 ml water: one-third Vita-zu tablet. This year we used Pams® tinned sardines in soya oil which appear identical in every way to the Brunswick® brand used in the 2004 fairy prion transfer, and were trialled in 2014 on a Pycroft’s petrel (*Pterodroma pycrofti*) translocation in the Hauraki Gulf with no issues.

The 6 mm diameter Teflon® tubing commonly used to make crop tubes for NZ burrowing seabird translocations was too wide for fairy prions, so flexible smaller-diameter food-grade vinyl tubing was

obtained from a hardware store. Tubes were cut to 85 mm lengths and blunted/rounded at one end. One tube was used per bird, so disinfection between chicks was not required. However, all tubes were cleaned and disinfected with chlorhexidine solution at the end of the day. Food had to be blended to an extremely smooth fluid to prevent blockages through the Luer-lock component of the 30ml Plexi-vet syringes.

#### **4.4.3 Meal size and feeding frequency**

Up to 15 ml of sardine puree was delivered to each chick on the first feeding day. Thereafter, chicks were fed at approx. the same time each day, with volumes increasing daily by 5 ml, if chicks were keen, to around 30 ml/day.

Chicks requiring more than 30 ml to maintain body weight were scheduled to be fed twice on the same day (usually among the first birds to be fed in the morning and last in the afternoon) to try to avoid feeding any one chick more than one-quarter to one-third of its own body weight at one time. The second feed of the day was delivered at the burrow.

Volumes were gradually decreased (usually by 5 ml/day) when chicks showed signs of rejecting food (over-flows or regurgitations).

### **4.5 Managing/monitoring emerging chicks**

#### **4.5.1 Burrow blockade removal**

Blockade gates were left at all occupied burrow entrances for a minimum of 2 nights to force chicks to become familiarised with their burrows and surroundings. The mesh gates allowed chicks to look out from the burrow entrance, although they were constrained from exiting.

Blockades were removed from burrow entrances on an individual basis when chicks' wings measured 159 mm or over. In most cases, blockades were not removed until chicks' body surface down coverage was <20%, assuming that chicks with more down cover than this would not be ready for fledging. In the most extreme case, a chick with 30% down cover did not have its blockade removed until its wing measured 178 mm. Other cues for blockade removal were clear signs of meal rejection, together with decreasing chick body weight.

Stick fences were erected at all opened entrances to monitor emergence behaviour of each chick.

#### **4.5.2 Monitoring fledging**

Burrows and chicks were monitored daily before feeding (chick roll-calls) to determine emergence periods (burrow entrance stick fences knocked down) and fledging dates (burrow unoccupied).

### **4.6 Chick weights, wing measurements and down cover**

Weight and wing-length were recorded to help with chick management—i.e. meal sizes and dates of blockade removal. All chicks were weighed the day after transfer, and measured when each chick was predicted to be approaching 160 mm in wing-length (rough calculations made using transfer day wing length and a wing-growth rate of 10 mm every 3 days). Wings were then measured roughly every second or third day as required.

Weight, wing-length, and down cover were all assessed closely (on a daily basis) before birds finally departed to establish if chicks had successfully fledged at the appropriate time, or if they were considered to have disappeared prematurely from the burrow. Wing growth rate was also assessed

where possible. Ultimately, each chick needed to be assessed for its likely ability to fly out to sea after it disappeared from the colony site.

## **4.7 Chick health**

### **4.7.1 Disease and parasite screening**

Based on the results of disease and parasite screening of other national seabird translocations to date, it was deemed unnecessary to screen the fairy prion chicks being translocated to Mana Island (as per discussion with Kate McInnes, DOC Wildlife Health Coordinator, in December 2012 regarding a range of seabird species). Tests for Malaria and Erysipelothrix (via blood samples), Salmonella and Campylobacter (via cloacal samples), Coccidia and other parasites such as Strongyle, Ascarid, Capillaria and Heterakis eggs (via faecal samples) of samples of chicks of other species transferred elsewhere have generally returned negative results.

The current standard protocol for seabird translocations was followed: to only select chicks that are in healthy condition without injury, deformity or excessive ecto-parasite burdens.

### **4.7.2 Monitoring chick health**

Chicks were monitored on a daily basis for appropriate weight change and behaviour, with the expectation of undertaking closer investigation if any birds were observed to be unwell or losing too much weight. (The Nest, Wellington Zoo, had previously been contacted and was available to receive any fairy prion chicks requiring veterinary treatment.) Daily scrutiny of burrows for any signs of regurgitation and to check that chicks were defaecating normally following the transition onto the artificial diet was not considered essential given prior translocation knowledge of hand-feeding this species, although burrow checks of some individuals were made as required.

### **4.7.3 Plumage condition**

A proportion of chicks were sprayed with fresh water on one occasion each (before handling for feeding), after they had shed most of their down, to check for the waterproofing quality of feathers. This has not previously been carried out with this species. The aim was to score the outcome with each chick—water beading or water soaking in to feathers—and relate this to future survival of birds.

## **4.8 Post-release management**

No post-release management was required as all chicks are considered to have fledged successfully to sea and are not expected to return to the release site for at least 2.5 years.

# **5. Results**

## **5.1 Collection and transfer of chicks from Takapourewa**

### **5.1.1 Finding chicks**

Locating 120 chicks that met transfer criteria took nine people searching for a total of 12 hours and 50 minutes (although Colin Miskelly spent most of this time measuring and banding chicks brought to him by other team members). This equates to 115.5 person-hours of searching. A total of 1655 burrows was inspected, of which 870 were too deep to ascertain their contents, at least 397 contained live prion chicks (five of which could not be extracted), 13 contained dead chicks, 33 had failed eggs, seven had adult prions, and 295 were empty. Other species found in the burrows included 15 tuatara, 13 raukawa

geckos, 7 skinks (those identified were spotted skinks and northern grass skinks), three ant nests and a Cook Strait giant weta. No bird species other than fairy prions were encountered.

### **5.1.2 Selecting chicks**

Of the 392 fairy prion chicks checked, 191 had wings that were too long, 75 had wings that were too short, and six chicks were of the correct 'age' but were underweight. The wing-length criteria were relaxed for three chicks that had long wings but still had a lot of down, as they were judged to be naturally large individuals that were unlikely to fledge before 24 Jan (i.e. the target minimum fledging date). We stopped searching as soon as we had marked 120 healthy chicks that were predicted to fledge between 24 Jan and 2 Feb.

Initial measurements of the 120 chicks that met our selection criteria (plus an additional chick banded on 22 Jan – see below) are given in Appendix 2.

### **5.1.3 Collecting and transferring chicks**

We found 111 of the 120 marked chicks on the morning of 22 Jan. Most of the missing chicks are likely to have fledged, but one may have been eaten by a large tuatara that was found in its burrow.

The 12 marked birds that were not selected were mainly considered unsuitable for transfer because they were of relatively low bodyweight on 22 Jan (11 were less than 123 g, of which 8 were less than 117 g). One heavier bird (137 g) was rejected for having badly soiled and matted plumage.

During processing of chicks on 22 Jan, one unbanded chick was found to have been inadvertently brought in. As we had no record of which burrow it came from, we banded the chick (D-209021) and included it among the 100 birds moved to Mana Island.

Weights and wing-lengths of each translocated chick on the morning of transfer are recorded in Appendix 3. The 100 chicks weighed a mean  $149 \pm 15$  g (range 121–188 g) following collection from natal burrows on Takapourewa and had wings measuring  $153 \pm 7$  mm (range 139–168 mm).

