

Second transfer of diving petrel chicks to Motuora (Gummer, Graham and Gardner-Gee, 2008).

Second transfer of common diving petrel chicks (*Pelecanoides urinatrix urinatrix*) from Wooded Island to Motuora in the Hauraki Gulf

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ABSTRACT

Sixty-six common diving petrel chicks *Pelecanoides urinatrix urinatrix* were transferred from Wooded Island to Motuora (Island) in two operations during November 2008 in the second year of a translocation project initiated and funded by the Motuora Restoration Society (MRS) and supported by the Department of Conservation (DOC).

Transferred chicks, 2–23 days from fledging, were housed in artificial burrows on Motuora. Blockade gates prevented chicks from leaving burrows prematurely, providing a familiarisation period at the new colony site. Removal of gates commenced on the day after the transfer and proceeded on an individual basis—based on wing length and growth rate, weight, and down coverage criteria—to ensure chicks were hand-fed right up to their departure in order to reach optimum fledging weights.

All chicks were hand-fed on a daily basis 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.

A total of 62 chicks (94% of chicks transferred) were presumed to have fledged successfully from the Motuora colony site; fledging condition suggested that all chicks had a high chance of post-fledging survival. These chicks departed at a mean weight exceeding previous diving petrel transfer average chick fledging weights, and stayed on Motuora for a mean period of 13 days, more than long enough to allow imprinting at the release location. The loss of a single chick within 12 h of arrival on Motuora was likely to be related to the stress and/or potential trauma associated with transfer conditions; pathology results were inconclusive. Aspiration pneumonia was considered to be the primary cause of death in two later chick mortalities. Kidney failure due to severe gout caused the death of a fourth chick.

1. Introduction

Common diving petrels (*Pelacanooides urinatrix*) are small (130 g, 20 cm), stocky, black and white petrels that have a rapid, direct flight, and dive frequently for krill and copepods, swimming underwater using their short wings for propulsion (Heather & Robertson, 2000).

Adults and juveniles are largely sedentary, staying over the New Zealand continental shelf waters near their breeding colonies and visiting burrows for 8–10 months of the year (Taylor, 2000). The timing of breeding varies considerably between the northern and southern populations. On islands off northern New Zealand diving petrels return to colonies from March onwards, burrow preparation activity peaks in late May, eggs are laid in August and chicks fledge in late November/early December (Heather & Robertson, 2000).

Diving petrels breed in burrows or cavities 0.25–1.5 m long in coastal slopes and cliffs, often under vegetation, and are nocturnal on land. They lay a single egg each season, which hatches after c.53 days (Heather & Robertson, 2000). The chick is brooded for 10–15 days and then fed nightly by both parents until fledging (Heather & Robertson, 2000; Miskelly & Taylor, 2004). Chicks fledge at 44–59 days old and generally fly out to sea on the first night that they emerge from the burrow (Miskelly & Taylor, 2004). Young birds return to their natal colony from 1 year old, but generally do not begin to breed until 2–3 years old (Heather & Robertson, 2000).

Surveys of key populations of the northern diving petrel (*Pelacanooides urinatrix urinatrix*) suggest that there are 100,000 to 150,000 breeding pairs (Taylor, 2000). The largest colonies are found on islands off Northland and in the Bay of Plenty, Sugarloaf Is. near New Plymouth, and on Brother and Trio Is. in the Cook Strait. The largest colony in the inner Hauraki Gulf is on Wooded I. (0.95 ha) lying 200 m off the northern coast of Tiritiri Matangi Island (Taylor & Tennyson, 1999). The southern and subantarctic subspecies have larger populations, with millions of pairs estimated to be breeding on islands off Stewart I., the Chathams Is., and in the subantarctic.

Northern common diving petrels have been the subject of a previous translocation project led by the Department of Conservation on Mana I. in the Cook Strait (Miskelly & Taylor, 2004). A total of 243 chicks, up to 6 weeks from fledging, were transferred from Brothers I. (Cook Strait) and Sugarloaf I. (Taranaki) to Mana I. (Cook Strait), from 1997 to 1999; they were housed in artificial burrows and hand-fed a diet based of frozen krill with added supplements. Fledging success was reported as 48%, with at least 20 of the 116 chicks that fledged returning to Mana I. by 2003 and a colony of 15 breeding pairs (including immigrants) recorded by 2002 which has subsequently expanded. Two-year-old birds were reported as breeding. Returning chicks had fledged at the heavier end of the fledging weight range for this species, and were recorded as spending as little as 2 nights on Mana I. prior to fledging. Average fledging weight was 117.6 g (range 83–145 g) (Appendix 1). Chicks stayed on Mana I. for an average of 16 nights (range 0–44 nights) prior to fledging.

Artificial diets for hand-feeding translocated petrels and shearwaters—species that naturally feed on predominantly fish, squid or krill—have since been developed and tested, with tinned sardines proving to be the most practical and effective option to date. Chicks of eight species fed sardines in soya oil appeared to fledge in excellent condition, and chicks of four of these species involved in the early translocation projects are now known to have survived and returned to colony sites as adults. Tinned sardines were considered suitable for diving petrels following the successful fledging results, and return as adults, of translocated fairy prions (*Pachyptila turtur*), another krill-feeding species.

The 2008 diving petrel transfer to Motuora is the second stage in a 3–4 year project in which MRS plans to translocate up to 200 chicks to establish a new colony of the species. A transfer of

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30 birds in 2007 allowed managers to: define optimum chick selection criteria; refine transfer methodology; determine the suitability of Brunswick™ tinned sardines in soya oil as an artificial diet for feeding chicks of this species to fledging; identify appropriate meal sizes and feeding frequency using this diet (for chicks up to 9 days from fledging); and develop criteria for burrow blockade gate removal at the release site. A sound system broadcasting diving petrel calls was installed at the artificial colony site in March 2008, to attract passing adults at sea.

Based on the time of return of adult diving petrels to Mana I., the first birds may have begun returning to Motuora in spring 2008 as 1-year-olds, although a higher proportion are more likely to be found in their second year in 2009. Two-year-olds can be expected to commence breeding during the 2009/10 season, although breeding at the site may occur earlier if immigrants arrive at the colony site before returning chicks.

The main aims for the 2008 transfer were to:

- Locate up to 60 healthy diving petrel chicks (fitting predetermined weight and wing length criteria) on Wooded I. and transfer them to artificial burrows on Motuora in two operations.
- Hand-feed all chicks on a daily basis (including transfer day) to maintain or improve weight and to further any growth and plumage development, ensuring chicks have adequate reserves for fledging.
- Determine an appropriate feeding regime (i.e. daily meal size) for younger chicks hand-fed for up to 3 weeks at the release site.
- Monitor all chicks/burrows daily to determine patterns in weight change and feather (wing) growth, and to record key behavioural events (emergence and fledging).

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2. Methods/Results

All methods were based on recommendations made in the 2007 transfer (Gummer and Gardner-Gee, 2007), refining techniques used in other seabird transfers within New Zealand, and incorporating recommendations made by G. Taylor and C. Miskelly (pers. comm., 2007). Equipment used, and additional items required for the 2008 transfer, are listed in Appendix 2.

2.1 Burrow assessment on Wooded I.

Wooded I. was revisited on 8 March 2008 in order to fix tunnels to boxes so that they could not drift (or be pulled out by pukekos) from boxes. Twenty-five boxes already in the ground were cleared, tunnels fixed in place with rapid drying glue, and stones placed on both lids and tunnels to reduce pukeko disturbance. No boxes showed any sign of use, nor was there any sign of excavation at recent burrows. No adult birds were seen.

An additional 11 boxes were installed during the visit into an area without any burrows, to see if birds would begin to use the boxes provided. All loose ply and material was collected and either removed from the island or stored for the 2008 collection trips.

During this March visit, it was clear that there had been much activity around the marked burrows, such that many were no longer obvious. No attempt was made to relocate these marked burrows, or uncover tapes and rocks marking burrows. This would have been very time consuming, and marked tapes would only get reburied again in the months before the next collection trip.

2.2 Collection of chicks from Wooded I.

Based on recommendations made after the 2007 transfer (Gummer and Gardner-Gee, 2007), the first 2008 transfer (30 chicks) was planned for 13 November 2008 as it was predicted that the greatest number of suitable chicks was likely to be located around this date. To minimise overall disturbance to the Wooded I. colony, a single combined and intensified selection and collection trip was planned to commence 6 days prior to the scheduled first transfer day.

A second transfer (a further 30 chicks) was planned to occur 9 days later. By transferring birds in two operations, the duration of each transfer could be reduced, with the aim of minimising the risk of chick deaths through stress and dehydration. Accommodation on Tiritiri Matangi for both expeditions was booked 9 months in advance.

2.2.1 Search time

The two collection teams visiting Wooded I. were limited to five people per team to minimise damage to burrows.

The first collection team (Transfer 1)—Sharen Graham, Richard Griffiths (DOC), Deane Williams, Su Sinclair and Melanie Duplain—came ashore at the west landing on Wooded I. using the Tiritiri aluminium dinghy with outboard motor on the afternoon of 8 November. Access to the top plateau was via the old 'ridge track' that was first cleared of dead boxthorn. The west landing and ridge track were used on all subsequent visits by this collection team. Searching for chicks commenced on the plateau area and progressively expanded to cover burrows on each of the slopes with methodical checking of all burrows for 6.5 hours.

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Eleven hours were spent searching on 10 November, and 8 hours on 11 November. Poor weather conditions meant that landing was not feasible on 9 November. This allowed up to 3 days (127.5 total person hours) to select chicks from known burrows marked in 2007, and to find additional chicks in unmarked burrows.

Team 1 located 92 chicks; 62 chicks were marked as suitable for transfer (44 for Transfer 1 and 18 for Transfer 2). This means, as predicted, that it took approx. 2 person-hours to find each suitable chick. Refer Appendix 3 for summary table of occupied burrows found.

The second collection team (Transfer 2)—Robin Gardner-Gee, Sharen Graham, Elizabeth Milne (SOTM), Peter Wilson and Andrea Ravenscroft—assembled on Tiritiri Matangi on 17 November, but was unable to reach Wooded I. until 18 November due to high winds. On 18 and 19 November the party reached Wooded I. at 8 am each day, using the east landing. The party departed 6–6.30 pm on both days. During these 2 days (approx. 80 person hours of searching) approx. 180 additional burrows were inspected on the eastern and northern flanks of the island.

Team 2 located a total of 46 chicks (Appendix 3). The location of a further 48 remaining chicks (i.e. those not designated for Transfer 1) were also known from the first collection trip. The size range of these 94 birds is given below (Table 1).

Table 1. Expected wing lengths on 21 November 2008 for 94 Wooded I. diving petrel chicks, based on a daily wing growth rate of 2.7 mm.

Expected wing length on 21/11/08	<85 mm	85-94 mm	95-99 mm	100-120 mm	121-125 mm	>126 mm
No. chicks	36	6	7	24	7	14

2.2.2 Chick search methods

Methods used to search and mark burrows, and select chicks suitable for Transfer 1 are detailed in Appendix 4, along with selection criteria used.

Transfer 2 search methods were the same as those outlined for Transfer 1, but selection criteria and burrow marking methods were revised for Transfer 2 as it was decided to focus on older birds (to reduce chick management period on Moutora). These are also detailed in Appendix 4.

2.2.3 Inspecting marked burrows

Only 41 of the 131 burrows located and marked in 2007 were relocated in 2008 (31% of all 2007 marked burrows). Of these, 16 were artificial boxes (70% of the 23 boxes installed in 2007) and 25 were natural burrows (24% of all the natural burrows marked). In addition, 19 of the 41 marked burrows were found to be empty, three contained adults only and one had been taken over by a fluttering shearwater.

Only 18 of the relocated burrows were recorded with evidence of breeding (14% of all 2007 marked burrows inspected); chicks were found in all of these (8 boxes; 10 natural burrows), and eight were transferred to Motuora (Appendix 3a).

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Of the 11 artificial burrows installed in unoccupied areas on top of the plateau in March 2008, only one of these was occupied by breeders (Appendix 3b). The tunnel access to many of the others had been blocked through digging activity.

2.2.4 Inspecting unmarked burrows

A total of 269 new burrows were found and inspected in November 2008. Of these, 217 were given new numbers and flagged, although only 142 burrows showed evidence of diving petrel activity; 90 burrows were recorded as being empty, 23 were recorded with unknown content because the chamber was never actually reached, and 14 contained chicks or adults of other species (fluttering shearwaters and a single penguin).

At least 124 of the burrows found this year were known to have breeding activity, and 116 (43% of all new burrows inspected) contained chicks of which 58 were transferred to Motuora (Appendix 3c).

2.2.5 Transfer day 1 (13 November)

The initial aim was to transfer 30 chicks in Transfer 1. However, as plenty of suitable chicks had been located by the end of searching on 11 November, it was decided to transfer up to 40 chicks, provided that all chicks met weight/wing length criteria, and that transfer protocols were adhered to (in particular that the chick collection was completed by 11 am to ensure the chicks were collected and transported to Motuora before the heat of the day).

Transfer 1 collection team arrived on the western side of Wooded I. around 7.30 am on 13 November. Four people retrieved the suitable chicks from marked burrow sites and assessed the suitability of marginal chicks (very close to fledging). Burrow number, band and time of collection for each chick were recorded on transfer box lids by Helen Lindsay. All this information was then handwritten onto a master sheet that accompanied the birds to Motuora. Once full (four birds per box), transfer boxes were carried down the ridge track to west landing where they were placed in deep shade beside a rock face. Otherwise, methods used on transfer day are as detailed in Appendix 5.

Of 44 burrows previously identified as containing chicks potentially suitable for Transfer 1, only 39 chicks were relocated on the transfer day—the other five birds had either fledged overnight or wandered away from their natal burrows. The first transferable chick was collected at 7:35 am and the last chick removed from its burrow at 10:10 am. The aluminium dinghy was loaded at around 10.30 am to ferry boxes to a Reubens water taxi where they were placed inside the cabin for the direct sea journey to Motuora (approx. ½ hour).

Weights and wing lengths of 39 chicks on the morning of Transfer 1 are recorded in Appendix 5. Chicks weighed a mean of 168.4 g (n=39; S.D. 12.8 g; range 132–199 g), and had wings measuring a mean of 96.6 mm (n=20; S.D. 12.5 mm; range 81–120 mm). Wing lengths of 19 chicks were recorded as being over 5 mm shorter than their likely straightened and flattened length (variation in measuring experience of collectors) when compared to HG wing measurements taken on the day after transfer on Motuora (allowing for 2–3 mm growth over that 24 hr period). If these measurements are changed to more probable estimates, the mean wing length is 97.2 mm (n=39; S.D. 9.6; range 81–120 mm).

2.2.6 Transfer 2 (21 November)

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The second transfer was planned for 22 November but as poor weather (35 knot NE winds) was forecast for this day it was decided to bring the transfer forward to 21 November. The collection criterion were also changed for the second transfer (refer Appendix 4) as the decision was made to select older birds (ideally with wing lengths of 100–120 mm that would spend approx. 1–2 weeks on Motuora) in order to reduce the feeding time necessary on Motuora.

The initial aim of the second transfer was to take 30 chicks to Motuora. However, as the first transfer had already successfully moved 39 chicks, there were fewer artificial burrows available on Motuora for use than expected. Twenty seven burrows were available on 21 November, so 38 chicks of the 96 known chicks were identified as potential transfer candidates: 24 had wing lengths predicted to be 100–120 on transfer day; seven were older birds with predicted wing length over 120 mm that would require reassessment on transfer day; and seven were younger birds with predicted wing lengths of 95–99 mm that would also need to be reassessed on transfer day. Chicks were assigned to the three people who had found the burrows initially, and notebooks were drawn up the night before with a list of the chicks each person needed to relocate. Notebooks also listed the expected wing length of each chick (to help prioritise burrow searching on transfer day), burrow location, burrow type and any notes recorded about access.

Transfer 2 collection team arrived on the western side of Wooded I. (calm, clear weather) around 7.30 am on 21 November. Three people (RGG, SG, EM) retrieved the suitable chicks from marked burrow sites and assessed the suitability of marginal chicks (very close to fledging). Burrow number, weight, wing length, band and time of collection for each chick were recorded on transfer box lids by collectors. This information was transferred to a master list by AR who kept a running tally of the number of chicks collected and kept the three collectors informed of the tally. AR also shifted each box from the top plateau as soon as it was full and carried it down the ridge track to west landing where they were placed in deep shade beside a rock face.

Thirty of the 38 selected burrows were rechecked on transfer day. Three of the thirty burrows were empty on transfer day; presumably the chicks had either fledged overnight or wandered. Chicks were found in the remaining 27 burrows and all were suitable for transfer.

The first transferable chick was collected at 8.00 am and the last chick removed from its burrow at 10:26 am. The aluminium dinghy (operated by PW) was used to ferry boxes to a DOC boat where they were placed inside the cabin for the direct sea journey to Motuora (approx. ½ hour). The chicks and half the transfer party left Wooded I. for Motuora at approx. 11 am. The remainder of the party made their way back to Tiritiri Matangi by dinghy and returned to Auckland later in the day by ferry.

Weights and wing lengths of 27 chicks on the morning of Transfer 2 are recorded in Appendix 5. Chicks weighed a mean of 164.9 g (n=27; S.D. 12.3 g; range 141–190 g), and had wings measuring a mean of 110.9 mm (n=25; S.D. 6.8 mm; range 100–122 mm).

The mean weight of all 66 transferred chicks (Transfers 1 & 2) was 167.0 g (S.D. 12.7 g; range 132–199 g). The mean wing length of chicks from both transfers was 104.6 mm (n=45; S.D. 12.1 mm; range 81–122 mm), or 102.8 mm ± 10.8 mm (n=66, with estimates included).

2.3 Preparation of Motuora artificial colony site

The diving petrel colony site created in September 2007 was extended by 20 burrows in October 2008 to provide accommodation for up to 62 chicks at any one time. Burrows were of the same design: 110 mm (external diameter) Novapipe tunnels leading to chambers made of treated

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timber, set into a sloping bank, with tunnels set in trenches and entrances concealed below ground level. Chambers consisted of three wooden walls, with the rear wall left as soil to allow adult birds the option to extend burrows further into the bank. Thick wooden chamber roofs were hinged: the front half of the lid easily opens/closes and the back half remains buried beneath turf to optimise insulation. An approximate volume of 10 L of coarse beach sand was added to the floor of each chamber (up to the lower edge of the walls) to a depth of 100 mm, and under the Novapipe to provide drainage. Refer Gardner-Gee & Brown (2007, unpubl. report) for construction details.

The 42 existing artificial burrows were made ready by hand weeding (mostly pulling of kikuyu grass roots/shoots from inside chambers). Throughout the year they were inspected regularly by the resident rangers for any sign of occupation. No occupation was observed.

The person contracted to manage the chick-feeding (HG) arrived on Motuora on the afternoon of 11 November, and two volunteers on the morning of 12 November, allowing a full day for preparations. Scrapes were made in the sand floors of the burrows and lined with a layer of dry grass as nesting material, and blockade gates were firmly installed at entrances. These consisted of plastic coated chicken mesh (<15 mm diameter to prevent diving petrel heads pushing through) anchored flush to the whole pipe entrance with a no. 8 wire hoop and three 300 mm long stakes. The stakes were driven into the ground so that the tops of the rods were flush with the hoop or soil level i.e. not presenting a hazard to chicks exploring on the surface.

A minimum of two plastic potting-mix sacks, one-third filled with beach sand, were placed on top of each burrow to improve insulation in an effort to keep the burrows as cool as possible inside during the day. Three sacks were placed on new burrows 43–62 to provide extra protection from rain.

