Conservation Services Programme (CSP)

Key demographic parameters and population trends of tākoketai/black petrels (*Procellaria parkinsoni*) on Aotea Great Barrier Island, 2025/26

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Front image: Tākoketai/black petrel chick carrying a solar satellite device Credit: E. Bell, WMIL, 2026.

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Executive Summary

This report is part of the ongoing study of the tākoketai/black petrel (*Procellaria parkinsoni*) on Aotea/Great Barrier Island that began in the 1995/96 breeding season. During the 2025/26 breeding season, 491 tākoketai study burrows were intensively monitored within the Mt Hobson/Hirakimata study area on Aotea. The nine census grids held 204 of these study burrows, 121 of which were occupied by breeding pairs (59.3%) that produced 62 chicks - a breeding success rate of 51.2%. This is the lowest rate on record.

A total of 700 adults (164 newly banded) and 183 fledgling chicks were captured during the 2025/26 field season.

A total of 522 returned chicks has been recaptured at the colony over the course of the study. Of these, 133 returned chicks were identified during the 2025/26 breeding season, 35 of which were caught for the first time. Not all cohorts were represented this season yet; this season had the highest number of cohorts represented (by at least one individual). Understanding the factors affecting return rates of chicks (e.g., survival vs imperfect detection) remains a challenge.

Intensive night surveys (between 2115 hours and 0515 hours) continued this season. The percentage of banded tākoketai caught is marginally higher for intensive night surveys (47.9%) than the ad-hoc surveys (45%). The percentage of returned chicks caught is relatively higher for intensive night surveys (intensive 18.8%, ad-hoc 13.3%), as well as the number of banded tākoketai caught per survey (intensive n=5.3, ad-hoc n=2.1), and the number of returned chicks caught per survey (intensive 2.1 returned chicks/survey, ad-hoc 0.6 returned chicks/survey).

Two feral cat predation events, both in the South Forks area, and one rat predation event were recorded in the study colony on Hirakimata this season. Introduced species still pose a threat to the tākoketai population and it is imperative pest control measures continue.

WMIL recommends:

- That the standard population monitoring on Aotea continues with three visits (i.e., at egg-laying (Dec); at chick hatching/chick guard (late Jan/early Feb), and at chick fledging (late Apr/early May) per season to track population trends.
- That intensive night surveys continue to capture pre-breeders and returned chicks and improve recapture probabilities, ultimately improving juvenile survival estimates.
- That three additional census grids are added to the study area to increase the proportion of the tākoketai population monitored on Aotea.

- That the transect surveys across either the high-quality habitat (35-ha) around Hirakimata or the entire the core tākoketai habitat (1000 ha around the summit) is repeated to provide an updated land-based population estimate for Aotea.
- That satellite tracking of returned chicks at the pre-breeding stage (age 3–5 years) be undertaken to determine foraging areas and risk around Aotearoa New Zealand waters.
- That genetic sexing of more tākoketai be undertaken to determine sex-related differences in survival. In-depth modelling on the effect of age, age difference in pairs, and experience on breeding success to investigate senescence impacts in tākoketai.

Introduction

Tākoketai/black petrels (*Procellaria parkinsoni*) are a medium–sized endemic seabird that only breeds on Te Hauturu–o–Toi/Little Barrier Island and Aotea/Great Barrier Island in the Tīkapa Moana/Hauraki Gulf of Aotearoa New Zealand. Tākoketai are ranked as Nationally Vulnerable under the New Zealand Threat Classification System and Vulnerable on the IUCN Red List of Threatened Species (BirdLife International 2020, Robertson et al. 2021). They are recognised to be at risk of being adversely impacted by high rates of bycatch in commercial fisheries within New Zealand's Exclusive Economic Zone (Edwards et al. 2023). Of the 248 observed captures of tākoketai recorded between 2019 and 2026, 64.9% of captures occurred in bottom-longline fisheries, 14.5% in surface-longline fisheries and 12.5% in trawl fisheries (https://www.mpi.govt.nz/fishing-aquaculture/sustainable-fisheries/managing-the-impact-of-fishing-on-protected-species/accidental-captures-of-seabirds-and-protected-marine-species-by-commercial-fishers-from-1-january-to-31-march-2026; accessed 30/6/2026). Tākoketai and their offspring on Aotea are also exposed to threats on land, principally depredation by ngeru mohoao/feral cats (*Felis catus*), kiore/rats (*Rattus* spp.) and poaka/feral pigs (*Sus scrofa*) (Bell 2013).

To monitor the ongoing population-level impacts of commercial fisheries on tākoketai, it is necessary to quantify population parameters such as annual burrow occupancy rates, annual reproductive success as well as both adult and juvenile annual survival rates to create accurate assessments of population trends. To this end, a long-term research project aimed at quantifying these population parameters was initiated in 1995/96 (Bell & Sim 1998).

During this first season, three 40 m x 40 m study grids were set up within the largest known breeding colony on Hirakimata/Mt Hobson on Aotea, and all burrows within the grids were marked and monitored. Additional burrows located within 25 m of the public walking tracks were also monitored. In 1998/99, the number of study grids was increased to six, and then to nine in 1999/00 (Bell & Sim 2000a, Bell & Sim 2000b). Over the years, additional burrows situated near the public walking tracks or within the census grids have continued to be added (Bell et al. 2023), so that by the 2025/26 season a total of 491 study burrows were being monitored by Wildlife Management International Limited (WMIL).

This report provides a summary of the results of the monitoring work undertaken on Aotea by WMIL in the 2025/26 season, with updates on the trends in several population parameters including annual burrow occupancy and annual reproductive success, as well as results from the satellite tracking of chicks undertaken on Hauturu and Aotea this season.

Te reo names are used throughout the document for all bird species and locations after the first use (e.g., tākoketai/black petrel or Aotea/Great Barrier Island) and common English names for all mammalian predator species after the first use (e.g., ngeru mohoao/feral cat).

Project Objectives

This project builds on previous demographic work funded by commercial fisheries levies administered by the Conservation Services Programme (CSP) of the Department of Conservation (DOC), direct DOC funding, as well as funding from the Ministry for Primary Industries/Fisheries New Zealand (MPI/FNZ) since 1996. Specifically, this project was primarily funded through CSP project POP2025-03 and as per the CSP annual plan 2025/26.

Main objective for the 2025/26 season was:

- To monitor the key demographic parameters at the breeding colony of the tākoketai population.

In addition, through Live Ocean and direct DOC support, funding was made available for tracking devices and thus an additional objective was to:

- Assist with the deployment and retrieval of a range of tracking tags (GLS and satellite transmitters) to adults and juveniles.

Methods

Study site and field methods

The colony residing around the Hirakimata summit represents the highest density of logistically accessible tākoketai on Aotea and has historically been the site of previous research prior to the establishment of WMIL's monitoring programme (Imber 1976, Imber 1987, Scofield 1989, Hunter et al. 2001, Imber et al. 2003a). Since the 1995/96 season, a network of study burrows (burrows where demographic data is recorded) has been progressively established within a c. 35-ha study area in the vicinity around the Hirakimata summit over the past 31 years and to date includes a total of 491 study burrows (Figure 1).