### **5.1.4 Arrival of chicks on Mana Island**

After the helicopter arrived on Mana Island at 1350 hrs, it took less than 15 minutes to move the 50 transfer boxes to the shaded areas at the colony site where they remained for the welcoming ceremony (see Section 7: Consultation and community relations). No insects were found inside the boxes, but some grass seed heads were isolated. Processing of chicks commenced around 1500 hrs, and the last chicks were housed in burrows by 1930 hrs.

Chicks were scheduled to receive their first introductory artificial meal the following day. Prior to feeding, all 100 chicks were weighed and found to have lost an average of  $31 \pm 11$  g (range 8–54 g) of body weight within a 23–33-hour period following weighing on Takapourewa after collection from natal burrows (Appendix 3). (Weights were recorded between 0800 hrs and 1130 hrs on Takapourewa on 22 Jan and between 1045 hrs and 1700 hrs on 23 Jan when chicks were removed from artificial burrows for hand-feeding).

## **5.2 Hand-feeding chicks**

Sardines from 118 tins blended with 40 Mazuri® Vita-zu™ tablets were prepared for 11 chick feeding days. A total volume of 10,480 ml of sardine puree was fed to the 100 chicks, with individuals receiving 2–11 meals and consuming on average  $105 \pm 61$  ml of food (range 22–274 ml) during their time on Mana Island.

No issues were encountered with hand-feeding chicks. None of the chicks made weight gains while on Mana Island because they were relatively advanced in development when they were transferred.

Feeding some of the lighter chicks twice a day was the best way to get individuals to accept larger volumes of food when they were getting nearer to fledging (and if they were rejecting food at the first feed of the day), to keep their weights within the target fledging weight range. Fourteen chicks were given double feeds as follows: eight chicks on 1 day only, three chicks on 2 days, two chicks on 3 days and one chick was fed twice on 4 subsequent days.

Chicks fledged after final meal sizes ranging from 5–40 ml.

### 5.3 Fledging behaviour

The first 18 blockades were removed on 24 Jan after 2 nights in place. Thereafter, blockades were removed on a daily basis (15 on 25 Jan, eight on 26 Jan, 15 on 27 Jan, 20 on 28 Jan, 13 on 29 Jan, two on 30 Jan, five on 31 Jan) with the last two taken away on 1 and 2 Feb, after 10 and 11 nights in place.

Ninety chicks came out of their burrows on their first night after the blockades were removed, and the majority of chicks (88) fledged on this first night out (Appendix 3). Stick fence status at burrow entrances of 11 chicks indicated they spent one additional night on the surface before fledging. A single chick appeared to have visited the surface for 2 nights before departing Mana Island.

Two chicks escaped from burrows via blockaded entrances. In the first instance, it was suspected that the gate at burrow FP26 had been accidentally bent (trodden on), creating space for the chick to exit the burrow on its third night on Mana Island. The gate at burrow FP2 was not entirely flush with the tunnel pipe end and here the chick must have squeezed through a small gap on its sixth night on Mana Island.

None of the transferred chicks was found in any burrow other than their own. Nor were any chicks found in nearby old artificial burrows AB1–30 (i.e. the nearest burrows of those used to house 2002–04 transferred chicks).

### 5.4 Fledging dates and chick condition

All 100 chicks were presumed to have fledged successfully from the Mana Island colony site. Fledging dates, weights and wing-lengths (measurer Helen Gummer) are listed for each chick in Appendix 3.

The first chicks departed the colony on the night of 24 Jan, and the last chick to leave fledged on the night of 2 Feb. They had spent a mean of  $6 \pm 2$  days (range 3–12 days) on Mana Island including the transfer day, or for comparison with 2002–2004 data, 5 days (range 2–11) days not including the transfer day.

Chicks fledged at a mean base weight of  $109 \pm 7$  g ( $n=100$ ; range 88–135 g) and with wings measuring a mean of  $171 \pm 5$  mm ( $n=83$ ; range 159–180 mm) on the morning before they departed. From a rough assessment of wing measurements of chicks approaching fledging, wing growth was not complete by the time of departure in any chicks, although the growth rate was observed to slow (from approx. 3 mm/day to approx. 2 mm/day) in a few cases. The majority of chicks (78) departed with <10% body surface down cover (usually just around the ruff of the neck and some on flanks). Of these, 41 had no down or only wisps present. The five downiest chicks had an estimated 20–30% body surface cover when they departed (ruff, flanks and lower belly). One of these chicks escaped from a blockaded burrow, and blockade gate removal for others was deemed necessary because wing growth rate was observed to be slowing (in one chick to approx. 1 mm/day) and/or chicks were rejecting food and consequently losing weight rapidly.

Fledging condition of the two chicks that escaped from blockaded burrows was as follows. The chick from FP2 weighed 102 g on the day before departure (accepting 30 ml of food this day), and had a wing of 167 mm and down covering 30% body surface 2 days before departure. The chick from FP26 also weighed 102 g on the day (last meal 20 ml) before it disappeared; however the last wing

measurement was 147 mm on the transfer day, and no down cover estimate was made at this point. This chicks' wings would have been approaching the lowest fledging wing length (158 mm) when it went missing, and it is estimated the chick weighed enough to survive another night or two at the colony (without further hand-feeding) and still fledge above the lowest fledging weight (86 g) if it chose to 'hole-up' elsewhere at the colony before final departure.

## **5.5 Chick health**

### **5.5.1 Condition of chicks on arrival**

All chicks were considered to be in good condition on arrival on Mana Island. One or two ticks were observed on at least nine chicks, but these all dropped off naturally after a few days. Three chicks had slightly closed or fully sealed right eyes on arrival. One recovered naturally by 24 Jan, and the eyes of the other two were flushed daily with saline and were fully open by 25 Jan.

### **5.5.2 Chick with cyst (D-208897)**

One chick (burrow FP33) was found on 26 Jan to have a growth or cyst, approx. the size of a small marble, on its upper back. This had not been seen or felt in the transfer day health check by handlers, nor in the following days when it was likely to be concealed beneath down, but was discovered at its first wing-measuring event on Mana Island. The cyst appeared soft and fluid-filled, and the skin was white (not inflamed) and feathers were developing from follicles in this region. The bird was bright, alert and responsive, and took food readily.

By 28 Jan, the appearance of the cyst appeared to improve, with size slightly decreasing and appearance less 'puffy' and fluid-filled. At no time was a general infection suspected as the chick showed no signs of sickness or raised temperature. However, this chick was noted to have the greatest tick burden on arrival, with five ticks on its lower bill recorded on 24 Jan, so it may have been slightly more vulnerable to a parasitic loading than other chicks.

Because the condition appeared to improve, the decision was made to let the chick fledge from Mana Island, rather than send it off for treatment at The Nest, Wellington Zoo. It was also suggested that because the species does not dive to forage, the slightly less-developed feathering in the cyst region of the back was less significant in terms of insulation (Graeme Taylor, pers. comm. Jan 2015).

### **5.5.3 Temperature control**

Over two-thirds of chicks showed signs of digging at the back of their burrow chambers. Digging behaviour was noted at first to alert us to any chicks that might be stressed in blockaded burrows. However, digging at the front, near the entrance pipe, was only seen in two burrows. The rest all seemed to be making deeper scrapes in the beach gravel in back corners and this was attributed to birds perhaps wanting to get a little cooler down in the cold gravel. Day-time temperatures on the Mana Island cliff-top were approaching 30°C on some days and there was little wind in the first week when chicks were in residence.

