

**First transfer of grey-faced petrel
(*Pterodroma macroptera gouldi*) chicks from
Taranga (Hen) Island to Matakohe-Limestone
Island**

2004



**Prepared by Helen Gummer and Colin Bishop
for the
Friends of Matakohe-Limestone I.
(December 2004/January 2005)**

REPORT ON TRANSFER AND FLEDGING OF GREY-FACED PETREL (OI) CHICKS ON MATAKOHE-LIMESTONE ISLAND (DECEMBER 2004)

Prepared by Helen Gummer and Colin Bishop
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ABSTRACT

Forty grey-faced petrel chicks or oi were successfully transferred from Taranga (Hen I.) to Matakoho-Limestone I. in a single operation on 1 December 2004. This was the first transfer in a translocation project initiated by the Friends of Matakoho-Limestone Island. The transferred cohort consisted of a spread of ages as there were only a small number of suitable chicks found at the source colony in late October. None were considered to have emerged from burrows on Taranga. Due to unforeseen natural circumstances, a large proportion of the chicks were transferred in less than optimum body condition with relatively low weights and slower development compared to normal chicks of this species at this age. All chicks were supplementary-fed with tinned sardines in soya oil, blended with water and delivered via syringe and crop-tube – a diet and technique used in other common and endangered seabird chick translocation projects in New Zealand. Following the deaths of nine chicks in the first week after transfer, meal sizes were reduced and feeding frequency increased to suit the lighter chicks still requiring large weight gains to reach normal fledging weights. The mortality of chicks was likely to be caused by the inability of under-nourished individuals to cope with the transition from natural to artificial diet and the initial feeding regime. Many of these chicks would not have naturally survived to fledge from the source colony. A total of 28 chicks (70%) were presumed to have successfully fledged from the Matakoho-Limestone I. colony site. They spent a mean of 26 days on the island, and departed with mean weight and wing length of 555 g and 312 mm respectively – close to average fledging measurements for this species.

INTRODUCTION

The grey-faced petrel *Pterodroma macroptera gouldi* is a member of the Procellariidae family of seabirds, all have distinctive external nostrils encased in a tube on the top or sides of the bill. This species colonises mainland headlands, cliff tops and offshore islands from the Three Kings to Taranaki on the west coast and near Gisborne on the east coast. The main colonies occur on Taranga (Hen I.), Mokohinau I., the Mercury and Alderman I., Whale I. and White I. This species is the most common breeding in the New Zealand region with over 1,000,000 pairs (Heather & Robertson 1996: Field guide to the birds of NZ). Their diet is mainly squid, with some fish and crustaceans.

Matakoho-Limestone I. is a 40 ha (approx.) island located in the upper Whangarei Harbour. The island is a designated scenic reserve managed by a voluntary community incorporated society – Friends of Matakoho-Limestone Island (FOMLI) – formed in 1991. A full-time ranger is resident on the island. A large scale revegetation programme is

underway with species introductions carried out (both assisted and unassisted) as habitat and food source increase. It is highly likely that petrels, shearwaters and other seabirds once bred on Matakohe-Limestone I.

This is the first stage of a five year project in which FOMLI plan to translocate around fifty oi chicks annually to Matakohe-Limestone I. Breeding seabirds excrete considerable quantities of guano which will help lift the nutrient levels on the island. Nest burrows will provide additional habitat for lizards, kiwi and invertebrates.

Man made burrows were constructed and set into the ground in a suitable location on Matakohe I. Helen Gummer, a seabird ecologist, with extensive experience in petrel translocations was contracted by FOMLI and supervised the feeding and welfare of the birds until the first chicks fledged. All chicks were banded. Approximately three years after the fledging date the first birds should begin returning to Matakohe-Limestone I. and start prospecting for suitable nesting burrows and partners. Breeding may not take place until the birds are seven years old.

AIMS

- To re-locate 40 grey-faced petrel chicks on Taranga (Hen I.) and transfer them by helicopter to Matakohe-Limestone I.
- To install the chicks in artificial burrows at the petrel colony site on Matakohe-Limestone I.
- To blockade all chicks in artificial burrows for two nights to familiarise chicks with their new environment.
- To supplementary feed all chicks to further growth and development and to ensure chicks have adequate reserves over the emergence period and for fledging.
- To monitor all chicks/burrows daily to determine patterns in weight change and feather (wing) growth, and to record key behavioural events (emergence and fledging).
- To screen (blood sample, cloacal swab, physical examination) 20 chicks as soon as possible following transfer to provide baseline information for the national wildlife health monitoring scheme.
- To provide recommendations for subsequent chick transfers.

METHODS/RESULTS

Transfer from Taranga (Hen I.)

As there has been little research carried out on the grey-faced petrel population on Taranga a preliminary trip was made to locate burrow sites, weigh and measure (wings) chicks so that approximate fledging dates and therefore the transfer date could be determined. This was carried out on 19–24 October 2004.

On 1 December 2004 the forty oldest chicks out of the fifty identified on the October trip were removed from their burrows, placed in carry boxes (lined with shredded paper) and

carried to a central location on the main ridge of Taranga. Study hole lids at the burrow sites were reinstated and sealed.

As there is no suitable helicopter landing site on the main ridge the carry boxes were placed in two large sacks which were airlifted in a cargo net to the lighthouse on Taranga (2-3 minute flight). The boxes were then transferred into the helicopter and flown (approx. 30 minutes) to Matakohe-Limestone I.

Final preparations at artificial colony site

Prior to the arrival of chicks, all burrows were lined with a thick layer of dead, dry grass as nesting material. Large sods of compacted earth were provided as blockades, but sections of round fence post were also provided to block the entrances of more mobile (advanced) chicks.

Thistles were removed (dug out) from the entire colony area, particularly those at burrow entrances, to avoid potential foot injuries/infections developing in emerging chicks. The feeding shelter was equipped with hand-washing facilities and a bench suitable for feeding chicks on.

Arrival of chicks on Matakohe-Limestone I.

The helicopter arrived on Matakohe-Limestone at approximately 1630 hrs. Chicks were loaded directly onto the truck and trailer with gaps between each box to allow air flow (to prevent chicks overheating) and parked underneath a tent in the shade for the duration of the powhiri. At 1800 hrs, the truck transported the chicks up to the colony site where boxes were unloaded under trees in the shade above the site. Boxes were then carried down to the shed for chick processing as required.