Benches inside the feeding shed were cleaned and disinfected with Virkon.

2.4 Arrival of chicks on Motuora

Transfer 1 chicks arrived at Motuora shortly before 11 am on 13 November, accompanied by DW. Chicks were taken ashore via the inflatable. All 10 boxes were carried immediately to a well-ventilated, shady area by the potting shed where they were opened so that the welfare of each chick could be assessed. All 39 chicks were found to be alive and well on arrival. During the inspection, the most advanced chicks (visual assessment of plumage only) were indicated by marking the top of the box so that these chicks could later be easily retrieved and placed into burrows that were considered to be the most vulnerable to flooding in heavy rain (as listed in Gummer and Gardner-Gee, 2007).

Conditions were overcast and not excessively hot, so chicks were carried immediately up to the colony site and placed in the shade by the feeding shed. A team of three (contractor and two volunteers) commenced the processing of chicks at around 11.30 am. Each bird was re-weighed (to obtain a pre-feed weight) before being fed up to 10 mL of sardine puree (slightly more watery than the standard mix). Refer Section 2.5 for techniques used. For most other transferred seabird species, a drink of water is usually sufficient on the transfer day, with the first meal delivered on the following day. However, feeding diving petrel chicks on the day of transfer is considered important as they process food very quickly (chicks fed nightly by both parents): delaying this introductory meal can set chicks back with weights becoming more difficult to maintain and any weight gains slower to achieve.

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Chicks were then carried to burrows in a small carry-box and placed into the back of numbered established burrows (1 to 42) with blockade gates firmly installed at tunnel entrances. Burrow and band number data were recorded. Six of the most advanced chicks were placed into six of the nine damper burrows (10, 11, 15, 23, 36, 37); the other three damp burrows were left vacant (38, 39, 40). The last chick was installed in its burrow at 3:00 pm.

All 23 unoccupied burrows at the colony site were left without gates, allowing additional vacant burrows for birds in the first transfer 2008 cohort to explore if required.

Transfer 2 chicks arrived at Motuora at approximately 11.30 am on 21 November, accompanied by RGG, SG and HL. Chicks were taken ashore via the inflatable. All seven boxes were carried immediately to a well-ventilated, shady area by the potting shed where they were opened so that the welfare of each chick could be assessed. All 27 chicks were found to be alive and well on arrival. The most advanced chicks were indicated by marking the top of the box so that these chicks could later be easily retrieved and placed into burrows that were considered to be the most vulnerable to flooding in heavy rain, or into burrows that had only recently been vacated by Transfer 1 chicks (38, 39, 40, 10(b), 15(b), 23(b), 36(b)).

Conditions were hot (clear, calm weather), so the chicks were transported to the colony site with white plastic covers draped loosely over the black transfer boxes to reflect the light and heat. Boxes were placed in deep shade under the *Macrocarpa* trees by the feeding shed where a sea breeze helped to keep them cool. Feeding of Transfer 2 chicks began at approximately 12.40 pm.

2.5 Hand-feeding chicks

Chicks were fed a diet of tinned Brunswick™ Canadian sardines containing 89% fish, 10% soya oil and <1% salt. Recipe and food preparation methods are detailed in Appendix 6. Equipment required for daily feeding is listed in Appendix 7. Post-feeding clean-up routines are described in Appendix 8.

A total of 192 tins of sardines was prepared and a total of 768 meals delivered to chicks (Table 2). Food delivery methods and hygiene measures are detailed in Appendix 9 along with the process followed on feeding days for monitoring chick weight, wing length and emergence behaviour.

Chicks were hand-fed with the aim of reaching a mean fledging weight similar to, or greater than that achieved in the 2007 transfer (i.e. ≥ 133 g), and aiming to fledge all chicks >110 g (based on the minimum fledging weight of chicks that fledged from Mana I. and are known to have survived and returned as adults).

Chicks were fed once per day (around the same time each day) using the following feeding regime (adapted from the fairy prion transfers and trialled with diving petrels in 2007):

- Day 1: 10 mL (1 can sardines 106 g : 75 ml water)
- Day 2: 15 mL (1 can sardines 106 g : 50 mL water from here on)
- Day 3: 20 mL
- Day 4: 25 mL
- Day 5: 25 mL
- Day 6: 30 mL (Transfer 1 chicks) or 25 mL (Transfer 2 chicks)
- Day 7 onwards: Meal sizes varied around the 25–30 mL volume to attain an approx. 2–4 g weight gain per chick per day (younger chicks), or maintain weight only (more advanced chicks). Volumes ≥ 30 mL were not fed to chicks weighing <120 g nett weight

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as it is not ideal to deliver meals amounting to roughly a quarter of a bird's body weight, of artificial food, in such a short period of time on a daily basis.

Feeding of chicks took three people 3–4 hours (actual feeding/processing time) to complete when all 39 Transfer 1 chicks were present. The feeding team generally left the potting shed at 8.30 am after food preparation, and feeding tended to commence between 9.00 and 9.30 am following the chick roll-call. With the arrival of 27 Transfer 2 chicks, two feeding teams operated, with feeding of over 60 chicks completed within around 4 hours. The second feeding team departed Motuora on 26 November, leaving a single team of three people to feed 46 chicks, taking around 4–5 hours until numbers declined.

This year, there were many chicks transferred that were around 3 weeks from fledging. These young chicks were a little tricky to feed to begin with as the Teflon crop-tube size was relatively large relative to bill size, but food delivery was still achievable using this apparatus. Good feeders required at least one break in the middle of a meal; difficult feeders required several breaks (e.g. every 5–10 mL).

Some chicks close to departing also showed a noticeable resistance to feeding, with food delivery slow (small amounts at a time with rests). In these instances, meal sizes were gradually reduced (5 g increments), particularly when chicks showed signs of overflowing during feeding, and were not emerging from burrows, and wings had stopped growing. In general, the longer the chick resided on Motuora, the more likely it was that meal size had to decrease closer to fledging. (Most of the earlier chicks to fledge were easily fed 25 and 30 mL right up until departure.)

No regurgitation incidences were recorded throughout the entire project, although some of the difficult feeders overflowed during food delivery, losing a small proportion of their meal, and one chick brought up a little pure oil (refer Section 2.9).

TABLE 2: NUMBER OF TINS OF SARDINES (106 g) USED TO FEED DIVING PETREL CHICKS ON MOTUORA FROM 13 NOVEMBER TO 6 DECEMBER 2008

	Feeding day																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Chicks fed	39	38	36	36	36	36	36	35	61	61	59	57	56	50	46	45	37	27
Tins used*	6	7	8	9	9	10	9	9	13	13	12	13	14	14	11	10	10	9

	Feeding day							
	19	20	21	22	23	24		
Chicks fed	20	18	12	10	6	2	Total no. chicks meals: 768	
Tins used*	8	6	4	3**	3**	3**	Total no. tins used: 192	

* Food amounts include roughly 1 spare pottle of food leftover (to allow for spillages etc.).

** Minimum blend: 3 tins.

2.6 Blockade gate removal

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Blockade gates were removed on an individual basis with the aim of preventing chicks disappearing prematurely, ensuring all chicks could be fed and reach optimum fledging weights. No gates were removed on the chicks' first night on Motuora. The first two gates were removed on the second night following the transfer (14 November). Gates were removed on an individual basis, based on a combination of factors.

Consistent wing measuring by one person (HG) was largely achievable, so gate removal could occur when chick wings had either stopped growing or slowed to ≤ 1 mm/day AND there was $\leq 5\%$ down coverage. Towards the end of the project, in some cases gates were removed when chicks had $>5\%$ down cover (but usually $<15\%$) because wing growth had clearly ceased and/or there was evidence of chick restlessness (e.g. found in tunnel, or digging). Gates were generally not removed if chicks were still growing at a faster rate than 1 mm/day (i.e. 2 mm/day).

Gates were also removed if there was evidence of digging at the entrance of burrows housing generally advanced chicks. Gates were only removed from burrows where chicks were regularly found in the tunnel if the chick was considered to be close to fledging. (In many cases chicks sitting in tunnels did not seem ready to depart; they may have found discomfort for some reason in the chamber, e.g. ants, sloping chamber floor etc.)

Initially gate removal tended to occur in the early evening (prior to dusk) to prevent any restless, or less settled (e.g. recently transferred) chicks wandering out of burrows during the day after handling and feeding. Later, gate removal occurred at the end of the feeding process.

A total of three chicks were found in burrows other than their own during the morning roll-call. The chick from Burrow 9 was found once in another burrow in the same row 2–3 m away; the chick from Burrow 16 moved three times to a burrow next door and a burrow nearby in the row below; and the chick from Burrow 22(b) moved to a burrow 2–3 m away in the row below.

2.7 Daily chick monitoring

Chicks were weighed daily before feeding to identify weight gain or loss, which influenced meal size to be delivered. Wings were measured every third day for younger chicks, and then daily for more advanced chicks (≥ 120 mm) to obtain a clear picture on individual growth rates so that gate removal could be scheduled (gate removal was mostly based on this daily measure together with down coverage). Weights and wing-lengths continued to be recorded daily once gates were removed to obtain accurate fledging data. Refer Appendix 9 for methods.

Down coverage was estimated roughly every 5 days, then every few days until departure, to aid with scheduling gate removal. Down cover percentage was mainly used as a cue to preventing premature blockade gate removal; chicks with $\geq 5\%$ estimated cover were prevented from departing as in most cases the wing feathers were still growing.

2.8 Daily burrow monitoring

Burrows were monitored daily to determine potential emergence periods and fledging dates (refer Appendix 9 for methods). Any emergence behaviour was monitored by recording the daily status (intact or knocked down) of 3-stick fences placed at burrow entrances once blockade gates were removed. Fledging dates were recorded as the day before the night of departure; burrows were found to be empty on the following morning. Refer Section 2.10 for fledging data.

Second transfer of diving petrel chicks to Motuora (Gummer, Graham and Gardner-Gee, 2008).

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 presence of faeces of normal appearance following the transition onto the artificial diet. No regurgitation was found in any burrows and chicks were all observed as excreting waste matter during the transition onto the sardine diet.

Regular inspections of burrows are also necessary to check for build up of waste matter and the presence of maggots (which need to be removed). Burrows of Transfer 1 chicks were cleaned (soiled nest material replaced with new dry grass) around 10 days following transfer and burrows of the younger Transfer 2 chicks cleaned around 1 week following transfer. Nest material removal was avoided in burrows of birds close to fledging so as not to remove the scent associated with that individual burrow.

A single chick (from Burrow 61) was moved to Burrow 22(b) when there were large numbers of ants found at its original burrow.

2.9 Chick health and mortality

All chicks appeared in good condition on arrival to Motuora. Lice were observed on quite a few birds at low levels, and on a few individuals in relatively higher levels—these were most apparent on hot days and were seen crawling through head feathers (e.g. 10 or so lice seen at a time). Birds afflicted with higher loadings of these external parasites were otherwise in good condition with good body weights. The burrow contents (grass and sand) of one affected chick were often found to be churned up as if the chick had been extremely restless within the chamber. Refer Discussion.

Some chicks developed slightly scruffy plumage as a result of resting against the back mud wall of the artificial burrows on Motuora; this occurred most commonly in the more recently constructed burrows that were damper within. Grass nests often repeatedly had to be pushed up the rear wall in an attempt to prevent this. One chick frequently developed a build up of dried mud on its bill that had to be regularly broken off.

The only other health issue to report is related to chick excrement colour in the latter part of the project. Four chicks were reported as passing waste with a noticeable bright green tinge; two chicks were part of the Transfer 1 cohort (Burrow 35 observed by HG; Burrow 4 by DW/AR), and two were Transfer 2 birds (Burrows 45 and 62 observed by DW/AR). All were hand-fed for between 2 and 3 weeks. Refer Discussion.

A total of four chicks died on Motuora; details are as follows:

- Chick A: D-190818 (Burrow 29; Transfer 1)
Chick found on the morning of 14 November (day after first transfer) in the chamber. There was no concern about this chick on the transfer day, and it was recorded as feeding well (10 mL introductory feed). There was no sign of regurgitation in the burrow or around the chick's face. No excrement could be found inside the burrow (it may have been present but concealed on the rear wall). Refer Discussion and Recommendations.

Refer Appendix 11a for preliminary pathology report.

Pathology report summary: Inconclusive as to cause of death, although there was some evidence of minor trauma prior to death.

- Chick B: D-191012 (Burrow 5; Transfer 1)

Second transfer of diving petrel chicks to Motuora (Gummer, Graham and Gardner-Gee, 2008).

Chick found in tunnel during roll-call on 30 November. Again, there had been no cause for concern with this chick; it had been feeding well for over 2 weeks. There was no sign of regurgitation in the burrow, and no sign of digging at the entrance (refer Discussion and Recommendations).

Refer Appendix 11b for preliminary pathology report.

Pathology report summary: Evidence of both aspiration pneumonia (through aspirating food material) and kidney disease.

- Chick C: D-190702 (Burrow 44; Transfer 2)
Chick found dead in burrow around 1.30 pm on 30 November. It had been fed over an hour prior to this and had seemed lethargic and quiet. The chick took 14 mL of food, but feeding stopped when a small amount of oil (with greenish tinge) came up the throat—previously not seen in any other birds. This is most likely to have been the soya oil component of the diet and is an indication that the bird was full and probably over-fed. (Its small wing size confirmed this bird as a smaller individual.) The 5 g increase in weight from 29 to 30 November may also indicate that not all of the previous meal had been digested. In addition, no faeces were found in the burrow, although this had recently been cleaned (nest material changed). Refer Discussion and Recommendations.

Refer Appendix 11c for preliminary pathology report.

Pathology report summary: Died of kidney failure.

- Chick D: D-190717 (Burrow 59; Transfer 2)
Chick found dead, face down and wings outstretched, on the ground 3 m from the burrow entrance on 30 November. Maggots were already on the corpse (in the sun). Body weight indicated that some of the previous meal had been processed. The chick had been feeding well and appeared healthy; although on reflection, there was a large leap in weight from 137 g to 144 g on 29 November—a likely indicator of overfeeding—and this bird should perhaps have received less food on the 29th (refer Discussion and Recommendations).

Refer Appendix 11d for preliminary pathology report.

Pathology report summary: Died due to aspirating food material (aspiration pneumonia).

Procedures for all chick corpses were followed as detailed in Appendix 10 (no swabs for microorganism culture taken). Because one chick was found on Friday (14 November), there was a delay in sending it for *post mortem*; it was kept chilled (not frozen) over the weekend, sent off Motuora on Sunday night, and couriered to Massey University on Monday for arrival on Tuesday 18 November. The other three chicks were sent off the island on Sunday afternoon (the day corpses were found) and couriered to Massey on the following day for arrival on Tuesday 2 Dec.

2.10 Fledging dates

Sixty-two chicks (94% of chicks transferred) were presumed to have fledged successfully from the Motuora colony site. Fledging dates, duration on Motuora and emergence periods are given for each chick in Appendix 5. Chicks were recorded as departing the colony from 14 November (two chicks), with the last (two chicks) fledging on the night of 6 December. The last Transfer 1 chick fledged only a night before the last Transfer 2 chicks (i.e. on 5 December).

Second transfer of diving petrel chicks to Motuora (Gummer, Graham and Gardner-Gee, 2008).

Transfer 1 chicks (n=37) spent a mean of 15.8 days on the island (S.D. 5.0 days; range 2–23 days), departing the colony site following a mean emergence period of 1.9 nights (S.D. 1.3 nights; range 1–5 nights). Only three chicks spent less than 1 week at the release site.

Transfer 2 chicks (n=25) spent a mean of 9.6 days on the island (S.D. 4.2 days; range 2–16 days), departing the colony site following a mean emergence period of 1.6 nights (S.D. 0.9 nights; range 1–4 nights). Only eight chicks spent less than 1 week at the release site.

Together, all 62 fledging chicks spent a mean of 13.3 days on Motuora (S.D. 5.6 days; range 2–23 days) following a mean emergence period, on the surface prior to fledging, of 1.8 nights (S.D. 1.2 nights; range 1–5 nights). Note that 36 chicks fledged on the night that the gate was removed for the first time; these chicks may have had departure slightly delayed in favour of getting the birds away at good weights with minimal, or no wing growth to complete at sea after fledging. A total of 11 chicks spent less than 1 week at the release site.

2.11 Fledging weights and wing lengths

All 62 chicks that fledged successfully from the Motuora colony site were considered to have a good chance of post-fledging survival. Fledging weights and wing lengths are detailed for each chick in Appendix 5, as recorded on the day before the night of chick departure.

Transfer 1 chicks (n=37) fledged with mean weight and wing length of 136.9 g (S.D. 8.5 g; range 112–150 g; median 138 g) and 124.8 mm (S.D. 3.4 mm; range 118–132 mm) respectively. Nineteen of these chicks fledged when their wings appeared to have completed growth (same measurement for 2 or more days in succession) and 17 chicks departed with wing growth reduced to ≤ 1 mm/day. Only a single Transfer 1 chick fledged when its wing was known to be still growing at up to 2 mm/day.

Transfer 2 chicks (n=25) fledged with mean weight and wing length of 133.8 g (S.D. 7.3 g; range 116–149 g) and 125.0 mm (S.D. 2.2 mm; range 121–129 mm) respectively. Ten of these chicks fledged when their wings appeared to have completed growth (same measurement for 2 or more days in succession) and 14 chicks departed with wing growth reduced to ≤ 1 mm/day. Only a single Transfer 2 chick fledged when its wing was known to be still growing at up to 2 mm/day.

Together, all 62 fledging chicks departed at the following: mean weight 135.6 g (S.D. 8.1 g; range 112–150 g); mean wing length 124.9 mm (S.D. 2.9 mm; range 118–132 mm).

3. Discussion

3.1 Monitoring for returning adults

There was no evidence of any diving petrels using artificial burrows on Motuora prior to the 2008 transfers. The sound system has been operating at a very low volume, so it is also unlikely that any new immigrants would have been attracted into the site. Most diving petrels commence breeding at 2-3 years, so the chicks fledged in 2007 are likely to begin returning in 2009, hence more intensive monitoring is recommended for 2009 onwards (refer Recommendations).

3.2 Source colony

Second transfer of diving petrel chicks to Motuora (Gummer, Graham and Gardner-Gee, 2008).

A total of 310 burrows were inspected this year on Wooded I. during the chick selection and collection trips, with only 13% of these being burrows that were first found in 2007; 87% were new burrows found in 2008. It is likely that many of the "new burrows" found in 2008 were actually examined in 2007 but the 2007 flags were unable to be located (lost, buried, or moved).

Altogether, 134 chicks were found, and over half of these were deemed suitable for transfer on the planned transfer dates. With the number of suitable diving petrel chicks available for the first transfer exceeding expectations, the number of chicks in the Transfer 1 cohort was increased from the recommended 30 birds to 39 chicks. This meant that fewer birds (27) were collected during Transfer 2, with the final number of chicks dictated by burrow availability on Motuora.

In total, 12% of chicks transferred in 2008 came from marked burrows found in 2007, and 88% of transferred chicks came from burrows found in the 2008 search effort. This is likely to be a similar scenario in 2009, so it is worth continuing to plan a search period that allows up to 2 person-hours to find each suitable chick for subsequent transfers.

It is still worth continuing to install artificial burrows at fragile burrows as required; boxes have been accepted by many birds and it was encouraging to see that 35% of all boxes installed in 2007 contained chicks this year, and that one of the recently installed 'vacant' boxes in a generally unoccupied area had been claimed by a breeding pair.