No signs of heat stress were observed in any chicks, and chicks' feet felt cool when birds were removed from burrows. This digging behaviour did not raise concern, and so spare sand-bags (to add as an extra insulation layer) were not deployed.

### **5.5.4 Plumage waterproofing**

Due to time limitations, only approx. one-third of all chicks were sprayed on one occasion each with fresh water to assess plumage waterproofing quality. Water beaded and rolled off the feathers of all chicks with the exception of one bird (burrow AB17) that was sprayed after handling for feeding.

## 6. Other observations

For the period fairy prion chicks were in residence on Mana Island, the weather conditions were hot, calm and dry with clear skies. A southerly breeze occurred from 28 Jan onwards. There was patchy cloud cover from 30 Jan, and drizzle and light showers recorded for the nights of 31 Jan and 1 Feb respectively. Chicks fledged in good weather conditions and are likely to have experienced favourable conditions at sea in the following days when learning to forage.

Moon phases were as follows: new moon 21 Jan (the day before transfer), quarter moon 28 Jan (77 chicks had fledged on this night or before), and full moon 4 Feb (last chicks departed nights of 1 and 2 Feb).

## 7. Consultation and community relations

Planning for the 2015 translocation began in May 2013 with the appointment of the project manager and contacts made with all stakeholder groups seeking their support and participation including the full involvement by Ngāti Koata and Ngāti Toa. Ngāti Koata representatives Lonae Paul and Hauora Paul assisted with capture of the birds on Takapourewa, and accompanied them across Cook Strait to Mana Island.

The fairy prions were welcomed onto Mana Island by a large crowd, including FOMI members, and invited guests listed in Section 3: Personnel. All assembled near to the colony site to meet the helicopter, and representatives from Ngāti Toa (Mana Island tangata whenua) blessed the birds on their arrival, and acknowledged the gift brought across Cook Strait by Ngāti Koata.

Media coverage included newspaper items in:

- Dominion Post (24 Jan 2015)
- Kapi-Mana news (date unknown)

The project was also reported on blogsites:

- <http://blog.tepapa.govt.nz/2015/01/27/a-box-of-fluffy-birds-moving-fairy-prions-from-takapourewa-stephens-island-to-mana-island/>
- <http://blog.tepapa.govt.nz/2015/02/10/a-box-of-fluffy-birds-the-sequel-fairy-prion-chicks-fly-from-mana-island/>
- <https://www.beehive.govt.nz/release/community-brings-fairy-prions-mana-island>
- <http://explorediscovernature.blogspot.co.nz/2015/01/feeding-fairy-prions-volunteers-week-on.html>

## 8. Costs

Budgets for the project over 2013 to 2016 were prepared on the basis of experience with previous translocations however significant savings have been made to date for various reasons as listed in the notes to the Finances below. Budgeted expenses (excluding GST) to January 2015 amounted to \$34,818 and actual \$25,081 (Table 1). Budgeted expenses for the remainder of 2015 and for the 2016 translocation based on the experience to date are estimated at \$19,890 (Table 2). This compares with the original estimate made at the start of the programme of \$24,163.

While actual expenditure from previous translocations can act as a guide for the future each translocation is unique and requires careful consideration of any special features. At the start of the

programme a 10% contingency was allowed for, but proved unnecessary and has been dropped for the final year.

**Table 1: Finances for fairy prion translocation Takapourewa/Stephens Island to Mana Island January 2013–2015**

Fairy Prion Translocation Takapourewa/Stephens Island to Mana Island January 2013 and 2015

Finances (GST exclusive)

Description	Budget v Actual 2013 - 2015			
	Budget	Actual*	Variance	
Helicopter hire	6,957	7,125	168	
Equipment	5,402	2,796	- 2,606	Significant savings made by borrowing of equipment from Matiu/Somes
Artificial burrow box making	2,550	1,651	- 899	Anticipated purchase of tools did not eventuate
Contract services	8,610	9,520	910	Increase in time planning and reporting
Boat charter	3,000	1,800	- 1,200	A charter in 2014 did not take place saving \$900
Airfares (Ngati Koata)	-	431	431	Ngati Koata were not expected to require airfares
Food	2,560	1,758	- 802	Significant savings made per person
Contingencies (10%)	5,740	-	- 5,740	Not needed
<b>TOTAL COSTS</b>	<b>34,818</b>	<b>25,081</b>	<b>- 9,737</b>	

\* Actuals for 2015 are for January only

**Table 2: Budget for fairy prion translocation project to 2016**

	2015-16 Budget
(excl GST)	
Helicopter hire	7,300
Equipment	450
Artificial burrow maintenance	200
Contract services	7,700
Boat charter	2,000
Airfares (Ngati Koata)	440
Food	
Chick collection	600
Chick feeding	800
PR	400
Contingencies (10%)	-
<b>TOTAL COSTS</b>	<b>19,890</b>

## 9. Discussion and recommendations

### 9.1 Finding and collecting chicks on Takapourewa

Locating 120 suitable chicks took approx. 2 full days (starting on the afternoon of 18 Jan), though we were assisted in achieving this by having the fulltime assistance of the two resident DOC staff. The chicks were more advanced in their development than expected with close to 49% rejected for having wings that were too long (i.e. the chicks had a high likelihood of fledging before the transfer day). When combined with a small (but unknown) number of chicks that are likely to have fledged before their burrows were inspected, our findings indicate that more than half the chicks were too advanced to be suitable for transfer on 22 Jan. Bringing the transfer date forward a few days would decrease the search effort required to find 120 suitable chicks, and thereby reduce the impacts on the source colony (by reducing the number of burrows requiring inspection, and the spatial extent of the colony covered to find the required number of chicks).

**Recommendation:** In 2016, the collecting trip should be scheduled for 13–17 Jan, while retaining the same wing-length and weight criteria for chick selection, with the aim of transferring chicks to Mana Island on 17 Jan.



## 9.2 Chick condition at transfer

Chicks were all noted to be in good condition at transfer, so none were considered to require food on the transfer day. A single chick later found to have a cyst on its back was likely to have been transferred with the condition, but it was not observed until the chick was in residence on Mana Island (see Section 9.6: Chick Health).

**Recommendation:** Retain the same chick selection criteria (noting the recommended earlier transfer date above). Any chicks weighing under 120 g on the day of transfer must be given an initial feed on the day that they arrive on Mana Island.

**Recommendation:** Consider giving all 100 chicks 10 ml of food (sardines blended with Hartmann's solution) on arrival in 2016 to get a head start on food introduction and help slow the rate of chick body weight loss so that chick fledging weights can be marginally improved (see Section 9.5: Fledging condition). Meals on the first official feeding day (i.e. day after transfer) can proceed at 15 and 20 ml, depending on how close they are considered to be to fledging.

## 9.3 Hand-feeding chicks on Mana Island

Hand-feeding of chicks went very smoothly this year; there were no issues with food preparation, equipment, or technique. Second meals given at the burrow to some chicks were practical this year because the weather conditions were so good. However, it did require careful forward planning to ensure that these birds were fed first and last in the day.

**Recommendation:** Maintain the same number of personnel, and similar balance of experienced and less experienced volunteers on chick feeding teams as in 2015. However, the final team member (Team 2b in 2015) could arrive as part of Team 2a in 2016. Team 2a (comprising three people) could then all help with the clean up and depart at the same time. The contractor (with the Mana Island DOC ranger) can feed the very small numbers of chicks that are last to depart.