Installation of chicks at artificial colony site

Chicks were weighed and measured (right wing), then given 20 ml of boiled (cooled) water via a syringe and crop tube to prevent dehydration following the stress of the transfer. Chicks were then placed in numbered burrows (head facing away from pipe) and pipe entrances blocked (leaving air gaps for ventilation). In some instances, disoriented chicks made their way down the tunnels; these were replaced in the chambers and extra grass pushed into the pipe at the chamber end to keep chicks in the chamber. All data were recorded in a prepared notebook along with the Taranga burrow number (recorded on each transfer box during collection at the source colony).

NB Physical examination or banding of birds was not made at this stage to keep handling to a minimum on the transfer day. Banding occurred several days later by Andrea Booth (DOC).

Supplementary feeding

Chicks were fed a diet of tinned 'Brunswick' Canadian sardines (89%) in soya oil (10%) and salt (<1%). Each 106 g tin of fish was blended with 50 ml cold (boiled >3 mins)

water. Food preparation methods and equipment required for feeding are detailed in Appendices 1 and 2. A total of 380 tins of sardines were prepared for 24 chick feeding days (Table 1).

Food delivery methods and hygiene measures are detailed in Appendix 3 along with the process followed on feeding days for monitoring chick weight, wing length and emergence behaviour. Post-feeding clean-up methods are given in Appendix 4.

Chicks were given an introductory feed of 50 g only on the first feed day (2 December). Chicks were then scheduled to be fed a day or two days after the first introductory meal, with amounts increasing to 100 g (every other day) or 130-150 g (every second to third day). NB Naturally chicks of this stage in development can take meals of up to 200 g from parents in a short period of time.

Groups of chicks were fed each day for nearly two weeks following transfer, although individuals were receiving food every second or third day. By 12 December, the surviving 31 chicks were scheduled to be fed on the same day, with feed days occurring every other day. By this stage, most meal sizes were reduced to 100 g to avoid over-filling and to give a slow but steady weight gain of around 10 g over two days. Younger growing chicks tended to gain more weight than this; older, more active chicks, naturally in weight decline mode, could generally only be maintained at steady weights.

Table 1: Number of tins of sardines (106 g) used to feed grey-faced petrel chicks

	December 2004																			
	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Chicks fed	40	25	15	25	8	10	25	5	26	6	31	0	31	0	31	0	27	0	24	0
Tins used	16	21	17	27	15	9	25	6	26	5	24	0	24	0	24	0	21	0	23	0

	December 2004										January 2005							
	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6	7	8
Chicks fed	24	0	20	0	17	0	12	0	6	0	7	0	7	0	2	0	2	0
Tins used	21	0	18	0	18	0	15	0	9	0	6	0	6	0	2	0	2	0

Daily chick/burrow monitoring

Blockades were removed from burrow entrances on 3 December. Stick fences were then erected at each entrance to monitor emergence behaviour of each chick. Burrows and

chicks were monitored daily, even if a non-feed day, to determine emergence periods and fledging dates. Daily burrow inspections were also important to monitor the general health and welfare of each chick, in particular checking for any signs of regurgitation in the burrow and that chicks were defecating normally following the transition onto the artificial diet.

Weights of all chicks were obtained daily for the first 5 days until a daily weight loss pattern was established. To reduce handling, chick weights were then only obtained before feeding. Wing lengths were recorded on feeding days, but no more frequent than every third day. Weight and wing lengths were primarily recorded to help with management of each chick. Weight and wing length are also important data to record as close as possible to fledging. All data were transcribed onto individual data sheets (Appendix 5).

Background information on grey-faced petrel fledging weight and wing length statistics

Grey-faced petrel weights peak dramatically before falling to a weight at which birds are able to fly/fledge. Parental meals may reduce in size and frequency after chick weight peaks as chicks need to lose weight while plumage development is completed. Key information below on weights, wing lengths and emergence behaviour prior to and at fledging is based on data collected by Graeme Taylor at the Bethell's Beach (west Auckland) colony:

- Peak weight for grey-faced petrel chicks occurs at around 75-80 days (approx. 175-190 mm wing length)
- Peak weights reach 800-1100 g after feeds (900 g for normal healthy chicks)
- Fledging weight range is 480-580 g (most commonly 520-550 g). *Chicks are not fed for last 3-5 days or longer before fledging; fledging weights are not post-feed weights.*
- Fledging wing length range is 305-340 mm (average around 315-320 mm)
- Wing growth accelerates with age: at >250 mm the primaries grow at 5 mm/day; at 200-250 mm the primaries grow at 4 mm/day; at <200 mm the primaries grow at <4 mm/day, etc. It would take a chick approximately 12-13 days to grow from 200 mm to 250 mm and a further 14 days to grow from 250 mm to the average fledging wing length of 320 mm. Therefore, chicks with wings measuring 200 mm could be expected to fledge approximately 27 days later.
- Chicks have not been recorded naturally as emerging from burrows with wings less than 250 mm.
- Chicks emerge from burrows each night for an average of 2 weeks before fledging.

NB From experience with other seabird chick transfers, chicks fed on the artificial sardine diet tend to fledge at heavier weights and with longer wings than naturally-reared chicks. If this is the case with grey-faced petrels then it could be expected that chicks in the best condition fledge at weights up to 600 g and with wing lengths closer to 340 mm.

Condition of chicks on arrival at Matakoho-Limestone I.

From the information above, and given the estimated fledging dates based on the weight and wing length data collected at the Taranga source colony in late October, it would be expected that the chicks collected for transfer on 1 December would be at their peak weights or in the process of losing weight to reach fledge weight. In other words, chicks were expected to be around 600 g in weight with many expected to weigh around 900 g and extremely heavy birds over 1 kg. More advanced chicks on the decline in weight would still be expected to arrive at weights well above average fledging weight.

In reality, the average weight of the 40 transferred chicks was 478 g (\pm 102 g) with a range of 270 g to 700 g (Appendix 6). Only seven chicks weighed 600 g or more on the transfer day; at least one of these weights later proved to be a post-feed weight as the deceased chick's base weight after regurgitation proved to be only 420 g. Half the chicks had either lost weight (14 chicks) or were virtually the same weight (6 chicks) on the transfer day as they were on 22 October. Eleven chicks had only gained less than 100 g in the 5-6 weeks between handling. The remainder had mostly gained over 100 g with only a single chick actually doubling its weight (from 345 g on 22 October to 700 g on 1 December). Most of these chicks would have been expected to have at least doubled their weight over November.