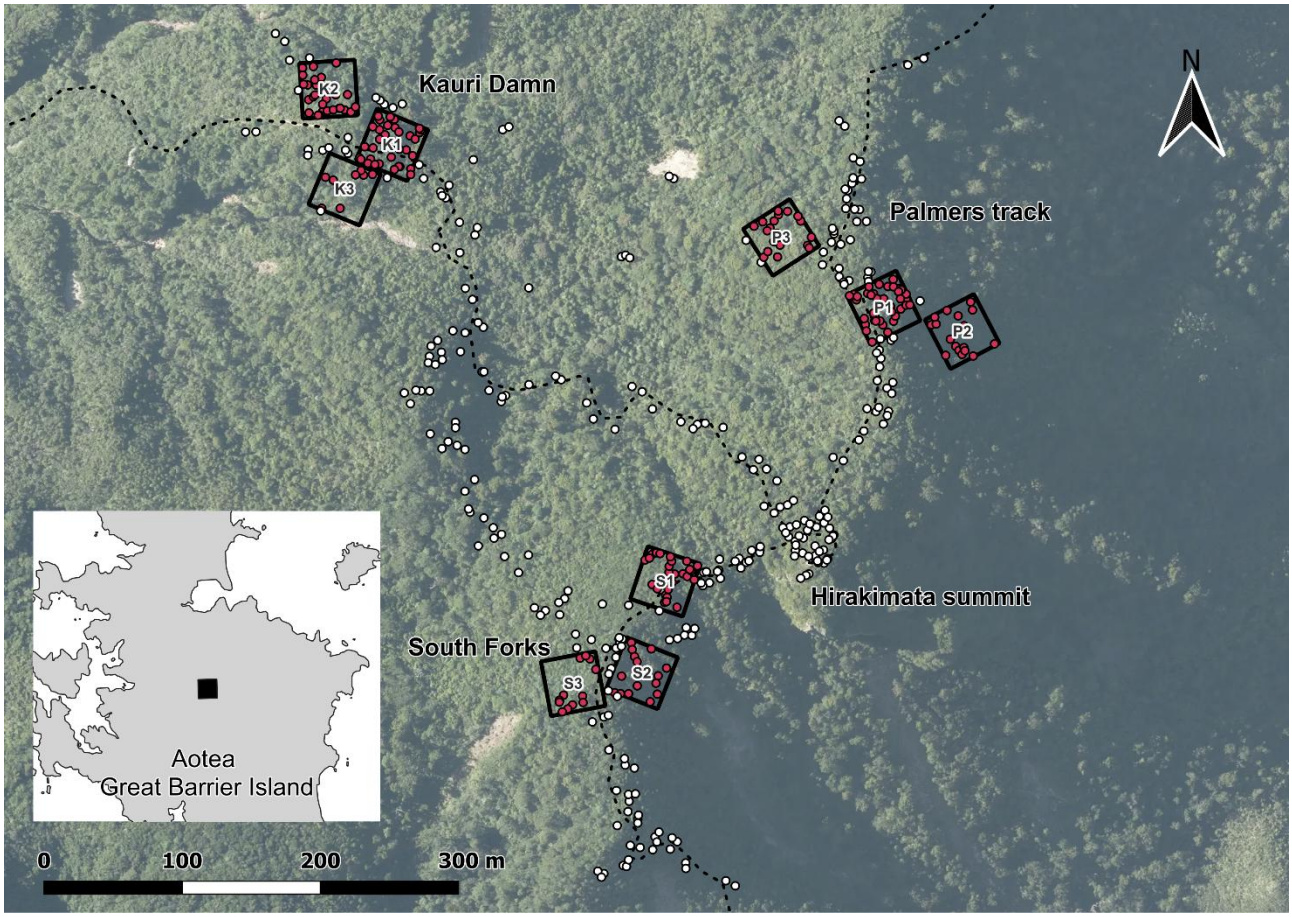

Figure 1: Map of the 491 tākoketai/black petrel study burrows (red points – study burrows inside the census grids, white points – study burrows outside the census grids) that have been established in the vicinity of Mt Hobson/Hirakimata on Aotea/Great Barrier Island. Dashed lines are public walking tracks and squares are the nine census grids (Kauri Dam 'K', South Forks 'S' and Palmers Track 'P').

Of those 491 study burrows, 204 are located within nine 40 m x 40 m census grids (census grid burrows) and the other 288 burrows (non-census grid burrows) were arbitrarily established due to their close proximity (within 25 m) of the public walking tracks (Figure 1; Figure 2; see Bell et al. 2025 for further details on the establishment of the census grids). A further three burrows with the census grids are routinely occupied by breeding pairs of tītī/Cook's petrels (*Pterodroma cookii*) and are not included in the total. A conservation dog search was conducted in December 2025 to identify any new burrows within the census grids. Five additional burrows were added to the study this season; two previously monitored unmarked burrows and three new burrows in the following census grids; K1 (n=1), P1 (n=1) and S2 (n=1) (Figure 2).