**Recommendation:** Meals on the first few chick feeding days in 2016 could be increased in size more rapidly for younger chicks (those with shorter wings and more down cover) than they were in 2015 (e.g. first meal 20 ml rather than 15 ml, increasing in 10 ml increments rather than 5 ml increments).

**Recommendation:** Double-feeding chicks (i.e. two feeds per day) is an effective tool for getting some lighter, more advanced chicks to accept more food on a daily basis and could be used to a greater extent in 2016 to marginally improve fledging weights (see Section 9.5: Fledging condition).

**Recommendation:** Consider replacing the soy oil component of the diet with fish oil (recommended brand: Nutralife Omega3 Fish Oil Liquid) as per recommendations to improve the diet used for NZ seabird translocations. Currently, this product has been used with four other species nationally. The soy oil is tipped off the fish and discarded, and 20 ml of fish oil (per tin) is added instead to the mix. Whilst we have a proven diet and methodology that produces good results with fairy prions, there is still the potential to improve it, but this should be done in a way that allows robust comparison with the existing regime. For this reason, we suggest a 50:50 trial where we will get immediate information on any differences in the birds at fledging, and the potential to compare recovery rates in 3-6 years' time.

## 9.4 Fledging behaviour

The majority of chicks (90% of those translocated) came out of burrows on the first night blockades were removed from entrances, indicating birds may well have emerged earlier than this if allowed. Based on results from translocations of other species, this year we leant towards blocking fairy prions in longer than in the transfers 11+ years ago, with the aim of allowing plumage to develop as much as

possible before departure, using the extent of body surface down cover as a guide (see Section 9.5: Chick condition at fledging). Shed down was an indicator that plumage was close to completion, but also that chicks were more active within burrows (potentially exercising and/or preening), resulting in birds potentially more physically prepared for fledging to sea. Consequently, chicks were very ready to leave when gates were finally removed.

The length of time (number of nights) the 2002–04 translocated chicks spent on the surface on Mana Island before fledging had no significant effect on whether birds were recovered back at the release site or not. So, the fact that 88% of the 2015 translocated cohort departed on their first night out of the burrow should not influence return rates to Mana Island. Conditions at night were largely clear when most chicks fledged, with the first quarter moon.

## 9.5 Fledging condition

It is difficult to meaningfully compare fledging weights of the 100 chicks translocated in 2015 (mean 108.6 g) with all those translocated in 2002–04 that were fed the same diet (mean 119.5 g;  $n=204$ ; Miskelly et al., 2009) because this year's chicks were generally more advanced at transfer, spending less time (3–12 days including transfer day; 2–11 days excluding transfer day) at the release site than those 11+ years ago (2–21 days excluding transfer day). Data presented in Miskelly & Gummer (2004) show that translocated chicks staying on Mana Island for 1–5 days in 2004 fledged at a mean of 110 g ( $n=16$ ), and those staying at the release site 6–10 days fledged at a mean of 114 g ( $n=40$ ), both lower means than for chicks staying beyond 12 days. Chicks that are closer to fledging are less likely to accept large volumes of artificial diet so weight maintenance presents more of a challenge, as was the case this year. It should be noted that the 2015 fledging weights still exceeded those recorded for parent-reared chicks on Takapourewa in 2004 (mean 106 g;  $n=30$ ; Miskelly & Gummer, 2013).

Fledging wing-lengths for 29 parent-reared chicks on Takapourewa in 2004 averaged 163 mm (range 148–176 mm; C. Miskelly unpublished data). The mean fledging wing-lengths of translocated chicks in 2015 (171 mm;  $n=83$ ) exceeded both the 'natural' wing-lengths, and also the fledging wing-lengths recorded for previous cohorts of translocated chicks (169 mm in 2002,  $n=20$ ; 170 mm in 2003,  $n=84$ ; 168 mm in 2004,  $n=100$ ; Miskelly & Gummer, 2004), even though the 2015 chicks were on Mana Island for relatively less time. This can be attributed to a more tailored blockade removal regime, based largely on down coverage and not solely on wing measurements. (Note, however, that fledging wing measurements on Takapourewa were taken by different personnel, as well as those in 2002 on Mana Island, i.e. not Colin Miskelly or Helen Gummer.)

In summary, the 2015 chicks did not reach the generally heavy fledging weights usually achieved by hand-feeding the sardine diet, because most were on Mana Island for <9 days excluding transfer day (only two chicks stayed 10 and 11 days). However, we consider the chicks fledged with slightly further developed plumage than in previous transfers.

Prolonging the blockading period allows chick plumage to develop as far as possible (so chicks spend less energy at sea completing feather growth) but this needs to be carefully balanced with the need to remove blockade gates before chicks lose too much weight, so that they have enough reserves to carry them through their first days learning to forage at sea.

**Recommendation:** Aim to use the same blockade-removal criteria in 2016 as used in 2015. If any chicks lose down prematurely due to potential wet weather conditions in 2016, then blockade removal should be based on a combination of actual wing-length and wing growth rate if available (i.e. blockades should be removed as soon as chicks' wings appear to be slowing in growth) as well as chick response to feeding.

**Recommendation:** Aim to improve the mean fledging weight of translocated chicks in 2016 by at least 5 g using the following strategies: feeding all chicks 10 ml of food on arrival on the transfer day

(instead of fluids only), increasing meal size more rapidly for some chicks, and feeding chicks twice/day where necessary.

## 9.6 Chick health

The single health issue reported for the project this year was that of a chick with a cyst on its back. It is quite likely that the cyst was initially small and therefore less noticeable on Takapourewa, and that it developed to maximum size during the first few days on Mana Island, following the stress of transfer. The condition did not appear to compromise the bird’s daily well-being, movement or behaviour. For this reason, the chick was allowed to take its chances by fledging normally from the release site. Moving this chick into a captive environment for veterinary examination and treatment would not have been without risk as fairy prions do not cope well in the veterinary hospital environment (Lisa Argilla, pers. comm. Jan 2015). All risks were carefully balanced during decision-making.

Checking for chick plumage water-proofing quality is logistically difficult to factor in as the timing for each spray assessment is specific to each chick (when down is shed), must occur before extensive handling, and has to occur when the chick is out of the burrow. Because this species is at the release site for a relatively short time, there would be no time to give effective water-proofing ‘therapy’ if a chick was deemed to have poor plumage condition. For these reasons, it is not deemed practical to do this assessment in 2016.

**Recommendation:** Plan to send any chick to The Nest, Wellington Zoo, if their welfare is a cause for concern, or if it is considered that their survival and well-being at sea would be severely compromised if they were allowed to fledge with a specific condition.

## 10. Acknowledgements

Many thanks are owed to all those listed in Section 3: Personnel, for their significant contributions to the fairy prion supplementary translocation.

Thanks are due to Department of Conservation staff for their assistance in organising logistics for this year’s translocation.

We would also like to acknowledge Shane Cotter and Matiu/Somes Island Charitable Trust for the kind loan of chick feeding equipment and supplies.