As a consequence of the relatively poor condition of transferred chicks, many wings were behind in growth with shorter measurements than originally predicted. This had several implications:

- Chicks were going to require a much more intensive feeding regime to get them up to appropriate fledging weights.
- Chicks were going to be fledging from Matakoho at later dates than originally predicted (which may possibly effect post-fledging survival).
- Chicks that have never peaked in weight may not have the fat reserves to fuel them during fledging and the first days at sea (this will definitely effect post-fledging survival rates).
- Chicks considerably behind in growth begin to show abnormal emergence behaviour, emerging as much as several weeks prematurely (a common behaviour for starving chicks) and even emerging from burrows during the day.

Health screening

Twenty chicks (listed in Appendix 7) were screened on 10 December: blood smears (white blood-cell counts), cloacal swabs (bacterial infections) and faecal samples (endoparasite loadings). Collection of ectoparasites and physical examinations occurred on 12 and 14 December (due to time constraints on blood sampling day). Screening results can be obtained from the Department of Conservation.

All chicks were checked in the days following transfer for abnormalities. At this stage it became apparent that one chick (burrow 19) appeared to have recovered from old injuries sustained at the source colony early in life. These consisted of an upper leg break (naturally reset), a dropped right wing, and the tip of the upper mandible broken off. The chick had limited mobility in the leg and wing and had obviously been set back in

growth for its age. The chick was clearly unable to fledge. This bird was euthanised on 24 December.

Mortality

A total of 12 chicks died on Matakoho-Limestone I. Nine chicks died in the first week after transfer, one at 20 days after transfer, one just prior to fledging, and one chick was euthanised (see above). Most of these chicks were relatively light for their stage of development (wing length) and some wing lengths were behind in growth based on measurements taken on Taranga on 22 October (Appendix 6). Many were lighter in weight at collection for transfer than they were 5-6 weeks earlier in October. All except two were found in burrow chambers; burrows of deceased chicks were blocked to prevent any other chicks entering them. Circumstances leading up to death are detailed for each chick below:

Three chicks were found dead on 06/12/04:

- Burrow 5: Weight at death (420 g) indicated that transfer weight (660 g) was actually a post-feed weight (i.e. chick probably fed large amount on Taranga night before transfer). Chick was unable to cope with the large amounts of artificial diet, but did not regurgitate until the night before, or day of death. Initial predicted fledging date 23/12/04, but at given wing length chick would not be expected to have fledged until early January.
- Burrow 16: Weight at death 340 g. Chick showed the more usual signs of being full by regurgitating the last portion of the feed given on 05/12/04. Probably unable to cope with new diet, meal size and frequency. Chick extremely light for stage of development.
- Burrow 20: Weight at death 280 g. Regurgitation found on 06/12/04 was likely to be from the 03/12/04 feed and was possibly missed when chick was removed in subsequent days. If noted, this would have been an indication to reduce meal size and/or frequency. Chick excessively underweight for stage in development. Initial predicted fledging date 25/12/04, but at given wing length chick would not be expected to have fledged until mid January.

Three chicks were found dead on 08/12/04:

- Burrow 6: Weight at death 380 g. Chick showed no signs of being full during or after feeds. First sign of regurgitation in burrow was on the morning found dead. Probably unable to cope with the meal size and frequency. Initial predicted fledging date 27/12/04, but at given wing length chick would not be expected to have fledged until early to mid January.
- Burrow 10: Base weight 320 g on day before death. Chick excessively light for stage of development. Behaviour abnormal, with chick emerging prematurely. No regurgitation found in burrow; dead weight (440 g) indicated food from previous meal still in crop/stomach. Initial predicted fledging date 13/12/04, but at given wing length chick would not be expected to have fledged until late December.
- Burrow 23: Weight at death (520 g) indicated chick had not regurgitated last meal. No evidence of regurgitation found in or around burrow. Chick emergence abnormal/premature (at wing length 164 mm); chick found dead on surface.

Chick had a more advanced appearance with less down. Initial predicted fledging date 27/12/04, but at given wing length chick would not be expected to fledge until mid January.

One chick was found dead on 09/12/04:

- Burrow 15: Weight at death 425 g. Chick showed no signs of being full during or after first feeds. Chick refused feed on 08/12; food from last meal came up throat, then regurgitated much of what would have been left in stomach including traces of parental meal. Probably unable to cope with new diet, meal size and frequency. Initial predicted fledging date 31/12/04, but at given wing length chick would not be expected to have fledged until mid January.

One chick was found dead on 10/12/04:

- Burrow 13: Weight at death 420 g. Chick found with regurgitant which contained artificial diet with squid beaks and other traces of parental meal. No regurgitation was recorded prior to this. Chick had not looked weak or sick but emergence behaviour abnormal; chick emerging from tunnel by day and generally emerging prematurely. Chick probably unable to cope with new diet, meal size and frequency. Initial predicted fledging date 01/01/05, but at given wing length chick would not be expected to have fledged until mid January.

One chick was found dead on 11/12/04:

- Burrow 28: Weight at death 365 g. Chick found weak on 08/12/04 at entrance to pipe next to regurgitant. Chick picked up a little after the small watery feeds on 08 and 09/12/04; feeding on 10/12/04 split into two small meals (am and pm) but these were found regurgitated in chamber the next day. Chick had little down; behaviour and plumage were of a more advanced chick but wing length indicated a set-back in growth. Emergence behaviour premature (wing 209 mm) and abnormal (daytime). chick extremely light for stage in development. Initial predicted fledging date 20/12/04, but at given wing length chick would not be expected to have fledged until early January.

One chick was found dead on 21/12/04:

- Burrow 34: Weight at death 420 g. Chick found weak on 20/12/04, large amount of regurgitant at entrance to pipe. Chick refused feed on 20/12/04. This chick initially appeared to be responding to artificial diet although remained in poor condition. Emergence behaviour premature (wing 230 mm). Initial predicted fledging date 24/12/04, but at given wing length chick would not be expected to have fledged until early January.

One chick was found dead on 06/01/05:

- Burrow 24: Weight at death 505 g (wing length 305 mm) w Weight at transfer 470 g. This chick and responded to the artificial diet well. The chick's condition improved from poor to good just prior to it being found dead. Chick was absent from burrow site on 04/01/05 and was found dead on 06/01/05 approximately

100m from the burrow site on a formed track. Chick possibly died from dehydration after becoming lost (weather conditions were hot and dry).

Emergence periods and fledging dates

Emergence and fledging dates are recorded for each chick in Appendix 8.