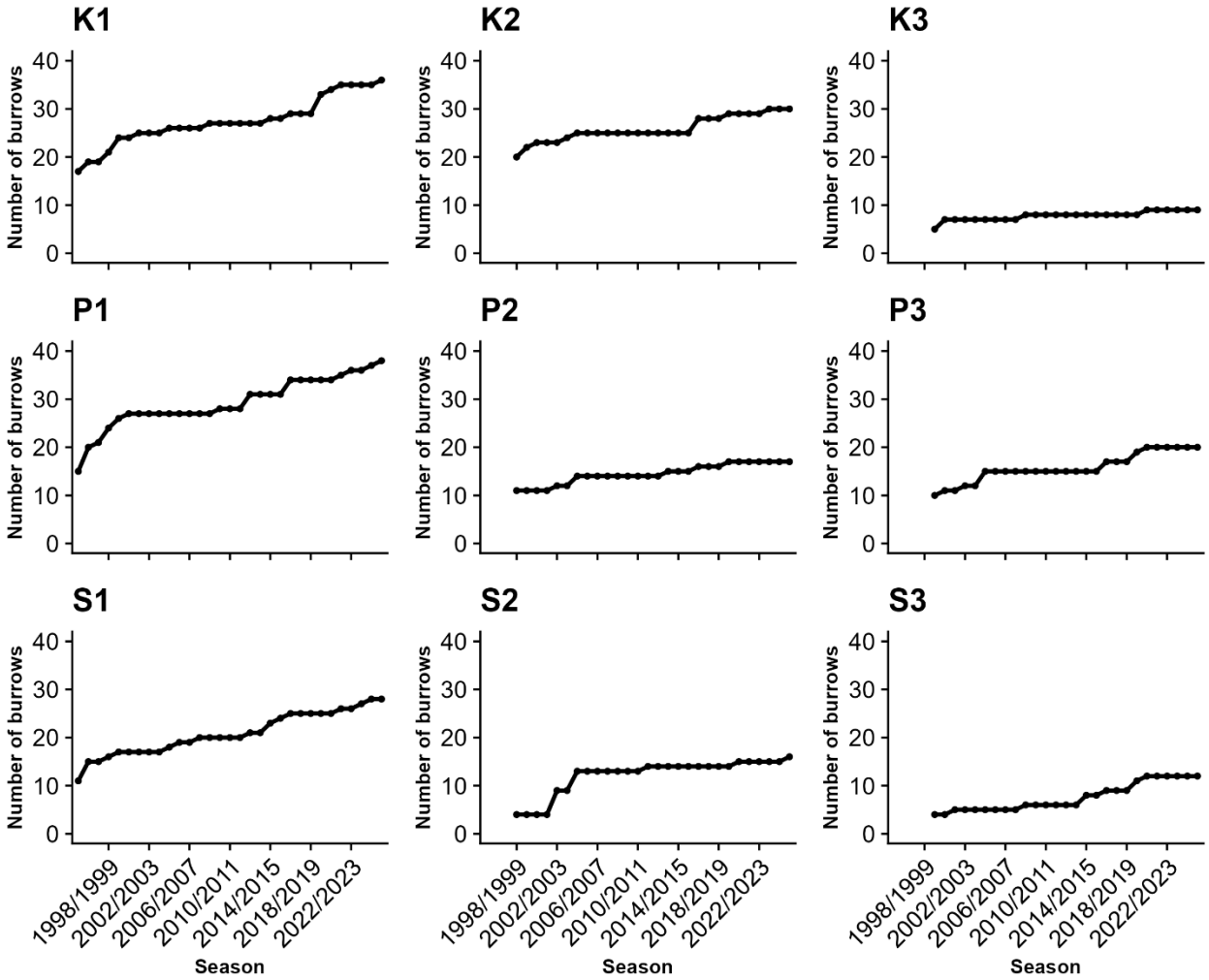

Figure 2: The cumulative number of tākoketai/black petrel census grid burrows in each of the nine census grids (Kauri Dam 'K' 1-3; Palmer's 'P' 1-3; and South Forks 'S' 1-3) on Aotea/Great Barrier Island between 1995 to 2026. Note: the first point for each study grid indicates when the study grid was first established (K1, P1, S1 in 1995/96, K2, P2, S2 in 1998/99, and K3, P3 and S3 in 1999/00).

The first visit to the Hirakimata study area occurred from 30 November to 10 December 2025 (Trip 1) and was focused on identifying recruits (i.e., birds banded as chicks returning to the colony to breed). A conservation dog search was also completed during this trip focusing on areas in and around each of the nine census grids to identify any new burrows. Timing of this trip was aimed at coinciding with the end of the pre-egg laying exodus and the start of the egg laying period when large numbers of birds would be returning to the island. During the recruitment trip, the field team systematically searched the colony each night from 2115 hours (approximately 1 hour after dusk when the first non-breeding tākoketai began calling) to 0515 hours (dawn). Birds were captured on the surface, at launch sites, and in burrows. For all night-work, captured birds were checked for bands, and any band numbers were recorded. If unbanded, an individually numbered metal size H-band and a yellow darvic band were applied to the bird's leg (Table 1), before being subsequently released. Before release, a small mark was made on each bird's forehead using white correction fluid to provide a means of visually checking whether a bird had already been captured, if encountered again on the same or another subsequent night.

The study burrows were monitored during Trip 1 as well as again in two subsequent trips to the colony. The second visit occurred from 22 January to 5 February 2026 (Trip 2) and coincided with late incubation / hatching / early chick rearing. Trip 3 occurred from 1 to 15 May 2026 and coincided with the late chick rearing/chick fledging period.

To determine the breeding status and breeding outcome for each burrow, and to record the occupants of each burrow, each study burrow was checked once in Trip 1, at least twice during Trip 2, and once in Trip 3. During each burrow check, any resident adults were removed from the burrow and checked for bands. If banded, the band number of each bird was recorded, otherwise the bird was banded with an individually numbered metal size H-band.

This season, a coloured darvic leg band was also fitted to the opposite leg to the metal band of any birds handled from the study population. The colour depended on the bird's breeding category (Table 1). These birds too received a small correction fluid mark on their forehead to provide a means of quick visual identification during subsequent checks, without having to remove the bird. The presence of an egg or chick was also recorded. After each check, a palisade of twigs was erected over the burrow entrance to provide a quick means of checking for recent activity (i.e., arrivals and departures of parents switching incubation/brooding duties) during subsequent checks of the same burrow. During the final trip of each season (Trip 3), fledgling chicks found in the study burrows were extracted and banded. For the two trips focused on assessing the burrow demographics (Trip 2 and Trip 3) the field team also spent several nights walking the public track system within the 35-ha study area, capturing any tākoketai found on the ground.

Table 1: Tākoketai/black petrel darvic assignment for 2025/26 season and beyond.

Intended birds	Band Colour	Writing Colour	Notes
Chicks	Red	White	A different letter per cohort of chicks (A = 2026, B = 2027, C = 2028, etc.)
Partner #1	Green	White	First partner caught in a study burrow
Partner #2	White	Black	Second partner caught in a study burrow
Surface Birds	Yellow	Black	Surface birds at the colony – this will be swapped to either white or green if caught in a study burrow in the future. A different letter per season (A = 2026, B = 2027, C = 2028, etc.)

Satellite tracking

Forty-seven satellite devices were deployed on chicks departing Aotea and Hauturu on Trip 3 this season. Chicks were chosen from known study burrows and a small number of un-marked burrows, or from the surface within the study areas on Aotea and Hauturu. Devices were deployed on fully-grown chicks estimated to be within a few days of fledging. Specifically, chicks were weighed using 1 kg Pesola™ scales to determine whether or not they were heavy enough to carry the devices. Then maximum wing chord length was measured as well as ratio and growth of the 9th and 10th primary was examined to assess age and rate of development. Minimum size requirements for body mass was >840 g and >330 mm for maximum wing chord.

For both devices, birds weighed 810 – 1000+ g, so the total instrument load of these devices ranged 1.08 – 2.17% of the birds' body weights. Three birds below the body mass threshold (range 810-835 g) were chosen for device deployment as they were anticipated to fledge that of the following night based on the completion of their 10th primary feather. Telonics TAV-2917 devices (Figure 3a) were attached to contour feathers on the birds' backs, above the centre of gravity, using 4–6 strips of Tesa™ tape. Application of the devices took between 9 and 33 minutes. For Interrex Solar units (Figure 3b), a plastic baseplate was taped to the contour feathers on the bird's back, again using 4-6 strips of Tesa™ tape and devices were then secured to the baseplates with two cable ties. Application of the devices took between 13 and 25 minutes. See Appendix 1 (Table 6) for the individual meta-data of each device deployment.

Three breast feathers were also collected from each bird and were subsequently sent to InfogeneNZ for DNA sex determination. Two different models of devices were deployed, and their weights, costs and specifications are summarised in Table 2 below.

Figure 3: a) A Telonics TAV-2917 satellite device and b) A Interrex Mini C3 UBILINK X1 solar satellite device taped to tākoketai/black petrel chicks backs, Hirakimata/Mt Hobson, Aotea/Great Barrier Island.

Telonics TAV-2917 devices

Twenty-three Telonics TAV-2917 satellite tracking devices were deployed on chicks departing the Aotea colony between 4 and 14 May 2026 and four devices were deployed on chicks departing Hauturu between 1 and 5 May 2026. Twelve of these Telonics TAV-2917 devices were funded by Live Ocean and were programmed to transmit periodic messages to Argos instruments on polar–orbiting satellites passing overhead for the first week at 2-hour intervals and then switching to 10-hour intervals for the remainder of the time. The remaining 15 Telonics TAV-2917 devices were funded by DOC and programmed to transmit periodic messages for the first two weeks at 6-hour intervals and then switching to 24-hour intervals for the remainder of the time. Location data for Telonics devices were downloaded via the CLS (Live Ocean devices) and ArgosWeb (DOC devices) web interfaces (https://environmental-monitoring.groupcls.com/home/env/telemetry & https://argos-system.cls.fr/argos-cwi2/login.html). Tracks were then processed using the sdafilter function from the argosfilter R package to systematically remove erroneous/unrealistic positions caused by low-quality satellite fixes (Freitas et al. 2008, R Core Team 2024). Values supplied to the algorithm were a threshold of 20 m/s, angles between 15-25 degrees and distance jumps of between 2500 and 5000 m. Tracks were then visualised in QGIS and any further erroneous positions or fixes that occurred between exceptionally long time periods were also removed (QGIS Development Team 2026).