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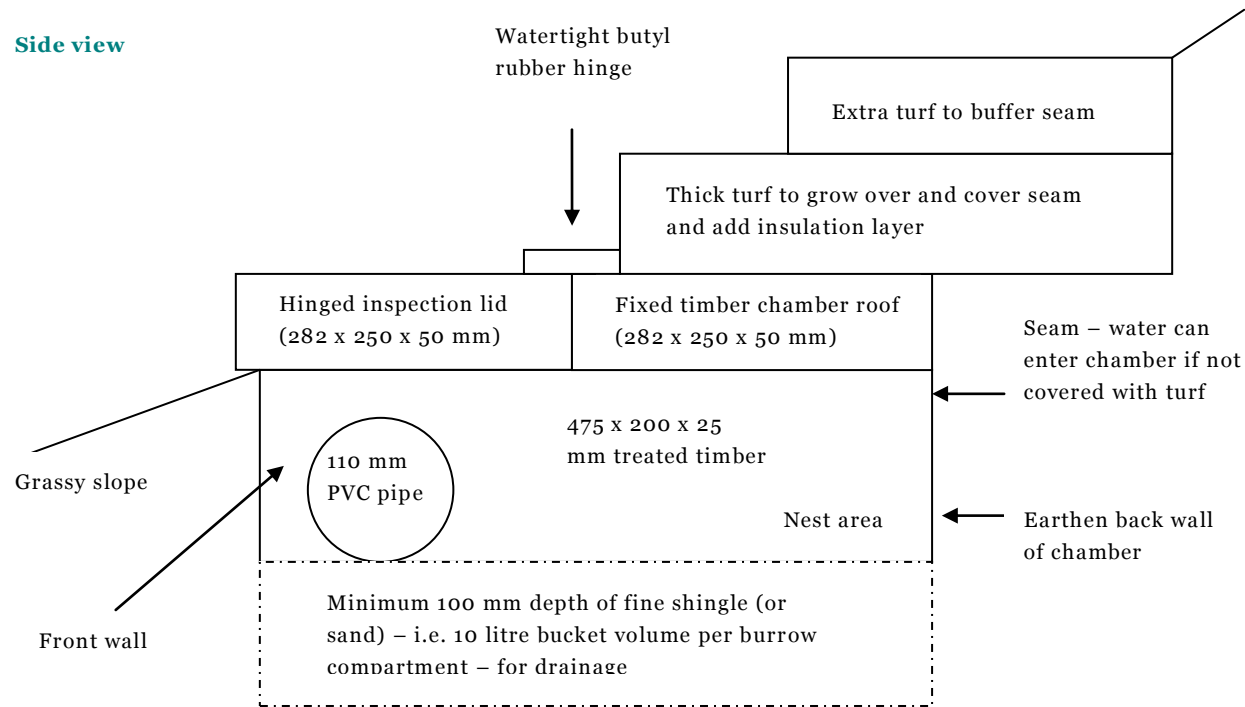
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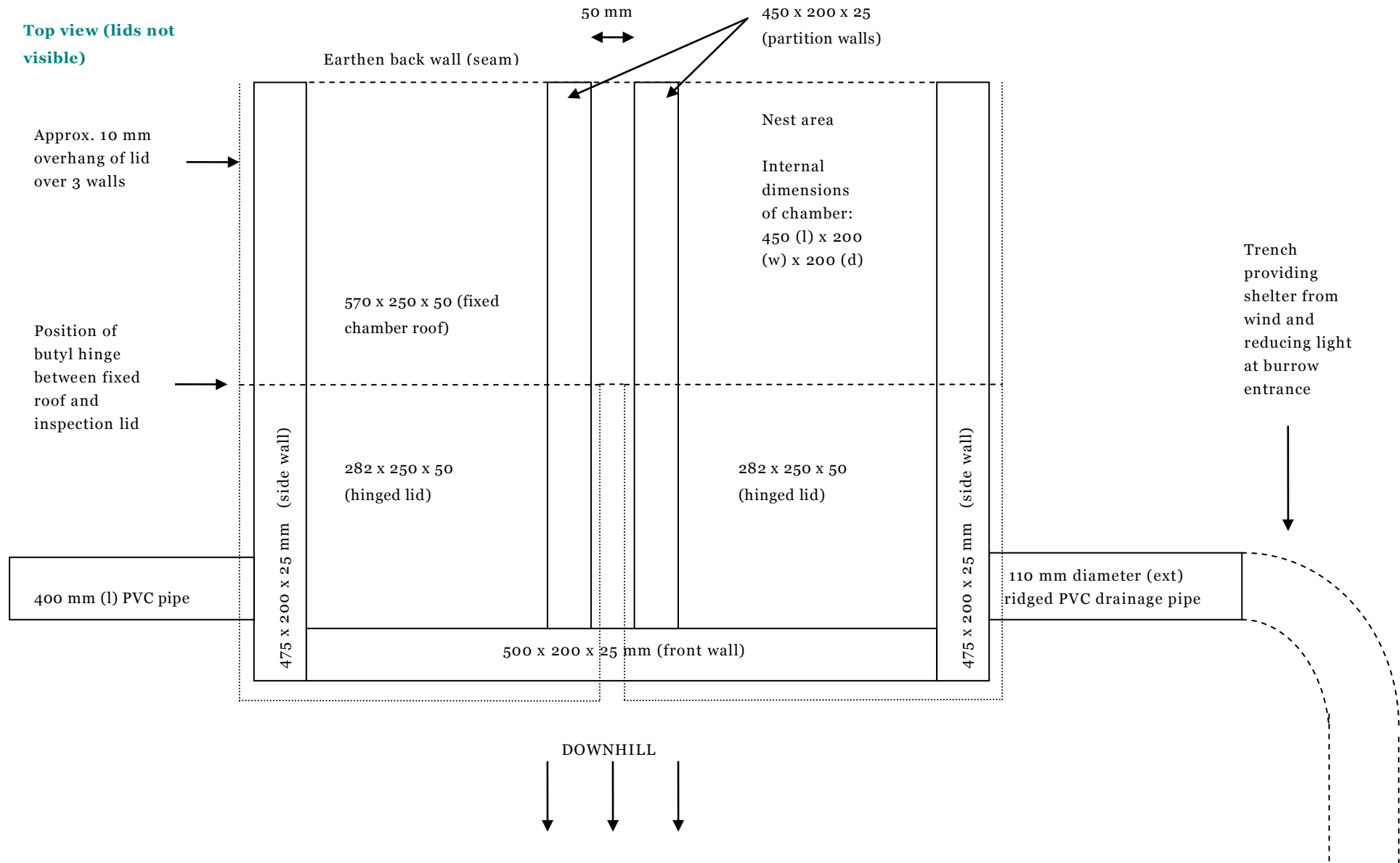
## Appendices

<b>Appendix 1</b>	Diagram of artificial double-chamber sloping-ground/cliff burrow design for fairy prions (adapted from: Gummer et al., 2014)
<b>Appendix 2</b>	Data for 121 fairy prion chicks banded on Takapourewa in January 2015
<b>Appendix 3</b>	Transfer and fledging data for 100 fairy prions transferred to Mana Island in 2015

## Appendix 1: Diagram of artificial double-chamber sloping-ground/cliff burrow design for fairy prions (adapted from: Gummer et al., 2014)



**Top view (lids not visible)**



## Appendix 2: Data for 121 fairy prion chicks banded on Takapourewa in January 2015

Note: Chicks with band numbers D-208801 to D-208831 were sourced from the south side of the dam paddock; all remaining chicks were from the north side.