Chicks were first recorded emerging from burrows on the night of 3 December following blockade removal (five birds: burrows 8, 10, 11, 21 and 26). One of these chicks (burrow 10) went missing but returned to its burrow after a 3-day absence. There were no obvious negative impacts to blocking chicks in for 2 nights after transfer; only one younger chick showed evidence of digging in its chamber for a single night only. Other chicks that have been absent from their burrows (and not found in other artificial burrows) but returned at a later date include: burrow 4 (1 day missing), burrow 18 (1 day), burrow 22 (2 days), burrow 25 (1 day), burrow 36 (6 days, returned for 2, then remained missing). Five other chicks were missing from their burrows but were retrieved in neighbouring burrows/pipes. The last chick to emerge did so on 23 December.

The first chicks are considered to have fledged on the night of 15 December: burrow 11 and 12. The last two chicks departed the colony on 8 January. Chicks (n=27) spent a mean of 26.4 days on Matakoho-Limestone I. (range 15 to 39 days)

Fledging data

Weights and wing lengths of each chick at fledging are recorded for in Appendix 8. Ideally, weights and measurements were recorded on the day preceding the night of fledge (i.e. roughly 12 hrs before departure); however, many final measurements were made sooner than this (2 or more days before departure) and as a result fledging weights and wing lengths were estimated for chicks based on their individual patterns of growth and weight gain/loss.

Chicks (n=27) departed Matakoho-Limestone I. at a mean weight of 555 g (range 460 to 640 g) and with a mean wing length of 312 mm (range 295 to 325 mm). One chick (burrow 36) spent 6 days absent from the burrow site, returned for 2 days/feeds and then remained absent. This bird may have become lost and died on the island of dehydration or fledged. If fledged, the chick would have been in poor condition and low in weight (around 400 g.).

Although wing growth rates have not been calculated for this report, raw data show that the primaries of many chicks did not reach the normal growth rate (5 mm/day) exhibited by healthy chicks of this species.

DISCUSSION / RECOMMENDATIONS

Selection for future transfers

- A larger number of chicks are required at the source colony to be able to select those of optimum size (age) and optimum condition (weight) for transfer. It may be required to find at least 100 chicks in order to be able to select 40 of the best with less of an age spread. There is an unquantified risk that some breeding pairs may be affected by chick removals and therefore the team needs to ensure it has an adequate pool of burrows to work from over several years, rather than relying on taking chicks from the same burrows repeatedly.
- Chicks should only be transferred if measurements fall within pre-set criteria. Criteria would include minimum weights and minimum wing lengths. There would be no maximum weight limit as the heavier chicks will be in the best condition at fledge. A maximum wing length should ideally be set to avoid transferring any chicks already emerging. However, it is common for large chicks exceeding this wing length to have not emerged; in these cases chicks can be taken if there is clear evidence that they have not left their burrows.
- Selection criteria could be as follows:

Minimum weight (on transfer day):	500 g (chicks could be taken at 450 g if there is a shortage of birds over 500 g but they require more frequent feeding at the release site and may not fledge in the best condition)
Minimum wing length (on transfer day):	200 mm (or <200 mm if prepared to care for chicks for a month or more at the release site)
Maximum wing length (on transfer day):	250 mm (this is when chicks tend to start emerging from burrows) OR >250 mm if not yet emerged

(Indicators that chicks have emerged include down at the burrow entrance and chicks looking wet in the day following a night of rain.)

- To be sure of finding the optimum chicks for a transfer, burrows should be inspected in the days immediately prior to the transfer day with all chicks weighed and measured and prioritised in terms of their suitability for transfer. This is also when a chick's general health can be assessed by a basic physical examination (in particular wings, legs and feet, eyes); chicks with any abnormalities would not be included in the selection. Chicks can be banded at this stage, to ensure the correct identity of the chick collected on the transfer day.
- A comparison of chick weights recorded in the days before a transfer at the source colony to those recorded on the transfer day at the release site provides a picture of whether the chick has received a parental meal during the night or two nights immediately prior to transfer. This is useful information for feeders at the release

colony site as chicks carrying full loads of parental meal will not require feeding for a few days until the bulk of the parental meal has been digested.

- The use of stick fences to monitor activity at a natal burrow can also be useful in determining if a chick has been visited by a parent on the nights before transfer. However, interpretation of fences is not always straight forward as fences may have been knocked down by other non-resident birds. Collectors can write on the transfer box if the natal burrow fence was intact or down on the morning of the transfer.
- Burrows that had study holes built into them on the first trip appeared to be in as good as condition as those that were unaltered. No burrows had been abandoned or flooded due to this method. Care was taken to ensure that the study lids were replaced carefully and sealed around on the transfer day.
- Transferring the chicks from the main ridge on Taranga to the lighthouse beneath the helicopter was the most practical option and least stressful for the chicks. This option was chosen because of the lack of suitable landing/hovering sites on the main ridge, limited time available and to reduce additional stress on the chicks that could be caused by carrying them by hand to the lighthouse or beach areas.

Transfer

- Aspects of the 2004 transfer appeared to run smoothly in terms of chick welfare. The transfer boxes worked well, although it is really important to leave gaps between boxes wherever they are placed (ground, truck etc.) to prevent chicks over-heating. The only time this is not practical is for the duration of the short helicopter trip.
- The issue of chicks overheating during transfer will be even more important in subsequent transfers of heavier chicks (with more fat layers) which will be more prone to overheating. It is essential chicks stay in the shade with plenty of space around each box to allow cool airflow. For this reason the timing of the arrival of birds at Matakoho worked well (i.e. late afternoon as opposed to midday), with birds processed at the colony site in the cool of early evening.
- Shredded paper worked well as a lining for the transfer boxes; it was a previous recommendation to avoid adding any twigs/sticks to the box as these can cause eye injuries in transit, and natal burrow nesting material was not really abundant.

Matakoho colony site

- The burrow site has been well-constructed with measures taken to avoid burrows overheating, or flooding in heavy rain (although they will still need checking in wet weather conditions). This is particularly important, as non-emerging chicks will not move if burrows fill with water: they will drown or become fatally chilled. In the event that flooding occurs, the transfer boxes should work well as back-up/temporary accommodation but they must be kept somewhere dark and cool (e.g. storage shed by old managers house ruins).
- In January 2005, burrows can be cleaned out (nest material removed). After next winter, the burrows can be aired/dried (lids off) and a thick dry nest of grass (dead

buffalo grass worked well this year) added a week or two before the next chicks arrive (November 2005), and a reserve of at least two full sacks of *really dry* grass collected as a reserve (in case burrows flood). Exposed pipes will need recovering with soil or sand sacks.

- Each year, thistles should be removed from the colony site before the chicks arrive. (Chicks can stand or land on thistles and potentially get foot infections.)

