Report on the 2016 supplementary translocation of fairy prion (titiwainui) chicks from Stephens Island (Takapourewa) to Mana Island

Friends of Mana Island Inc.

April 2016

Report title	Report on the 2016 supplementary translocation of fairy prion (titiwainui) chicks from Stephens Island (Takapourewa) to Mana Island
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Report date	5 April 2016
Report writers	Helen Gummer, Colin Miskelly, Graeme Taylor and Brian Bell
Project manager	Brian Bell, Friends of Mana Island (FOMI) Executive
Type of translocation	Wild to wild translocation Supplementation (the species already exists at the release site)
Species transferred	Fairy prion *Pachyptila turtur* Threat status according to the NZ threat classification series 4 (Robertson et al. 2013): At Risk / Relict
Release site	Mana Island Scientific Reserve
Report reference	This report can be cited as: Gummer, H.; Miskelly, C.; Taylor, G.; Bell, B. 2016. Report on the 2016 supplementary translocation of fairy prion (titiwainui) chicks from Stephens Island (Takapourewa) to Mana Island. Friends of Mana Island Inc.

1. Summary

One-hundred fairy prion (*Pachyptila turtur*) or titiwainui chicks were transferred from Stephens Island (Takapourewa) to Mana Island in a single operation on 17 Jan 2016. This was the second 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, as recommended in Miskelly & Gummer (2013).

A team arrived at the Stephens Island source colony on 13 Jan 2016 to inspect fairy prion burrows in order to obtain 100 chicks suitable to transfer on 17 Jan. A total of 1547 burrows was inspected on 13–15 Jan to find 273 accessible chicks, from which 127 meeting 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 (240 chicks) and 2015 (100 chicks). From this larger pool of chicks, 100 were found to be suitable to transfer on 17 Jan. Chicks were of unknown sex and expected to be no more than 12 days from fledging (wings 145–162 mm; weights >120 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 soya oil (50 chicks) or fish oil (50 chicks), 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 heavier than those for parent-reared chicks on Takapourewa. Weights were in line with those recorded for chicks translocated to Mana Island in 2002–04 that stayed a similar period of time at the release site, and heavier than those recorded for chicks transferred in 2015. Fledglings had wing-lengths longer than their counterparts hand-fed the same diet in 2002–04 even after spending relatively less time at the release site. Fledging wing-lengths were also longer than those recorded in 2015 with chicks spending 2 days longer on Mana Island in 2016. Most chicks fledged on their first night out of the burrow.

Weather conditions were mostly warm, overcast but dry, with light to moderate winds when most chicks fledged, and conditions at sea appeared reasonably favourable for all the new fledglings with the only notable weather being gale-force southerly winds on night of 27 Jan towards the end of the project when most chicks had already left the colony site.

2. Introduction

2.1 Project background

Fairy prion (*Pachyptila turtur*) or titiwainui chicks were translocated from Stephens Island (Takapourewa) 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 (Miskelly & Gummer 2013). 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 Stephens Island, which holds an estimated 1.4 million pairs of fairy prions (Jamieson et al. in press).

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 under supervision by DOC, and with assistance from Te Papa, Ngāti Koata, Ngāti Toa, and funding from OMV New Zealand Ltd. One hundred chicks transferred in January 2015 all fledged successfully.

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 Stephens Island;
- 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 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 & 2016)	Colin Miskelly and Brian Bell
Source colony chick selection and collection (Stephens Island)	13–17 Jan 2016	Graeme Taylor and Lyn Adams (DOC, Wellington), Brian Bell, Jason Christensen (FOMI Executive), Clinton Purches (DOC, Palmerston North), and Lonae Paul and Santana Mackey (Ngāti Koata), assisted by resident DOC staff Polly Hall and Andre de Graaf
Transfer day public relations	17 Jan	Brian Paget
Release site initial preparation	18 Dec	Jeff Hall (DOC, Mana Island) and Dale Shirtliff (FOMI Commitee)
Release site final	14–21 Jan 2016	Helen Gummer, and Team 1: Grant Timlin, Claudia Duncan and Alex

preparation, transfer day and post-transfer chick feeding (Mana Island)		Carroll (FOMI volunteers)
Transfer day and post-transfer chick feeding (Mana Island)	17–24 Jan 2016	Helen Gummer, and Team 2: Gillian Candler, Ros Batcheler and Heather Mackenzie (FOMI volunteers)
Chick feeding (Mana Island)	21–29 Jan 2016	Helen Gummer, and Team 3: Dave Cornick, Anne Graeme and Sue Freitag (FOMI volunteers)
Volunteer catering (Mana Island)	17–24 Jan 2016	Philippa Doig (FOMI volunteer)
Logistics (Mana Island)	As required	Jeff Hall
Boat transport (Mana Island)	As required	Dave Wrightson (DOC) and Eliot Falconer (Knuckle Charters Ltd)
Helicopter transport (Stephens Island)	13 and 17 Jan 2016	Precision Helicopters Ltd
Biosecurity	As required	David Moss (DOC, Wellington)
Health & Safety Plan development	2015	Mana Island: Helen Gummer and Dale Shirtliff (FOMI Committee) Stephens Island: Colin Miskelly (Te Papa) and Helen Gummer

4. Methods

4.1 Selection/collection trip to Stephens Island

A team of seven personnel (refer Section 3. Personnel) travelled to Stephens Island on 13 Jan 2016 for the following objectives:

- To determine availability of fairy prion chicks on Stephens Island for transfer to Mana Island on 17 Jan 2016;
- 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;
- To mark burrows of at least 120 suitable chicks (with bamboo wands marked with plastic tape) to enable easy collection on the transfer day
- To prepare 50 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 Stephens Island).

4.1.1 *Finding and selecting chicks*

Following discussion with the resident DOC rangers on Stephens Island, we focussed the entire search effort on the dam paddock – i.e. the same site where most of the 2002–04 and 2015 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. This season we concentrated the search in the open grassland area on the northern side of the valley and ignored the taupata shrublands where possible. This made relocation of marker poles much easier compared with other seasons. 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). All chicks that were extracted were taken to a central processing area for weighing and measuring. Team members were shown how to measure wing lengths and most birds were pre-screened. Those that were close to or within the daily wing length criteria were measured and weighed by Graeme Taylor for consistency. Other chicks were measured and weighed by Brian Bell. Graeme banded those chicks considered suitable for transfer. A sample of chicks not needed for transfer was banded by Brian Bell for training purposes. Each banded chick suitable for transfer was returned to its burrow, which was marked with a bamboo wand with a flag bearing the band number of the chick. No markers were placed on nests of chicks outside the weight and wing length criteria.

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 13 Jan to 135–155 mm on 15 Jan (the day that we completed searching for chicks).

All 127 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 adding 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 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 obvious 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'. One operator (Graeme Taylor) measured and weighed each chick for consistency.

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 BK117 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. 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 Preparing artificial burrows to accommodate chicks

The same artificial burrow site used for the 2015 fairy prion transfer was re-commissioned (refer Gummer, Miskelly & Bell 2015, for details on burrow design and colony location).