Interrex Solar units

Seventeen Interrex Mini C3 UBILINK X1 solar satellite devices were deployed on chicks departing the Aotea colony between 9 and 14 May 2026 and three devices were deployed on chicks departing Hauturu between 4 and 5 May 2026. Fix rate was either every 3 minutes or every 30 minutes. Location data for Interrex devices were downloaded via the Druid web interface https://www.ecotopiago.com/#/login and then visualised in QGIS (QGIS Development Team 2026).

Table 2: Model, number, funder, weight and location of deployment for each satellite tracking device.

Device Model		Number	Funded By	Weight (g)	Deployment location
TAV-2917	Telonics	12	Live Ocean	17 g	Te Hauturu-o-Toi (n=4) Aotea (n=8)
Mini C3 UBILINK X1	Interrex	20	Live Ocean	10.8 g	Te Hauturu-o-Toi (n=3) Aotea (n=17)
TAV-2917	Telonics	15	DOC	17 g	Aotea (n=15)

Data entry and analysis

All mark–recapture and breeding status data were entered into a Microsoft Access™ database at the completion of each trip. Microsoft Excel™ was used to calculate breeding occupancy and breeding success as percentages which was then compared to previous years. The statistical software R (R Core Team 2022) using the 'ggplot2' package (Wickham 2016) was also used to visualise a variety of demographic parameters (e.g., number of burrows within the study, the age distribution of known aged birds, and number of birds banded as chicks re-sighted at the colony from each cohort, etc).

Results

Burrow occupancy and breeding success

The number of census grid burrows has continued to steadily increase over time from 123 burrows in 1999/00 (when all nine census grids were established) to 203 burrows in 2025/26, more than double the number since the final grids were established, with three burrows added in the current season (Figure 4). Two of the new burrows were discovered during the conservation dog search in Trip 1 in the S2 and K1 grids; one being dug out by two non-breeders and the second was a breeding burrow which produced a chick. The other burrow was found in grid P2 with a non-breeding bird during Trip 2.

Breeding occupancy within the 204 census grid burrows was 59.3%, with breeding success estimated at 62 tākoketai chicks likely to fledge (51.2%) from their burrows in the 2025/26 season (Table 3; Figure 4). This season marked the lowest estimated breeding success on record for census grid burrows.

Two chicks were known to have died, possibly in the process of fledging (leaving the burrow and on its maiden flight from the colony), as they were recovered on the track towards the summit. These deaths have been taken into account for this season's breeding success estimate. The remains of a banded chick from the previous season were found in its burrow this season indicating it did not fledge. The previous season's breeding success data was updated with this new information.

Causes of breeding failure in census grid burrows in the 2025/26 breeding season included: eggs or chicks that disappeared from breeding burrows (n=26, i.e., exact cause of breeding failure unknown), crushed eggs (n=13), abandoned eggs (n=9), embryonic deaths (n=6), chick deaths (n=3, exact cause of death unknown), infertile eggs (n=1), and one feral cat predation (n=1).

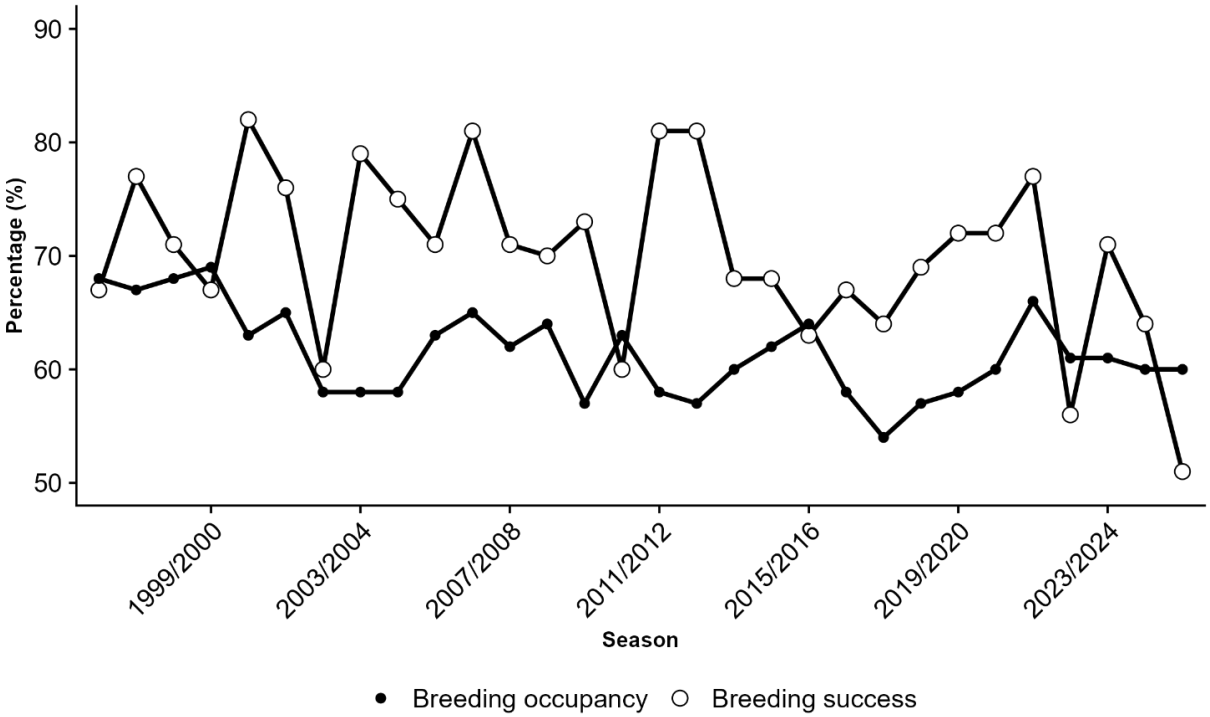

Figure 4: Breeding occupancy (percentage of census grid burrows occupied by a breeding pair – black points) and breeding success (percentage of breeding burrows that fledge a chick – white points) of all tākoketai/black petrel census grid burrows at Hirakimata/Mt Hobson on Aotea/Great Barrier Island between 1996 and 2026.

The number of burrows within the census grids occupied by a breeding pair of tākoketai has steadily increased over time (Figure 5). There were 121 burrows occupied by a breeding pair in 2025/26.