Providing similar timing and methodology is followed, it seems likely that at least 60 suitable chicks will be found on Wooded I. for the planned 2009 transfer. A target of up to 80 chicks in 2009 could be realistic, especially if the first transfer cohort contains a larger proportion of chicks <1 week from fledging—this year only three of the Transfer 1 chicks had departed before the Transfer 2 chicks arrived. To get a population established, it is advantageous to get as many birds returning simultaneously as possible, and so the larger the cohort, the higher the chance of birds encountering other birds on their return as adults (C. Miskelly, pers. comm.).

Since quality chicks are being transferred and fledging from Motuora (86 chicks over 2007–08), we may have fledged sufficient numbers over 3 years for the project to be successful without the need for a fourth transfer (i.e. fourth year of disturbance to the Wooded I. colony). If we succeed with 60 chicks in 2009, we will exceed the chick numbers (116) fledging from Mana I. where a colony has successfully established. However, to transfer as many as we safely can in the third year will further increase the success of the project.

3.3 Chick transfer

Both transfers were well-coordinated and went smoothly, and in addition we were lucky to experience favourable weather conditions for boating on both occasions.

A single chick was found dead on the day after transfer in its Motuora burrow. Unfortunately, the chick was found on a Friday, so fast transport to Massey University for *post mortem* was logistically difficult. The fact that only one mortality occurred around the time of transfer is a reflection that the transfer techniques worked well this year, and that any issues encountered in 2007 associated with overheating and dehydration have been resolved. Loss of a single chick at transfer is an acceptable result given the number of birds transferred and the hot conditions at the location.

3.4 Hand-feeding chicks

Second transfer of diving petrel chicks to Motuora (Gummer, Graham and Gardner-Gee, 2008).

In 2007, we were able to establish that chicks readily adapted to the artificial diet of tinned sardines in soya oil, and fledged in good condition within 9 days of transfer. This year, it was established that the same diet can be used for chicks up to 23 days from fledging. However, the feeding regime needed to be refined for these younger chicks.

The approach I (HG) used was to find the uppermost limits for food delivery, not in terms of volume—I already recommended limiting all meal sizes to a 30 mL maximum (or up to a quarter of body weight if a chick weighed <120 g)—but in terms of the number of successive days that this volume can be sustained. For some birds, daily feeds of 30 mL comfortably maintained weight; for others they made steady daily gains of 2–4 g; but occasionally if a chick made a larger leap in weight over 24 hrs, the next meal needed to be reduced in size. Abnormal daily gains in weight (e.g. I would suggest ≥ 4 g for this species) are an indication that the food is accumulating in the digestive tract and that digestion is occurring at a slower rate than ingestion. Chicks need to be allowed to process the food in the gut so that it does not ferment and cause an infection. A periodic small feed is recommended to allow birds to 'clean-out' the system. During *post mortems* of deceased hand-fed seabird chicks, pathologist often comment on the dilation of the proventriculus due to the presence of a large volume of food. Parental meals much greater than 30 mL have been known to be delivered to wild diving petrel chicks (both parents may feed the chick on the same night), however it is likely to be the nature of our artificial diet that means it is not processed as quickly as the semi-digested natural diet. We may have to make slight compromises on chick weight and be slightly more conservative again with food volumes.

If these large weight gains are missed when a chick is handled, then it is likely to be fed the same amount as the previous day, i.e. more than required. In future, all feeders and handlers need to be extra-vigilant about these changes so that a decision to reduce food volume at that time can be made on the spot. This strategy relies on accurate weighing on a daily basis.

Presence of fresh faeces was monitored on a daily basis for all chicks when possible. Particular attention was paid to this in the first week following transfer, through the diet transition phase, but it became harder to keep track of this for each chick when there were more chicks to feed (and more people involved in the feeding operation). Absence of excrement tends to indicate that a chick is blocked up and not effectively digesting food. A combination of both approaches—recording all excrement passed during handling events and closely watching for abnormally large daily weight gains—is worth employing in subsequent operations.

Following discussion with Graeme Taylor, and the incident of pure [likely soya] oil being regurgitated by one of the chicks before it died, with accumulations in its stomach (refer Section 3.7), we are wondering if diving petrels may have a problem coping with the amount of soya oil in the food, given that this species naturally has a low level of oil in its diet (unlike some of the other petrel and shearwater species). Questions have also been raised about possible causes of gout and kidney failure, which has been seen before as a cause of death in hand-reared seabirds. Pathologists report that the underlying cause remains difficult to pin down but possible suggested causes include inadequate fluids in the slurry mix, gut stasis leading to dehydration, and food related toxins causing kidney damage. The DOC vet, Kate McInnes, believes that gout could easily have been caused during the time from translocation to death; while it may be related to the individual bird, pathology results suggest that the diet could cause a problem for at least a proportion of the birds and that this may effect their long-term survival.

The 2009 transfer may provide an ideal opportunity to further refine the artificial diet for this species (which will be of significance to all other seabird species fed this diet after translocation) pending further discussion between DOC and MRS.

Second transfer of diving petrel chicks to Motuora (Gummer, Graham and Gardner-Gee, 2008).

3.5 Fledging weight and size

The range of fledging weights of the 62 chicks that fledged from Motuora between 14 November and 6 December, after a mean of 13 days at the release site, was again relatively narrow (within 38 g) compared to the 62 g range presented for Mana I. fledging weights but was close to the 30 g range recorded for the 2007 Motuora fledging weights (refer Appendix 1). The mean fledging weight of the northern NZ chicks fed sardines on Motuora this year (136 g; n=62) exceeded those achieved with the chicks on Motuora in 2007 (133 g; n=24) and with central NZ chicks during the three Mana I. transfers (118 g; n=116) where chicks were fed a diet based on krill.

Only five chicks fledged from Motuora at weights less than the 124 g mean of 20 fledging chicks that returned to Mana I. as adults, but these five Motuora chicks still exceeded the minimum weight of the Mana I. returning birds by at least 2 g. Although there is likely to be some differences in diving petrel weight with changing latitude (e.g. northern birds reach longer wing lengths and are potentially heavier), most of the Motuora chicks are considered to have a very good chance of surviving to return to as adults.

It is likely that we have established the full fledging wing length range during this year's operation (118–132 mm), exceeding last years maximum length by 1 mm; however, it is interesting to note that our longest measurements still fall short of the longest recorded adult wing length for the species (137 mm), and most of our chicks appeared to have ceased wing growth by fledging time, or had slowed down to a growth of ≤ 1 mm/day. It will be interesting to obtain accurate wing measurements from any of our birds that return as adults.

3.6 Blockade gate removal and chick departure

This year, we continued with the strategy of blockading chicks in their burrows until they reached appropriate weights (such that they could survive a night or two without feeding if they went missing prematurely) and until wing growth had stopped or slowed down to ≤ 1 mm/day as post-fledging survival of chicks is likely to be improved if they have attained close to maximum wing lengths prior to departure.

The strategy is run with the small risk of compromising any extended emergence behaviour (i.e. two or more nights) that occasional chicks might exhibit, in favour of getting heavier, fully grown birds away with a better chance of post-fledging survival. Gates were, however, removed if there was any sign of digging in the burrow. Using a fixed wing length as a trigger to remove gates can be risky because some chicks may disappear prematurely before they are ready to fledge; missing chicks can not be fed, so their fledging success and/or chances of post-fledging survival are compromised. We may need to try this approach next year with at least a proportion of the later fledging chicks, to simplify methods in future projects if accurate and consistent daily wing measurements are not feasible.

Emergence periods (mean 1.8 nights) were probably more extended than those occurring naturally in the wild because we decreased meal size relatively slowly (if necessary) as chicks came close to fledging to determine the maximum weights that chicks will depart at. Given the feeding regime, it is possible that chicks emerging for up to 5 nights were waiting to lose weight in order to take off. With an increased sample size, maximum fledging wing lengths and heaviest fledging weights are now confirmed for this species (on this diet) this year, so appropriate targets can be set for subsequent transfers.

Second transfer of diving petrel chicks to Motuora (Gummer, Graham and Gardner-Gee, 2008).

3.7 Chick health and mortality

Unlike blood-sucking parasites, feather lice are less likely to cause a decline in chick health, although they may be considerably uncomfortable. Treatments are not considered to be necessary unless feather damage is significant; treatments can carry other risks. We could collect some lice in 2009 and send them off for identification to contribute to baseline information.

The green colour observed in the excrement of four chicks on the day before they fledged is of concern and replicates exactly what happened with fluttering shearwaters hand-fed for a similarly long proportion of their rearing period. If this is related to a dietary imbalance, I have been informed that this can correct itself as soon as the chicks feed on a natural diet at sea, although we do not really understand the long-term implications. There are various discussions in progress about whether or not to include a seabird vitamin/mineral supplement into the diet, particularly for the younger chicks fed for a longer period, and whether to alter the fluid content of the diet (refer Section 3.4). Ideally, we want to avoid hand-feeding chicks for longer than 2 weeks on Motuora as this is still around one-third of their rearing period.

Also of concern is the fact that two chicks died through aspirating food material into the trachea/lungs. This can be caused during the hand-feeding process in several ways; some of these include: delivery of too large a volume, delivering food too quickly, chick struggling during food delivery, crop tube not inserted far enough into oesophagus, food delivery continuing on removal of tube from throat, chicks overflowing during feeding etc. This highlights the importance of utilising experienced personnel to hand-feed chicks. However, it is also possible that the crop tubes used for diving petrels are just a little on the large side in terms of width, and/or perhaps need to be slightly longer. It will be well worth investigating a narrower option that still allows food to pass through without blockages occurring during food delivery.

4. Recommendations for 2009 transfer

Recommendations listed are additions or modifications to methods already described under Section 3.

CHICK NUMBERS

- a) Consider installing an additional 8 burrows on Motuora to house transferred chicks. This would allow 70 chicks to be accommodated simultaneously in 2009 and would enable up to 80 chicks to be fledged from Motuora. This would create a strong cohort that would be likely to enhance the establishment success on Motuora.
- b) Consider transferring up to a maximum of 45 chicks in the first transfer, if this number of chicks are suitable, providing that the time protocols (loading the boat before 11 am to avoid the mid-day heat) can still be adhered to. A team of 3 people on Motuora would be able to feed and process this number on the transfer afternoon within a 4–5 hour period.
- c) For the second transfer, bring the number of chicks that matches the number of available burrows; this will be a minimum of 17 chicks if 45 of 62 burrows are still occupied (or 25 if 45 of 70 burrows are still occupied). However if more older chicks are taken in the first transfer, then based on this year's results, it is possible that up to 10 chicks will have fledged before the second cohort arrives and the second transfer is more likely to be 27

Second transfer of diving petrel chicks to Motuora (Gummer, Graham and Gardner-Gee, 2008).

(or 35) chicks. This would give a total of around 72 chicks from 62 burrows (or 80 chicks from 70 burrows).

WOODED I.—CHICK SELECTION AND COLLECTION

d) Chick **wing length** criteria for 2009 transfers should be as follows:

Minimum wing length on transfer day:
95 mm
Maximum wing length on transfer day:
130 mm
NB: wing lengths must be used in conjunction with weight guidelines (see below). For example, suitable chicks can be as much as 130 mm (even chicks with minimal down coverage), but such chicks must weigh 150 g or more.

NB In 2008 the minimum wing length on transfer day was set at 80 mm in order to ensure enough chicks were available for transfer. However, as we now know more about the timing of the northern breeding season, we can refine the guidelines further and avoid taking smaller chicks.

If more suitable chicks are located than needed on transfer day, prioritise chicks that have wing lengths over 105 mm: chicks in these size ranges achieve good fledging weights with about 2 weeks or less of hand-feeding on Motuora. In 2008 the chick that stayed the longest time on Motuora (23 days) was transferred at 92 mm, and the eight chicks that stayed 20 days or more ranged between 85 and 94 mm on transfer day.

The above recommended wing length criteria are based on the 2008 fledging data:

2008 Fledging data				
Wing length (estimated) on transfer day:	Mean wing length on fledging	Mean weight on fledging	Mean no. days on Motuora (range)	Sample size (Transfer 1 and 2 combined)
80-89 mm	123 mm	133 g	20 (17-22)	6
90-94 mm	125 mm	138 g	19 (17-23)	11
95-99 mm	124 mm	138 g	15 (13-17)	7
100-104 mm	126 mm	131 g	15 (10-18)	12
105-109 mm	126 mm	139 g	13 (10-16)	5
110-114 mm	126 mm	137 g	10 (7-13)	8
115-119 mm	123 mm	136 g	6 (2-8)	10
120-124 mm	125 mm	138 g	4 (2-8)	3

The recommended criteria should yield enough chicks while optimising the length of chick feeding (i.e. having most chicks on Motuora long enough to stabilise weight after transfer and regain some weight before fledging, without feeding the chicks for an unnecessarily long period of time). If these criteria had been in use in 2008, approximately 30 of the chicks located in the first collection trip would have been suitable for transfer. If these 30 chicks had all been moved in Transfer 1, the second collection trip would have had over 50 suitable chicks to select from. Hence if patterns are similar in 2009, 60-90 chicks

Second transfer of diving petrel chicks to Motuora (Gummer, Graham and Gardner-Gee, 2008).

should be able to be collected from Wooded Island using the criteria above, with most of the chicks being collected on the later collection trip.

e) Chick **weight** criteria for 2009 transfers should be as follows:

Wing length on transfer day	95–99 mm	100–109 mm	110–119 mm	≥120 mm
Minimum weight on transfer day	110 g	130 g	140 g	150 g with any down % cover*

* If options are limited, chicks with wings ≥120 mm can be taken at 140 g ONLY IF they have >20% down cover.

f) Identify the suitability of chicks for transfer by estimating the likely wing length on the transfer day (add approx. 3 mm growth per day—in 2007 the average wing growth rate for chicks on Wooded I. was 2.7 mm/day, range 2.5–3.1 mm). The following tables can be used on collection trips in the days leading up to the transfer day to identify chicks that are likely to be suitable on transfer day.

Guidelines for collection trip for Transfer 1 (flag colours for 2009 indicated in brackets):

Days before transfer	Target wing length ranges (mm) for suitable chicks in the days leading up to transfer			
	Suitable for Transfer 2 (white)	Marginal for Transfer 1 (yellow & white)	Suitable for Transfer 1 (yellow)	Marginal Transfer 1 (yellow & blue)
	Chicks expected to be 95 -130 mm on Transfer 2 day	Slightly too small: recheck if needed on Transfer 1 day	Chicks expected to be 95 -130 mm on Transfer 1 day	Slightly too big: recheck if needed on Transfer 1 day
5	53-74	75–79	80–115	116–120
4	56-77	78–82	83–118	119–122
3	59-80	81–85	86–121	122–125
2	62-83	84–88	89–124	125–128
1	No chick handling			
transfer day	68-94	Any chick opportunistically found with wings measuring 95-130 mm, that meet the weight criteria set for that wing length, may be suitable.		

Guidelines for collection trip for Transfer 2 (flag colours for 2009 indicated in brackets):

Days before transfer	Target wing length ranges (mm) for suitable chicks in the days leading up to transfer		
	Marginal (pink & white)	Suitable for transfer (white)	Marginal (white & blue)
	Slightly too small: recheck if needed on transfer day	Chicks expected to be 95 -130 mm on transfer day	Slightly too big: recheck if needed on transfer day
5	75–79	80–115	116–120
4	78–82	83–118	119–122
3	81–85	86–121	122–125

Second transfer of diving petrel chicks to Motuora (Gummer, Graham and Gardner-Gee, 2008).

2	84–88	89–124	125–128
1	No chick handling		
transfer day	Any chick opportunistically found with wings measuring 95-130 mm, that meet the weight criteria set for that wing length, may be suitable.		

NB: Chick wing growth rate slows down as chicks get closer to fledging and more advanced chicks may not be growing as fast as 2.7 mm/day, especially after they reach c.115 mm wing lengths. Hence marginally too big chicks are more likely to still be present than their predicted wing lengths might suggest.

- g) Allow up to 2 person-hours of search time to locate one chick suitable for transfer. In 2009, it is likely that the proportion of marked burrows found on Wooded I. will again be less than expected, so effectively search teams should be planning to start from scratch.
- h) For Transfer 1, 2009, the following colours are to be used to flag burrows:
- Yellow tape for burrows with chicks likely to be suitable for Transfer 1.
 - White tape for burrows with chicks suitable for Transfer 2.
 - Yellow and blue tape for chicks that are marginally too big for Transfer 1 and need to be reassessed on actual Transfer Day 1.
 - Yellow and white tape for chicks that are marginally too small for Transfer 1 and need to be reassessed on actual Transfer Day 1.
 - Blue tape for chicks not suitable for either transfer, and also for empty burrows just checked.
 - Pink tape as an indicator of burrow entrance where these are not obvious.

For Transfer 2, 2009, the following colours are to be used:

- White tape for burrows with chicks suitable for Transfer 2.
 - Blue and white tape for chicks that are marginally too big for Transfer 2 and need to be reassessed on actual Transfer Day 2.
 - Pink and white tape for chicks that are marginally too small for Transfer 2 and need to be reassessed on actual Transfer Day 2.
 - Blue tape for chicks not suitable for transfer, and also for empty burrows just checked.
 - Pink tape as an indicator of burrow entrance where these are not obvious.
- i) This year, some of the bands needed to be closed further on Motuora. We strongly recommend the limited number of delegated banders involved in the 2009 collection trip to undergo a refresher training session with these bands prior to visiting Wooded I. to ensure they can fully close bands with confidence. This session should be supervised by an experienced bander/trainer, and all bands used in the training session destroyed and reported to the Banding Office. In addition, it would be important for the training session to cover the removal of over-closed bands.

MOTUORA—CHICK FEEDING/MONITORING

- j) There may be an opportunity in 2009 to research and further refine the feeding technique for diving petrels. There are several issues that still need to be addressed regarding the artificial diet for seabirds, specifically relating to the incidences of gout and kidney failure in deceased hand-fed chicks. The 2009 diet will be determined after further discussions with DOC seabird scientists and veterinarians.

Second transfer of diving petrel chicks to Motuora (Gummer, Graham and Gardner-Gee, 2008).

- k) Hand-feed chicks with the aim of reaching a mean fledging weight similar to that achieved in the 2008 transfer (i.e. 136 g), and aiming to fledge all chicks >110 g (based on the minimum fledging weight of chicks that fledged from Mana I. and are known to have survived and returned as adults).
- l) Unless the results of diet discussions indicate otherwise, use the following feeding regime (adapted from the fairy prion transfers, trialled with diving petrels in 2007 and slightly modified in 2008):
- Day 1: 10 mL (1 can sardines 106 g : 75 mL water)
 - Day 2: 15 mL (1 can sardines 106 g : 50 mL water from here on)
 - Day 3: 20 mL
 - Day 4: 25 mL
 - Day 5: 25 mL
 - Day 6: 25 mL
 - Day 7 onwards: Meal sizes vary around the 25–30 mL volume to attain an approx. 2–4 g weight gain per chick per day (younger chicks), or maintain weight only (more advanced chicks).
 - Do not feed 30 mL volumes to chicks weighing <120 g nett weight as, although the crop is large and distensible, it is not ideal to deliver meals amounting to roughly a quarter of a bird's body weight, of artificial food, in such a short period of time on a daily basis.
 - Avoid feeding 30 mL volumes to a chick for more than several days in a row, particularly if there is a clear daily weight gain.
 - Closely observe each chick's weight, when recording, in comparison to its weight recorded for the previous day. If any chicks gain >4 g over a 24 hr period, the food volume must be greatly reduced for the meal about to be delivered.
 - Likewise, if the chick is gaining close to 4 g each day for several subsequent days (e.g. 3 days), then the next meal size must be dropped to allow the chick to process any old food in the gut.