Initial preparations commenced in mid-December 2015 with weed-eating the long grass across the slope, and clearing out trenches leading up to burrow entrances. Personnel arrived on Mana Island by DOC boat on the afternoon of 14 Jan for 2 full days of final preparations before the arrival of chicks (refer Section 3. Personnel).

All 100 numbered artificial burrows were checked to ensure they were safe to accommodate this year's transferred chicks. Plastic mesh blockade gates were installed at every burrow entrance to ensure chicks could not exit burrows. Deep 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).

4.2.2 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.

The sound system was checked at night to ensure it was operating at full capacity before the fairy prion chicks arrived.

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.

In line with recommendations made following the 2015 transfer, chicks were given their first meal of sardines blended with oil and isotonic fluids—up to 10 ml of puree each—to compensate for any dehydration and weight loss that occurred during transfer. They were then carried to numbered burrows in individual carry boxes.

One burrow known to be recently used by adult prions (burrow FP62) was left unoccupied and open, i.e. without blockades. One chick was placed in AB17, an artificial box installed at a natural fairy prion site adjacent to FP1, which had shown little evidence of being visited by prions during the current breeding season.

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 translocation. This year we aimed for a mean fledging weight slightly heavier than last year (at least 5 g heavier than the 109 g recorded in 2015). As a minimum target, chick fledging weights needed to fall within known fledging weight ranges recorded for the species on Stephens Island (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). Pams® brand of sardines was used again this year.

In line with recommendations to improve the diet made following last year's transfer, we replaced the plant-based soya oil in the tinned sardine diet with commercially produced fish oil for half the birds. Nutralife® Omega3 Fish Oil liquid (with added Vitamin D) has been used with four other seabird species nationally. Whilst we had a proven diet and methodology that produces good results with fairy prions, there was still potential to improve it. So that this could be done in a way allowing robust comparison with the existing regime, we suggested a 50:50 trial to give us immediate information on any differences in the birds at fledging, and the potential to compare recovery rates in 3-6 years' time.

Therefore, the two recipes used in 2016 were:

1) 1 x 106 g tin sardines including soya oil : 50 ml water : one-third Vita-zu tablet (50 chicks)
2) As above but with all soya oil tipped off and the addition of 20 ml fish oil per tin (50 chicks)

Flexible food-grade vinyl tubing was cut to 85 mm lengths to make crop-tubes, 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 10 ml of sardine puree was delivered to each chick on the first feeding (transfer) day. After the second feeding day, chicks were fed at approx. the same time each day. Volumes increased daily by 10 ml, if chicks were keen, to around 30 ml/day.

All fish oil diet chicks were fed in the morning (burrows AB17, then FP1–24 and burrows FP50–75 with FP62 unoccupied), and all soya oil birds were fed after that (burrows FP25–49 and FP76–100).

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 familiarise chicks 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. Other cues for blockade removal were clear signs of meal rejection, together with decreasing chick body weight and/or wing growth rate.

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. 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 petrel 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

Due to time limitations, the waterproofing quality of chicks' feathers was not checked this year, i.e. no chicks were sprayed with fresh water after they had shed most of their down, a procedure often carried out on other seabird species translocations to identify birds with poorer plumage condition.

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 Stephens Island

5.1.1 Finding chicks

Locating 127 chicks that met transfer criteria took eight people searching for a total of 10.6 hours (Graeme Taylor spent most of this time measuring and banding chicks brought to him by other team members and Brian Bell also spent more than half his time processing chicks not suitable for transfer). This equates to approximately 80 person-hours of searching. A total of 1547 burrows was inspected, of which 835 were too long to ascertain their contents, at least 273 contained live prion chicks, another 14 burrows contained chicks which could not be extracted, 14 contained dead chicks, 21 had failed eggs, and 350 were empty. Other species found in the burrows included tuatara (15 burrows), geckos (three burrows), and skinks (21 burrows). No bird species other than fairy prions were encountered.

5.1.2 Selecting chicks

Of the 273 fairy prion chicks checked, 198 chicks were banded (Appendix 1). The majority of chicks not banded were considered too young for transfer and a smaller proportion too advanced. However the main reason some chicks were not banded was we ran out of metal bands! We stopped searching as soon as we had marked 127 healthy chicks deemed suitable for transfer.

5.1.3 *Collecting and transferring chicks*

We found 125 of the 127 marked chicks on the morning of 17 Jan. One banded chick was found dead in the nest and the other nest was empty.

The 25 marked birds that were not selected were mainly considered unsuitable for transfer because: 11 weighed less than 120 g, nine were only just above 120 g (some also had scruffy looking plumage), four had wings longer than 162 mm, and one had muddy plumage.

Weights and wing-lengths of each translocated chick on the morning of transfer are recorded in Appendix 2. The 100 chicks weighed a mean 144 ± 15 g (range 120–200 g) following collection from natal burrows on Stephens Island and had wings measuring 153 ± 5 mm (range 145–162 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. There were no bio-security concerns on first inspection of boxes. Processing and hand-feeding of chicks commenced around 1430 hrs, and the last chicks were housed in burrows by 1930 hrs.

Chicks were scheduled to receive their second artificial meal the following day. Prior to feeding, all 100 chicks were weighed and found to have lost an average of 23 ± 9 g (range 4–47 g) of body weight within a 23–33-hour period following weighing on Stephens Island after collection from natal burrows (Appendix 2). (Weights were recorded between 0800 hrs and 1145 hrs on Stephens Island on 17 Jan and between 0930 hrs and 1700 hrs on 18 Jan when chicks were removed from artificial burrows for hand-feeding).

5.2 Hand-feeding chicks

Sardines from 157 tins blended with 50* Mazuri® Vita-zu™ tablets (and 1.5 litres of Nutra-life Fish Oil) were prepared for 12 chick feeding days. A total volume of 15,859 ml of sardine puree was fed to the 100 chicks, with individuals receiving 3–12 meals and consuming on average 159 ± 64 ml of food (range 15–277 ml) during their time on Mana Island.

No issues were encountered with hand-feeding chicks, although one chick was observed to have a rattle on its chest on the second feeding day and it is not known whether this was caused by the hand-feeding process (refer Section 5.6 Chick health).

Feeding some of the lighter chicks twice a day was the best way to get individuals to accept larger volumes of food, especially if they were rejecting food at the first feed of the day, to keep their weights within the target fledging weight range. Five chicks were given double feeds as follows: three chicks on 3 subsequent days and two chicks on 4 subsequent days. Two of these chicks were ones observed with health issues on arrival on Mana Island (refer Section 5.6 Chick health).

Chicks fledged after final meal sizes ranging from 0–28 ml.

*NB Fifty tablets only were sourced for this project; vitamins were not added in the last day or two of feeding.

5.3 Fledging behaviour

The first four blockades were removed on 19 Jan after 2 nights in place. Thereafter, blockades were removed on a daily basis (five on 20 Jan, six on 21 Jan, nine on 22 Jan, 15 on both 23 and 24 Jan, 20 on 25 Jan, and 16 on 26 Jan) with the last 10 taken away on 28 Jan after 12 nights in place. No blockades were removed on 27 Jan as a precaution, as gale-force winds were predicted for the night.