Chick feeding

- Artificial diet, preparation and feeding techniques for *Pterodroma* petrels have been developed, trialled and refined over recent years with three species. At Bethell's Beach this year (2004), heavier grey-faced petrel chicks (i.e. in better condition) and those more advanced (longer wings) were able to cope with the transition from natural to artificial diet with a small introductory meal at the first feed. For Limestone I. however, many lightweight chicks and many behind in development proved unable to cope with the same kind of transition. It was recognised that these chicks had much weight to gain to sustain growth/development and reach appropriate fledging weights, and as a consequence these chicks were set on a meal plan that did not allow a slow enough transition for the less than optimum condition they were at.

In subsequent transfers, it will pay to make this transition slower for all chicks, to allow them to finish digesting parental meals, 'clean out' the system, and slowly introduce the sardine diet. Making the first two feeds for each chick a little more watery would help prevent any dehydration issues, especially if chicks have not been fed for many days at the source colony. This slow transition would mean that chicks lose weight for a period of several days, but this should not be a problem if they arrive with good weights.

Helen Gummer recommended using the following feeding process:

- Transfer day: 20 ml water only (no food)
- Day 1: 50 g of more watery food (1 can sardines : 100 ml water) only to chicks that have not been fed at the source colony on the night before transfer (compare selection and transfer weights)
 - Day 2: Repeat for remaining chicks not fed yesterday.
 - Day 3: Feed all chicks fed on Day 1 with 100 g of the more watery mix.
 - Day 4: Repeat with all remaining chicks fed on Day 2.
 - Day 5: Feed all chicks fed on Day 1 and 3 with 100 g of normal mix (1 can sardines : 50 ml water)
 - Day 6: Repeat with all remaining chicks fed on Day 2 and 4.

NB On Day 3 onwards, feed <100 g to chicks that clearly had very large parental meals on the night before transfer, or to very heavy chicks that may have food still in the system.

- Following the deaths of chicks in 2004, meal sizes were reduced and feeding frequency increased (maximum 100 g every second day) to obtain target weight gains. Chicks in excellent condition, arriving at peak weights, should be able to cope with larger meals less frequently (up to 150 g every 3 days). Meal size and frequency after Day 6 will have to be decided on a case by case basis, dependent on chick's base weight, in future transfers.

- It is important that every burrow is carefully and consistently inspected for signs of regurgitation, especially in the first week after transfer, while chicks adjust to a new diet and feeding regime, and to ensure chicks are passing waste matter (faeces/urates). During the first few days, it is useful to have a 'trained eye' to be involved in extracting chicks from chambers in order to check for the above and pick up on anything abnormal.

Chick health monitoring

- Once chicks are settled into the new colony site and feeding regime, it may be useful to perform other health checks such as inspections for parasite loadings and body condition (prominence of keel). Chicks that are to survive following fledging are usually at the heavier end of the fledging weight range, and the keel should be surrounded by muscle mass (not protruding).
- Screening for potential diseases should ideally occur at the source colony and preferably with chicks that are not to be transferred (if it is only baseline information for the species)! This would be achievable if more chicks were found at the source colony, and after prioritisation for transfer.
- If screening is to occur post-transfer at the release site, schedule screening and physical examination to occur just before feeding and preferably not on the day after a feed; this will help reduce incidences of regurgitation though handling birds with full stomachs. A settling-in period should be allowed before bleeding etc, but screens ideally should be made as soon after transfer as practical.
- Ensure there are clear protocols as to how sick chicks, with no chance of survival, are dispatched.

ACKNOWLEDGEMENTS

The first transfer in the translocation of grey-faced petrels from Taranga to Matakoho-Limestone I. can be considered a success. Many thanks are owed to the following participants in this project:

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APPENDICES

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Appendix 1

Grey-faced petrel chick food preparation

- 1) Wash hands (with antibacterial soap).
- 2) Boil water for up to four 1 litre thermos flasks (for food-warming baths).
- 3) Make up 8 litres of Johnson's antibacterial solution in small bucket (1 tablet / 2 litres cold water, so 4 tablets/ 8 litres water).
- 4) Clean sink/bench area and wipe over with cloth soaked in antibacterial solution.
- 5) Heat water for cleaning after food preparation (at least two kettles).

Equipment for food preparation:

Blenders / knife / spatula / cold (boiled for >3 mins) water / sardines / food containers

Recipe:

1 (106 g) tin sardines in soya oil (include oil contents)

50 ml cold (boiled > 3 mins) water

Contents of sardine cans: sardines (89%), soya oil (10%), salt (<1%)

NB Process a mix of only 3 tins of fish (with 150 ml water) in each batch to prevent strain on blender.

- 6) Place 150 ml cold (boiled > 3 mins) water in blender with 1 tin of fish and liquidize. Add half of second tin (chop fish up in tin) and blend. Add remainder of second tin and blend. Repeat with third tin until smooth. Pour mixture into container - maximum 2 batches (6 tins) per container.
- 7) Place food containers in chilly bin with at least two chilly blocks. Food must be kept cool at the colony site (to prevent contamination) and then warmed just before use.
NB Keep one container out of chilly bin for first round of feeding.
- 8) Wash out sardine tins in hot, soapy water for disposal.
- 9) Wipe down blender bases with cloth (soaked in antibacterial solution).
- 10) Remove blender blades and rinse out blender etc. before doing two thorough washes (with the petrel washing-up brush) in very hot, very soapy water to remove all oil. Rinse off detergent before placing equipment in bucket of antibacterial solution for the day (minimum soak period 2 hrs).

Appendix 2

Checklist of equipment to transport to colony site on grey-faced petrel chick feeding day

- 1 container of food (not chilled) for first feeding round
- 1 large chilly bin containing rest of food containers + 2 chilly blocks
- 1 small chilly bin (food-warming bath)
- 2 syringes (50 ml Bovivet plexiglass)
- 2 crop-feeding tubes (6.3 x 140 mm Teflon speed feeding tubes)
- 1 tall jar (for crop tube sterilising chlorhexidine solution)
- 2 rectangular rinse baths
- 1 lid (for resting loaded syringes on)
- 1 spatula
- 1 container (3 litres) boiled (>3 mins) water (for rinsing)
- Up to 4 thermos flasks (total 4 litres) of hot water (food-warming baths)
- Waterproof notebook and pencil
- Clean pillow cases (weigh bags)
- Any other supplies to restock e.g. tissues, rubbish bags, paper towels, hand-washing water, chlorhexidine solution refill.

Microshields chlorhexidine (5%) is a pink runny sterilising liquid made into a solution with water:

1 part chlorhexidine to 9 parts water (e.g. 100 ml chlorhexidine to 900 ml water).