Band (D-)	First capture date	First capture wing (mm)	First capture weight (g)	Transferred Yes/No	Reason not suitable for transfer
208801	18 Jan	147	132	Yes	
208802	18 Jan	132	115	Yes	
208803	18 Jan	145	150	Yes	
208804	18 Jan	140	159	Yes	
208805	18 Jan	132	152	Yes	
208806	18 Jan	128	139	Yes	
208807	18 Jan	135	147	Yes	
208808	18 Jan	140	146	Yes	
208809	18 Jan	131	131	Yes	
208810	18 Jan	139	182	Yes	
208811	18 Jan	141	151	Yes	
208812	18 Jan	129	142	No	Low weight
208813	18 Jan	149	148	No	Low weight
208814	18 Jan	140	130	Yes	
208815	18 Jan	145	168	Yes	
208816	18 Jan	145	139	Yes	
208817	18 Jan	132	134	Yes	
208818	18 Jan	145	137	Yes	
208819	18 Jan	146	122	Yes	
208820	18 Jan	132	124	Yes	
208821	18 Jan	132	151	Yes	
208822	18 Jan	149	158	Yes	
208823	18 Jan	147	131	Yes	
208824	18 Jan	131	160	Yes	
208825	18 Jan	148	160	No	Soiled plumage
208826	18 Jan	135	137	Yes	
208827	18 Jan	133	142	Yes	
208828	18 Jan	142	114	No	Low weight
208829	18 Jan	121	155	Yes	
208830	18 Jan	135	137	Yes	
208831	18 Jan	149	121	Yes	
208832	19 Jan	149	137	No	Missing
208833	19 Jan	143	161	Yes	
208834	19 Jan	141	152	Yes	
208835	19 Jan	151	165	Yes	
208836	19 Jan	148	119	Yes	
208837	19 Jan	140	211	Yes	
208838	19 Jan	135	127	Yes	
208839	19 Jan	150	168	No	Low weight
208840	19 Jan	144	128	Yes	
208841	19 Jan	132	145	Yes	
208842	19 Jan	141	161	No	Missing
208843	19 Jan	147	175	Yes	
208844	19 Jan	143	174	Yes	
208845	19 Jan	133	129	Yes	
208846	19 Jan	150	156	No	Low weight
208847	19 Jan	132	161	Yes	

Band (D-)	First capture date	First capture wing (mm)	First capture weight (g)	Transferred Yes/No	Reason not suitable for transfer
208848	19 Jan	150	161	Yes	
208849	19 Jan	131	184	Yes	
208850	19 Jan	148	122	No	Missing
208851	19 Jan	147	188	Yes	
208852	19 Jan	137	156	Yes	
208853	19 Jan	136	156	Yes	
208854	19 Jan	152	208	Yes	
208855	19 Jan	147	179	Yes	
208856	19 Jan	137	146	Yes	
208857	19 Jan	131	146	Yes	
208858	19 Jan	136	146	Yes	
208859	19 Jan	148	158	Yes	
208860	19 Jan	149	139	No	Missing
208861	19 Jan	151	149	Yes	
208862	19 Jan	149	156	Yes	
208863	19 Jan	131	138	Yes	
208864	19 Jan	134	158	Yes	
208865	19 Jan	152	152	Yes	
208866	19 Jan	131	210	Yes	
208867	19 Jan	152	152	Yes	
208868	19 Jan	132	135	Yes	
208869	19 Jan	135	129	Yes	
208870	19 Jan	133	157	Yes	
208871	19 Jan	148	131	Yes	
208872	19 Jan	142	168	Yes	
208873	19 Jan	141	117	Yes	
208874	19 Jan	145	149	Yes	
208875	19 Jan	149	172	Yes	
208876	19 Jan	148	146	No	Low weight
208877	19 Jan	142	156	Yes	
208878	19 Jan	138	136	Yes	
208879	19 Jan	137	161	Yes	
208880	19 Jan	135	145	No	Missing
208881	19 Jan	140	134	Yes	
208882	19 Jan	135	145	Yes	
208883	19 Jan	138	166	No	Missing
208884	19 Jan	152	149	Yes	
208885	19 Jan	150	131	Yes	
208886	19 Jan	141	152	Yes	
208887	19 Jan	153	154	Yes	
208888	19 Jan	144	116	Yes	
208889	19 Jan	150	133	Yes	
208890	19 Jan	152	136	No	Low weight
208891	19 Jan	136	140	Yes	
208892	19 Jan	145	135	No	Low weight
208893	19 Jan	135	148	Yes	
208894	19 Jan	135	120	No	Low weight
208895	19 Jan	149	140	Yes	
208896	20 Jan	145	169	Yes	
208897	20 Jan	135	170	Yes	
208898	20 Jan	144	166	Yes	
208899	20 Jan	151	188	Yes	
208900	20 Jan	144	141	Yes	
209001	20 Jan	148	182	No	Missing



Band (D-)	First capture date	First capture wing (mm)	First capture weight (g)	Transferred Yes/No	Reason not suitable for transfer
209002	20 Jan	176	211	Yes	
209003	20 Jan	161	196	Yes	
209004	20 Jan	158	193	Yes	
209005	20 Jan	136	171	Yes	
209006	20 Jan	130	165	No	Missing
209007	20 Jan	172	207	Yes	
209008	20 Jan	136	171	No	Low weight
209009	20 Jan	167	202	Yes	
209010	20 Jan	160	195	Yes	
209011	20 Jan	155	190	Yes	
209012	20 Jan	161	196	Yes	
209013	20 Jan	132	167	No	Low weight
209014	20 Jan	189	224	Yes	
209015	20 Jan	186	221	Yes	
209016	20 Jan	158	193	No	Missing
209017	20 Jan	141	176	Yes	
209018	20 Jan	148	182	Yes	
209019	20 Jan	163	197	Yes	
209020	20 Jan	157	191	Yes	
209021	22 Jan	133	156	Yes	

## Appendix 3: Transfer and fledging data for 100 fairy prions transferred to Mana Island in 2015

Note: Emergence period (nights out) includes fledging night, and total number of days on Mana Island includes transfer day. Transfer wing measurements by Colin Miskelly; fledging wing measurements and down cover estimates by Helen Gummer

Band (D-)	Mana I. burrow no.	Transfer weight (g)	Transfer wing (mm)	Oral fluids on transfer day (mm) (N=none)	23-33h weight loss after transfer (g)	Date blockades removed	Possible emergence delay? (Y/N)	Date of fledging (pm)	Fledging weight (g)	Fledging wing (mm)	Total volume of food accepted (ml)	Last meal (ml)	Nights out of burrow before fledging	Estimated down cover at fledging (% body surface)	Total days on Mana I.	Comments
208801	90	147	160	<5	33	25/01/2015	Y	25/01/2015	110	>167	49	14	0	5	4	Tick on lower bill. Last down cover estimate and wing measure 24/01/2015
208802	53	176	147	10	54	28/01/2015	Y	28/01/2015	101	167	108	13	0	15	7	
208803	85	141	161	<5	19	24/01/2015	N	26/01/2015	110	174	52	10	0	<5	5	
208804	32	140	155	5	26	28/01/2015	Y	28/01/2015	107	174	130	10	0	<10	7	Right eye sealed on arrival; flushed daily with saline and open and fine by 25/01/2015
208805	54	156	148	8	45	29/01/2015	Y	29/01/2015	101	168	168	26	0	10	8	1 day of double feeds before fledging
208806	74	150	143	10	44	31/01/2015	Y	31/01/2015	105	177	246	27	0	<15	10	1 day of double feeds before fledging
208807	18	142	149	7	27	29/01/2015	Y	29/01/2015	113	174	156	16	0	5	8	
208808	17	169	153	10	49	28/01/2015	Y	28/01/2015	110	171	134	20	0	5	7	
208809	56	135	146	5	26	28/01/2015	Y	28/01/2015	103	165	135	20	0	5	7	
208810	22	164	156	10	30	29/01/2015	Y	30/01/2015	118	180	154	10	1	0	9	
208811	55	172	157	10	50	26/01/2015	Y	27/01/2015	110	175	91	15	1	<5	6	
208814	31	165	153	3	47	25/01/2015	Y	26/01/2015	111	166	74	20	1	<5	5	
208815	72	149	159	<5	21	25/01/2015	Y	25/01/2015	119	167	43	15	0	0	4	
208816	92	162	161	<5	43	24/01/2015	Y	25/01/2015	113	>168	53	18	1	<5	4	Last down estimate and wing measure 24/01