Eighty-eight chicks came out of their burrows on their first night after the blockades were removed. The majority of chicks (81) fledged on their first night out of the burrow (Appendix 2). Stick fence status at burrow entrances indicated 17 chicks spent one additional night on the surface before fledging. Two chicks appeared to

have visited the surface for 2 nights before departing Mana Island.

Only two chicks were found in burrows other than their own. The chick from burrow FP56 had dug under the burrow dividing wall and was found in the neighbouring chamber of burrow FP55 with the resident chick. The chick from burrow FP57 was found on one morning in nearby, unoccupied burrow FP62. No chicks were found in nearby old artificial burrows AB1–30 (i.e. the nearest burrows 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 2.

The first chick departed the colony on the night of 19 Jan, and the last 10 chicks fledged on the night of 28 Jan. They had spent a mean of 8 ± 2 days (range 3–12 days) on Mana Island including transfer day, *or for comparison with 2002–2004 data, 7 days (range 2–11) not including the transfer day*.

Chicks fledged at a mean base weight of 113 ± 7 g (n=100; range 101–128 g) and with wings measuring a mean of 174 ± 5 mm (n=100; range 162–183 mm) on the morning before they departed. From a rough assessment of wing measurements of chicks approaching fledging, wing growth was only complete by the time of departure for a single chick (same measurements for 3 days), and <1 mm/day in one other chick. The growth rate was observed to slow from approx. 3 mm/day to approx. 1 mm/day in 10 cases, and to approx. 2 mm/day in around 47 cases.

Over half the chicks (55) departed with <5% body surface down cover (usually just wisps around the ruff of the neck if any left). Around 33 chicks were recorded as departing with 10–15% down cover. The 12 downiest chicks had an estimated 20–40% body surface cover when they departed (ruff, flanks and lower belly). Blockade gate removal for the downiest of these was deemed necessary because wing growth rate was observed to be slowing (to approx. 1 mm/day) and the chick was declining food and consequently losing weight.

5.5 Comparing fish oil and soya oil diets

Fifty fish oil fed chicks lost on average 23 ± 9 g between pre-transfer weighing on Stephens Island on 17 Jan and first weighing on Mana Island on 18 Jan, i.e. after the first meal on Mana; and, 50 soya oil fed chicks lost on average 24 ± 8 g over the same period. However, all the fish oil fed chicks were processed first on 18 Jan (morning) and the soya oil chicks were weighed in the afternoon which could account for the extra 1 g difference. It is likely there is no statistically significant difference between these weights.

Chicks fed the fish oil diet lost a mean 0.8 g per day after 18 Jan, significantly less than chicks fed a soya oil diet (mean of 1.4 g per day; T-test p = 0.0076). Other data comparisons between chicks fed the two different diets are found in Table 1.

Table 1: Comparison of transfer, fledging and hand-feeding data between two groups of translocated fairy prion chicks fed with diets containing two different oils in 2016.

	Fish oil fed chicks (n=50)	Soya oil fed chicks (n=50)
Transfer weight	144 ± 14 g (range 127–200 g)	144 ± 16 g (range 120–192 g)

Fledging weight	115 ± 7 g (range 101–128 g)	110 ± 6 g (range 102–128 g)
Mean daily weight loss	0.8 ± 1.0 g (range 0.8–4.0 g)	1.4 ± 1.1 g (range 0.0–4.5 g)
Transfer wing-length	153 ± 5 mm (range 145–162 mm)	154 ± 5 mm (range 145–162 mm)
Fledging wing-length	174 ± 4 mm (range 164–183 mm)	173 ± 5 mm (range 162–182 mm)
Total volume of food accepted	161 ± 63 ml (range 15–277 ml)	156 ± 65 ml (range 22–275 ml)
Last meal size	11 ± 5 ml (range 0–25 mm)	15 ± 6 ml (range 5–28 mm)
Total days at release site (includes transfer day)	8.7 ± 2 days (range 3–12 days)	8.0 ± 2 days (range 4–12 days)

5.6 Chick health

5.6.1 Condition of chicks on arrival

All chicks were considered to be generally in good condition on arrival on Mana Island, with the exception of those listed below. One or two ticks were observed on at least 15 chicks, mostly under or at the base of the lower bill, but these all dropped off naturally after a few days. Only one chick (D-210076) had particularly mucky plumage and was missing a central tail feather (likely sourced from a muddy natal burrow).

5.6.2 Chick with potential respiratory ailment (D-210011)

One chick (burrow FP74) was found on the day after transfer to have a slight, deep rattle on the chest when breathing. This had not been observed during feeding on the transfer day but may have been missed; therefore, it was unclear whether the bird arrived with this condition, or if the symptom was a result of food aspiration during the first or second hand-feeding event. The Nest, Wellington Zoo provided veterinary advice on how to monitor the situation. Possible scenarios included the following: the chick may have been transferred with a respiratory condition such as aspergillosis (fungal) and symptoms may have been exacerbated by the stress at transfer; or a bacterial infection may have started as a result of aspirating food (Megan Jolly, pers. comm. Jan 2016). In either case, the bird would deteriorate in health rapidly over 2 days, by which time we could send the chick to The Nest on the next scheduled boat.

The bird remained bright, alert and responsive, and took food readily during its whole stay on Mana Island (7 days, including transfer day), so there was no need to send it off for treatment. The chick was deliberately and cautiously fed slightly less than it perhaps required, avoiding overflows or regurgitations.

5.6.3 Chick with weak foot (D-210019)

One chick (burrow FP37) was found on arrival on Mana Island to have a slightly weak right foot which it tended to hold with toes curled up. The upper surface of these toes was slightly grazed (not fresh wounds but tiny old scabs). The chick had full movement in the leg, foot and toes, but was reluctant to spread its foot. However, it was deemed to be a mild injury (possibly a sprain) that would likely benefit from exercise at sea once the bird fledged.

5.6.4 Chick with sealed eye (fused eyelid) (D-210046)

One chick (burrow FP86) was found on arrival on Mana Island to have a relatively high parasite loading (mites crawling out of feathers) and was the hungriest chick noted (readily took 20 ml of food on the transfer day, and made begging vocalisations most days). Of greater concern still was the fact that its left eye was sealed shut. Daily flushing with saline and manipulation of the eyelids (up to 3 times/day) resulted in a tiny gap opening up in one corner (19 Jan), then the other corner (21 Jan), and then the fused eyelid finally broke apart in the middle (22 Jan), probably due to tension of the open eyelid on either side, without causing an open wound. Usually, sealed eyes can be opened over a 1–2 day period, but the process took 6 days to complete. Regular flushing continued until the eye appeared normal (without any weeping) by 24 Jan. The chick fledged on 26 Jan, apparently with vision in both eyes.