At the colony site stored in a bucket should be:

- Castor oil (to lubricate syringes)
- Scales (1000 g and >1000 g Pesola scales)
- Wing rule (400 mm)
- Spare pillow cases
- Spare tissues and paper towels
- Chick first-aid kit (Aureomycin powder, flexi-cohesive bandage, veterinary eye ointment, small scissors)
- Hand-washing water
- Antibacterial soap
- Spare pencils
- Rubbish bags and bin
- Spare transfer box(es)

Appendix 3

Grey-faced petrel chick feeding, measuring and monitoring

A 3-person team is ideal for a full feeding day: one feeder (concentrating on feeding, food temperature, hygiene) and two handlers.

- 1) Wash hands (with antibacterial soap).
- 2) Fill two rinse baths with boiled (>3 mins) water.
Fill jar with chlorhexidine solution and stabilise (to prevent tipping over with syringes/tubes resting in jar)
- 3) Assemble syringes and crop tubes (hand-tight) and lubricate plunger with smear of castor oil.
- 4) Place first food container in small chilly bin in 1 litre of hot water to warm up.
Use clean spatula to stir regularly (even temperature).
Test temperature on wrist: mixture should be *just* warm (cold mix may be rejected by chick; hot mix may damage chick's internal tissues).
- 5) Complete rounds of all occupied burrows to record fence status (emergence behaviour) and check on welfare of all birds before commencing feeds.
Check nest for signs of regurgitation and that faeces are present and normal (dark brown gritty faeces with white fluidy urates, usually seen on chamber walls).
NB Don't bother erecting fences at this stage (see 6 below).
- 6) Search all pipes for any missing chicks (two chicks can be found in one burrow) by feeling inside entire length of every pipe with fence recorded as down. Two people can feel inside pipe from each end, or use long soft stick to feel from entrance end. Fences can be restored at this stage, or at the end of all chick processing.
- 7) Process chicks in the following order:
Extract from burrow (replace lid to keep chamber cool and dry)
Weigh (to obtain pre-feed or base weight)
Wing length (right wing) if wing measuring day
Any other handling (e.g. screening, physical examination)
Feed (record amount delivered)
Return to burrow (face chick to back of chamber opposite pipe).

NB No post-feed weight is required as long as it is established that 100 ml of food is 100 g in weight.
- 8) Weigh birds over a surface (to prevent injury if fall from scales). Replace weigh bags as soon as soiled. Keep birds in bags (to keep calm) for wing measuring, removing right wing to measure – straightened and flattened to record maximum wing cord.

- 9) For feeding, load syringe full to an excess of 50 ml, ensuring all air bubbles are removed. The excess allows for up to 10 g to be left in the bottom of the syringe after delivery of 50 g to the chick, important for the sterilising process. Wipe the crop tube with a clean tissue to remove residue food.
- 10) During feeding, the handler holds the chick firmly on a surface with crop (breast area) unrestricted while the feeder inserts the crop tube to the back and side of the throat (to keep airway clear), stretching the head and neck up at all times. Food is delivered in 50 g batches (up to 30 seconds delivery time) which allows chick to rest in between loads. Food delivery stops at the pre-determined amount, or earlier if signs of food coming back up throat. Chick is rested briefly, then carried immediately back to the burrow (not in bag) held in an upright position to prevent any regurgitation incidences.
- 11) After feeding, wipe the crop tube with a tissue and place tube upright in jar of chlorhexidine for a minimum of 2 mins sterilising time. After sterilisation, remove syringe/tube and eject remaining food (<10 g) in syringe – this is important to remove any disinfecting solution that may have soaked into the food in the tube. Rinse the outside (entire length) of tube through two rinse baths. The syringe/tube is now ready to draw up more fresh food (there should be no air bubbles present).
- 12) Keep monitoring food temperature regularly and stir with spatula before drawing up food (the thick part of the mix can settle). Remove from water bath if too warm. Towards the end of each batch, get the next batch out to warm up using a new flask of hot water (takes at least 15 mins). Thoroughly clean spatula before using in the next mix.
- 13) On a full feeding day, the syringe barrels need to be rinsed out and disinfected (fill them with chlorhexidine for minimum 2 mins) and rinse baths replaced at least once during the day (twice if very hot weather). Thoroughly rinse syringes with clean (boiled) water before use again.
- 14) After all feeding is complete, check all fences at burrow entrances are restored. Three thin straight sticks are sufficient, lightly placed in the soil at the entrance so as not to barricade the chicks in!

Appendix 4

Grey-faced petrel chick post-feeding clean-up

- 1) Heat water for cleaning (at least two kettles).
- 2) Wash hands, then remove food preparation equipment (blender jugs etc.) from antibacterial solution that have been soaking over the day in the small bucket. Rinse equipment under cold tap and air dry.
- 3) Pour the antibacterial solution from the bucket into the large chilly bin (ready for soaking the days equipment after washing).
- 4) Discard surplus sardine mixture in the sea (to prevent oiling up drains).
- 5) Rinse all equipment under hot tap to remove bulk of mixture before doing two thorough washes (with petrel washing-up brush) in very hot, very soapy water to remove all oil. Pass hot, soapy water through tube and syringe, then remove tube and plunger for more thorough washing (put dish-wash liquid in syringe barrel and use petrel bottle brush to remove oil residue).
- 6) Rinse off detergent before placing in chilly bin of antibacterial solution (minimum soak period 2 hrs). After sterilising, rinse equipment under cold tap and air dry. Discard the antibacterial solution (recommended to change this every 24 hours); fresh solution is made on the next feeding day.
- 7) Shake out weigh bags and soak in Napisan overnight. Weigh bags from the previous weighing day will need to be rinsed several times and dried.
- 8) Boil water (>3 mins), enough to fill the boiled water container full ready for the next feeding day and to set aside (in a clean/sterilised food container) for use in food preparation on the next feeding day.