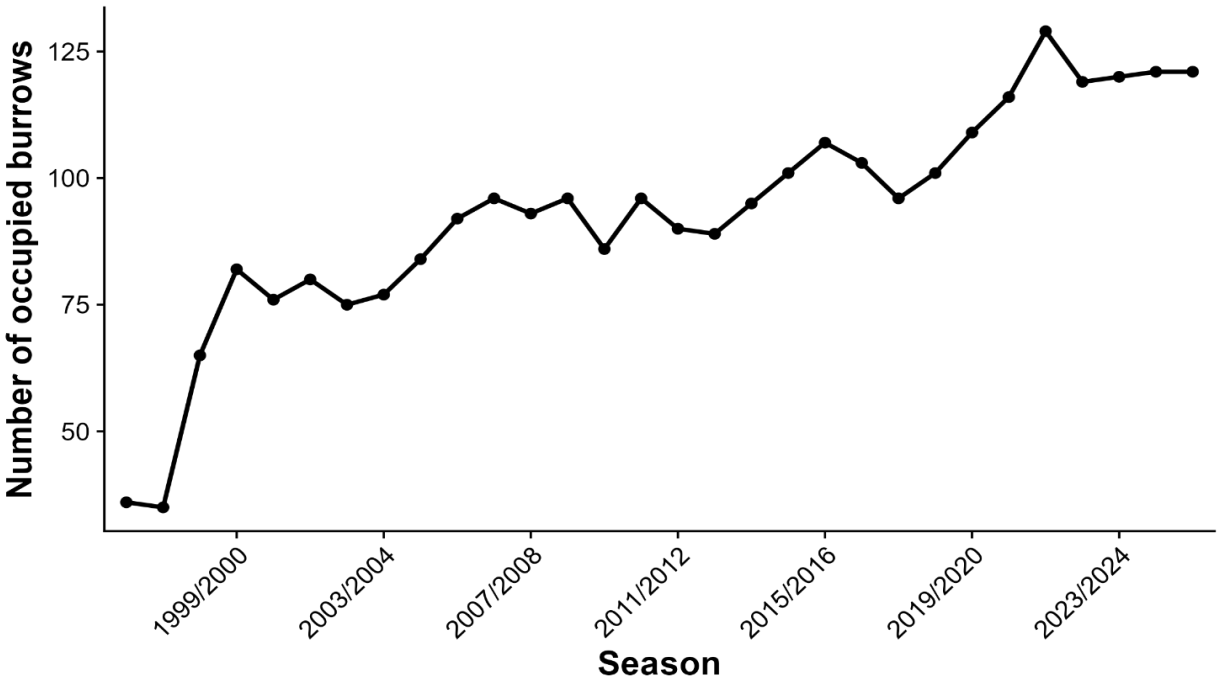

Figure 5: The number of burrows occupied by a tākoketai/black petrel breeding pair in census grid burrows at Hirakimata/Mt Hobson on Aotea/Great Barrier Island between 1996 and 2026.

Figure 6 further depicts breeding occupancy and breeding success broken down by each census grid by each potential state (breeding failure, breeding success, non-breeding burrows and unoccupied burrows). Both estimated breeding occupancy and estimated breeding success was similar across census grid groups; K grids at 65% occupancy and 54% breeding success, P grids at 56% occupancy and 47% breeding success and S grids at 56% occupancy and 51% breeding success.

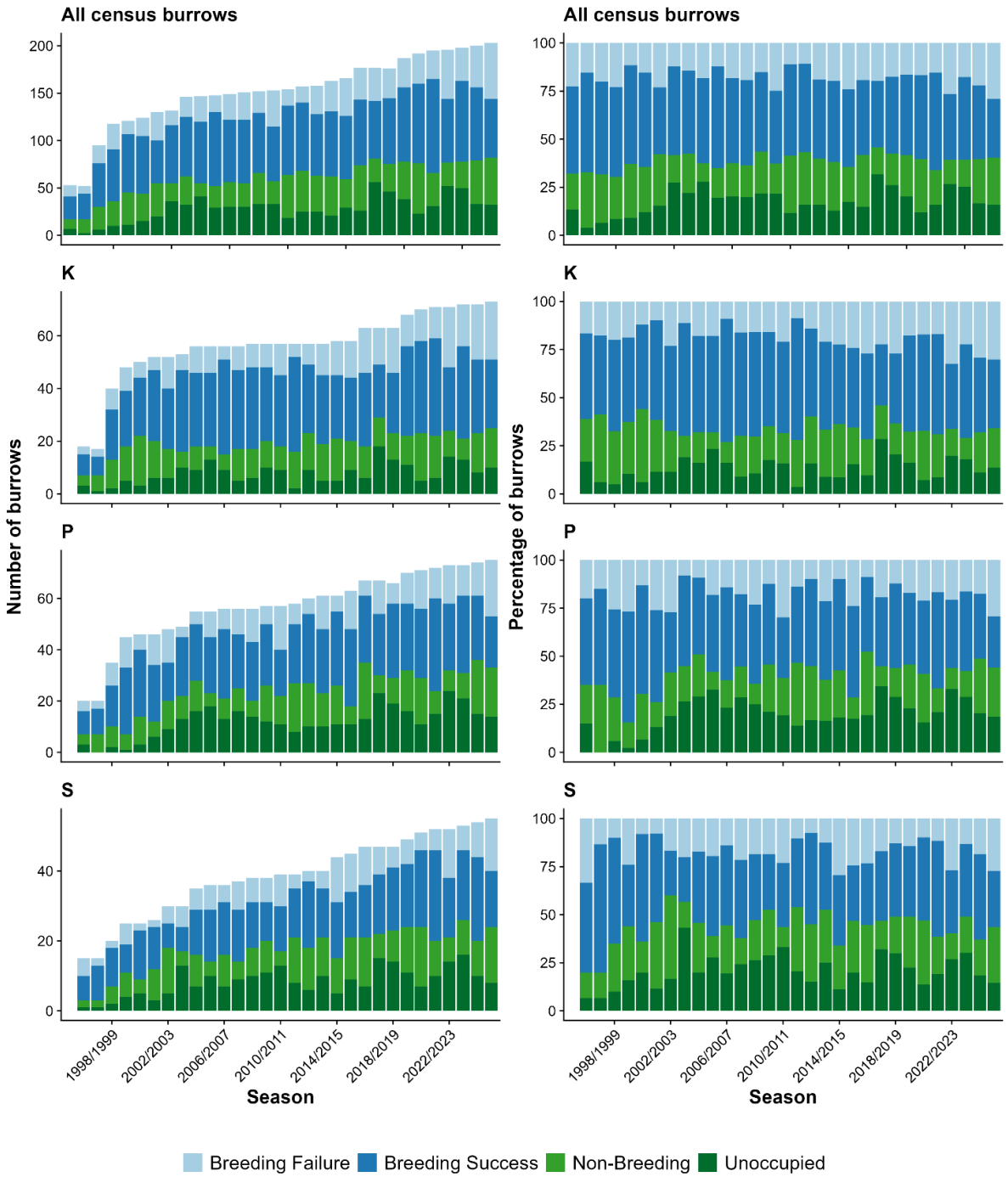

Figure 6: The outcome (breeding failure, breeding success, non-breeding and unoccupied burrows) of census grid burrows (census grids combined and grids K, P and S) each season of all tākoketai/black petrel census grid burrows at Hirakimata/Mt Hobson on Aotea/Great Barrier Island between 1996 and 2026. Left panel depicts the total number of burrows by each outcome; right panel depicts the percentage of burrows by each outcome.

Table 3 further summarises breeding success and the number of chicks fledged each season, including from non-census grids.

Table 3: Summary of breeding success of tākoketai/black petrels (percentage of breeding burrows that fledged a chick; number of successful fledglings followed in parentheses) at Hirakimata/Mt Hobson on Aotea/Great Barrier Island between 1995 and 2026 within census grid study burrows, non-census grid burrows and all burrows combined. The number of census grid, non-census and total number of study burrows are the number of burrows where a breeding attempt was observed.