NB Seventeen parent-reared chicks weighed in October 2007 and over a month later in November 2007 gained a mean of 2.3 g/day (range 1.2–3.7 g/day) (Gummer and Gardner-Gee, 2007).

- m) Investigate options for a narrower gauge of crop tube, to help reduce the potential incidences of aspiration during hand-feeding.
- n) Continue to check as often as possible for evidence of excretion by each chick throughout their time on Motuora. It will be useful for runners to carry a notebook each to record this when away from the feeding shed.
- o) Collect samples of feather lice for examination by Richard Jakob-Hoff at Auckland Zoo, who is interested in collecting this baseline information for native avian species.

MOTUORA—BLOCKADE GATE REMOVAL

- p) Continue to measure wings daily for advanced chicks, especially once they reach 120 mm, to obtain a clear picture on individual growth rates so that gate removal can be scheduled (if gate removal is to be based on slowed wing growth rate); and then daily once gates are removed to obtain accurate fledging data.
NB Down cover must never be relied on as a sole guide to gate removal as it can be prematurely lost on the transfer day, or through handling, especially in wet weather.

Second transfer of diving petrel chicks to Motuora (Gummer, Graham and Gardner-Gee, 2008).

- q) If consistent wing measuring by one person is achievable, gate removal can occur when:
- Chick wings have stopped growing, OR
 - Chick wings have slowed in growth to ≤ 1 mm/day,
AND
 - Chicks have $\leq 5\%$ down coverage.
- NB Gates can be removed if chicks have $>5\%$ down cover (but preferably below 20%) if wing growth has clearly ceased and/or there was evidence of chick restlessness (e.g. found in tunnel, or digging).
- r) If consistent measuring is not achievable, then rough criteria for gate removal is as follows:
- Wing length: ≥ 120 mm
 - Weight: ≥ 120 g (preferably >130 g; absolute minimum 110 g)
 - Down cover: Not exceeding 10% (over entire body)
- NB The gates to some burrows may have to be removed before the chick's wing reaches 120 mm, or if the chick has $>5\%$ down cover (but $<15\%$); the cue for this is either rapid down loss (which is obviously not caused through emergence behaviour above ground), evidence of digging within a burrow, or slowed wing growth (<1 mm/day).
- s) Consider moving any chick that is regularly found in its tunnel and is still far from fledging to a new burrow; conditions may not be comfortable in the chamber and chicks spending much of their time in the tunnel may be more at risk to the elements etc.

MOTUORA—BURROW AND SITE MAINTENANCE

- t) Refer Appendix 12 for burrow site maintenance recommendations.
- u) Continue to use sand-bags on the exposed lids of all burrows accommodating transferred chicks as it is difficult to ascertain which burrows heat up more than others, and there is overall a small benefit in stabilising the internal temperatures. Presence of sandbags is also a useful indication of occupied burrows for runners collecting chicks.

MOTUORA—MONITORING FOR RETURNING ADULTS

- v) Refer Appendix 12 for all monitoring recommendations.

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Finally MRS would like to acknowledge the tremendous contributions Helen Gummer has made: MRS could not have undertaken this project without Helen's seabird translocation expertise, and we so value her knowledge, skills, commitment, patience and willingness to work with us. Thank-you Helen.

Appendices

- Appendix 1: Comparative fledging data for transferred common diving petrel chicks.
- Appendix 2: Equipment list for 2009 diving petrel transfer (based on 60 chicks).
- Appendix 3: Outcome of inspections of marked burrows (found in 2007) and new burrows (found in 2008) on Wooded I.
- Appendix 4: Recommendations for collection of chicks from Wooded I.
- Appendix 5: Transfer and fledging data for diving petrel chicks transferred to Motuora in 2008.
- Appendix 6: Diving petrel chick food preparation guide (based on 30 chicks).
- Appendix 7: Checklist of equipment to transport to colony site (based on 1 team).
- Appendix 8: Diving petrel chick post-feeding clean-up.
- Appendix 9: Diving petrel chick feeding, measuring and monitoring guide (based on 30 chicks).
- Appendix 10: Procedures in the event of chick death.

Second transfer of diving petrel chicks to Motuora (Gummer, Graham and Gardner-Gee, 2008).

Appendix 11a: Pathology report for Chick A lost on Motuora on 14/11/2008
Appendix 11b: Pathology report for Chick B lost on Motuora on 30/11/2008
Appendix 11c: Pathology report for Chick C lost on Motuora on 30/11/2008
Appendix 11d: Pathology report for Chick D lost on Motuora on 30/11/2008
Appendix 12: Recommendations for monitoring diving petrels on Motuora

Second transfer of diving petrel chicks to Motuora (Gummer, Graham and Gardner-Gee, 2008).

Appendix 1: Comparative fledging data for transferred common diving petrel chicks

NB Adults weigh a mean of 130 g and have wing lengths averaging 127 mm (range 113-137 mm) (Heather & Robertson, 1996).

MOTUORA FLEDGLING DATA

Year/ source colony/ chick number	Mean weight	Range of weights	Mean wing length	Range of wing lengths	Mean days on Motuora
2008 Wooded <i>Sample size: 62 successful fledges (of 66 chicks transferred)</i>	136 g	112–150 g	125 mm	118–132 mm	13 days (2–23 days)
2007 Wooded <i>Sample size: 24 successful fledges (of 30 chicks transferred)</i>	133 g	118–148 g	126 mm	121–131 mm	5 days (2–9 days)

MANA I. FLEDGLING DATA

Year/ source colony/ chick number	Mean weight	Range of weights	Mean wing length	**Range of wing lengths	Mean days on Mana
All 1997-99 chicks <i>Sample size: 116 successful fledges (of 243 chicks transferred)</i>	118 g	83–145 g			16 days (0–44 days)
1999 Brother's <i>Sample size: 26 successful fledges (of 49 chicks transferred)</i>	129 g	109–142 g	118 mm	Approx. 110–123 mm	
1998 Brother's <i>Sample size: 28 successful fledges (of 40 chicks transferred)</i>	125 g	113–145 g	-	Approx. ? –120 mm	
1997 Brother's <i>Sample size: 9 successful fledges (of 39 chicks transferred)</i>	-	-	-	Approx. 110–116 mm	
1998 Sugarloaf <i>Sample size: 12 successful fledges (of 63* chicks transferred)</i>	117 g	99–135 g	-	Approx. 110–119 mm	
1997 Sugarloaf <i>Sample size: 41 successful fledges (of 52* chicks transferred)</i>	-	-	-	Approx. 110–124 mm	

* A total of 4 chicks died during transfer from the Sugarloaf Is.

** Wing lengths were not measured on a daily basis on Mana I. so fledging lengths were not recorded for all birds on the day prior to departure.

Second transfer of diving petrel chicks to Motuora (Gummer, Graham and Gardner-Gee, 2008).

Appendix 2: Equipment list for 2009 diving petrel transfer (based on 60 chicks: numbers will need to be revised if additional burrows installed on Motuora and 80 chicks transferred)

WOODED I—NOVEMBER CHICK COLLECTION

Item	Quantity	Comments	Current stock (Dec 08)	Required	Responsibility 2009
Fluteboard* pet boxes and diagonal pre-cut dividers (2 per box to give 4 compartments)	15 (+ a few spare)	20 black ones will need to go to Tiri with collection teams—5 are currently being used to store gear but we can switch gear to white boxes for storage some time during the year so black ones are freed up.	15 (black) stored flat on Motuora; 5 (black) containing gear on Motuora. 1 (white) with RGG; remaining white stored flat on Motuora.	Look at options for covering boxes in a white (heat-reflective) material	
Shredded newsprint paper (not photocopy paper which is too scratchy)	Large bag	Enough to give a 2 cm layer in each compartment.	0	Fresh	
Plastic bin bags (large, drawstring)	c.10	Used to cover storage box left over night on Wooded, shade transfer boxes etc.	0	10	
Packing tape Duct tape	1 roll of each	Useful to stick onto transfer boxes for writing on in marker pen (can be peeled off fluteboard after transfer so boxes are clean for the next year).	½ of each with RGG	1 new of each	
Plywood boards 200 x 200 mm	Lots! (50-100)	Study hole covers for diving petrel burrows.	50? left on Wooded; 7 with RGG	50	
Plywood boards 400 x 400 mm	20+	A mix of sizes is fine, e.g. 400 x 300 mm, 500 x 400 etc. for repairing damaged fluttering shearwater and penguin burrows. This large size is also used for standing and sitting boards while moving through burrow areas.	5 left on Wooded; 13 in shed on Motuora	5	
Rocks	Plenty	Weighing down plywood covers	5 left on Wooded; more on beach!		
Artificial plywood burrows	10	Plywood 200 x 200 with lid. To replace damaged burrows, ease of chamber access etc.	12? left on Wooded		
Flagging tape (3 different colours plus pink)	4 rolls of each colour	To mark burrow sites, chicks to take, marginal chicks etc. (blue, yellow, white & pink needed 2009). (From Geosystems)	4½ pink, 4 green 5 red, 5 orange 1 blue, 1 yellow, all with RGG	3 yellow 3 blue 4 white	
Permanent marker pens	4+	For marking flagging tape and boxes	4 old with RGG	4 new	

Second transfer of diving petrel chicks to Motuora (Gummer, Graham and Gardner-Gee, 2008).

		(fine tipped Stephens vivid markers)			
Pencils and sharpener	4+	For recording data	0	8 and sharpener	
Waterproof notebooks	4	For recording data; 2008 books were only partly used – enough space of 2009 data.	5 used with RGG		
Rubber bands	Lots	For notebooks and data sheets		Packet	
Narrow hand-trowels	4	Digging out holes and artificial burrows.	3 with RGG; 1 owned by HL		
Secateurs	4	Clearing tree roots to access chicks.	On Motuora with weeding gear		
Holding bags (~250 x 300 mm max size)	~40	Dark cotton material, identical in weight. Ones with cord preferred as then checks can be hung in trees if needed. 25 probably enough for collection trip if dirty ones washed each night.	25 bags (all 20 g with cords) on Motuora, 25 bags (c.20 g and no cords) with RGG		
Napisan	500 g?	For washing holding bags	0	1 small pack	
Bucket	c. 10 L	For soaking holding bags	0	1	
Banding kit	3	Banding pliers, circlip pliers, bag: kit not needed for everybody on team as only experienced banders will be banding	3 with RGG		
D bands	120	From banding office	220 with RGG		
Pesola scales (300 g)	4		4 UoA ones available from RGG		
Wing rule	4		4 with RGG		
Disposable vinyl gloves (pairs)	12	Several pairs per person to eat lunch with. Not used 2007 or 2008; water and disinfectant probably more useful (see below)	15 + with RGG		Not required
Disinfectant hand wash	1	To clean hands before eating	0	1 large pack to last both collection trips	
1.5 L bottles	2	To hold hand wash water—soft drink bottles fine	0	2	
First aid kit	1	Have used personal kits last two years	RGG will bring personal kit again in 2009		
Laptop	1	Essential. Makes chick selection easier if we can enter straight onto laptop and calculate expected wing lengths. Used Richard G's and	0	1	

Second transfer of diving petrel chicks to Motuora (Gummer, Graham and Gardner-Gee, 2008).

		Helen L's in 2008.			
CDROMs (and/or flash drive)	4	To back up data and to make data sheet copies to send to Motuora with chicks	0	4 new	
Datasheets	10	If laptop not available, paper datasheets needed to create backup for data/select chicks	Updated copies needed	10	
Collection instructions and selection guidelines	1	Selection guidelines/colour coding for burrows to be copied into back of notebooks	Updated copy needed	1	

*Fluteboard boxes are corrugated synthetic plastic-type material; they are splash-proof (hence no bin bags required during collection of birds in rain, although bin bags may be required if sea conditions are very rough with lots of heavy deck spray), they can be washed/disinfected for use the next year, and they are an option for back-up accommodation in severe flooding conditions.

Port Nicholson Packaging Ltd (General manager: Michael van Boheemen (michael@pnp.co.nz))
 PO Box 38133
 33 Fitzherbert St
 Petone
 Email: www.pnp.co.nz Ph: 04 568 5018 Fx: 04 568 5538

The pet carry boxes 4(25 x 240 x 310 mm) are a standard cut: in 2008 the cost (including freight and GST) for 20 black standard size boxes was \$470.00. This included two diagonal dividers per box. Ventilation holes come at 20 mm diameter; MRS requested to have no ventilation holes so that smaller ones (appropriate for diving petrels) could be made by MRS (10-15 mm diameter).

MOTUORA—ARTIFICIAL BURROWS

Item	Quantity	Comments	Current stock (Dec 08)	Required	Responsibility 2009
Artificial burrows (chambers)	60-80	Model on Motuora.	62 installed on Motuora		Not required unless additional burrows installed
Novapipe (tunnels) – drainage type, 110 mm external diameter	300 mm per burrow	Allow 300 mm per burrow; can get at least three tunnels from 1 m of pipe.	62 installed on Motuora		Not required unless additional burrows installed
Sharp spades	4	Removing turf, digging holes	On Motuora with rangers		Not required unless additional burrows installed
Shovel	1		On Motuora with rangers		Not required unless additional burrows installed

Second transfer of diving petrel chicks to Motuora (Gummer, Graham and Gardner-Gee, 2008).

Hand trowels	4	Digging out narrow trenches.	On Motuora with weeding gear		Not required unless additional burrows installed
Hammer or tomahawk	2	Or some other narrow hand tool to compact soil around burrows.	On Motuora with weeding gear		Not required unless additional burrows installed
Spirit level	1	To set boxes at correct slope			Not required unless additional burrows installed
Hacksaw (plus spare blades)	1	Cutting up Nova pipe – leaves a tidier edge than a bigger saw.	On Motuora with weeding gear		Not required unless additional burrows installed
Old 10 L buckets	Several	For carrying sand or beach gravel to burrows	On Motuora with rangers		Not required unless additional burrows installed
Old 20 L buckets	Several	Useful to put soil in to remove from the site, otherwise it becomes a mud bath in the rain. Also good not to smother grass so site is grassed over by the transfer.	On Motuora with rangers		Not required unless additional burrows installed
Butyl (hinge material)	Spare	To repair hinges if needed, and to hinge new burrow lids if installed	5 hinges on Motuora with model burrow		
Paint (white or bright colour)	?	Numbering burrows. All burrows numbered 2008	Brush and paint on Motuora if repainting required (with rangers)		
Blockade gates	1 per burrow	Plastic coated chicken mesh squares 130 x 130 mm fit over entrances with 3 stakes of no. 8 wire (300 mm long) woven through mesh and hammered into ground.	90 stakes and 63 mesh gates on Motuora plus 7 spare mesh squares. Roll of stake wire and extra mesh (?) with rangers		
Heavy wire cutters/pliers	2	Needed to cut extra stakes, to push stakes into ground and to remove stakes if ground hard.	2 on Motuora with rangers		
Fresh, dry grass reserve	2 small sacks	To line chambers and replace wet nesting material after heavy rain or to provide dry material for alternative accommodation (pet boxes).	Collect grass on Motuora and dry out in advance	Min. 2 sacks	

Second transfer of diving petrel chicks to Motuora (Gummer, Graham and Gardner-Gee, 2008).

MOTUORA—CHICK FOOD PREPARATION AND FEEDING

Item	Quantity	Comments	Current stock (Dec 08)	Required	Responsibility 2009
Brunswick sardines <i>in soya oil</i> (106 g tins)	250 tins	Ring-pull tins. Diet recipe is 1 can sardines to 50 ml fresh (boiled then cooled) water.	64 tins on Motuora	186 (or 2 x the packs of 96!)	
Large kettle	2	With ability to boil water for 3 minutes (precaution to prevent contamination).	2 on Motuora (in potting shed)		
Blenders (with separate base and jug) 800 W	2	Two models the same, so that bases can be rotated to save straining motor of one with continuous use during food prep.	2 on Motuora; measuring cup/key broken on one, replacement required. Blades not sharpened before storage.	1 measuring cup/key replaced, or wooden key only made. Blades need sharpening.	
Small kitchen knife	2	1 to open tins, 1 to extract fish from tins	2 on Motuora		
Small plastic spatula	1	To scrape blended fish from blender.	1 on Motuora		
Small measuring jug	2	250 ml (for measuring chlorhexidine and also water for food mix)	2 on Motuora		
15 litre bucket	1	Container for sterilising solution.	1 on Motuora		
c. 10 litre bucket	1	Container for holding bags/Napisan; used island one in 2008	0	1	
Plastic pottles	c.10	Storing blended food (must be able to fit in hot-water bath, pottle size dependent on type of food flask)	11 on Motuora		
Plastic tubs	4	Rinse baths	6 on Motuora		
Plastic box (with lid)	1	For transporting assembled syringes/feeding tubes	1 on Motuora		
Plastic bottles (3 litre)	3	Storing boiled water overnight. Carrying fresh/clean water to feeding site. Big sterilised juice bottles are good.	on Motuora		
30 ml Bovivet Plexi syringes	4	Long-lasting syringes from (Shoof farm products www.shoof.co.nz)	3 on Motuora		
c.70 mm x 6.2 mm O/D Teflon crop-feeding tubes	4+ spares	Tubes screw directly into syringe barrel (hand-tight only) once metal Luer-lock fitting is removed	2 unused and 6 used (but good) on Motuora	2 new	HG to bring gear to make extra tubes if needed in 2009
Castor oil	1 small bottle	Lubricate syringes	Discard used (opened) bottles	1 new	

Second transfer of diving petrel chicks to Motuora (Gummer, Graham and Gardner-Gee, 2008).

Teaspoons	10	To stir food when warming (clean teaspoon for new food pottle)	10 on Motuora		
Metal thermos flasks	3	Carrying boiled water to site for use in hot-water bath. (2 x 3 litre flasks)	2 on Motuora (third is broken)	1 new	
Food thermos flask (hot-water bath)	2	Warming food for up to an hour per batch prior to feeding.	2 on Motuora		
Soft tissues	16 boxes	Wiping chicks after feeding.	½ box on Motuora	16 new	
Kitchen towel	6 rolls	Drying hands in feeding shed and food preparation area.	0	6 new	
Old hand towels	4	To rest chick on surface when feeding.	4 on Motuora		
20 l bucket (clean)	2	To carry gear to colony site and for use as lined rubbish bins in feeding shed.	2 on Motuora		
Large chilly-bin	1	In hot weather, pots of food need to be kept cool for use later in the day.	1 on Motuora		
Ice-packs (chilly slicks)	10	See above. Also used to pack with dead chicks sent away for post mortem.	8 on Motuora		
Small chilly bin (smallest size, e.g. for 6-pack)	1	Worked well to warm second batches of food when two teams operating.	Used Kits in 2008, which worked well.	? If purchasing new, ask HG as these are also used for shearwaters and need to be a certain type for them.	
20 litre water container (with tap)	1	Storing fresh (non-boiled) water (for hand-washing etc. at feeding site.	1 on Motuora		

MOTUORA—WEIGHING AND MEASURING

Item	Quantity	Comments	Current stock (Dec 08)	Required	Responsibility 2009
Plastic nail boxes	4	For carrying birds from burrows to shed, particularly in bad weather	4 on Motuora (with pegs inside)		
Newspaper	Lots	To line carry buckets or boxes	Some on Motuora	New	
Holding bags (~250 x 300 mm max size)	~40	Dark cotton material, identical in weight. No cord required at the top. 25 bags are enough for the Wooded trip; these will go to Motuora with the 2 nd transfer.	25 bags (all 20 g with cords) on Motuora, 25 bags (c.20 g and no cords) with RGG		
Pesola scales (300 g)	2 + spare	Spare will come from Wooded with the 2 nd transfer.	2 on Motuora (collection trip will use UoA scales)		
Wing rule	2		2 on Motuora (separate from 4 collection rules with RGG)		
Banding kit	1	D-bands (c. 30), banding pliers, circlip pliers.	1 on Motuora (separate		

Second transfer of diving petrel chicks to Motuora (Gummer, Graham and Gardner-Gee, 2008).