Band (D-)	Mana I. burrow no.	Transfer weight (g)	Transfer wing (mm)	Oral fluids on transfer day (mm) (N=none)	23-33h weight loss after transfer (g)	Date blockades removed	Possible emergence delay? (Y/N)	Date of fledging (pm)	Fledging weight (g)	Fledging wing (mm)	Total volume of food accepted (ml)	Last meal (ml)	Nights out of burrow before fledging	Estimated down cover at fledging (% body surface)	Total days on Mana I.	Comments
208817	44	163	148	<5	45	27/01/2015	Y	27/01/2015	107	166	94	10	0	5	6	
208818	91	142	160	5	24	24/01/2015	N	26/01/2015	110	171	67	15	0	5	5	
208819	45	132	159	5	27	25/01/2015	Y	25/01/2015	102	>165	48	17	0	<10	4	
208820	68	158	150	<5	44	29/01/2015	Y	29/01/2015	108	174	165	19	0	<10	8	
208821	43	162	148	5	42	27/01/2015	Y	27/01/2015	105	165	82	15	0	10	6	
208822	82	166	163	7	41	28/01/2015	Y	28/01/2015	110	179	107	15	0	10	7	
208823	97	171	163	<3	42	24/01/2015	Y	26/01/2015	116	177	55	13	2	<5	5	
208824	42	161	144	5	38	27/01/2015	Y	27/01/2015	114	163	102	20	0	<5	6	
208826	41	154	150	5	40	28/01/2015	Y	28/01/2015	105	172	153	35	0	<15	7	
208827	21	139	151	6	23	29/01/2015	Y	29/01/2015	111	173	176	25	0	5	8	
208829	80	155	139	<5	35	31/01/2015	Y	31/01/2015	108	169	204	15	0	10	10	
208830	70	143	152	<3	30	27/01/2015	Y	27/01/2015	101	168	122	30	0	10	6	1 day of double feeds before fledging
208831	86	128	160	<5	26	26/01/2015	Y	26/01/2015	96	172	63	15	0	10	5	
208833	12	137	155	5	21	24/01/2015	Y	25/01/2015	105	>163	32	8	1	<10	4	
208834	38	132	154	7	25	27/01/2015	Y	27/01/2015	101	171	128	38	0	5	6	1 day of double feeds before fledging
208835	88	165	161	<2	54	24/01/2015	N	25/01/2015	102	>170	31	7	0	15	4	Last down estimate and wing measure 24/01
208836	2	142	158	6	32	N/A	Y	27/01/2015	102	>167	110	30	0	<30	6	Last down estimate and wing measure 25/01. Chick escaped via blockaded entrance.
208837	73	121	147	10	8	27/01/2015	N	28/01/2015	117	169	135	25	0	15	7	

Band (D-)	Mana I. burrow no.	Transfer weight (g)	Transfer wing (mm)	Oral fluids on transfer day (mm) (N=none)	23-33h weight loss after transfer (g)	Date blockades removed	Possible emergence delay? (Y/N)	Date of fledging (pm)	Fledging weight (g)	Fledging wing (mm)	Total volume of food accepted (ml)	Last meal (ml)	Nights out of burrow before fledging	Estimated down cover at fledging (% body surface)	Total days on Mana I.	Comments
208838	1	133	145	7	26	29/01/2015	Y	29/01/2015	99	168	197	36	0	10	8	3 days of double feeds before fledging
208840	8	149	158	3	29	24/01/2015	N	25/01/2015	110	>163	41	10	0	<5	4	
208841	49	135	145	10	29	31/01/2015	Y	31/01/2015	98	173	200	10	0	30	10	3 days of double feeds before fledging. Down on ruff, belly and flanks; blockade removed as chick rejecting food and losing weight.
208843	69	125	155	5	11	24/01/2015	Y	24/01/2015	111	162	34	19	0	<10	3	
208844	79	158	154	<5	38	24/01/2015	Y	24/01/2015	117	160	32	20	0	<5	3	Tick under lower bill
208845	5	138	146	5	33	28/01/2015	Y	28/01/2015	97	165	153	36	0	5	7	1 day of double feeds before fledging
208847	61	152	146	5	39	29/01/2015	Y	29/01/2015	104	170	165	30	0	<15	8	1 day of double feeds before fledging
208848	27	132	159	5	18	25/01/2015	Y	25/01/2015	103	166	26	5	0	10	4	
208849	28	188	143	4	51	2/02/2015	Y	2/02/2015	114	178	219	10	0	30	12	Down on ruff, belly and flanks; blockade removed as last chick and wing growth slowing.
208851	48	150	155	<5	18	26/01/2015	Y	26/01/2015	115	169	42	6	0	<15	5	
208852	7	135	149	10	24	25/01/2015	N	26/01/2015	106	>161	85	25	0	5	5	Right eye slightly closed on 22/01; fine by 24/01
208853	63	150	147	5	38	28/01/2015	Y	28/01/2015	107	168	159	35	0	10	7	Ticks on lower bill and nostril
208854	99	174	165	<5	30	24/01/2015	Y	25/01/2015	135	>172	40	13	1	<15	4	Last down estimate and wing measure 24/01
208855	77	154	157	<5	32	24/01/2015	Y	25/01/2015	111	>163	34	9	1	5	4	Last down estimate and wing measure 24/01
208856	26	143	147	9	36	N/A	Y	24/01/2015	102	-	35	20	0	-	3	Chick escaped via blockaded entrance (suspect blockade was bent outwards accidentally)
208857	37	141	142	5	14	1/02/2015	Y	1/02/2015	103	176	274	25	0	10	11	1 day of double feeds