Breeding season	Census grid burrows breeding success % (no. of chicks fledged)	No. of census grid burrows occupied by breeders % (total census grid burrows)	Non-census grid study burrows breeding success % (no. of chicks fledged)	No. of non-census grid burrows occupied by breeders % (total no. non-census burrows)	Total Breeding success % (No. of chicks fledge)	Total no. of study burrows occupied by breeders % (total no. study burrows)
2025/26	51.2% (62)	59.3% (204)	54% (101)	65.2% (287)	52.9% (163)	62.7% (491)
2024/25	65.0% (78)	60.0% (200)	70.2% (134)	66.8% (286)	68.2% (212)	64.0% (486)
2023/24	70.2% (85)	61.1% (198)	73.7% (137)	65.0% (286)	72.3% (222)	63.4% (484)
2022/23	56.3% (67)	60.7% (196)	63.0% (121)	67.8% (283)	60.5% (188)	64.9% (479)
2021/22	77.3% (99)	65.6% (195)	71.4% (142)	70.1% (284)	73.7% (241)	68.3% (479)
2020/21	72.4% (84)	60.4% (192)	78.3% (159)	71.5% (284)	76.2% (243)	67.0% (476)
2019/20	71.6% (78)	58.3% (187)	78.9% (142)	64.5% (279)	76.1% (220)	62.0% (466)
2018/19	69.6% (71)	57.6% (177)	76.5% (143)	69.0% (271)	74.0% (214)	64.5% (448)
2017/18	63.5% (61)	54.2% (177)	62.6% (114)	67.2% (271)	62.9% (175)	62.1% (448)
2016/17	67.0% (69)	58.2% (177)	68.6% (129)	68.6% (274)	68.0% (198)	64.5% (451)
2015/16	62.6% (67)	64.5% (166)	68.9% (126)	67.8% (270)	66.6% (193)	66.5% (436)
2014/15	68.3% (69)	62.0% (163)	70.0% (133)	70.4% (270)	69.4% (202)	67.2% (433)
2013/14	68.4% (65)	60.1% (158)	71.1% (123)	65.0% (266)	70.1% (188)	63.2% (424)
2012/13	80.9% (72)	56.7% (157)	80.9% (152)	70.9% (265)	80.9% (224)	65.6% (422)
2011/12	82.0% (73)	57.8% (154)	70.3% (90)	50.4% (254)	75.1% (163)	53.2% (408)
2010/11	60.4% (58)	62.7% (153)	61.4% (105)	67.6% (253)	61.0% (163)	65.8% (406)
2009/10	73.3% (63)	56.6% (152)	73.1% (122)	65.5% (255)	73.1% (185)	62.2% (407)
2008/09	69.8% (67)	63.6% (151)	73.0% (127)	71.9% (242)	71.9% (194)	68.7% (393)
2007/08	71.0% (66)	62.4% (149)	80.7% (134)	72.8% (228)	77.2% (200)	68.7% (377)

Breeding season	Census grid burrows breeding success % (no. of chicks fledged)	No. of census grid burrows occupied by breeders % (total census grid burrows)	Non-census grid study burrows breeding success % (no. of chicks fledged)	No. of non-census grid burrows occupied by breeders % (total no. non-census burrows)	Total Breeding success % (No. of chicks fledge)	Total no. of study burrows occupied by breeders % (total no. study burrows)
2006/07	81.3% (78)	64.9% (148)	83.4% (136)	72.1% (226)	82.6% (214)	69.3% (374)
2005/06	70.7% (65)	62.6% (147)	60.8% (101)	75.5% (220)	64.3% (166)	70.3% (367)
2004/05	75.0% (63)	57.5% (146)	77.2% (115)	67.7% (220)	76.4% (178)	63.7% (366)
2003/04	79.2% (61)	58.3% (132)	63.6% (89)	70.7% (198)	69.1% (150)	65.8% (330)
2002/03	60.0% (45)	57.7% (130)	56.0% (70)	65.4% (191)	57.5% (115)	62.3% (321)
2001/02	76.3% (61)	64.5% (124)	66.1% (76)	69.7% (165)	70.3% (137)	67.5% (289)
2000/01	81.6% (62)	62.8% (121)	72.4% (71)	70.0% (140)	76.4% (133)	66.7% (261)
1999/00	67.1% (55)	69.5% (118)	77.8% (77)	72.8% (136)	72.9% (132)	71.3% (254)
1998/99	70.8% (46)	68.4% (95)	80.2% (65)	68.6% (118)	76.0% (111)	68.5% (213)
1997/98	77.1% (27)	67.3% (52)	81.4% (57)	70.7% (99)	80.0% (84)	69.5% (151)
1996/97	68.6% (24)	66.0% (53)	76.2% (48)	71.6% (88)	73.5% (72)	69.5% (141)
1995/96	87.0% (20)	53.5% (43)	94.7% (36)	80.9% (47)	91.8% (56)	67.8% (90)
Average	**70.8% (63)**	**61.1% (149)**	**72.0% (128)**	**68.8% (218)**	**71.6% (172)**	**65.7% (373)**

There was one detected feral cat predation on a tākoketai chick within the study burrows this season (Figure 7). Additionally, there was one feral cat predation of an adult tākoketai within the study area, which was suspected to be from a study burrow. Two study burrows were adjacent at the site where remains of the adult was found (no carcass was recovered only primary and body feathers, and thus identity of the adult is unknown). Both study burrows were occupied by a chick and both measured at a similar body mass and thus attributing the predated adult to either study burrow was not able to be made at this stage. Predation of either adults or chicks by feral cats within the study site has remained relatively constant over time. Predation by feral cats can account for between 0-3 chicks predated from study burrows each season (average 0.6 ± 0.9 (sd) chicks predated per season) and between 0-2 adults predated within the study area each season (average 0.8 ± 0.7 (sd) adults predated per season). Raw data of known feral cat predation events of tākoketai at the Hirakimata/Mt Hobson study site is available in Appendix 2 (Table 7).