		To remove any band if any injury occurs on Motuora or band any chicks that arrive unbanded.	from 3 collection banding kits with RGG)		
Plastic bags (medium ziplock type)	60+	Used to bag up dead birds, samples, etc.	c. 30 small and 30 medium on Motuora; + 80 larger bags		

MOTUORA—HYGIENE

Item	Quantity	Comments	Current stock (Dec 08)	Required	Responsibility 2009
Chlorhexidine 5% conc. Runny pink liquid (<u>not soapy handwash</u>)	500 ml	For short-term disinfection of feeding equipment. (Dilute 10 ml with water up to 200 ml.)	200 ml from 2008 on Motuora	500 ml fresh	HG
Jars (Greggs plastic spice jars)	4	To stand crop tube in for disinfecting. Greggs plastic spice jars with labels soaked off work well.	2 on Motuora (2 thrown out)	4	HG
Milton tablets (1 tablet to 2 l water)	7 boxes	For overnight soaked disinfection. 30 tablets per box.	2 boxes on Motuora	5 boxes	
Dettol antibacterial soap	2	Hand-washing (one for food preparation and one for the feeding site)	2 empty on Motuora	2 refills	
Antibacterial wipes	2 boxes	Quick cleaning of hands at feeding site.	0	2 boxes	
Dish-washing liquid	2 litres	Washing equipment daily – use lots!	0	2 L fresh	
Rubber gloves (medium size)	3 pairs	1 for washing-up, 1 for Virkon, 1 for Napisan	1 Napisan pair on Motuora	2 pairs	
Washing-up brush	1	For sardine cans	0	1 new	
New washing-up brush	1	Keep separate for cleaning equipment	0	1 new	
New bottle brush	1	1 large, 1 small for cleaning feeding equipment (baby bottle brushes?)	0	2 new-same as type bought for 2008	
Napisan	1kg tub	Soaking holding bags and feeding cloths.	Full tub on Motuora		
Disposable kitchen-tidy bags	30	For daily load of fishy clean-up tissues! (or save up a stack of supermarket shopping bags!)	10 on Motuora	20	
Virkon (50 g sachets)	1	To clean bench surfaces in feeding shed and food preparation area; to scrub transfer boxes before storage,	1 on Motuora expires 03/2010		
Large black rubbish bags	10	For rubbish, storing washed sardine cans etc	2 on Motuora	8	

Second transfer of diving petrel chicks to Motuora (Gummer, Graham and Gardner-Gee, 2008).

Packing tape	1 roll	For sealing rubbish bags, labelling boxes	0	1 roll	
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MOTUORA—CHICK HEALTH

Item	Quantity	Comments	Current stock (Dec 08)	Required	Responsibility 2009
Sterile saline solution (10 ml sachets)	8	Useful to flush eyes damaged during transit, or wounds.	4 (20 ml) on Motuora (expiry 03/2010), 8 (10 ml) with RGG (expiry 09/2009)	4 (10 ml) required; others OK to return	
Betadine	1 small	Treatment for open wounds.	1 Betadine bottle with RGG (expiry 09/2009)	Return to Motuora; OK to use	RGG
Bandage (flexi-cohesive)	1 roll	Type that stretches and sticks to itself; for strained wings etc.	1 on Motuora		
Small sharp scissors	1		1 on Motuora		
Veterinary eye ointment	1 small	For eye infection following damage.		New	

MOTUORA—DEAD BIRD KIT

Item	Quantity	Comments	Current stock (Dec 08)	Required	Responsibility 2009
Plastic zip-lock bags	20+	For sending dead chicks, samples etc.	30 + on Motuora		
Plastic disposable gloves	20+	For handling dead birds, faeces etc	5 on Motuora, 15+ more with RGG		
Polystyrene chilly-boxes (c. 300 x 200 mm)	6	For sending dead chicks with ice-pack off island for post mortem	6 on Motuora		
Ice-packs (chilly slicks)	12 for dead birds	For sending dead chicks off island for post mortem (2 per box as boxes are quite large). Separate from 6 needed to keep food cool.	2 dead bird slicks on Motuora (8 in total on Motuora)	10 more	
Wildlife health submission form	Several	To include with dead chicks sent for post mortem. Obtainable from DOC; document number OLDDM-724628	5 printed out on Motuora	5 more	
Dead bird instructions and courier address	1	Included in 2007 Transfer Report: Appendix 10: Procedures in the event of chick death	1 printed out on Motuora 2008	Ensure up to date	
Printed address labels to Massey University	Several	For fast labelling of chilly bins containing corpses	1	6 to print	HG
Equipment for cloacal and choanal swabs	Enough for 6 deaths	To ensure micro-organisms can be cultured and identified from dead birds even if there is a delay in getting birds off island.	0	6	

Second transfer of diving petrel chicks to Motuora (Gummer, Graham and Gardner-Gee, 2008).

MOTUORA—CHICK DISEASE SCREENING FOR UP TO 10 CHICKS (LIST SUBJECT TO CHANGE FOLLOWING ADVICE)

NB The translocation permit requires that diagnostic samples be collected from any birds that become sick during the project. Kevin Parker has got full kit for sampling and is willing to be on stand-by if needed. He is also willing to come over to the island and give training at a suitable time.

Item	Quantity	Comments	Current stock (Dec 08)	Required	Responsibility 2009
Box of slides with frosted ends	1	(How many contained?)			
Pencil	1+	For labelling slides			
Box of cover slips	1	(How many contained?)			
Slide covers	20	For slide transport			
Tube of capillary tubes (100 microlitres)	1	(How many contained?)			
Alcohol	?				
Cotton wool	?				
Cloacal swabs	10 (+ spares?)	Small size is important; medium activated charcoal probably best. Buy minimum necessary as they expire.			
Plastic pottles	40	Faecal samples; ectoparasite storage			

All of the above can be purchased, with advice, from:

Gribbles Veterinary Pathology
 35 O'Rourke Road, Penrose, Auckland
 PO Box 12545, Penrose, Auckland
 Phone 09 526 4560
 Fax 09 526 4569

An additional guideline will need to be prepared on sample collection once the relevant training has been received.

MOTUORA—RECORD KEEPING

Item	Quantity	Comments	Current stock (Dec 08)	Required	Responsibility 2009
Water-proof notebooks	4	Recording daily monitoring and feeding events. 2 are required for roll-calls and these can also be used by runners). 2 also for the chick data? (see below)	1 used with plenty of empty pages with RGG	3 new	
Data recording sheets and	1 per	These may be more efficient in the shed		To print	HG

Second transfer of diving petrel chicks to Motuora (Gummer, Graham and Gardner-Gee, 2008).

clip boards	chick	than waterproof notebooks			
Pencils (soft type e.g. B or 2B)	10			10	
Chick measurement and feeding record forms	1 per chick	Back up hard copies (if laptop fails)	2008 forms on Motuora could be altered and used in 2009 if needed		
Laptop with chick measurement and feeding record forms	1	Best if a laptop is available for whole feeding period so data can get entered immediately, report worked on etc. Used Helen G.'s in 2008.	0	1	
CDROM/flash drive	1	To back up data	0	1	
Calculator	1	Not used in 2007	1 on Motuora	0	

MOTUORA—MONITORING FOR RETURNING ADULTS

Item	Quantity	Comments	Current stock (Dec 08)	Required	Responsibility 2009
Portable sound player and recording	1	If people are unable to successfully vocally mimic diving petrel calls		RGG has recording and has use of UoA player for 2009	RGG
Waterproof notebook and pencils	1 per person	1 needed for rangers for day monitoring, 1 for RGG for night monitoring		2	RGG
Banding kit	1	D-bands (c. 30), banding pliers, circlip pliers. To band any new immigrants.	1 on Motuora		
Flagging tape, stakes and markers		To mark any burrows found.	Rangers can use general supplies on Motuora, RGG has extra		
Permanent marker pens		To mark any natural burrows found (fine tipped Stephens vivid markers).	On Motuora		
Excel data spreadsheets		To fill in weekly after inspecting all artificial burrows.	RGG compiled, rangers have copy 04/09		

STORED CHICK FEEDING GEAR ON MOTUORA (as at December 2008)

In shed behind potting shed:

- 5 black transfer boxes with gear in them.
- 1 orange chilly bin with gear stored in it.

Second transfer of diving petrel chicks to Motuora (Gummer, Graham and Gardner-Gee, 2008).

- 1 square Milton bucket with gear stored in it.
- 2 white plastic bucket with gear stored in them.

NB These nine items all have green tags that list contents in each.

Also stored in same shed: 15 black pet boxes (plus 20 divider pairs), white transfer boxes and dividers, 13 ply boards (for Wooded I.), one cardboard box of burrow gates and stakes, one water tank, 6 polystyrene chilly bins for dead birds, one shopping bag of newspaper, and one model burrow.

STORED CHICK COLLECTION GEAR (as at December 2008)

One box of collection gear is with RGG (rgg@clear.net.nz).

Second transfer of diving petrel chicks to Motuora (Gummer, Graham and Gardner-Gee, 2008).

Appendix 3a: Outcome of November 2008 inspections of marked burrows (found in 2007) on Wooded I.

Burrow number	Burrow type 2008	Burrow status Oct/Nov 2007	Burrow status 8–19 Nov 2008	Chick transferred 2008
HG12	Box	Adult/chick	Adult only	
RGG10	Natural	Chick	Adult only	
RGG31	Natural	Chick	Adult only	
HG08	Box	Adult/egg	Adult/Chick	
RGG19	Box	Chick	Adult/Chick	
HG02	Natural	Chick	Chick	Transferred
HG03	Natural	Adult/egg	Chick	
HG05	Box	Chick	Chick	Transferred
HG13	Box	Chick	Chick	Transferred
HG28	Natural	Chick	Chick	Transferred
HL10	Natural	Chick	Chick	
RGG04	Box	Chick	Chick	Transferred
RGG12	Natural	Empty	Chick	Transferred
RGG16	Natural	Empty	Chick	
RGG24	Natural	Chick	Chick	
RGG32	Natural	Empty	Chick	
RGG34	Box	Chick	Chick	Transferred
SG02	Natural	Chick	Chick	Transferred
SG14	Box	Empty	Chick	
SG24	Box	Chick	Chick	
SG30	Natural	Chick	Chick	

Appendix 3b: Outcome of November 2008 inspections of artificial burrows installed in March 2008, on Wooded I.

Burrow number	Burrow type 2008	Burrow status Oct/Nov 2007	Burrow status 8–19 Nov 2008	Chick transferred 2008
KH02	Box	n/a	Empty	
KH03	Box	n/a	Empty	
KH04	Box	n/a	Empty	
KH05	Box	n/a	Empty	
KH06	Box	n/a	Empty	
KH07	Box	n/a	Empty	
KH08	Box	n/a	Empty	
KH09	Box	n/a	Empty	
KH10	Box	n/a	Empty	
KH11	Box	n/a	Adult/Chick	
KH12	Box	n/a	Empty	

Second transfer of diving petrel chicks to Motuora (Gummer, Graham and Gardner-Gee, 2008).

Appendix 3c: New burrows found in November 2008 on Wooded I. with evidence of diving petrel activity

Burrow number	Burrow type 2008	Burrow status 8–19 Nov 2008 (T = transferred)	Burrow number	Burrow type 2008	Burrow status 8–19 Nov 2008 (T = transferred)
EM11	Natural	Adult	EM37	Natural	Chick
EM13	Natural	Adult	EM47	Natural	Chick
RG817	Natural	Adult	EM51	Natural	Chick
RG837	Natural	Adult	EM54	Box	Chick – T
RG848	Natural	Adult	EM58	Box	Chick
DW05	Natural	Adult only	EM60	Natural	Chick
DW10	Natural	Adult only	EM65	Natural	Chick
MD04	Natural	Adult only	EM67	Natural	Chick – T
MD10	Natural	Adult only	EM68	Natural	Chick – T
RG03	Natural	Adult only	MD01	Natural	Chick – T
SG44	Natural	Adult only	MD05	Natural	Chick
SG49	Natural	Adult only	MD06	Natural	Chick
SS03	Natural	Adult only	MD08	Natural	Chick
SS09	Natural	Adult only	MD09	Natural	Chick
SS12	Natural	Adult only	MD11	Natural	Chick – T
SG59	Natural	Adult /chick	MD12	Natural	Chick – T
RG23	Natural	Adult/chick	MD13	Natural	Chick
RG25	Natural	Adult/chick	MD14	Natural	Chick – T
SG48	Natural	Adult/chick	MD15	Natural	Chick
MD07	Natural	Adult/egg	MD16	Natural	Chick
RG04	Natural	Adult/egg	MD17	Natural	Chick – T
RG16	Natural	Adult/egg	PA07	Natural	Chick – T
AR01	Natural	Chick	PA08	Natural	Chick – T
DW01	Box	Chick – T	PA10	Natural	Chick
DW02	Natural	Chick	RG05	Natural	Chick – T
DW03	Natural	Chick	RG06	Natural	Chick
DW04	Natural	Chick – T	RG07	Natural	Chick
DW06	Natural	Chick – T	RG08	Natural	Chick
DW07	Natural	Chick	RG09	Natural	Chick
DW08	Natural	Chick – T	RG10	Natural	Chick
DW09	Natural	Chick	RG11	Natural	Chick
DW11	Natural	Chick – T	RG12	Natural	Chick
DW12	Natural	Chick	RG13	Natural	Chick – T
EM01	Natural	Chick – T	RG14	Natural	Chick – T
EM02	Natural	Chick – T	RG15	Natural	Chick – T
EM14	Natural	Chick – T	RG17	Natural	Chick – T
EM15	Natural	Chick	RG18	Natural	Chick
EM17	Natural	Chick – T	RG19	Natural	Chick
EM22	Natural	Chick – T	RG20	Natural	Chick
EM35	Natural	Chick – T	RG21	Natural	Chick – T

Second transfer of diving petrel chicks to Motuora (Gummer, Graham and Gardner-Gee, 2008).

Burrow number	Burrow type 2008	Burrow status 8–19 Nov 2008 (T = transferred)	Burrow number	Burrow type 2008	Burrow status 8–19 Nov 2008 (T = transferred)
RG22	Natural	Chick – T	SS05	Natural	Chick
RG24	Natural	Chick	SS06	Natural	Chick
RG26	Natural	Chick – T	SS07	Natural	Chick – T
RGG809	Natural	Chick	SS08	Box	Chick
RGG810	Natural	Chick	SS10	Natural	Chick – T
RGG811	Natural	Chick	SS11	Natural	Chick – T
RGG823	Natural	Chick	SS13	Natural	Chick – T
RGG829	Natural	Chick	SS14	Natural	Chick
RGG831	Natural	Chick	SS15	Natural	Chick – T
RGG833	Natural	Chick	SS16	Natural	Chick
RGG835	Natural	Chick	SS17	Natural	Chick – T
RGG839	Natural	Chick – T	Unmarked	Natural	Chick
RGG840	Natural	Chick – T	Unmarked	Natural	Chick
RGG841	Natural	Chick – T	Unmarked	Natural	Chick
RGG842	Natural	Chick	Unmarked	Natural	Chick
RGG843	Natural	Chick – T	EM62	Natural	Egg
RGG847	Natural	Chick – T			
RGG849	Natural	Chick			
RGG850	Natural	Chick – T			
SG38	Natural	Chick – T			
SG39	Natural	Chick – T			
SG40	Natural	Chick – T			
SG41	Natural	Chick – T			
SG42	Natural	Chick – T			
SG43	Box	Chick			
SG45	Natural	Chick – T			
SG46	Natural	Chick – T			
SG47	Natural	Chick			
SG50	Natural	Chick – T			
SG51	Natural	Chick – T			
SG52	Natural	Chick			
SG53	Natural	Chick			
SG54	Natural	Chick			
SG55	Natural	Chick – T			
SG56	Natural	Chick – T			
SG57	Natural	Chick – T			
SG58	Natural	Chick			
SG60	Natural	Chick – T			
SG61	Natural	Chick – T			
SS01	Natural	Chick – T			
SS02	Natural	Chick – T			
SS03	Natural	Chick			
SS04	Natural	Chick – T			

Second transfer of diving petrel chicks to Motuora (Gummer, Graham and Gardner-Gee, 2008).

Appendix 4: 2008 Recommendations for collection of chicks from Wooded Island

Chick selection criteria for 13 November 2008 transfer

Minimum weight (on Transfer Day 1):

- 110 g for chicks with wings 80–100 mm
- 130 g for chicks with wings 100–110 mm
- 140 g for chicks with wings 110–120 mm (and only chicks >120 mm if >20% down present)
- 150 g for chicks with wings >120 mm (and no down present)

Minimum wing length (on Transfer Day 1):

- 80 mm (2–3 weeks on Motuora)

Maximum wing length (on Transfer Day 1):

- 130 mm (must weigh 150 g or more)

Down coverage should be assessed as a percentage of the ENTIRE body (not just as a proportion of the upper body).

Revised chick selection criteria for 21 November 2008 transfer

Minimum weight (on Transfer Day 2):

- 110 g for chicks with wings 95–99 mm
- 130 g for chicks with wings 100–110 mm
- 140 g for chicks with wings 110–120 mm
- 140 g for chicks >120 mm ONLY IF >20% down present
- 150 g for chicks with wings >120 mm but <20% down present

Minimum wing length (on Transfer Day 2):

- 100 mm (1-2 weeks on Motuora)

Maximum wing length (on Transfer Day 2):

- 130 mm (must weigh 150 g or more)

Methods below are outlined for Transfer 1; methods were generally repeated for Transfer 2.

FORMS, NOTEBOOKS AND EQUIPMENT

- 1) Take out hard copy lists of all the currently marked burrows with details of burrow type and chamber access (via entrance or study hole), so that every one has access to that information as they work. These should be added to each personal bird kit.
- 2) Write the chick wing length guidelines (see 17) into notebook covers ready for the first day; the criteria changes with each search day so everyone needs to be very clear about which wing length range they are using on each search day. Also needed are the shorter wing length ranges for chicks not suitable for the first transfer, but likely to be suitable for the second transfer (see 18).

Second transfer of diving petrel chicks to Motuora (Gummer, Graham and Gardner-Gee, 2008).

- 3) Take out plenty of paper copies of the data forms for filling in during the evening (although laptop is preferable).
- 4) Before you leave from Tiritiri for Wooded, ensure the following are packed:
 - Four bird kits (each containing trowel, notebook, pencil, permanent marker pen, flagging tape in four colours, wing rule, 300 g pesola scale, holding bags and disposable gloves).
 - A banding kit for each qualified bander.
 - Plenty of study hole covers, including the larger versions to cover shearwater burrows, kneel on etc.
 - Spare artificial burrows to use in the event that an occupied burrow is collapsed.
 - Hand cleaning products (to use before eating).
- 5) Before leaving Tiritiri, put a load of beach stones into the boat as plenty are required to weigh down study-hole covers and burrow lids.