5.6.5 Temperature control

Digging behaviour was noted to alert us to any chicks that might be stressed in blockaded burrows and, based on last year's observations, any that might be over-heating. However, digging at the front, near the entrance pipe, was not seen in any burrows. As seen last year, birds seemed to be making deeper scrapes in the beach gravel in back corners and this was attributed to individuals being restless and/or birds perhaps wanting to get a little cooler down in the cold gravel. Only 16 chicks showed signs of digging in their burrows, and no other signs of heat stress were observed in these chicks. The digging behaviour did not raise concern unless birds looked as if they were going to burrow under the division into the neighbouring chamber, in which case holes were blocked with large stones.

6. Other observations

For the period fairy prion chicks were in residence on Mana Island, the weather conditions were mainly overcast, warm and dry with light to moderate winds. The worst weather was recorded for the nights of 18 Jan (heavy rain overnight) and 27 Jan (gale-force southerlies). All prion chicks were blockaded into burrows on 18 Jan, and were unaffected by the heavy rain. Prion chicks remaining at the site on 27 Jan were constrained from exiting burrows that night, with the exception of four chicks that had already emerged on the previous night and were very ready to depart; blockading these latter chicks in might have been too stressful for them.

Moon phases were as follows: first quarter moon 17 Jan and full moon 24 Jan (all chicks fledged between first and last quarter, with many in the nights immediately around the time of full moon).

7. Consultation and community relations

Planning for the 2016 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 Santana Mackey assisted with capture of the birds on Stephens Island, and accompanied them across Cook Strait to Mana Island.

The fairy prions were welcomed onto Mana Island by a crowd, including FOMI members, and invited guests. All assembled near to the colony site to meet the

helicopter.

The project was also reported on the following blogsite:

- http://exploreDiscovernature.blogspot.co.nz/2016/01/sardine-smoothies-again-feeding.html

8. Costs

Initial funding for the first two years from our sponsor OMV was confirmed at $20,000 with a further $25,000 indicated and subsequently confirmed making a total of $45,000 (excluding GST). Budgets for the project over 2013 to 2016 were prepared on the basis of experience with previous translocations. Budgeted expenses (excluding GST) for the full programme amounted to $48,953 including a contingency of $5,740. Actual expenses amounted to $43,858 making a surplus of $1,142 (Table 2).

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 this proved unnecessary and was dropped for the final year.

Table 2: Finances for fairy prion translocation Stephens Island (Takapourewa) to Mana Island 2013–2016

Description	Budget v Actual									
	2013		2014		2015		2016		Total	
	Budget	Actual	Budget	Actual	Budget	Actual	Budget	Actual	Budget	Actual
Receipts	10,000	10,000	10,000	10,000	25,000	25,000	-	-	45,000	45,000
Payments										
Helicopter hire	-	-	-	-	6,957	7,125	7,300	7,125	14,257	14,250
Equipment	4,497	1,258	905	1,081	-	178	450	485	5,852	5,551
Burrow box making	50	-	2,500	1,651	-	-	200	306	2,750	1,957
Contract services	560	560	2,240	2,933	5,810	6,125	7,700	7,455	16,310	17,073
Boat charter	-	-	1,000	-	2,000	1,800	2,000	900	5,000	2,700
Airfares (Ngati Koata)	-	-	-	-	-	-	440	431	440	431
Food	-	-	320	-	2,240	2,727	1,800	1,718	4,360	4,445
Contingencies (10%)	649	-	1,175	-	3,916	-	-	-	5,740	-
TOTAL PAYMENTS	5,756	1,818	8,140	5,665	20,923	17,955	19,890	18,420	48,953	43,858
NET SURPLUS	4,245	8,182	1,860	4,335	4,077	7,045	- 19,890	- 18,420	- 3,953	1,142

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

Finances (GST

Descrip	Budget v 2013 -			
	Bu	Act	Vari	
Helicopter	6	7	1	
Equip	5	2	- 2	Significant savings made by borrowing of equipment from Matiu/Somes
Artificial burrow box	2	1	- 8	Anticipated purchase of tools did not
Contract	8	9	9	Increase in time planning and
Boat	3	1	- 1	A charter in 2014 did not take place saving
Airfares (Ngati	-	4	4	Ngati Koata were not expected to require airfares
F	2	1	- 8	Significant savings made per
Contingencies	5	-	- 5	Not
TOTAL	34	25	- 9	

9. Discussion and recommendations

9.1 Finding and collecting chicks on Stephens Island

Locating 127 suitable chicks took just over 1.5 full days (starting on the afternoon of 13 Jan), though we were assisted in achieving this by having the fulltime assistance of the two resident DOC staff. Fewer prion chicks were checked this year (273) compared to last year (392) to find enough suitable ones for transfer, as chicks were generally less advanced in their development this year than last year because the transfer date had been brought forward by 5 days. This strategy successfully decreased the search effort required to find suitable chicks (80 person-hours of searching in 2016 compared to 115.5 person-hours in 2015), which helped to reduce the impacts on the source colony because overall number of burrows requiring inspection was less than in 2015 (1547 burrows inspected in 2016 compared to 1655 in 2015).

Recommendation: In any future operations sourcing fairy prion chicks from Stephens Island, the collecting trip should be scheduled to allow transfer on or around 17 Jan, while retaining the same wing-length (142–162 mm) and weight (≥120 g) criteria for chick selection.

9.2 Chick condition at transfer

Chicks were all noted to be in good condition on arrival on Mana Island, with the exception of two birds. One chick had a weak foot and showed reluctance to open up the toes, however the foot/toes were not considered to be broken, i.e. condition more likely associated with a sprain. The other chick had a notable number of external parasites and a sealed eye (see Section 9.6: Chick Health). One other bird had muddy plumage and a missing central tail feather.

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 required to a lesser degree than last year because chick weight loss was slowed more effectively this year (feeding on transfer day, and faster subsequent increases in meal size—10 ml increments).

Analysis of fledging data of chicks fed on fish oil versus those fed soya oil indicates that the fish oil was beneficial in obtaining heavier fledging weights and therefore longer fledging wings (Table 1).

Recommendation: In any future operations, we recommend translocated fairy prions be fed the standard diet of tinned Canadian sardines (89% fish in 11% soya oil), blended with fresh (boiled) water, Nutralife® Omega 3 Fish Oil (with Vitamin D), and Mazuri® Vita-zu™ seabird vitamin/mineral supplement (product code: Small 5M25). The recipe to follow is 1 x 106 g tin sardines (with soya oil tipped off) : 20 ml fish oil liquid : 50 ml water : one-third vitamin tablet.

Recommendation: In any future operations, give all transferred chicks 10 ml of food (diet as above) on arrival at the release site to get a head start on food introduction and help slow the rate of chick body weight loss. Water may be replaced with isotonic fluids for this transfer day meal although this is not considered essential (Baukje Lenting, Senior Veterinarian, The Nest, pers. comm. Feb 2016). Meals on the second feeding day (i.e. day after transfer) can proceed at up to 20 ml, depending on how close they are considered to be to fledging, and up to 30 ml on the third feeding day.

Recommendation: Double-feeding of chicks (i.e. two feeds per day) is an effective way to get some lighter chicks to accept more food on a daily basis and should be considered in any future transfers to marginally improve fledging weights. However, careful forward planning is required to ensure that these chicks are fed first and last in the day.