Appendix 5

Grey-faced petrel chick measurement and feeding record form

Band no:									
Transferred TO Matakohe-Limestone I. burrow no:									
Transferred FROM Taranga (Hen I.) burrow no:									
(Diet: 1 tin sardines (106g) / 50 ml water)									
Date	Predict fledge	Pre-feed weight (g)	Post-feed weight (g)	Fed (g)	Wing (mm)	Wing/tail class (+/- mm)	Down present Y/N	Fence status D/PD/I	Comments
1/12/2004									
2/12/2004									
3/12/2004									
4/12/2004									
5/12/2004									
6/12/2004									
7/12/2004									
8/12/2004									
9/12/2004									
10/12/2004									
11/12/2004									
12/12/2004									
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26/12/2004									
27/12/2004									
28/12/2004									
29/12/2004									
30/12/2004									
31/12/2004									
1/01/2005									
2/01/2005									
3/01/2005									
4/01/2005									
5/01/2005									
Additional notes:									

Appendix 6 : Grey-faced petrel chick weights and wing lengths recorded on Taranga (Hen I.) on 22 October and 1 December 2004

Hen burrow	Limestone burrow	Weight (g) 22/10/2004	Weight (g) 1/12/2004	Weight loss/gain (November)	Wing (mm) 22/10/2004	Wing (mm) 1/12/2004	Comments
A1	34	470	400	Loss	94	208	Deceased/Limestone
B1	7	470	620	>100 g gain	95	221	
D1	24	460	470	Similar	98	165	Deceased/Limestone
D3	33	440	410	Loss	93	214	
E1	27	500	630	>100 g gain	82	185	
E2	11	390	380	Similar	110	249	
E3	29	530	610	<100 g gain	98	191	
F1	16	285	360	<100 g gain	75	169	Deceased/Limestone
F2	26	515	430	Loss	103	228	
F3	37	410	470	<100 g gain	80	191	
F5	1	397	370	Loss	108	226	
F6	20	410	270	Loss	90	163	Deceased/Limestone
F7	18	540	520	Loss	110	244	
G1	22	585	600	Similar	110	224	
G2	15	425	380	Loss	80	161	Deceased/Limestone
H1	12	540	620	<100 g gain	130	270	
I1	25	505	590	<100 g gain	92	198	
I2	3	345	360	Similar	85	174	
I3	28	465	350	Loss	103	198	Deceased/Limestone
I4	21	650	530	Loss	98	242	
I5	32	545	560	Similar	100	247	
I6	19	455	350	Loss	77	151	Stunted (early injuries)
I7	39	380	510	>100 g gain	87	209	
J1	5	460	660	?	95	176	Deceased (420 g)/Ll.
J2	6	365	400	<100 g gain	85	170	Deceased/Limestone
J3	8	445	390	Loss	100	245	
J4	17	435	550	>100 g gain	110	279	
J5	40	382	460	<100 g gain	80	172	
K1	35	430	500	<100 g gain	100	225	
K2	13	330	430	100 g gain	76	161	Deceased/Limestone
K3	38	420	450	<100 g gain	93	214	
K5	30	450	500	<100 g gain	120	227	
K6	31	537	430	Loss	96	210	
L1	23	365	470	100 g gain	85	163	Deceased/Limestone
L2*	14	345	700	>100 g gain	90	226	
M1	4	455	540	<100 g gain	96	202	
N1	10	525	390	Loss	120	227	Deceased/Limestone
N2	2	510	410	Loss	120	238	
N3	36	480	480	Similar	98	203	
O1	9	410	580	>100 g gain	81	181	
*Best example of normal (expected) weight increase although lower base weight to start with.							
Mean weight of 40 chicks on 22/10/04:					451 g	(S.D = 75 g; range 285 - 650 g)	
Mean weight of 40 chicks at transfer on 01/12/04:					478 g	(S.D = 101 g; range 270 - 700 g)	
Mean wing length of 40 chicks on 22/10/04:					96 mm	(S.D = 13 mm; range 75 - 130 mm)	
Mean wing length of 40 chicks at transfer on 01/12/04:					206 mm	(S.D = 33 mm; range 151 - 279 mm)	

Appendix 7

Screening and physical examination of 20 grey-faced petrel chicks transferred to Matakohe-Limestone I. in December 2004

20 chicks screened (blood, cloacal, faecal) on 10/12/04. Due to time constraints on this day, basic physical examinations made on 12/12 (parasites collected on 14/12).													
Chick ages range between approx. 70-100 days (fledging occurs approx. 110 days at weights ranging between 480-580 g)													
Band	Burrow	Blood smear	Faecal sample *	Cloacal swab	Wt at screen (g)	External parasites **	Body condition (keel)***	Mouth memb.	Feather condition	Eyes/bill	Limbs	Faeces/urates	Behaviour
E-212151	1	Y	Y	Y	435	Nil found	Fair	Pink	OK	OK	OK		Normal for age/size (not yet emerged)
E-212152	2	Y	Y	Y	445	Nil found	Poor-fair	Pink	OK	OK	OK		Normal for age/size (not yet emerged)
E-212153	3	Y	Y	Y	390	Nil found	Poor-fair	Pink	OK	OK	OK		Normal for age/size (not yet emerged)
E-212157	7	Y	Y	Y	545	Nil found	Fair-good	Pink	OK	OK	OK		Normal for age/size (not yet emerged)
E-212161	11	Y	Y	Y	420	Nil found	Fair	Pink	OK	OK	OK		Normal for age/size (emerging)
E-212162	12	Y	Y	Y	620	Nil found	Good	Pink	OK	OK	OK		Normal for age/size (emerging)
E-212164	14	Y	Y	Y	600	Nil found	Good	Pink	OK	OK	OK		Normal for age/size (not yet emerged)
E-212167	17	Y	Y	Y	600	Nil found	Fair-good	Pink	See 3	OK	OK		Normal for age/size (emerging)
E-212168	18	Y	Y	Y	540	2 x lice	Good	Pink	OK	OK	OK		Normal for age/size (emerging)
E-212191	19	Y	Y	Y	420	See 1	Poor	Pink	Worn edges	See 1	See 1		Normal for age/size (not yet emerged)
E-212171	21	Y	Y	Y	560	Nil found	Good	Pink	Worn edges	OK	OK		Normal for age/size (emerging)
E-212174	24	Y	Y	Y	520	Nil found	Poor	Pink	OK (downy)	OK	OK		Normal for age/size (not yet emerged)
E-212175	25	Y	Y	Y	580	Lots of lice	Poor-fair	Pink	OK (downy)	OK	OK		Normal for age/size (emerging)
E-212176	26	Y	Y	Y	490	Nil found	Poor-fair	Pink	OK	OK	OK		Probably normal for age/size (emerged early?)
E-212177	27	Y	Y	Y	690	Nil found	Fair	Pink	OK (downy)	OK	OK		Normal for age/size (not yet emerged)
E-212178	28	Y	Y	Y	350	See 2	See 2		See 2	OK	OK	See 2	Abnormal; emerging in day, sitting in pipe
E-212179	29	Y	Y	Y	580	1 x lice	Fair-good	Pink	OK	OK	OK		Normal for age/size (not yet emerged)
E-212180	30	Y	Y	Y	510	Lots of lice	Fair-good	Pink	OK	OK	OK		Normal for age/size (emerging)
E-212181	31	Y	Y	Y	500	Nil found	Poor-fair	Pink	OK	OK	OK		Normal for age/size (not yet emerged)
E-212184	34	Y	Y	Y	480	4 x lice	Poor	Pink	OK (downy)	OK	OK		Normal for age/size (just emerging)

See next page

* Faecals mostly collected from burrow chamber (difficult to extract from nest material)
** Lice specimens were collected and preserved from all birds with lice found
*** Condition of younger birds may improve as breast muscle mass develops?