Band (D-)	Mana I. burrow no.	Transfer weight (g)	Transfer wing (mm)	Oral fluids on transfer day (mm) (N=none)	23-33h weight loss after transfer (g)	Date blockades removed	Possible emergence delay? (Y/N)	Date of fledging (pm)	Fledging weight (g)	Fledging wing (mm)	Total volume of food accepted (ml)	Last meal (ml)	Nights out of burrow before fledging	Estimated down cover at fledging (% body surface)	Total days on Mana I.	Comments
208858	14	164	150	10	29	30/01/2015	Y	30/01/2015	119	171	165	10	0	<20	9	Down on belly; blockade removed as wing growth slowing and chick rejecting food.
208859	20	134	159	10	13	25/01/2015	Y	25/01/2015	119	168	58	23	0	10	4	
208861	87	129	161	<3	18	25/01/2015	Y	25/01/2015	106	171	37	8	0	10	4	Tick on right eye
208862	89	138	160	<5	13	25/01/2015	Y	26/01/2015	113	172	36	5	1	<10	5	
208863	16	129	141	7	31	29/01/2015	Y	29/01/2015	88	163	169	21	0	10	8	4 days of double feeds before fledging
208864	50	172	149	5	47	25/01/2015	Y	25/01/2015	115	161	38	11	0	5	4	
208865	98	169	164	<5	46	25/01/2015	Y	25/01/2015	117	>168	58	23	0	<15	4	Last down estimate and wing measure 24/01
208866	46	184	144	<5	45	29/01/2015	Y	29/01/2015	117	168	117	10	0	<15	8	
208867	96	151	166	<5	32	26/01/2015	Y	26/01/2015	108	175	34	5	0	5	5	
208868	23	137	145	5	25	31/01/2015	Y	31/01/2015	102	177	233	20	0	15	10	2 days of double feeds before fledging
208869	57	157	147	10	44	28/01/2015	Y	28/01/2015	105	166	147	22	0	5	7	
208870	34	150	146	6	25	28/01/2015	Y	28/01/2015	116	170	133	20	0	10	7	
208871	47	148	158	5	43	24/01/2015	N	25/01/2015	101	>164	58	25	0	<5	4	
208872	10	138	155	8	19	28/01/2015	Y	28/01/2015	111	175	144	30	0	<10	7	
208873	3	128	152	5	23	28/01/2015	Y	28/01/2015	99	171	168	40	0	<15	7	2 days of double feeds before fledging
208874	65	128	157	<5	18	27/01/2015	Y	27/01/2015	102	172	111	30	0	5	6	
208875	84	149	160	8	25	25/01/2015	Y	25/01/2015	113	>168	39	8	0	<15	4	Last down estimate and wing measure 24/01
208877	24	164	151	5	35	26/01/2015	Y	26/01/2015	118	165	66	15	0	5	5	

Band (D-)	Mana I. burrow no.	Transfer weight (g)	Transfer wing (mm)	Oral fluids on transfer day (mm) (N=none)	23-33h weight loss after transfer (g)	Date blockades removed	Possible emergence delay? (Y/N)	Date of fledging (pm)	Fledging weight (g)	Fledging wing (mm)	Total volume of food accepted (ml)	Last meal (ml)	Nights out of burrow before fledging	Estimated down cover at fledging (% body surface)	Total days on Mana I.	Comments
208878	66	149	148	5	34	25/01/2015	Y	25/01/2015	106	159	53	20	0	10	4	Tick under lower bill
208879	29	160	151	5	34	28/01/2015	Y	29/01/2015	110	176	138	8	1	10	8	Tick under lower bill
208881	58	143	153	10	30	29/01/2015	Y	29/01/2015	105	172	192	35	0	5	8	
208882	40	139	147	5	24	27/01/2015	Y	27/01/2015	104	165	80	15	0	5	6	Bird found mostly in pipe on a daily basis
208884	83	147	161	-	33	27/01/2015	Y	27/01/2015	101	177	82	15	0	5	6	Slightly sealed right eye on 22/01; flushed with saline; fine and open by 25/01
208885	81	124	159	<5	17	24/01/2015	Y	24/01/2015	104	167	35	20	0	5	3	
208886	39	151	154	10	31	28/01/2015	Y	28/01/2015	109	173	93	12	0	10	7	Bird found mostly in pipe on a daily basis
208887	AB 17	142	164	<3	17	24/01/2015	N	25/01/2015	118	>170	46	15	0	<10	4	Last down estimate and wing measure 24/01. Fledged from old AB burrow converted to box.
208888	78	146	155	<5	27	24/01/2015	N	27/01/2015	105	171	87	15	1	<5	6	
208889	93	132	160	5	23	24/01/2015	N	25/01/2015	108	>165	60	25	0	0	4	Last down estimate and wing measure 24/01
208891	13	147	147	10	30	28/01/2015	Y	28/01/2015	105	167	157	35	0	10	7	Tick on bill
208893	6	167	151	5	29	28/01/2015	Y	28/01/2015	117	173	86	8	0	5	7	
208895	9	184	159	8	45	28/01/2015	Y	28/01/2015	123	176	104	12	0	15	7	
208896	11	134	151	0	16	27/01/2015	Y	27/01/2015	109	167	118	29	0	10	6	
208897	33	123	144	3	21	30/01/2015	Y	30/01/2015	104	171	237	29	0	10	9	5 ticks on lower bill. 4 days of double feeds before fledging. Fledged with globular cyst on upper back (see Section 5.5.2)
208898	59	146	151	5	24	25/01/2015	Y	25/01/2015	111	>159	42	13	0	<5	4	Last down estimate and wing measure 24/01

Band (D-)	Mana I. burrow no.	Transfer weight (g)	Transfer wing (mm)	Oral fluids on transfer day (mm) (N=none)	23-33h weight loss after transfer (g)	Date blockades removed	Possible emergence delay? (Y/N)	Date of fledging (pm)	Fledging weight (g)	Fledging wing (mm)	Total volume of food accepted (ml)	Last meal (ml)	Nights out of burrow before fledging	Estimated down cover at fledging (% body surface)	Total days on Mana I.	Comments
208899	75	132	159	5	16	24/01/2015	Y	24/01/2015	114	167	23	10	0	10	3	
208900	36	160	151	5	49	29/01/2015	Y	29/01/2015	103	173	161	20	0	20	8	Down on belly; blockade removed as wing growth slowing and chick starting to reject food
209002	35	154	153	7	26	27/01/2015	Y	28/01/2015	119	171	119	10	1	5	7	
209003	4	146	143	5	36	31/01/2015	Y	31/01/2015	104	170	246	25	0	10	10	1 day of double feeds before fledging
209004	67	171	158	5	34	27/01/2015	Y	27/01/2015	118	176	75	10	0	<5	6	
209005	60	129	152	<10	25	27/01/2015	Y	27/01/2015	98	167	127	32	0	5	6	2 days of double feeds before fledging
209007	15	161	147	7	40	28/01/2015	Y	28/01/2015	111	170	129	11	0	15	7	
209009	64	139	158	<5	26	28/01/2015	Y	28/01/2015	101	177	118	15	0	15	7	
209010	76	151	159	<5	35	27/01/2015	Y	27/01/2015	105	176	82	14	0	10	6	
209011	30	139	159	7	30	25/01/2015	Y	25/01/2015	98	169	33	10	0	10	4	
209012	95	134	168	<5	14	26/01/2015	Y	26/01/2015	115	177	84	24	0	10	5	
209014	52	157	157	<10	22	27/01/2015	Y	27/01/2015	116	174	68	10	0	5	6	
209015	51	183	142	3	42	29/01/2015	Y	29/01/2015	115	168	109	6	0	10	8	
209017	100	134	168	0	16	26/01/2015	Y	26/01/2015	109	176	54	9	0	10	5	
209018	71	126	157	10	18	26/01/2015	Y	26/01/2015	103	166	85	25	0	10	5	Tick under lower bill
209019	25	160	148	5	38	29/01/2015	Y	29/01/2015	110	169	174	30	0	10	8	
209020	19	164	155	7	43	28/01/2015	Y	28/01/2015	108	175	147	25	0	5	7	
209021	94	133	167	5	8	24/01/2015	Y	24/01/2015	122	175	22	8	0	0	3	