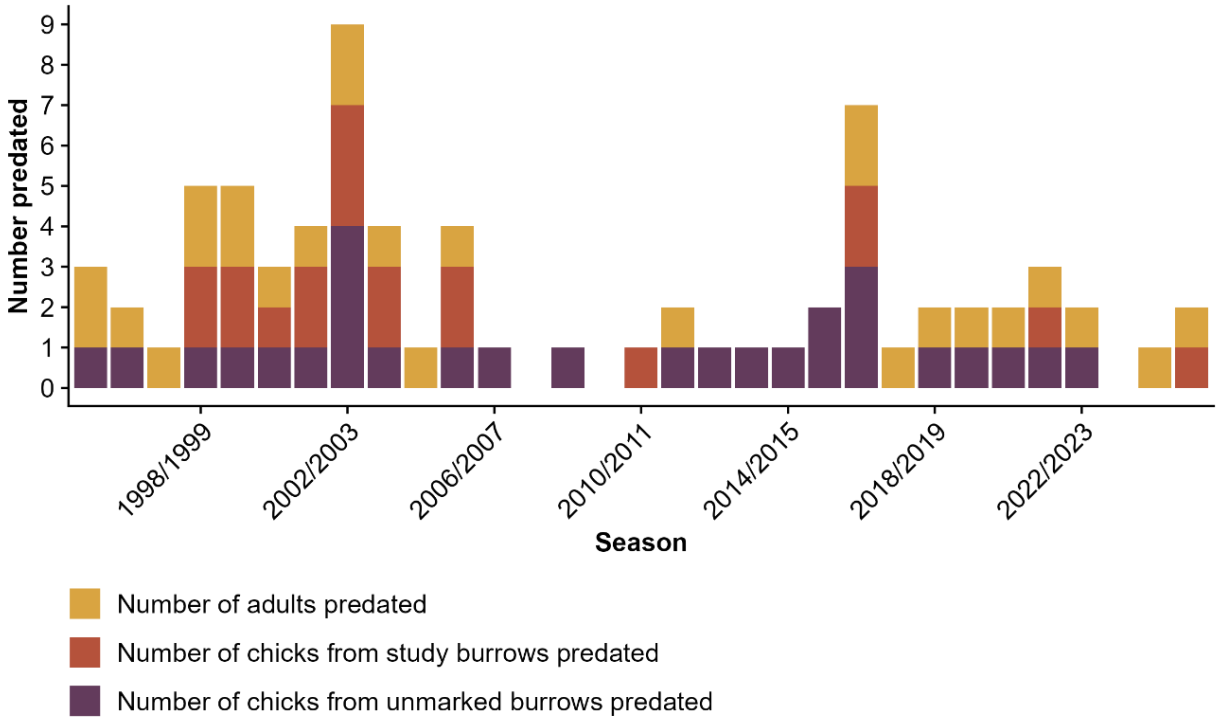

Figure 7: Number of predation events of tākoketai/black petrel chicks and adults by feral cats within the Hirakimata/Mt Hobson study site on Aotea/Great Barrier Island between 1996 and 2026

Recaptures during intensive nocturnal surveys

During the intensive survey period (2021/22 to 2025/26), between 8 and 16 surveys were undertaken each season equating to between 21.6% and 53% of all nights spent at the colony (see Appendix 3, Table 8). Prior to this intensive period (1995/96 to 2020/21), under 20% of nights spent at the colony had an ad-hoc night survey completed. Over the past five years, a total of 59 intensive night surveys were undertaken, with 8-night surveys completed during the 2025/26 season.

The percentage of banded tākoketai caught out of all captures is marginally higher for intensive on-land night survey work (47.9%) than the ad-hoc on-land night surveys (45%) (Appendix 3, Table 8). This pattern is also the same for the percentage of returned chicks captured (intensive 18.8% vs ad-hoc 13.3%). The number of banded tākoketai caught per survey is also higher for the intensive on-land night surveys (5.3 tākoketai caught/survey) compared to the ad-hoc on-land night surveys (2.1 tākoketai caught/survey). Again, this pattern continues for the number of returned chicks caught per survey, with intensive surveys (2.1 returned chicks/survey) being higher than ad-hoc surveys (0.6 returned chicks/survey).

Banding and recaptures

A total of 700 adults and 183 fledgling chicks were captured during the 2025/26 season (Table 4). Of those adults caught, a total of 164 adults were banded during the 2025/26 season for the first time, of which 81 were captured in study burrows, 28 were captured in unmarked burrows and 55 were caught on the forest floor. There were 75 adults banded during the recruitment trip in December (trip 1); 46 at night and 29 during the dog searches. The remaining new adults were banded during Trip 2. Of the 183 fledgling chicks banded during the 2025/26 season, 154 were from study burrows, 27 were from unmarked burrows and two were caught on the surface at night.

Table 4: Summary of the number of tākoketai/black petrels captured, banded, re-captured adults and chicks (i.e., resighted at the colony after fledging) at Hirakimata/Mt Hobson on Aotea/Great Barrier Island between 1995 and 2026.

Breeding season	Total number captured	Number of all adults recaptured	Number of adults banded	Number of fledglings banded in study burrows	Total number fledglings banded
2025/26	**883**	**700**	**164**	**154**	**183**
2024/25	932	571	143	213	218
2023/24	853	504	121	214	228
2022/23	793	490	174	119	129
2021/22	999	638	107	227	254
2020/21	1103	703	136	233	264
2019/20	960	636	154	155	170
2018/19	898	562	122	201	214
2017/18	800	541	84	154	175
2016/17	1074	476	244	173	354
2015/16	978	617	177	171	184
2014/15	918	536	167	200	215
2013/14	860	539	120	185	201
2012/13	1021	546	249	212	226
2011/12	551	340	48	161	163
2010/11	685	457	83	139	145
2009/10	789	510	107	160	172
2008/09	875	489	183	191	203
2007/08	594	347	56	191	191
2006/07	672	371	85	210	216
2005/06	632	332	155	141	145
2004/05	650	330	135	177	185
2003/04	536	358	67	108	111
2002/03	637	392	182	60	63
2001/02	621	346	115	136	160
2000/01	555	320	98	128	137
1999/00	542	257	150	130	135
1998/99	404	158	130	111	116
1997/98	296	151	59	81	86
1996/97	300	51	180	67	69
1995/96	129	30	40	48	59

Recapture of returned chicks

The cumulative number of birds banded as chicks returning back to the colony (hereafter ‘returned chick’), either as a breeding or non-breeding adult continues to steadily increase over time (Figure 8a). In the 2025/26 breeding season the cumulative number of returned chicks recorded back at the colony to date was 522 (re-sighted at least once after fledging over the course of the study), with 133 returned chicks recaptured at the colony this season (Figure 8a).

Of the 133 returnees identified this season, 35 had not been previously recorded since being banded prior to fledging. Of those 35 returnees, 11 were found as non-breeders in study burrows, eight were found in study burrows as breeders, with two returnees found breeding in an unmarked burrow. The rest (14 birds) were found on the surface during nocturnal searches of the colony.

Almost all cohorts (prior to the 2021/22 cohort) of chicks that have been banded since the study began in 1995/96 were represented by at least one individual present around the colony this season with the number of unique cohorts represented at its highest level since the study began (Figure 8b). No chicks from the 1995/96 or 2000/01

cohorts were seen back at the colony this season. Additionally, this is the first season where there were no re-sightings of returned chicks from the pre-1995 cohorts.