Footnotes:

1. Chick from burrow 19 has an old break in right upper leg that has naturally reset; leg is mobile (and weaker than left) but foot does not open. Right wing is dropped and does not open/flex and very tip of upper mandible missing. Appears chick has been attacked earlier in life and recovered; growth is set back and the delayed fledging would undoubtedly be unsuccessful. Chick was covered in lice on 12/12 but none were found on inspection on 14/12.
2. Chick from burrow 28 was emaciated, becoming weak by 08/12/04, but picking up by 10/12 (after small watery feeds). Found dead 11/12/04. Lumpy light-brown faeces with cream-coloured urates in burrow on 10/12. Emerging before average size (wing length) and probably lost more down in the rain. Chick was not checked for parasites prior to death.
3. Chick from burrow 17 has left 2nd (longest) primary missing and an abnormally long right 2nd primary

Appendix 8: Transfer, emergence and fledging data for 40 grey-faced petrel chicks transferred to Matakoho-Limestone I. in December 2004

Band	Hen burrow	Limestone burrow	Transfer weight (g)	Transfer wing (mm)	Fledging weight (g)	Fledging wing (mm)	Date (pm) of first emergence	Date (pm) of fledging	Emergence period (nights)	Total no. days* on Limestone	Comments
E-212151	F5	1	370	226	460	307	16/12/2004	24/12/2004	9	24	condition (keel) – fair/good
E-212152	N2	2	410	238	475	320	14/12/2004	27/12/2004	14	27	condition – fair/good
E-212153	I2	3	360	174	490	302	16/12/2004	04/01/2005	17	35	condition – fair/good
E-212154	M1	4	540	202	530	307	13/12/2004	25/12/2004	13	25	condition – fair/good
E-212155	J1	5	660	176			05/12/2004	-			Died 06/12/04
E-212156	J2	6	400	170			-	-			Died 08/12/04
E-212157	B1	7	620	221	560	314	10/12/2004	29/12/2004	17	29	condition – fair/good
E-212158	J3	8	390	245	465	305	03/12/2004	16/12/2004	14	16	condition – good
E-212159	O1	9	580	181	600	318	23/12/2004	04/01/2005	13	35	condition – fair/good
E-212160	N1	10	390	227			03/12/2004	-			Died 08/12/04
E-212161	E2	11	380	249	460	300	03/12/2004	15/12/04	13	15	condition - fair
E-212162	H1	12	620	270	620	310	06/12/2004	15/12/04	10	15	condition - good
E-212163	K2	13	430	161			04/12/2004	-			Died 10/12/04
E-212164	L2	14	700	226	575	320	12/12/2004	26/12/2004	15	26	condition – fair/good
E-212165	G2	15	380	161			-	-			Died 09/12/04
E-212166	F1	16	360	169			-	-			Died 06/12/04
E-212167	J4	17	550	279	620	320	09/12/2004	22/12/2004	13	22	condition – fair/good
E-212168	F7	18	520	244	510	320	08/12/2004	25/12/2004	18	25	condition – fair/good
E-212191	I6	19	350	151			-	-			Died 24/12/2004 (euthanised)
E-212170	F6	20	270	163			-	-			Died 06/12/04
E-212171	I4	21	530	242	570	310	03/12/2004	21/12/2004	19	21	condition – good
E-212172	G1	22	600	224	600	295	09/12/2004	18/12/2004	9	18	condition – fair
E-212173	L1	23	470	163			04/12/2004	-			Died 08/12/04
E-212174	D1	24	470	165			14/12/2004	-			Died 06/01/05 (dehydration?)
E-212175	I1	25	590	198	570	318	09/12/2004	04/01/2005	27	35	condition – fair/good
E-212176	F2	26	430	228	575	310	03/12/2004	28/12/2004	26	28	condition – good
E-212177	E1	27	630	185	640	325	11/12/2004	08/01/2005	24	39	condition – good

Grey-faced petrel chicks on Matakohe-Limestone I. (Dec 2004)
(H. Gummer and C. Bishop)

Band	Hen burrow	Limestone burrow	Transfer weight (g)	Transfer wing (mm)	Fledging weight (g)	Fledging wing (mm)	Date (pm) of first emergence	Date (pm) of fledging	Emergence period (nights)	* Total no. days on Limestone	Comments
E-212178	I3	28	350	198			06/12/2004	-			Died 11/12/04
E-212179	E3	29	610	191	575	309	12/12/2004	04/01/2005	24	35	condition - good
E-212180	K5	30	500	227	580	318	08/12/2004	26/12/2004	17	26	condition – fair/good
E-212181	K6	31	430	210	520	310	14/12/2004	27/12/2004	14	27	condition - good
E-212182	I5	32	560	247	585	318	06/12/2004	18/12/2004	11	18	condition – poor/fair
E-212183	D3	33	410	214	580	310	13/12/2004	28/12/2004	16	28	condition – fair/good
E-212184	A1	34	400	208			08/12/2004	-			Died 21/12/2004
E-212185	K1	35	500	225	550	315	07/12/2004	23/12/2004	14	23	condition – fair
E-212186	N3	36	480	203			07/12/2004	-			missing – fledged/died ?
E-212187	F3	37	470	191	600	311	14/12/2004	29/12/2004	15	29	condition – fair/good
E-212188	K3	38	450	214	525	312	04/12/2004	26/12/2004	18	26	condition – poor/fair
E-212189	I7	39	510	209	600	308	15/12/2004	28/12/2004	14	28	condition – fair/good
E-212190	J5	40	460	172	540	315	14/12/2004	08/01/2005	23	39	condition - fair
Mean			478	206	555	312			16	26	
S.D			102	33	50	7			5	7	
Range			270-700	151-279	460-640	295-325			9-27	15-39	
Sample			n=40	n=40	n=27	n=27			n=27	n=27	

* Total number of days on Matakohe-Limestone I. included transfer day