9.4 Fledging behaviour

The majority of chicks (88% 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 (compares to 90% of the 2015 translocated chicks). Based on results from translocations of other species, we leant towards blocking fairy prions in longer than in the transfers 12+ 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 81% of the 2016 translocated cohort departed on their first night out of the burrow should not influence return rates to Mana Island (compares to 88% in 2015). Conditions at night were largely clear when most chicks fledged, with the first quarter moon.

9.5 Fledging condition

The 2016 chick fledging weights (mean 113 g; n=100) once again exceeded those recorded for parent-reared chicks on Stephens Island in 2004 (mean 106 g; n=30; Miskelly & Gummer, 2013). In addition, the mean fledging weight was greater this year than for the 100 chicks translocated in 2015 (mean 109 g), even though the 2016 mean transfer weight was 5 g less than the 2015 mean. This improved fledging weight can likely be attributed to several things. Firstly, chicks were fed on arrival on the transfer day in 2016. Secondly, meal sizes were increased in larger increments in 2016. Finally, fish oil added to the diet of half of all chicks in 2016 may have significantly improved the condition (weight) of half the chicks. NB This year, fewer chicks were fed twice per day for a few days in a row than last year (five chicks in 2016; 14 in 2015), so extra feeding was not one of the main factors contributing to increased fledging weights in 2016. Unlike last year, some of the chicks made weight gains while on Mana Island this year.

Once again, it is difficult to meaningfully compare fledging weights of the 100 chicks translocated in 2016 with all those translocated in 2002–04 that were fed the same diet (mean 119.5 g; n=204; Miskelly et al., 2009) because again 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 12+ 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. Our 2016 mean of 113 g is in line with these results. 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.

The mean fledging wing-lengths of 100 translocated chicks in 2016 (174 mm; 162–183 mm) exceeded those recorded for the 2015 translocated chicks (171 mm; n=83) as well as the fledging wing-lengths of chicks translocated 12+ years ago (169 mm in 2002, n=20; 170 mm in 2003, n=84; 168 mm in 2004, n=100; Miskelly & Gummer, 2004). Achieving a greater fledging wing length is again attributed to a more tailored blockade removal regime, based largely on down coverage and not solely on wing measurements. It may also in part be attributed to half the birds receiving fish oil in the diet, which may generally improve the condition of chicks over those given soya oil. Heavier chicks have comparatively higher wing-loadings, so chicks will have had to grow longer wings before fledging. (Chicks were transferred with the same mean wing-length this year as last year, yet chicks stayed on average 2 days longer at the release site in 2016.)

The slowing of wing growth rate was observed in over half the chicks this year, with many more chicks than last year noted as having wing growth slowing to 1 or 2 mm/day, but a similar number (no more than two) showing signs of growth completion.

Recommendation: Prolonging the blockading period, until most of a chick's down cover is shed, is a useful way to allow chick plumage to develop as far as possible (potentially resulting in chicks having to 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. In future translocations, if any chicks lose down prematurely e.g. wet weather conditions, 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.

9.6 Chick health

The three different chicks with health issues (sealed/reopened eye; weak foot; rattle on chest) did not require veterinary treatment after transfer. None of the conditions appeared to compromise the birds' daily well-being, movement or behaviour, especially once the sealed eye of one bird was open again. For this reason, all three chicks were allowed to fledge normally from the release site. Moving chicks into a captive environment for veterinary examination and treatment carries risk as fairy prions do not cope well in the veterinary hospital environment (Lisa Argilla, Senior Veterinarian, The Nest, pers. comm. Jan 2015).

9.7 Burrow site

Day-time temperatures on the Mana Island cliff-top in Jan 2016 were not nearly as hot as those recorded for 2015 and there was usually a breeze at the colony site on most days when chicks were in residence. The fact that we only observed digging behaviour at 16 burrows this year (relatively cooler weather), compared to two-thirds of the burrows in 2015 (hotter conditions), strengthens the case that this behaviour, may be a result of chicks trying to get to a cooler space in the burrow. However, scrapes prepared for the birds this year were deliberately made a little deeper than last year in anticipation that this behaviour may occur, which may be why fewer birds needed to dig.

Recommendation: Add more thick turfs to the tops of burrows where sand-bags were needed this season, to improve insulation. Site/burrow maintenance needs to ideally occur in late March or early April at the latest each year.

10. Acknowledgements

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Appendices

Appendix 1	Data for 198 fairy prion chicks banded on Stephens Island in January 2016
Appendix 2	Transfer and fledging data for 100 fairy prions transferred to Mana Island in 2016

Appendix 1: Data for 198 fairy prion chicks banded on Stephens Island in January 2016

Band (D-)	First capture date	First capture wing (mm)	First capture weight (g)	Transferred on 17 Jan Yes/No	Reason not transferred on 17 Jan
D209901	13 Jan	156	150	No	Too advanced
D209902	13 Jan	152	147	No	Too advanced
D209903	13 Jan	154	145	No	Too advanced
D209904	13 Jan	152	145	No	Too advanced
D209905	13 Jan	154	139	No	Too advanced
D209906	13 Jan	161	140	No	Too advanced
D209907	13 Jan	123	135	No	Too young
D209908	13 Jan	166	135	No	Too advanced
D209909	13 Jan	107	105	No	Too young
D209910	14 Jan	106	128	No	Too young
D209911	14 Jan	126	144	No	Too young
D209911	14 Jan	114	120	No	Too young
D209912	14 Jan	81	115	No	Too young
D209913	14 Jan	156	179	No	Too advanced
D209914	14 Jan	130	173	No	Too young
D209915	14 Jan	157	155	No	Too advanced
D209916	14 Jan	80	108	No	Too young
D209917	14 Jan	120	123	No	Too young
D209918	14 Jan	85	110	No	Too young
D209919	14 Jan	159	140	No	Too advanced
D209920	14 Jan	92	118	No	Too young
D209921	14 Jan	121	170	No	Too young
D209922	14 Jan	124	135	No	Too young

D209923	14 Jan	126	105	No	Too young
D209924	14 Jan	157	145	No	Too advanced
D209925	14 Jan	110	115	No	Too young
D209926	14 Jan	109	115	No	Too young
D209927	14 Jan	114	110	No	Too young
D209928	14 Jan	126	160	No	Too young
D209929	14 Jan	109	115	No	Too young
D209930	14 Jan	120	110	No	Too young
D209931	14 Jan	128	175	No	Too young
D209932	14 Jan	110	125	No	Too young
D209933	14 Jan	78	70	No	Too young
D209934	14 Jan	118	100	No	Too young
D209935	14 Jan	170	165	No	Too advanced
D209936	14 Jan	96	160	No	Too young
D209937	14 Jan	162	150	No	Too advanced
D209938	14 Jan	156	155	No	Too advanced
D209939	14 Jan	129	135	No	Too young
D209940	14 Jan	128	160	No	Too young
D209941	14 Jan	120	115	No	Too young
D209942	14 Jan	156	140	No	Too advanced
D209943	14 Jan	115	105	No	Too young
D209944	14 Jan	121	170	No	Too young
D209945	14 Jan	157	140	No	Too advanced
D209946	14 Jan	147	107	No	Too light
D209947	14 Jan	120	120	No	Too young
D209948	14 Jan	155	135	No	Too advanced
D209949	14 Jan	127	130	No	Too young