ON ARRIVAL ON WOODED I.

- 2) Transfer all gear (boxes, tunnels, stones, covers, packs) to top plateau.
- 3) Hand out kits and show the new volunteers how to:
 - Investigate a burrow (natural and artificial)
 - Make a study hole in a natural burrow and properly cover it after inspection
 - Repair a collapsed burrow (either with boards or a box)
 - Weigh and measure a chick
 - Record the data
 - Mark the burrow.

NB Volunteers should be able to work alone most of the time but banding should be done by qualified banders, or under the supervision of a qualified bander. It is better practice to have two for banding if not very experienced.

- 4) Calibrate wing-length readings—straightened and flattened—together at the start to be sure you are all getting similar measurements (important!).
- 5) Approach every burrow as if it contains an incubating adult, i.e. cautiously. (On 23-25 October 2007, 23 adults were found, some still on eggs. It's unlikely many will be found by 8 Nov, but still possible.)
- 6) Be aware that fluttering shearwaters will also be incubating.
- 7) Anticipate that many burrows (mainly on the more friable top of the island) will have been modified, extended or disrupted.
- 8) We suggest getting the less experienced volunteers to start by checking the 10 or so new boxes that were installed in the area near the track in March this year (KH02-KH12 sequence). This area is relatively stable and accessible and should give the new volunteers a chance to get into the routine. They need to consider the following points when checking the boxes:
 - Be quite thorough but extremely careful, checking the entire pipe length and any side tunnels that may have been dug from the boxes.

Second transfer of diving petrel chicks to Motuora (Gummer, Graham and Gardner-Gee, 2008).

- At this stage, do not make any modifications to what may appear to be empty burrows, i.e. do not try to sort them out, fill in holes, stabilise them etc. as there is a high chance of disrupting a nearby chamber or blocking in a small chick in a side tunnel and causing more damage in the process.
 - If a burrow entrance is blocked, there is a good chance that the birds are using a burrow immediately adjacent.
- 9) The best strategy for the others might be to block the top area into 6-8 areas and each person work systematically across an area, checking all burrows as they go (the less experienced volunteers can then move onto their own block after the KH burrows). This minimises the number of times people have to crawl across areas and should also minimise the number of burrows that get missed or checked twice. It also means that the second team will know that newly marked areas have been thoroughly checked and can focus on new areas, rather than going back over the same areas covered by the first team.
- 10) If it helps, place some kind of marker (e.g. single stick) at the entrances of checked, unoccupied burrows (to indicate which have been checked).

RECORDING DATA AT BURROWS

- 11) Aim to record the following as a minimum at each burrow:
- Initial state of burrow, e.g. good, disrupted, no longer recognisable as diving petrel burrow, box upturned, burrow entrance buried, etc.
 - Any action taken, e.g. collapse, box installed, or study hole made with rock cover.
 - Content—adult only; adult with egg; adult with unknown; chick; burrow empty.
 - Chick data (see below).

NB If there is an adult present, there is no need to know if it is on an egg or small chick as clearly the chick will not be of use for transfer in November. However, look closely for signs of down (and measure/weigh if in doubt) as some advanced chicks can look like adults!

- 12) For all chicks found record:
- Weight
 - Wing length (right wing)
 - Down cover percentage (estimate)
 - Band only the chicks potentially suitable for the first transfer (see below) only IF there is a qualified bander available. (Otherwise the chick can be banded on Motuora, but its weight and wing length must be re confirmed on the transfer day, and Wooded I. burrow number clearly written on the transfer box.)

SELECTING CHICKS FOR TRANSFER 1

- 13) Identify which chicks might be suitable for Transfer 1 by estimating the likely wing length on the transfer day (add approx. 3 mm growth per day—in 2007 the average wing growth rate for chicks on Wooded I. was 2.7 mm/day, range 2.5–3.1 mm). Emphasis is on wing length at this stage as weights can change over the next few days, although you can rule out any real lightweights that are way under the weight criteria.

Second transfer of diving petrel chicks to Motuora (Gummer, Graham and Gardner-Gee, 2008).

As a guide, chicks that measure the following on these dates during the selection trip have a chance of being suitable to take on the first transfer day:

- 8 Nov: chicks with wings 65–105 mm (*marginal 60–65 and 105–110 mm)
- 9 Nov: chicks with wings 68–108 mm (*marginal 63–68 and 108–113 mm)
- 10 Nov: chicks with wings 71–111 mm (*marginal 66–71 and 111–116 mm)
- 11 Nov: chicks with wings 74–114 mm (*marginal 69–74 and 114–119mm)
- 12 Nov: no chick handling
- 13 Nov (transfer): any chicks opportunistically found with wings measuring 80–120 mm (or >120 mm if heavier than 150 g).

Important: write these guidelines into inside cover of field notebooks

*Taking into account human error/differences with measuring, it will pay to flag any chicks as 'marginals' (see marking method below) if they fall 5 mm under or over these specified wing lengths, i.e. possibly OK to take but need decision on transfer day. This is particularly important if you have a tendency to measure on the short or long side.

- 14) If a chick is probably too young for the first transfer, you may identify it as suitable for the second transfer later in the month.

As a guide, chicks measuring approx. 38 mm (on 8 Nov) through to 79 mm (on 13 Nov) will be suitable for the second transfer and can be marked in a different way.

- 8 Nov: chicks with wings 35–64 mm
- 9 Nov: chicks with wings 38–67 mm
- 10 Nov: chicks with wings 41–70 mm
- 11 Nov: chicks with wings 44–73 mm
- 12 Nov: no chick handling
- 13 Nov (transfer): any chicks opportunistically found with wings measuring 53–79 mm.

It may just be simpler to say that any chicks with wings measuring over 35 mm but too short for the first transfer should be marked (see below) so they can be revisited by the second selection team.

Important: write these guidelines into inside cover of field notebooks

SELECTING CHICKS FOR TRANSFER 2

- 15) Identify which chicks might be suitable for Transfer 2 by estimating the likely wing length on the second transfer day (add approx. 3 mm growth per day). NB For this transfer, the decision was made to focus on older birds (to reduce feeding time on Motuora).

As a guide, chicks that measure the following on these dates during the selection trip have a chance of being suitable to take on the second transfer day:

- 17 Nov: chicks with wings 65–105 mm (marginal chicks >105 mm)
- 18 Nov: chicks with wings 68–108 mm (marginal chicks >108 mm)
- 19 Nov: chicks with wings 90–114 mm (marginal chicks >114 mm)
- 20 Nov: no chick handling
- 21 Nov (transfer): any chicks opportunistically found with wings measuring >100 mm that meet weight criteria.

Important: write these guidelines into inside cover of field notebooks

Second transfer of diving petrel chicks to Motuora (Gummer, Graham and Gardner-Gee, 2008).

MARKING BURROWS

16) Use different colour codes from those used in 2007 for the marker tape tied to the rocks that weigh down box lids or study-hole covers. That way you can instantly see which burrows have been inspected.

For 2007, the colours were as follows:

- Yellow tape for chicks likely to be suitable for transfer.
- Blue and yellow tape for marginal chicks that needed to be reassessed on the transfer day.
- Blue tape left in place for chicks not suitable for transfer.
- Pink tape tended to remain as an indicator of burrow entrance where these were not obvious.

17) For Transfer 1, 2008, the following colours are to be used:

- Orange tape for burrows with chicks likely to be suitable for Transfer 1.
- Green and orange tape for chicks that are marginal for Transfer 1 and need to be reassessed on actual Transfer Day 1.
- Green tape for chicks not suitable for either transfer, and also for empty burrows just checked.
- Keep pink tape as an indicator of burrow entrance where these are not obvious.

18) For Transfer 2, 2008, the following colours are to be used:

- Red tape for burrows with chicks suitable for Transfer 2.
- Green and red tape for chicks that are marginal for Transfer 2 and need to be reassessed on actual Transfer Day 2.
- Green tape for chicks not suitable for either transfer, and also for empty burrows just checked.
- Keep pink tape as an indicator of burrow entrance where these are not obvious.

By doing this, it will be obvious that anything left with blue or yellow has not been inspected in 2008. Then next year you can go back to using blue and yellow again.

19) If burrow has tape from last year:

Copy old tape information into notebook, put new tape of appropriate colour and mark tape with same burrow number but updated content information and date once examination is complete.

20) If burrow has no tape:

Tie on tape of appropriate colour, write on tape the new burrow number (initials and numbers e.g. SG55), current burrow content and date once each inspection is complete.

TRANSFERRING DATA TO RECORD FORMS

21) Transfer all the data collected during the day to forms or spreadsheets each night, before it gets lost or illegible etc.

SEARCHING FOR ADDITIONAL BURROWS

Second transfer of diving petrel chicks to Motuora (Gummer, Graham and Gardner-Gee, 2008).

- 22) When the 30 quota for the first transfer (plus reserves) have been found, if there is more time, it will pay to find more chicks for the second transfer. You may find more older chicks that are suited for the first transfer, and in this case you can leave behind the youngest in your initial selection in favour of taking the older birds; that way we can be sure of having more birds to take in the second transfer.
- 23) Additional blocks can be selected and thoroughly searched to find more chicks and to provide as much information as possible for the second transfer. We would rather see the first team thoroughly search the top and leave the sides for the second team to search, than have unchecked burrows scattered throughout so that the second team has to trample over all the same areas again to check them.

DAY BEFORE TRANSFER

- 24) Avoid visiting Wooded I. the day before the actual transfer day (unless weather dictates that the transfer day must proceed as soon as possible), or only visit in the morning. It is really important to allow plenty of time on the day before transfer to sort, review and write up data collected in the field, make preparations for the transfer day, and have an early night so that everyone can start as early as possible on the transfer morning. Our strategy to avoid chick deaths this year is to transfer as early as possible in the day to avoid transferring at the hottest part of the day.
- 25) When preparing transfer boxes, line the floor with newspaper (for grip) and add only a thin layer (no more than 2 cm depth) of packed shredded paper so birds can not bury themselves in it and overheat. (Another important strategy to reduce heat stress.) Make sure the dividers sit firmly on the box floor with no gaps for legs to get caught in. Stick four strips of packing tape above each compartment on top of the lids to write bird band numbers and burrow numbers on.

TRANSFER DAY

- 26) Assign two people the task of visiting all orange tagged burrows. Weigh and measure each chick on the day of collection, to double-check their suitability for transfer. Weights are extremely important and chicks must fit the criteria for their wing-length grouping to be suitable. Record this data and your decision regarding transfer (transferred or returned to burrow).
- 27) Carefully check each chick for any abnormalities or obvious signs of poor health. This includes a check of both legs/feet, both wings and both eyes as a minimum. If in any doubt about a chick's health or condition, do not transfer.
- 28) If chick is suitable, place in transfer box and record band number, burrow number and time of collection on box above bird.
- 29) If chick is not suitable, return chick to burrow (you may find the chick is in fact suitable for the second transfer in which case you would need to change the tape colour).
- 30) Assign one person the task of shifting boxes out of the sun, carrying them down to the shore, liaising with the boat handlers, tidying up gear etc.

Second transfer of diving petrel chicks to Motuora (Gummer, Graham and Gardner-Gee, 2008).

- 31) Always place transfer boxes under the shady canopy out of the sun to reduce the risk of chicks overheating (keep moving them as necessary), but then carry boxes as soon as possible down to a shaded area on the landing platform (in 2007 this was once all chicks had been collected, but this year it will be better to do this as soon as boxes are filled and checked off to avoid heat stress).
- 32) Loading the boat needs to be achieved, ideally, by late morning before the heat sets in, e.g. 11.00am.
- 33) At all times, make sure the boxes are well spaced apart to allow air flow around the boxes. This is particularly important in the launch or water taxi.
- 34) At least one person is to escort birds to Motuora.
- 35) Leave all burrow markers in place on Wooded I.

Second transfer of diving petrel chicks to Motuora (Gummer, Graham and Gardner-Gee, 2008).

Appendix 5: Transfer and fledging data for diving petrel chicks transferred to Motuora in 2008

* Transfer wing lengths have been estimated for those mis-recorded on the transfer day, or recorded as being >5 mm from the probable [straightened and flattened] length based on measurements taken by HG the following day.

** Some chicks may have had departure delayed by late removal of blockade gate (e.g. chicks that fledged first night gate removed).

NB Total days on Motuora includes transfer day and is equal to number of nights including fledging night.

Transfer 1: 13 November 2008

Band (D-)	Motuora burrow no.	Transfer weight (g)	Transfer wing (mm)	Fledging weight (g)	Fledging wing (mm)	Date of fledging (pm)	Nights out	Total days on Motuora	Comments
190704	23(a)	170	120	144	128	20/11/2008**	1	8	Wing growth complete at departure
190705	4	168	85	126	125	4/12/2008	2	22	Wing growth complete at departure
190706	2	168	90	141	127	1/12/2008**	1	19	Departed with wing growth ≤1 mm/day
190708	3	186	100	137	129	28/11/2008	4	16	Departed with wing growth ≤1 mm/day
190709	1	172	89	147	127	2/12/2008	2	20	Departed with wing growth ≤1 mm/day
190710	10(a)	169	117	150	119	14/11/2008**	1	2	Wing growth complete at departure
190711	13	180	87	142	120	29/11/2008**	1	17	Departed with wing growth ≤1 mm/day
190801	11	168	109*	133	124	23/11/2008	3	11	Wing growth complete at departure
190802	41	164	97*	141	123	28/11/2008**	1	16	Wing growth complete at departure
190803	14	162	91	141	127	2/12/2008	3	20	Wing growth complete at departure
190808	25	177	97*	133	126	27/11/2008**	1	15	Departed with wing growth ≤1 mm/day
190809	7	186	96*	144	122	26/11/2008**	1	14	Departed with wing growth ≤2 mm/day
190810	6	164	95*	149	127	29/11/2008**	1	17	Wing growth complete at departure
190812	30	164	92*	140	130	5/12/2008	4	23	Wing growth complete at departure
190813	33	144	81	122	118	30/11/2008**	1	18	Departed with wing growth ≤1 mm/day
190814	36(a)	164	114	138	123	19/11/2008	3	7	Departed with wing growth ≤1 mm/day
190815	34	155	90	133	124	30/11/2008**	1	18	Departed with wing growth ≤1 mm/day
190816	31	186	92	145	127	4/12/2008	4	22	Wing growth complete at departure
190818	29	173	101	-	-	-	-	-	Found dead in burrow on 14/11/08
190821	32	186	103*	142	126	25/11/2008**	1	13	Departed with wing growth ≤1 mm/day
191011	8	161	93*	136	121	29/11/2008**	1	17	Departed with wing growth ≤1 mm/day
191012	5	182	88	-	-	-	-	-	Found dead in tunnel on 30/11/08
191013	37	171	110	146	130	25/11/2008**	1	13	Wing growth complete at departure
191014	35	164	94*	145	126	2/12/2008	2	20	Wing growth complete at departure
191015	42	170	99*	126	120	25/11/2008**	1	13	Wing growth complete at departure
191016	20	199	107*	150	128	28/11/2008	5	16	Departed with wing growth ≤1 mm/day
191018	22(a)	176	101*	130	119	22/11/2008**	1	10	Departed with wing growth ≤1 mm/day
191020	21	166	92	138	123	29/11/2008**	1	17	Departed with wing growth ≤1 mm/day
191021	15(a)	158	119	138	122	14/11/2008**	1	2	Wing growth complete at departure
191022	24	163	93*	131	124	30/11/2008**	1	18	Departed with wing growth ≤1 mm/day

Second transfer of diving petrel chicks to Motuora (Gummer, Graham and Gardner-Gee, 2008).

Band (D-)	Motuora burrow no.	Transfer weight (g)	Transfer wing (mm)	Fledging weight (g)	Fledging wing (mm)	Date of fledging (pm)	Nights out	Total days on Motuora	Comments
191023	17	184	95	144	125	28/11/2008**	1	16	Wing growth complete at departure
191024	16	132	86	128	125	4/12/2008	4	22	Wing growth complete at departure
191084	28	179	102*	112	120	24/11/2008**	1	12	Wing growth complete at departure
191085	27	154	90*	132	125	2/12/2008	2	20	Wing growth complete at departure
191086	9	170	100*	138	132	30/11/2008	5	18	Departed with wing growth \leq 1 mm/day
191088	12	152	96*	126	127	29/11/2008**	1	17	Wing growth complete at departure
191090	18	153	104*	128	128	28/11/2008	4	16	Wing growth complete at departure
191091	19	169	92*	138	126	30/11/2008**	1	18	Departed with wing growth \leq 1 mm/day
191096	26	159	85	131	125	2/12/2008**	1	20	Departed with wing growth \leq 1 mm/day
Mean Transfer 1		168.4	96.6	136.9	124.8		1.9	15.8	NB Transfer 1 wing length statistics
S.D.		12.8	12.5	8.5	3.4		1.3	5.0	including estimates (n=39) are:
Range min.		132	81	112	118	22/11/2008	1	2	Mean: 97.2 mm
Range max.		199	120	150	132	6/12/2008	5	23	S.D.: 9.6 mm
Sample size		N=39	N=20	N=37	N=37		N=37	N=37	Range: 81–120

Transfer 2: 21 November 2008

Band (D-)	Motuora burrow no.	Transfer weight (g)	Transfer wing (mm)	Fledging weight (g)	Fledging wing (mm)	Date of fledging (pm)	Nights out	Total days on Motuora	Comments
191093	10(b)	166	119	142	124	28/11/2008	2	8	Wing growth complete at departure
190852	15(b)	160	119	133	122	25/11/2008**	1	5	Wing growth complete at departure
190714	23(b)	160	121	136	124	23/11/2008	2	3	Wing growth complete at departure
190842	36(b)	162	109	139	127	3/12/2008	4	13	Wing growth complete at departure
190842	38	174	116	143	127	28/11/2008**	1	8	Departed with wing growth \leq 1 mm/day
190848	39	151	122	133	123	22/11/2008**	1	2	Departed with wing growth \leq 1 mm/day
190849	40	162	114*	134	124	26/11/2008**	1	6	Departed with wing growth \leq 2 mm/day
190701	43	144	100	120	124	5/12/2008	2	15	Wing growth complete at departure
190702	44	170	103	-	-	-	-	-	Died in burrow during day of 30/11/08
190703	45	176	101	133	126	5/12/2008**	1	15	Departed with wing growth \leq 1 mm/day
191097	46	168	114	137	127	30/11/2008	1	10	Departed with wing growth \leq 1 mm/day
191098	47	155	116	134	122	26/11/2008	2	6	Wing growth complete at departure
190825	48	150	117	138	123	25/11/2008**	1	5	Wing growth complete at departure
190841	49	190	111	141	128	2/12/2008	2	12	Departed with wing growth \leq 1 mm/day
191100	50	176	111	132	121	29/11/2008	2	9	Departed with wing growth \leq 1 mm/day
190901	51	169	116	138	123	25/11/2008**	1	5	Wing growth complete at departure
190823	52	153	115	127	127	28/11/2008	3	8	Departed with wing growth \leq 1 mm/day
191095	53	150	112	131	125	29/11/2008**	1	9	Wing growth complete at departure
190826	54	168	111	136	126	1/12/2008**	1	11	Departed with wing growth \leq 1 mm/day

Second transfer of diving petrel chicks to Motuora (Gummer, Graham and Gardner-Gee, 2008).