D209950	14 Jan	90	115	No	Too young
D209951	14 Jan	154	135	No	Too advanced
D209952	14 Jan	122	75	No	Too young
D209953	14 Jan	115	115	No	Too young
D209954	14 Jan	113	100	No	Too young
D209955	14 Jan	111	155	No	Too young
D209956	14 Jan	115	90	No	Too young
D209957	14 Jan	86	145	No	Too young
D209958	14 Jan	122	115	No	Too young
D209959	14 Jan	125	115	No	Too young
D209960	14 Jan	157	160	No	Too advanced
D209961	14 Jan	105	120	No	Too young
D209962	14 Jan	105	115	No	Too young
D209963	14 Jan	129	155	No	Too young
D209964	14 Jan	157	105	No	Too advanced
D209965	14 Jan	155	120	No	Too advanced
D209966	14 Jan	124	155	No	Too young
D209967	14 Jan	105	125	No	Too young
D209968	14 Jan	125	125	No	Too young
D209969	14 Jan	170	145	No	Too advanced
D209970	14 Jan	130	115	No	Too young
D209971	14 Jan	148	148	Yes	
D209972	14 Jan	132	118	No	Light (120 g)
D209973	14 Jan	137	148	Yes	
D209974	14 Jan	142	153	No	Too light (<120 g)
D209975	14 Jan	140	138	Yes	
D209976	14 Jan	138	163	Yes	

D209977	14 Jan	144	123	Yes	
D209978	14 Jan	135	136	Yes	
D209979	14 Jan	144	171	Yes	
D209980	14 Jan	141	143	Yes	
D209981	14 Jan	135	131	Yes	
D209982	14 Jan	149	151	Yes	
D209983	14 Jan	148	130	Yes	
D209984	14 Jan	135	130	Yes	
D209985	14 Jan	139	172	Yes	
D209986	15 Jan	145	153	Yes	
D209987	15 Jan	154	151	Yes	
D209988	15 Jan	150	149	Yes	
D209989	15 Jan	143	158	Yes	
D209990	15 Jan	139	158	Yes	
D209991	15 Jan	135	123	No	Light (120 g)
D209992	15 Jan	146	146	Yes	
D209993	15 Jan	148	158	Yes	
D209994	15 Jan	139	153	Yes	
D209995	15 Jan	145	158	Yes	
D209996	15 Jan	145	168	Yes	
D209997	15 Jan	145	155	Yes	
D209998	15 Jan	149	159	Yes	
D209999	15 Jan	153	148	Yes	
D210000	15 Jan	145	130	No	Too light (<120 g)
D210001	13 Jan	133	129	No	Too light (<120 g)
D210002	13 Jan	138	140	Yes	
D210003	13 Jan	133	155	Yes	

D210004	13 Jan	137	167	Yes	
D210005	13 Jan	132	155	Yes	
D210006	13 Jan	136	148	Yes	
D210007	13 Jan	133	156	Yes	
D210008	13 Jan	132	161	Yes	
D210009	13 Jan	145	157	Yes	
D210010	13 Jan	140	151	Yes	
D210011	13 Jan	144	130	Yes	
D210012	13 Jan	134	164	No	Light (122 g)
D210013	13 Jan	137	147	Yes	
D210014	13 Jan	149	136	Yes	
D210015	13 Jan	137	125	Yes	
D210016	13 Jan	134	137	Yes	
D210017	13 Jan	128	177	Yes	
D210018	13 Jan	133	167	Yes	
D210019	13 Jan	131	125	Yes	
D210020	13 Jan	132	145	Yes	
D210021	13 Jan	138	117	Yes	
D210022	13 Jan	146	139	Yes	
D210023	13 Jan	147	148	Yes	
D210024	13 Jan	140	145	No	Missing or deceased
D210025	13 Jan	132	137	Yes	
D210026	13 Jan	135	135	No	Unknown
D210027	13 Jan	148	138	Yes	
D210028	13 Jan	141	140	Yes	
D210029	13 Jan	143	140	Yes	
D210030	13 Jan	135	135	No	Too light (<120 g)

D210031	13 Jan	140	140	Yes	
D210032	13 Jan	133	145	Yes	
D210033	13 Jan	146	165	Yes	
D210034	13 Jan	134	143	Yes	
D210035	13 Jan	145	125	Yes	
D210036	14 Jan	142	112	Yes	
D210037	14 Jan	146	185	No	Advanced (161 mm) and light (125 g)
D210038	14 Jan	151	116	No	Advanced (162 mm) and light (122 g)
D210039	14 Jan	144	152	Yes	
D210040	14 Jan	150	149	Yes	
D210041	14 Jan	132	135	Yes	
D210042	14 Jan	150	150	No	Too advanced
D210043	14 Jan	141	147	Yes	
D210044	14 Jan	145	165	Yes	
D210045	14 Jan	139	138	Yes	
D210046	14 Jan	135	150	Yes	
D210047	14 Jan	147	135	No	Advanced (157 mm) and light (121 g)
D210051	14 Jan	152	131	No	Too light (<120 g)
D210052	14 Jan	147	160	Yes	
D210053	14 Jan	140	155	No	Light (120 g)
D210054	14 Jan	146	155	Yes	
D210055	14 Jan	146	165	Yes	
D210056	14 Jan	149	189	Yes	
D210057	14 Jan	133	137	Yes	
D210058	14 Jan	133	151	Yes	
D210059	14 Jan	133	170	Yes	

D210060	14 Jan	145	125	Yes	
D210061	14 Jan	145	165	Yes	
D210062	14 Jan	152	160	No	Too advanced
D210063	14 Jan	143	117	Yes	
D210064	14 Jan	133	165	No	Missing or deceased
D210065	14 Jan	141	175	Yes	
D210066	14 Jan	134	145	Yes	
D210067	14 Jan	150	152	No	Advanced (161 mm) and light (122 g)
D210068	14 Jan	140	115	No	Too light (<120 g)
D210069	14 Jan	135	158	Yes	
D210070	14 Jan	149	145	Yes	
D210071	14 Jan	133	115	No	Too light (<120 g)
D210072	14 Jan	133	134	No	Too light (<120 g)
D210073	14 Jan	146	152	Yes	
D210074	14 Jan	144	165	Yes	
D210075	14 Jan	146	126	Yes	
D210076	14 Jan	147	115	Yes	
D210077	14 Jan	134	174	Yes	
D210078	14 Jan	147	153	No	Too light (<120 g)
D210079	14 Jan	134	152	Yes	
D210080	14 Jan	151	157	Yes	
D210081	14 Jan	143	145	No	Too light (<120 g)
D210082	14 Jan	140	123	Yes	
D210083	14 Jan	141	165	Yes	
D210084	14 Jan	152	159	No	Too advanced
D210085	14 Jan	151	163	Yes	
D210086	14 Jan	153	141	No	Too advanced

D210087	14 Jan	133	135	Yes	
D210088	14 Jan	139	143	Yes	
D210089	14 Jan	145	127	Yes	
D210090	14 Jan	137	157	Yes	
D210091	14 Jan	138	122	Yes	
D210092	14 Jan	152	137	Yes	
D210093	14 Jan	145	172	Yes	
D210094	14 Jan	139	142	Yes	
D210095	14 Jan	150	132	Yes	
D210096	14 Jan	143	159	Yes	
D210097	14 Jan	150	152	No	Muddy plumage
D210098	14 Jan	132	117	No	Too light (<120 g)
D210099	14 Jan	141	152	Yes	
D210100	14 Jan	150	155	Yes	

Appendix 2: Transfer and fledging data for 100 fairy prions transferred to Mana Island in 2016

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

Band (D-)	Mana I. burrow no.	Transfer weight (g)	Transfer wing (mm)	Soya or fish oil diet	First meal on transfer day (ml)	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 fledge (% body surface)	Total days on Mana I.	Comments
209971	5	165	158	Fish	10	27	22/01/2016	N	24/01/2016	123	176	110	5	0	5	8	
209973	1	132	150	Fish	7	13	26/01/2016	Y	26/01/2016	108	176	194	13	0	10	10	
209975	30	140	151	Soya	8	23	25/01/2016	Y	25/01/2016	107	174	212	20	0	15	9	
209976	14	145	149	Fish	8	25	23/01/2016	Y	24/01/2016	115	170	164	15	1	<5	8	
209977	90	145	155	Soya	10	26	28/01/2016	Y	28/01/2016	106	182	220	5	0	10	12	
209978	31	145	147	Soya	7	25	26/01/2016	Y	26/01/2016	104	174	175	10	0	40	10	Blockade removed as light in weight and wing slowing in growth
209979	66	133	153	Fish	10	6	22/01/2016	N	25/01/2016	127	178	178	12	0	5	9	Tick under bill
209980	10	140	151	Fish	7	25	28/01/2016	Y	28/01/2016	118	179	241	15	0	10	12	
209981	88	150	147	Soya	6	31	25/01/2016	Y	25/01/2016	111	172	196	15	0	<5	9	Found in tunnel for 6 days following arrival
209982	4	145	158	Fish	7	22	23/01/2016	Y	23/01/2016	117	171	141	19	0	5	7	
209983	45	135	157	Soya	10	21	25/01/2016	Y	25/01/2016	114	175	225	20	0	20	9	
209984	38	129	146	Soya	8	25	24/01/2016	N	25/01/2016	104	169	217	12	0	<5	9	3 days double feeds (am and pm). Tick under bill
209985	52	145	147	Fish	10	11	24/01/2016	Y	24/01/2016	120	171	117	15	0	<10	8	
209986	56	132	153	Fish	8	17	24/01/2016	Y	24/01/2016	111	174	174	14	0	5	8	
209987	63	130	162	Fish	7	14	20/01/2016	N	22/01/2016	106	174	76	10	0	10	6	

209988	42	152	157	Soya	5	32	19/01/2016	N	21/01/2016	105	167	47	7	1	5	5	Tick under foot
209989	43	153	157	Soya	10	28	26/01/2016	Y	26/01/2016	109	177	199	15	0	30	10	
209990	40	120	146	Soya	10	16	23/01/2016	N	24/01/2016	104	165	199	15	0	5	8	3 days double feeds (am and pm). Ticks under bill
209992	67	147	153	Fish	5	28	28/01/2016	Y	28/01/2016	107	179	198	8	0	20	12	Tick under bill
209993	21	149	156	Fish	6	30	24/01/2016	Y	26/01/2016	117	178	193	10	2	<5	10	
209994	15	138	145	Fish	5	19	26/01/2016	Y	28/01/2016	124	176	277	12	0	<10	12	
209995	85	177	155	Soya	2	32	22/01/2016	Y	22/01/2016	128	168	64	10	0	20	6	Ticks under bill
209996	2	135	151	Fish	7	12	26/01/2016	Y	26/01/2016	125	177	222	10	0	20	10	Ticks present on arrival
209997	55	140	154	Fish	10	26	23/01/2016	Y	23/01/2016	107	170	135	10	0	5	7	Chick dug under division to burrow 56 and found with resident chick on 21/01/2016
209998	71	128	156	Fish	10	5	23/01/2016	Y	24/01/2016	124	172	187	7	1	5	8	
209999	18	138	159	Fish	6	26	22/01/2016	N	24/01/2016	111	174	140	10	2	0	8	
210002	46	130	153	Soya	10	16	24/01/2016	Y	24/01/2016	105	173	150	15	0	5	8	
210003	26	134	151	Soya	10	19	28/01/2016	Y	28/01/2016	110	178	272	14	0	5	12	
210004	93	157	153	Soya	10	20	23/01/2016	Y	24/01/2016	116	174	128	8	1	5	8	
210005	24	151	149	Fish	10	25	26/01/2016	Y	26/01/2016	112	174	162	10	0	20	10	
210006	75	137	153	Fish	8	30	23/01/2016	Y	23/01/2016	110	169	167	25	0	0	7	Tick under bill
210007	13	130	150	Fish	8	15	25/01/2016	Y	25/01/2016	113	174	168	10	0	<5	9	
210008	76	148	149	Soya	3	33	25/01/2016	Y	25/01/2016	109	175	165	10	0	<5	9	
210009	25	171	159	Soya	3	39	24/01/2016	Y	24/01/2016	115	176	117	13	0	15	8	
210010	48	162	158	Soya	7	26	24/01/2016	Y	24/01/2016	112	176	102	20	0	20	8	
210011	74	138	159	Fish	10	19	23/01/2016	Y	23/01/2016	113	173	115	15	0	15	7	Crackle heard on chest on day after transfer during feed. Refer Section 5.6.2.
210013	7	170	152	Fish	10	39	25/01/2016	Y	25/01/2016	119	171	177	10	0	15	9	
210014	99	138	162	Soya	6	12	21/01/2016	Y	21/01/2016	117	168	55	10	0	15	5	
210015	20	140	150	Fish	10	28	25/01/2016	N	27/01/2016	105	177	207	7	1	5	11	
210016	32	130	150	Soya	10	19	26/01/2016	Y	27/01/2016	109	178	247	15	1	5	11	
210017	47	185	145	Soya	3	43	26/01/2016	Y	26/01/2016	108	174	103	10	0	10	10	