Band (D-)	Motuora burrow no.	Transfer weight (g)	Transfer wing (mm)	Fledging weight (g)	Fledging wing (mm)	Date of fledging (pm)	Nights out	Total days on Motuora	Comments
190850	55	176	102	127	126	5/12/2008**	1	15	Departed with wing growth \leq 1 mm/day
190846	56	141	115	116	123	26/11/2008**	1	6	Departed with wing growth \leq 1 mm/day
190806	57	176	103	139	128	6/12/2008	2	16	Departed with wing growth \leq 1 mm/day
190822	58	172	103	131	129	6/12/2008	3	16	Departed with wing growth \leq 1 mm/day
190717	59	170	110	-	-	-	-	-	Found dead on 30/11/08 c. 3m from burrow entrance on ground
190715	60	190	107*	149	126	30/11/2008**	1	10	Departed with wing growth \leq 1 mm/day
190716	61/ 22(b)	160	106	123	126	3/12/2008	3	13	Departed with wing growth \leq 1 mm/day
190707	62	164	101	132	123	4/12/2008**	1	14	Wing growth complete at departure
Mean Transfer 2		164.9	110.9	133.8	125.0		1.6	9.6	NB Transfer 2 wing length statistics
S.D.		12.3	6.8	7.3	2.2		0.9	4.2	including estimates (n=27) are:
Range min.		141	100	116	121	14/11/2008	1	2	Mean: 110.9 mm
Range max.		190	122	149	129	5/12/2008	4	16	S.D.: 6.7 mm
Sample size		N=27	N=25	N=25	N=25		N=25	N=25	Range: 100–122

Transfer 1 & 2: All chicks

Band (D-)	Motuora burrow no.	Transfer weight (g)	Transfer wing (mm)	Fledging weight (g)	Fledging wing (mm)	Date of fledging (pm)	Nights out	Total days on Motuora	Comments
Mean		167.0	104.6	135.6	124.9		1.8	13.3	NB Transfer wing length statistics
S.D.		12.7	12.1	8.1	2.9		1.2	5.6	including estimates (n=66) are:
Range min.		132	81	112	118	14/11/2008	1	2	Mean: 102.8 mm
Range max.		199	122	150	132	6/12/2008	5	23	S.D.: 10.8 mm
Sample size		N=66	N=45	N=62	N=62		N=62	N=62	Range: 81–122

Appendix 6: Diving petrel chick food preparation (based on 30 chicks)

Equipment for food preparation:

Blenders / knife / spatula / cold sterile (boiled for >3 mins) water / small measuring jug (to 10 ml) / sardines / food pottles

Recipe:

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

50 ml cold (boiled > 3 mins) water (day 1 exception: 75 ml for first feed)

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

- 1) Make up 12 litres of FRESH antibacterial solution (e.g. Milton) in square bucket (1 tablet/2 litres cold water; 6 tablets/12 litres water).
- 2) Wash hands (with antibacterial soap).
- 3) Assemble syringes and crop tubes (hand-tight only). Lubricate plunger with smear of castor oil (on clean tissue), and also apply castor oil to screw thread of crop tube to make an airtight seal. Accurately indicate volumes on unmarked side of syringe barrel with fine-tipped vivid marker if necessary.
- 4) Place dry, sterilised equipment required for day in bucket (rinse bath pottles, spice jars for chlorhexidine, food flask cups, box of assembled syringes/crop-tubes), along with clean dry holding bags and towels.
- 5) Place 150 ml cold (boiled > 3 mins) water in blender with 1 tin of fish (chop fish up in tin) and liquidize until runny (at least 30 secs). Add second tin (chop fish up) and blend until runny. Add third tin (chop fish up) and blend until smooth. Pour mix into containers (3 tins fills 2 pottles) immediately after blender stops (so food does not settle). MOVE JUG TO SECOND BLENDER MOTOR for next batch (to prevent strain on motor).
NB Process a maximum mix of 4 tins of fish (with 200 ml water) in each batch to prevent strain on blender. 3 tins (with 150 ml water) is just enough mix to cover Sunbeam Multiblender Platinum blender blades. Rest blender between batches.
- 6) Place coloured lids on pottles of food when made, and chill as follows:
 - White lids on first pottles of food made. Put in freezer to cool down (up to 30 mins only, then move to fridge if necessary); these will be used last at the colony so need to be more chilled through the day.
 - Blue lids on the next pottles made. Place in freezer.
 - Repeat for green lids.
 - Leave 1–2 pottles out at room temperature with red lids (for the first feeding session).
- 7) Turn blenders off at plug on wall (to prevent any damage as generator turns on/off).
- 8) Place food pottles in chilly bin with at least three ice-blocks. Food must be kept cool at the colony site (to prevent contamination) and then warmed just before use.
NB These chilly blocks may also be required to keep any dead chicks cool if found during the roll-call.
- 9) Remove blender blades and rinse out blender etc. before doing a thorough wash (with the petrel washing-up brush) in very hot, very soapy water to remove all oil.

Second transfer of diving petrel chicks to Motuora (Gummer, Graham and Gardner-Gee, 2008).

Rinse off detergent before placing equipment in bucket of antibacterial solution for the day (minimum soak period 2 hrs).

NB Place upturned blender blades in small pottle of sterilising solution so blades are immersed but base is kept dry (base is prone to rust).

- 10) Wash out sardine tins in hot, soapy water (use rubber gloves) for disposal/recycling.
- 11) Put dish-wash brush and cloth back into separate container of sterilising solution after thoroughly cleaning brush with extra dish-wash liquid and clean hot water.
- 12) Wipe down blender bases and bench with cloth (soaked in antibacterial solution).
- 13) Boil water (standard boil) to fill two 1 litre thermos flasks (for food-warming baths).

Appendix 7: Checklist of equipment to transport to colony site (based on 1 team)

NB Quantities for 2 feeding teams are in brackets.

- 1-2 (2-4) room temperature container of food for first feeding round
- Chilly bin containing rest of food containers plus several chilly blocks
- 2 (4) food thermos flasks (food-warming baths)
- 2 (4) syringes (30 ml Bovivet plexiglass)
- 2 (4) crop-feeding tubes (6.3 x ~70 mm Teflon speed feeding tubes) + spares
- 3 (6) plastic spice jars (for crop tube sterilising chlorhexidine solution)
- 2 (4) rinse baths (pottles)
- Several teaspoons (clean one for each pottle)
- 1 (2) container (3 litres) boiled (>3 mins) water (for rinsing)
- 2 (3) thermos flask (1-2 litres) of hot water (food-warming baths)
- Waterproof notebooks and pencils
- Clean weigh bags
- Clean hand towels to rest chicks on
- Any other supplies to restock e.g. tissues, rubbish bags, paper towels, hand-washing water, newspaper etc.

Sterilising solution

Microshields chlorhexidine (5%) is a pink runny sterilising liquid made into a solution with water: 1 part chlorhexidine to 19 parts water (e.g. 10 ml chlorhexidine to 190 ml water). *Alternatively, antibacterial solution can be used (taken daily from bucket of fresh solution in bird kitchen); this is not ideal but preferable to no sterilisation between birds.* *NB Neither sterilising solutions are considered to be 100% effective given the short sterilising time.*

At the colony site stored in feeding shed should be:

- Castor oil (to lubricate syringes)
- Spare crop tubes
- Fine-tipped vivid markers (marking syringe barrels)
- Food temperature thermometer(s)
- Scales (2 x 300 g Pesola scales plus spare set)
- Wing rule (300 mm)
- Chlorhexidine concentrate supply
- Spacers to put in food thermos flasks (prevent pottles getting stuck inside)
- Spare weigh bags
- Spare tissues and paper towels
- Nail boxes to carry chicks between shed and burrows
- Newspaper to line nail boxes
- Coloured clothes pegs to mark burrows during collection of chicks
- Hand-washing water and antibacterial soap; and antibacterial hand-wipes
- Spare pencils
- Rubbish bags and bin
- Chick first-aid kit (saline, wound ointment, flexi-cohesive bandage, veterinary eye ointment, small scissors)
- Spare transfer boxes for back-up accommodation
- A sack of very dry grass for lining flooded burrows (or boxes if used as accommodation)
- Fencing pliers to install and remove blockade gates.

Appendix 8: Diving petrel chick post-feeding clean-up

- 1) Discard surplus sardine mixture in the sea so as not to oil up drains.

IN THE LAUNDRY

- 2) Wash hands (with antibacterial soap) before removing food preparation equipment (blender jugs etc.) from antibacterial solution that has been soaking over the day. Air dry on petrel dish-rack or bench wiped with cloth soaked in sterilising solution.
- 3) Retain the antibacterial solution for soaking the day's equipment after washing.
- 4) Empty chilly bin and return used ice-blocks to freezer.
- 5) Rinse all used feeding equipment under tap to remove bulk of fish mixture (if necessary) before doing a thorough wash (with petrel dish-wash brush) in very hot, very soapy water (ordinary dish-washing liquid) to remove all oil. Pass hot, soapy water through crop-tube and syringe under pressure, 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).
NB Avoid scratching the inside of syringe barrels with the bottle brush wire.
- 6) Thoroughly scrub used pottles inside and out; keep holding up to light to check all oil residue is removed.
NB Avoid using the bottle brush which can scratch the bottom of the pottles.
- 7) Rinse detergent off all washed equipment before placing in the container of antibacterial solution (minimum soak period 2 hrs). See 11 for final step.
- 8) Dish-wash brush, bottle-brush and cloth can be put into sterilising solution in a separate container after thoroughly cleaning the brushes with extra dish-wash liquid and clean hot water.
- 9) Wash out chilly bins and equipment buckets; wipe out with cloth soaked in antibacterial solution.
- 10) Shake out weigh bags, turn inside-out (allows faeces etc. to soak off) and soak in Napisan for at least a couple of hours (half level lid of Napisan to 5 litres water), but preferably overnight. Bags are rinsed several times and hung out to dry on the following morning.
- 11) After equipment has soaked in sterilising solution (at least 2 hrs), allow it to air dry overnight by removing from solution, shaking off excess liquid and placing items on clean bench (wiped over with cloth soaked in antibacterial solution) later that evening.
- 12) Before discarding solution —fresh antibacterial solution is made on the next feeding day (recommended change every 24 hours)— use some of this 'used' antibacterial solution to replace the solution in the tub for brushes and dish-cloths.

Second transfer of diving petrel chicks to Motuora (Gummer, Graham and Gardner-Gee, 2008).

IN THE POTTING SHED

- 13) Boil water (>3 mins), enough to fill the 3-L 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 9: Diving petrel chick feeding, measuring and monitoring (based on 30 chicks)

- One 3-person team is ideal for a full feeding day, consisting of: 1 feeder (concentrating on feeding, food temperature and hygiene); 1 handler (weighing and holding chick during feeding); and 1 runner (collecting chicks from burrows).
- Instructions are given for one team.
- Two teams are effective with >40 chicks to process each day.

SETTING UP

- 1) Wash hands (with antibacterial soap).
- 2) Fill two rinse baths with boiled (>3 mins) water.

NB If there is a shortage of boiled water, the first rinse bath can be tap water.

- 3) Make up Microshields chlorhexidine (5%) solution in measuring jug:
1 part chlorhexidine to 19 parts water (e.g. 10 ml chlorhexidine to 190 ml water).
- 4) Fill 3 small spice jars with sterilising solution. One is filled to depth of crop tube length, and stabilised to prevent it tipping over with syringe/tube resting in jar. The other 2 jars are filled equally and kept aside to use for flushing syringes during the feeding interval(s).
- 5) Place first food container (lid removed) in food thermos containing hot water to warm up. Pottle can be just resting in water, but care must be taken to ensure flask water does not flow up, over and into the food.
- 6) Use a clean teaspoon 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).

NB Warming of food can be delayed until after the burrow rounds (see 6 below) to avoid overheating food if it can not be closely monitored.

- 7) Spread clean towel on feeding bench.
- 8) Ensure carry-boxes are lined with layers of newspaper.
- 9) Calibrate Pesola scales.

CHICK ROLL-CALL

- 10) Complete rounds of all burrows to record fence status (emergence behaviour) and check on welfare of ALL birds *before* commencing feeds.
- 11) Visit each burrow in numerical order (to ensure all are checked), and:
 - Record stick fence status (D=fence down; I=fence intact; PD=partially down) or mesh blockade gate presence (G=gate).

Second transfer of diving petrel chicks to Motuora (Gummer, Graham and Gardner-Gee, 2008).

- Remove sandbags.
- Place one hand up pipe entrance from outside (to prevent any birds escaping) if burrow is not gated.
- Open burrow lid and sight chick, or feel to end of chamber (including under nest material) for bird.
- Feel up entire length of pipe from both ends (in case chick, or even a second chick, is in the tunnel).
- Record presence or absence of chick.

NB Don't bother erecting stick fences at burrow entrances at this stage. Fences are best restored at the end of the day after all chick-processing. Sand-bags are replaced on top of burrows after the chick has been fed.

- 12) Remove sand-bags from burrows that have been vacated, i.e. chicks fledged night before; this way, all occupied burrows stand out at the burrow site because they are still covered in sand-bags.
- 13) Check all burrows (even if stick fences are intact) that are not occupied by resident chicks to ensure other chicks have not been accidentally returned to wrong burrows on the previous day. Such chicks might not otherwise be found and may be recorded as departed from their own burrows, yet still require feeding. For this reason it is important to leave off all blockade gates of vacant (unoccupied) burrows to be sure any chicks accidentally put in wrong burrows can emerge/depart; spare vacant burrows also provide additional places for wandering birds to occupy reducing incidences of birds disappearing and missing feeds.

NB Burrows that have housed chicks that have died are left gated to prevent other chicks using them.

CHICK PROCESSING

- 14) Process chicks in the following order:
 - Extract from burrow
 - Check band if necessary
 - Weigh (to obtain pre-feed or base weight)
 - Measure wing length (right wing) if wing measuring day
 - Any other handling (e.g. physical examination, down coverage estimates)
 - Feed (recording amount delivered in mL; no post-feed weight required)
 - Return to burrow.

NB Wing measurements may be made on every third day for younger chicks, AND on a daily basis once chicks have <20% down coverage and are >118 mm wing length (to determine date of gate removal), AND on a daily basis following gate removal to obtain fledging data. Weights are recorded daily.

COLLECTING CHICKS FROM BURROWS

- 15) Collect chicks in weigh bag placed inside collection box. Further inspection of back of chamber may be required to check for possible regurgitation (burrow will smell particularly fishy if regurgitation has occurred there). Replace burrow lid to keep chamber cool (particularly in hot sun) and/or dry (particularly if raining).

Second transfer of diving petrel chicks to Motuora (Gummer, Graham and Gardner-Gee, 2008).

NB Mark the empty burrow when the chick has been removed (e.g. coloured clothes peg matching the colour of the carry box) so that the chick is returned to the same burrow.

- 16) Check nest for signs of regurgitation and faeces present and normal (dark brown gritty faeces with white fluidy urates, usually seen on chamber walls).

WEIGHING AND MEASURING CHICKS

- 17) Weigh birds over a surface (to prevent injury if bag falls from scales). Replace weigh bags as soon as soiled.
- 18) Keep birds in bags (to keep calm) for wing measuring, removing right wing to measure—straightened and flattened—recording maximum wing length.

FEEDING CHICKS

- 19) For feeding a 20 g meal, load syringe to 25 mL, ensuring all air bubbles are removed. (Either the tube or the top of the syringe may need to be tightened if air bubbles continue to enter while drawing up food.) The excess allows for 5 g of food to be left in the bottom of the syringe after delivery of 20 g to the chick, important for the sterilising process (see 23 below). Wipe the crop tube with a clean tissue to remove residue food before inserting into chicks throat.
- 20) During feeding, the holder holds the chick firmly on a surface covered with a towel with one hand (crop area unrestricted), while the feeder holds open the bill (mainly grasping the upper bill), stretching the head and neck forward and up at all times (around a 40° angle from the bench). With other hand holding the syringe, the feeder inserts the crop tube to the back and side of the throat (to keep airway clear). Food delivery stops at the pre-determined amount or earlier if signs of food coming back up throat. For a large volume of food, a break may be required mid-way through the meal (e.g. if a 30 mL meal is given, the feeder may withdraw the tube at 15 mL and allow the bird to rest). *The feeder is responsible for recording amount actually taken by chick.*

NB No post-feed weight is required as 10 mL of food tends to be 10 g in weight. If the feeder finds it difficult to grasp the bill, a second option is for the feeder to hold the chick's body with one hand and feed with the other, while the handler uses both hands to open and hold the bill stretched forward.

- 21) After feeding, the chick may need to be cleaned with a soft tissue so that there is no food on the bill or plumage. Particular attention is paid to the base of the bill where food can build up and form a crust if not cleaned away.

RETURNING CHICKS TO BURROWS

- 22) Chick is returned immediately to the carry-box in an upright position to prevent any regurgitation incidences. Chick is returned directly to chamber, facing back wall, and lid (and any sandbags) restored.

Second transfer of diving petrel chicks to Motuora (Gummer, Graham and Gardner-Gee, 2008).

NB A loose ball of grass can be placed at the entrance to prevent lively, unsettled chicks escaping via the tunnel.

FOOD HYGIENE AND TEMPERATURE CONTROL

- 23) After feeding, wipe the crop tube with a tissue and place tube upright in jar of sterilising solution for a minimum of 2 mins sterilising time. After sterilisation, remove syringe/tube and eject remaining food (5 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).

NB The delicate nature of the screw fitting of tube into syringe means that the tube can not frequently be detached (or the fitting will be damaged), hence the above sterilising process has been designed for this particular equipment.

- 24) Keep monitoring food temperature regularly and stir with teaspoon before drawing up food (the thick part of the mix can settle). Remove from water bath if too warm. Shortly after starting the first batch, get the next batch out of the chilly bin to warm up in the sun. When the old near-empty pottle is removed, the next pottle can then be placed in the flask with fresh hot water to warm up (takes at least 10 mins). Use clean teaspoon for stirring the next mix.
- 25) On a full feeding day, the syringe barrels need to be rinsed out and disinfected (filled with sterilising solution) several times during the day (to coincide with feeding intervals/tea-breaks). Rinse used syringes out with the rinse water, then draw up sterilising solution to top of barrel for 15-30 minutes (minimum). Thoroughly rinse syringes with clean water before use again, i.e. at least 3 flushes with tap water followed by 3 flushes with boiled water.
- 26) Rinse baths need to be replaced on a regular basis throughout day (minimum 3 times on a full feeding day).

CLEAN-UP AFTER FEEDING

- 27) At end of feeding session, check in notebook that all birds have been fed, *before* discarding food and equipment.
- 28) Eject remaining food and flush out syringes/tubes with water (use hot water if any left in flasks as this is more effective at removing fish residue from inside the tubes).
- 29) Stack all used items, used weigh bags etc. into bucket to take down for washing.
- 30) Wipe down all work surfaces with antibacterial wipes (or with kitchen towels soaked in leftover sterilising solution).
- 31) Throw out all used sterilising solution (this is made up daily but can last a second day if diluted).

Second transfer of diving petrel chicks to Motuora (Gummer, Graham and Gardner-Gee, 2008).

BLOCKADE GATES AND STICK FENCES

- 32) After all feeding is complete, remove any blockade gates at relevant burrows to allow chick emergence (this will be based on weight and wing length data, and down coverage). Before removing gate, check that the chick is not sitting at the entrance (to avoid injury or escape). Before erecting a stick fence, check that there are no blockages in the tunnel.

NB Diving petrels are an active, easily agitated species, so taking gates off in the late afternoon/early evening (before dusk) may reduce the risk of chicks wandering from burrows during the daytime. Alternatively, a loose ball of dry grass can be placed in the entrance behind the stick fence.