210018	6	128	149	Fish	9	5	28/01/2016	Y	28/01/2016	122	182	256	10	0	10	12	
210019	37	127	145	Soya	10	22	24/01/2016	Y	25/01/2016	105	168	232	20	1	<5	9	3 days of double feeds (am and pm). Right foot weak. Refer Section 5.6.3.
210020	87	128	148	Soya	9	16	25/01/2016	Y	25/01/2016	110	171	204	15	0	<5	9	
210021	36	127	152	Soya	8	18	24/01/2016	Y	24/01/2016	104	168	182	20	0	10	8	
210022	97	152	161	Soya	10	19	25/01/2016	Y	25/01/2016	112	182	183	10	0	20	9	
210023	50	177	162	Fish	7	32	25/01/2016	Y	26/01/2016	128	180	145	10	1	5	10	
210025	70	127	146	Fish	10	13	26/01/2016	Y	26/01/2016	122	172	243	20	0	<5	10	Tick under bill
210027	39	145	159	Soya	8	30	22/01/2016	Y	22/01/2016	109	174	137	21	0	10	6	
210028	60	157	157	Fish	4	34	25/01/2016	Y	25/01/2016	124	178	178	10	0	10	9	
210029	28	163	156	Soya	8	29	21/01/2016	Y	22/01/2016	120	170	83	10	1	5	6	
210031	11	137	155	Fish	8	12	25/01/2016	Y	25/01/2016	107	178	103	5	0	15	9	
210032	95	155	150	Soya	10	35	25/01/2016	Y	25/01/2016	113	171	214	18	0	5	9	Tick under bill. Consistently aggressive bird
210033	AB17	149	160	Fish	6	16	19/01/2016	N	21/01/2016	118	169	41	0	0	0	5	
210034	17	137	149	Fish	10	18	25/01/2016	Y	26/01/2016	120	177	207	15	1	<5	10	
210035	83	143	159	Soya	10	32	25/01/2016	Y	25/01/2016	109	178	235	25	0	10	9	Tick under bill
210036	65	150	156	Fish	10	33	26/01/2016	Y	27/01/2016	115	180	216	10	1	10	11	
210039	82	135	155	Soya	7	19	20/01/2016	N	20/01/2016	110	163	58	20	0	5	4	
210040	61	132	162	Fish	5	15	22/01/2016	Y	22/01/2016	107	176	81	20	0	15	6	
210041	22	161	145	Fish	10	38	26/01/2016	Y	26/01/2016	124	172	230	15	0	<5	10	
210043	84	142	157	Soya	9	19	24/01/2016	Y	24/01/2016	114	175	181	19	0	15	8	
210044	80	160	159	Soya	7	29	24/01/2016	Y	24/01/2016	109	180	95	12	0	15	8	
210045	12	148	155	Fish	9	25	23/01/2016	Y	24/01/2016	113	175	134	10	1	10	8	
210046	86	125	149	Soya	20	12	26/01/2016	Y	26/01/2016	112	175	275	20	0	10	10	Left eye sealed on arrival (fused eyelid); mite loading; hungry chick. 4 days of double feeds (am and pm). Refer Section 5.6.4.
210052	96	192	162	Soya	3	47	20/01/2016	N	20/01/2016	127	169	22	5	0	15	4	
210054	54	137	160	Fish	5	17	24/01/2016	Y	24/01/2016	120	179	184	24	0	<5	8	
210055	34	153	158	Soya	5	17	21/01/2016	Y	22/01/2016	117	171	58	5	1	5	6	

210056	33	150	158	Soya	6	20	23/01/2016	Y	23/01/2016	113	176	103	9	0	<10	7	
210057	3	200	147	Fish	7	47	25/01/2016	Y	26/01/2016	120	175	139	5	1	<10	10	
210058	35	135	145	Soya	7	17	28/01/2016	Y	28/01/2016	112	174	250	10	0	5	12	
210059	72	140	147	Fish	10	19	23/01/2016	Y	23/01/2016	113	164	121	15	0	10	7	
210060	41	123	154	Soya	10	12	20/01/2016	Y	20/01/2016	107	162	70	25	0	<5	4	
210061	57	145	155	Fish	5	15	19/01/2016	N	22/01/2016	106	168	28	5	1	0	6	Found in burrow 62 on morning of 22/01/2016
210063	77	129	156	Soya	7	4	25/01/2016	Y	25/01/2016	112	178	183	18	0	20	9	
210065	9	140	153	Fish	10	13	26/01/2016	Y	26/01/2016	116	179	191	10	0	15	10	
210066	51	164	146	Fish	10	32	28/01/2016	Y	28/01/2016	122	179	258	15	0	5	12	
210069	89	148	145	Soya	10	29	28/01/2016	Y	28/01/2016	107	181	245	10	0	<5	12	
210070	73	138	158	Fish	8	25	21/01/2016	Y	21/01/2016	110	170	74	3	0	5	5	
210073	29	160	156	Soya	5	31	24/01/2016	Y	24/01/2016	112	175	107	10	0	10	8	
210074	8	151	156	Fish	10	28	26/01/2016	Y	26/01/2016	117	181	242	20	0	5	10	
210075	91	129	157	Soya	10	19	22/01/2016	Y	22/01/2016	104	169	122	20	0	5	6	
210076	79	127	157	Soya	10	21	22/01/2016	Y	22/01/2016	104	173	149	10	0	10	6	Mucky plumage; missing 1–2 central tail feathers on arrival. 4 days double feeds (am and pm)
210077	27	159	148	Soya	3	27	26/01/2016	Y	26/01/2016	122	174	191	13	0	<10	10	Ticks under bill
210079	81	145	147	Soya	10	24	24/01/2016	Y	24/01/2016	105	167	164	13	0	15	8	
210080	98	135	160	Soya	4	23	22/01/2016	Y	22/01/2016	108	173	115	25	0	5	6	
210082	44	137	152	Soya	10	23	23/01/2016	Y	23/01/2016	113	168	175	28	0	5	7	
210083	92	142	155	Soya	10	29	21/01/2016	Y	22/01/2016	102	169	115	20	1	<5	6	
210085	59	135	160	Fish	5	15	19/01/2016	Y	19/01/2016	114	166	15	5	0	5	3	
210087	94	151	146	Soya	9	34	25/01/2016	Y	25/01/2016	110	170	203	5	0	20	9	
210088	68	143	151	Fish	7	23	28/01/2016	Y	28/01/2016	113	183	226	10	0	<5	12	
210089	69	139	155	Fish	5	23	23/01/2016	Y	23/01/2016	121	170	158	14	0	<5	7	
210090	58	155	147	Fish	10	32	25/01/2016	Y	25/01/2016	117	170	148	10	0	10	9	
210091	19	135	149	Fish	7	27	24/01/2016	Y	24/01/2016	105	168	136	7	0	20	8	
210092	100	132	161	Soya	10	16	23/01/2016	Y	23/01/2016	110	174	152	25	0	0	7	

210093	23	165	158	Fish	10	41	23/01/2016	Y	23/01/2016	111	177	108	10	0	15	7	Tick under bill
210094	64	141	150	Fish	5	25	25/01/2016	Y	25/01/2016	116	172	199	15	0	5	9	Found in tunnel 22/01/2016
210095	53	140	161	Fish	2	30	20/01/2016	Y	20/01/2016	101	169	20	5	0	10	4	
210096	16	145	153	Fish	10	26	26/01/2016	Y	27/01/2016	119	180	225	14	1	<5	11	Tick under bill
210099	49	135	153	Soya	10	16	23/01/2016	Y	23/01/2016	105	171	127	12	0	15	7	Tick on base of bill
210100	78	127	159	Soya	10	11	21/01/2016	Y	21/01/2016	110	168	87	11	0	10	5	