- 33) Check that ALL stick fences at burrow entrances without blockade gates are restored. At least 3 thin straight sticks are lightly placed in the soil at the entrance so as not to barricade the chicks in (or out!). (Two sticks can be placed at vacated burrows.)

FINAL BURROW CHECKS

- 34) Check that ALL chamber lids are firmly on (light-proof and water-proof).

Burrow site access after dark

Avoid visiting the colony site after dark to reduce risk of disturbing chicks exiting burrows, or already on the surface. Torchlight may cause birds to scamper off away from the burrows, and may reduce the chance of chicks returning to the burrow in the event that they are not yet ready to fledge, thus compromising fledging condition if they can not be hand-fed up until the day they depart. In addition, there is a risk of stepping on chicks under the grass in the dark.

Notebooks

A separate notebook is required for daily recording of fence status at each burrow and chick presence/absence following chamber inspection.

Rule up feeding notebooks (or print out data record sheets) before the transfer day. If 2 feeding teams are expected, 2 notebooks are required. Data for each chick is recorded on a separate page so that progress can be followed each day in the field. Each page includes:

- Chick band no. and burrow no. at top; and columns for:
- Date;
- Time;
- Pre-feed weight (including bag);
- Amount actually fed (in mL);
- Wing measurement (mm);
- Down coverage (%);
- Faeces (in burrow or bag);
- Vocal before feed;
- Vocal after feed;
- Good feeder;
- Poor feeder;
- Notes.

Appendix 10: Procedures in the event of chick death

- 1) Inspect bird for any external signs of cause of death, e.g. injury, missing feathers, staining (blood, faeces, regurgitant) around vent or head region.
- 2) Inspect burrow for signs of abnormal faeces, or any regurgitant. Collect any recent faeces and place in a plastic zip-lock bag.
- 3) Take cloacal and choanal swabs (for micro-organism culture), and label (see below).
- 4) Seal bird inside 2 plastic zip-lock bags, and label (see below).
- 5) Label plastic bag with bird in and any samples with the following (as a minimum): date found, location, species, individual ID (band no.), age (e.g. chick), and a contact name.
- 6) Place double-bagged bird and sealed swab samples in a cool location (e.g. fridge) until boat transport is available.
- 7) Wrap bagged bird and samples in newspaper and pack in an insulated polystyrene box with a frozen ice-pack.

NB The corpse or samples must not be resting directly on the ice-pack as freezing may compromise autopsy and diagnosis results.
- 8) Place Wildlife Submission Form inside box with:
 - Location, species, individual ID (band no.), age (e.g. chick), date corpse found, estimated date/time of death, transfer history, hand-feeding history, and any other relevant observations regarding health prior to death.
 - Contact name and contact details for results to be sent:
Robin Gardner-Gee
3/81 Beresford St West
Freemans Bay
Auckland 1011
rgg(at)clear.net.nz
 - Above address is also the return address for polystyrene box and ice-pack.
- 9) Mark the box externally with: URGENT / PERISHABLE / DO NOT FREEZE.
- 10) Send by overnight courier to:
Attention: Maurice Alley/Richard Norman/ Brett Gartrell
Room 7.19
Vet Tower, IVABS
Massey University
Fitzherbert Road
Palmerston North
- 11) Phone the lab to check suitability of sending date (lab is usually closed at weekends), and to advise staff of pending arrival of package.
Phone number:

Second transfer of diving petrel chicks to Motuora (Gummer, Graham and Gardner-Gee, 2008).

liver is more likely to be due to a pathological process, as straight trauma would be more likely to rupture liver lobes, and there was no surrounding haemorrhage in the body cavity. The fish slurry present in the choana may have happened during feeding or if the bird subsequently brought some of the meal up, however the trachea is clear ruling out death due to aspiration.

Accn. No.: 42523

Pathologist: V R Linley / M R Alley

Second transfer of diving petrel chicks to Motuora (Gummer, Graham and Gardner-Gee, 2008).

The cause of death was due to the kidney disease. Gout deposition is the visible result of urate accumulations in the tissues, and is an end stage sequela in some kidney diseases. Although the proventriculus/ventriculus of seabirds is particularly large and distensible, I do feel that this may have been overfull. Feeding a greater volume than the gut could handle as suggested in the history may be a possibility, but unrelated to the gout.

Pathologist: V R Linley / B D Gartrell

Second transfer of diving petrel chicks to Motuora (Gummer, Graham and Gardner-Gee, 2008).

Appendix 12: Recommendations for monitoring diving petrels on Motuora

Background:

There has been one previous diving petrel transfer: between November 1997 and December 1999, a total of 239 diving petrel chicks was transferred to Mana Island and hand-fed to fledging; of the 118 chicks that fledged, by 2004 twenty had returned to Mana Island and 15 bred there. The Motuora and Mana Island transfer procedures and set-ups are similar (i.e. both have an array of artificial burrows near cliff edges and both have an acoustic system) hence the Mana Island project gives us an idea of what to expect in terms of chick return and monitoring. In the Mana Island project 3-4 nocturnal searches per year were made initially, but search effort was later increased to 3-7 nocturnal searches per year, with searches in later years being conducted in both the pre-breeding season (Jan to August) and the breeding season when eggs and chicks are present in burrows (September to December). Initially searches concentrated on the area around the loud speakers and the artificial colony, and searchers looked for signs of occupation. Later however acoustic searching was used: the sound system was turned off to reduce background noise and birds were induced to call by mimicking their calls. Whenever good weather provided good listening conditions this method was used to search cliff areas around the artificial colony. Most birds detected were in natural burrows or dense vegetation on the cliff edge below the artificial colony, or on the cliff face itself. Breeding birds were mostly within 150 m of the loud speakers but in 2004 a small peripheral colony was found 1.5 km away from the artificial colony area.

Aims of Motuora monitoring:

The highest priority is that birds settle at the new site on Motuora, hence all unnecessary disturbances at the site are to be avoided. However, careful monitoring of the site will provide valuable information that can be used to assess the success of the Motuora transfers and guide future transfers.

Basic monitoring efforts on Motuora will include:

- Identifying adults—to determine return rates of translocated birds.
- Banding new immigrants—to determine proportion of new immigrants to birds that fledged from the site.
- Marking all burrows found—to establish breeding outcome.
- Banding chicks—to facilitate future monitoring of birds of known age and origin.

Second transfer of diving petrel chicks to Motuora (Gummer, Graham and Gardner-Gee, 2008).

Outline of monitoring and burrow maintenance proposed for 2009:

Month	Project manager (and volunteers)	MRS rangers (and volunteers)
March	<ul style="list-style-type: none"> • Clean out artificial burrows and weed entrances • Night check for activity • Cut first night monitoring track 	<ul style="list-style-type: none"> • Weed-eat artificial colony tracks and sound system tracks (check burrows immediately before weed-eating)
April	<ul style="list-style-type: none"> • Check artificial burrows • Night check for activity • Cut remaining night monitoring tracks 	<ul style="list-style-type: none"> • Weed-eat artificial colony tracks and sound system tracks (check burrows immediately before weed-eating) • Commence weekly daytime burrow checks in late April
May	<ul style="list-style-type: none"> • Night check for activity in late May (along with annual grey-faced petrel burrow check) • Trim night monitoring tracks 	<ul style="list-style-type: none"> • Continue weekly burrow/fence checks • Weed unused burrows • Trim colony tracks after night check
June-July	<ul style="list-style-type: none"> • Night check (optional- one check across these months would be ok) • Trim night monitoring tracks if needed 	<ul style="list-style-type: none"> • Continue weekly burrow/fence checks • Weed unused burrows • Trim colony tracks if needed • Visual check of occupied burrows in late July to determine incubation
August	<ul style="list-style-type: none"> • Night checks for activity in late August • Day check on any natural burrows located to determine incubation • Trim night monitoring tracks 	<ul style="list-style-type: none"> • Continue weekly burrow/fence checks, leave incubating birds undisturbed • Weed unused burrows • Trim colony tracks after night check
September	<ul style="list-style-type: none"> • Night checks for activity in late September • Day check on any natural burrows located to determine incubation • Trim night monitoring tracks 	<ul style="list-style-type: none"> • Continue weekly burrow/fence checks, leave incubating birds undisturbed • Weed unused burrows • Trim colony tracks after night check
October	<ul style="list-style-type: none"> • Night checks to identify breeding pairs (artificial and natural burrows) in late October • Day banding of chicks • Installation of any inspection holes needed • Trim night monitoring tracks 	<ul style="list-style-type: none"> • Continue weekly burrow/fence checks • Weed unused burrows • Trim colony tracks after night check • Visual check of burrows with incubating birds (10 weeks after incubation detected): adults with chicks by day can be inspected for bands
November		<ul style="list-style-type: none"> • Translocation of 60-80 further chicks from Wooded Island: end weekly checks once new chicks arrive

Second transfer of diving petrel chicks to Motuora (Gummer, Graham and Gardner-Gee, 2008).

ARTIFICIAL COLONY MAINTENANCE THROUGH YEAR: MRS ranger/s

NB: from March onwards, do weekly burrow check immediately before beginning maintenance work so you know if birds are present or not. On Mana Is. birds came back during the day as early as March and it's common from May onwards to have a few staying over by day. If birds are present in artificial burrows then weed-eating tracks is fine several metres away but not right around burrow (i.e. don't weed-eat within a 5 m radius of a burrow with a bird in it). Before weed-eating block the entrance of any occupied burrow with grass ball just to be sure the birds stays in the burrow and doesn't bolt into the path of the weed-eater. Make sure you remove the grass ball once maintenance work is finished for the day. From May onwards only do weed-eating after a night check, so the location of all burrows is known.

- a) Maintain the sound system volume at a relatively high setting throughout the year—it should be too loud to stand directly near a speaker, and the calls should be heard (loud) at the cliff edge. These sounds need to be able to project out to sea across all weather conditions.
- b) Maintain burrows: unused burrows should be well-maintained at all times with no grass growing in tunnels or chambers, and a smooth, level layer of sand in box. Check regularly and if necessary clear entrances by hand pulling grass within 50cm of the entrance so birds can easily locate them. Also hand weed around burrows if necessary to prevent grass growing inside burrows. However, as soon as the weekly checks show any evidence that a burrow is being visited or occupied, mark the burrow and exclude it from regular maintenance: it is likely that the regular activity of birds in a burrow will slow or stop grass growth within, and any grass taken in needs to be left (as nest lining).
- c) Maintain the access track through the artificial burrow site, the diagonal track up to the sound system and the track to the second speaker. Keep the grass on these tracks short throughout the year: weed-eat regularly in summer and autumn (Jan-April) then from May onwards trim tracks only as needed (once a month max) and only immediately after a night check so the location of all burrows is known. If new tracks are needed at any stage, arrange this with Project manager: a night check will need to be done before new tracks are cut to ensure no nesting birds are in new pathway. Hand trim tracks near any occupied burrows. Project manager will maintain night monitoring tracks.
- d) Keep rest of area in long grass. All long grass in the artificial colony area is out-of-bounds to everyone. Diving petrels will nest underneath long grass (as observed on Mana, G. Taylor pers, comm.) so it is critical that people monitoring or doing maintenance work keep to the access tracks as much as possible to prevent crushing birds and nests.
- e) Maintain fence along edge of main walking track to discourage public from entering artificial colony.

MONITORING ARTIFICIAL BURROWS FOR RETURNING ADULTS: MRS ranger/s

- a) Avoid disturbing the Motuora colony site at night throughout the year. There is nocturnal activity at diving petrel colonies most of the year, and all night-time disturbance should be avoided.
- b) At all times (day and night) keep to the access tracks within the colony site as some birds may choose to nest under the grass and can be easily crushed if stood on.
- c) Monitoring artificial burrows:
 - Commence weekly day-time inspections of all artificial burrows in late April.
 - Check entrance first for signs of activity, e.g. feathers, excrement, digging.
 - Slowly open chamber lid (in case a bird is present inside), remembering to block the entrance with the other hand to prevent the escape of a bird that might be in the tunnel. A torch may be useful to quickly shine into the burrow to see contents, particularly on a dull day, rather than opening lid up wide.
 - If a bird is present:
 - Gently close lid: don't handle the bird, just record presence (but if you happen to catch a glimpse of a band, note that down as well). It is essential that the lid is closed tight (i.e. lightproof) – failure to do this could cause the bird to change location as they are a light sensitive species. Place a sand bag on top to ensure the burrow is dark and to identify it as occupied.
 - Erect a light 2 or 3 stick fence at the entrance (**thin**, short straight sticks **lightly** placed). Mark the burrow with flagging tape as occupied and exclude it from regular maintenance but continue weekly fence checks (no visual checks). Record state of sticks each week and re-erect if knocked down. These regular fence checks will enable us to get a handle on visitation and commitment to the burrow.
 - If the burrow continues to be occupied, the birds may be a breeding pair. Egg laying usually takes place in August and once laid the egg is incubated for the next two months. To determine if incubating birds are present, do a cautious visual check of all occupied burrows in late July, and continue with weekly fence checks and cautious fortnightly visual inspections of the occupied burrow until incubation is detected (as indicated by a bird present during day from late July onwards, or egg actually sighted under or next to bird).
 - Once incubation has been confirmed, **leave the burrow undisturbed for at least 10 weeks** (incubation period c.53 days and adults will then brood the chick for 10-15 days). If no incubation detected, continue weekly fence checks and cautious fortnightly visual inspections of the burrow.
 - Ten weeks after incubation was first detected (if all goes well) the egg will have hatched, the chick will be about 2 weeks old, and rearing will be well underway with both parents feeding the chick nightly. There is less risk of abandonment once the rearing is underway so another cautious inspection can be made of burrows that had incubating birds to determine breeding outcome (presence of an unhatched egg, a live chick or dead chick). Any adult birds found in the burrow with a chick at this stage can be handled for identification; confirm presence of chick, pick up the adult, close the lid, record the band number, then return adult to the closed burrow via the entrance to allow it to find its own way to the chamber and chick. If the adult is unbanded, record that. Do not handle

the chicks. If no chick is visible, close the burrow without handling the adult in case the egg it is just hatching or is still being incubated.

- If no bird is present in burrow:
 - Check chamber for feathers, excrement, digging or nest material. Remove a few feathers (place in labelled paper envelope for storage and later identification if needed), and hide the rest under chamber floor material so that at the next inspection it can be easily seen if more feathers have appeared (i.e. the burrow is still active), but some scent still remains. Rub any excrement into the dirt so the scent remains, but any new excrement will be obvious at the next inspection. NB: Once a nest has formed, leave all nest material (grass, twigs, leaves, excrement) as found, and simply continue cautious checks for birds each week.
 - If there has been extensive digging at the back of a chamber, you can remove any of the soil if it is filling up the artificial chamber as there is a risk the pipe will block up. Note that such a burrow may have to be treated as a natural burrow if the chamber is no longer accessible (i.e. too deep to reach).
 - If there is any evidence of a visit, mark the burrow as visited and exclude it from regular maintenance: it is likely that the regular activity of birds in a burrow will slow or stop grass growth within, and any grass taken in needs to be left (as nest lining). Continue to make cautious checks of visited burrows as part of the weekly monitoring. If visiting birds do breed, an incubating adult will be present through the day after the egg is laid (late July onwards). Once a bird has been detected in a visited burrow, follow the procedures outlined above for occupied burrows.
- Make notes at each burrow so that there is an entry recorded for every burrow, e.g. record the number of feathers found, or the amount of nest material, the number faeces etc, or if the burrow has clearly not been used.
- Input all findings weekly into a spreadsheet, and let Project manager know asap if a bird is found in a burrow (Robin: rgg@clear.net.nz).

SEARCHING FOR NATURAL BURROWS: Project manager (with volunteers)

The following monitoring methods will be used to detect natural burrows formed by returning birds and determine the breeding outcomes of the birds in order to achieve the monitoring objectives outlined above (monitoring methods proposed by C. Miskelly and G. Taylor pers. comm.):

- a) Target main monitoring efforts for late August, September and October (when breeders will be incubating).
 - Additional night monitoring may be useful earlier in year to pick up early activity and become familiar with procedures.
 - Avoid disturbing the Motuora colony site at night at all other times.
 - This species can be present at the colony site at night through most of the year, but nocturnal visits increase from March onwards with a peak of activity in late May as birds prepare their burrows. Potential breeders are then ashore most nights from June on, especially dark and/or misty nights (C. Miskelly pers. comm.). Most of the prospecting by young birds (1-2 year olds) occurs in the period July-Nov. Breeding pairs incubate eggs (night and day) from laying in August through to hatching 8 weeks later and then brood the chicks for another fortnight. After that, both parents feed the chick each night until it fledges in late November/early December. In other words, there is nocturnal activity at diving petrels colonies most of the year, and all night-time disturbance except targeted monitoring should be avoided.

- b) On night monitoring trips March to September:
 - Turn off sound system early in the evening, then mimic calls after dark when methodically walking through the colony area (by tracks). This can be achieved by vocally imitating the call, or by carrying a portable player around, with a speaker, that can be started and stopped in short bursts.
 - Listen for any responses from the ground. It can be useful to work as a pair so that there is greater listening coverage but avoid larger groups. Keep torches switched off. Repeat (as few times as possible to avoid habituating birds to the call) until the source of the call is located. This may only be a call from underground but is sufficient to locate the burrow and entrance. NB Most birds respond very readily to mimicked calls, but one pair on Mana I. close to a speaker does not. It is presumed that they have become habituated to loud, persistent diving petrel calls.
 - Males in particular are often very responsive to mimicked calls, and may come up to the burrow entrance where they can be caught with little impact on the breeding activity. Return the banded bird well inside the burrow entrance so that it has to go back up its burrow.
 - Try to identify the sex of the responding bird through its call—diving petrels have a sexually dimorphic call (males have a plain, single-note call; females have a stutter) which means that if you have identified one sex at a burrow, you can tell if there is a partner in the same burrow on a subsequent monitoring night (without having to handle any birds).
 - Clearly mark the burrow but do not inspect it at night at this stage; to minimise disturbance, we will *not* pull birds out of burrows at night until they have large chicks.
 - Search on several consecutive nights if possible as not all birds come ashore every night. Dark moonless nights with lighter winds are best for searching.
 - From August onwards inspect any burrows found at night the next day; there should be a low risk of desertion during a day check. Use bird presence during

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the day to indicate probable incubation, without removing the bird or feeling or seeing the egg. NB It is unlikely that burrows at this stage on Motuora will be long enough to require study holes, but if the chamber cannot be reached, leave the inspection until later in the chick rearing period to avoid disturbing the adults.

c) On monitoring trip in October:

- Once the chicks are 2+ weeks old (usually mid-October onwards), the burrow can be monitored at night to capture the adults for identification if they have not been previously handled (there is little risk associated with handling the whole family unit at night once the rearing is well underway). Both parents almost invariably feed the chick every night, and so all the band recoveries can be obtained then. Mark the first adult handled in each burrow with a small dot of twink on forehead. Don't re-handle twink-marked birds and once the two parents have been identified, do not handle the adults further. NB Adults feeding chicks usually return early, in the first hour of darkness, and most chicks typically have both adults in attendance for the first 2 hours of darkness. Adults often retreat to a nearby hole or second chamber (typically within 1 m of the burrow entrance), or stay in the tunnel near the burrow entrance. It has been speculated that they are avoiding persistent begging by the chick. Adults rarely regurgitate during handling, and adults placed back in the burrow typically stay there (and so are likely to keep feeding the chick).
- If any modifications are required at the burrow (e.g. inspection hole) these should be made by day when the chick only is present and > 2 weeks old (i.e. on October trip)
- The chick can be banded by day at any stage prior to fledging.