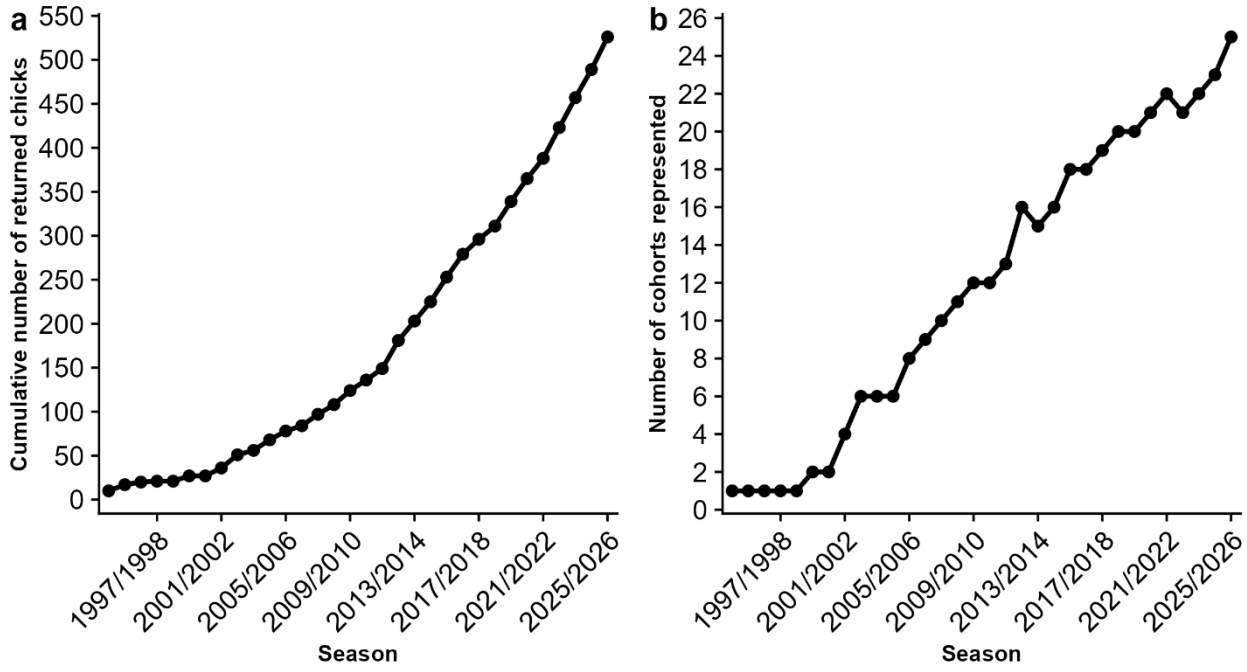

Figure 8: a) the cumulative number of tākoketai/black petrels banded as chicks that have returned to the colony as adults (returned chicks) at Hirakimata/Mt Hobson on Aotea/Great Barrier Island and b) the number of unique cohorts represented by returned chicks per season. Note: the time period before 1995 encompasses approximately 20 years of chick banding records (1972-1992; e.g., the first returned chick was banded in 1972 and recaptured again in 1977).

Of the 133 returnees resighted during the 2025/26 breeding season, the majority (n=14, 10.5%) of returned chicks were from the 2018/19 cohort (6.7% of the total number of chicks banded that season), followed closely by the 2019/20 cohort (n=12, 9.0%, or 7.1% of that cohort) (Figure 8b).

A total of 183 chicks were banded across the study site in the 2025/26 season, in line with the number banded in previous seasons (Figure 9a). The percentage of returned chicks from each cohort has remained relatively constant across the study, averaging at 12% ± 2% (range 7-16%) of each banded cohort re-sighted at some point back at the colony as adults (Figure 9b, black line). Raw re-sighting data show that tākoketai have about a four-year lag between fledging and maturity before being sighted at the colony. The sightings of returnees appear to be made up of early returnees (four- to six-year-old birds) with the percentage of returnees from a particular cohort peak and then have plateaued for the rest of the study (Figure 9b, black line). The largest proportion of returned chicks re-sighted within the 2025/26 are made up from younger cohorts, in particular, returnees from the 2018/19 cohort made up the largest contribution this season at 10% of returnees sighted (Figure 9b, red line).

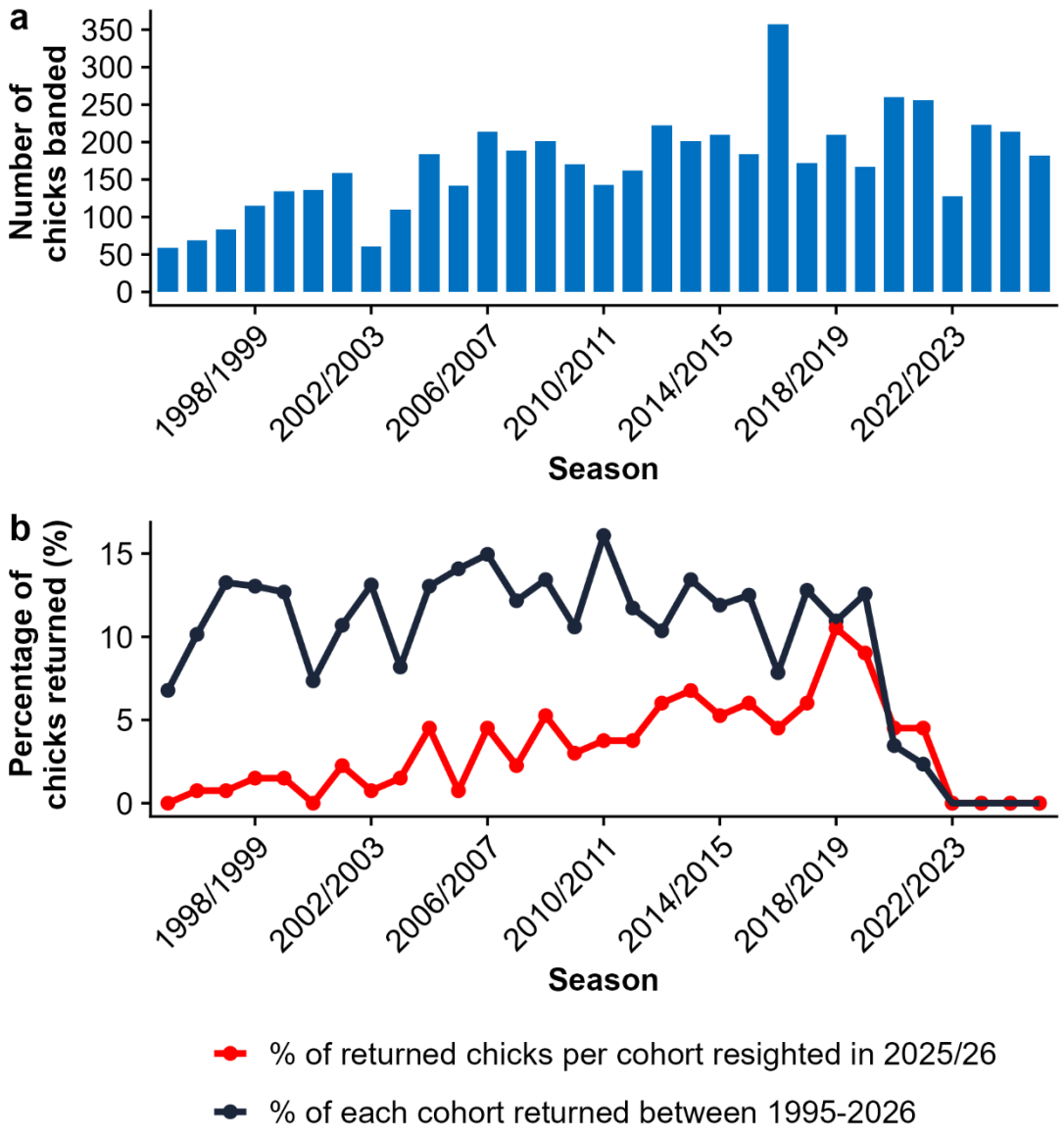

Figure 9: a) the number of tākoketai/black petrel chicks banded per season (1995/96 to 2025/26), b) the percentage of all banded chicks (1995-2026 black points and line; 2025/26 breeding season red points and line) from each cohort that have been re-sighted as adults at Hirakimata/Mt Hobson, Aotea/Great Barrier. There was a higher number of chicks banded in 2016/17 (n=395) due to randomised transect surveys undertaken within the 35-ha study area in May 2017 resulting in a higher than regular number of chicks in unmarked random burrows being banded.

Across the entirety of the study, the number of returned chicks re-sighted each season has increased steadily since the study's inception. From 2018/19 onwards however, the number of returnees resighted each season has plateaued, fluctuating between 118 and 140 birds per season. Whilst the proportion of individuals representing different cohorts fluctuates from year to year, the proportion of individuals representing older cohorts diminishes over time as younger cohorts return to the breeding colony (Figure 10a & 10b). For instance, in the 2025/26 breeding season, the 1996/97, 2002/03, and 2005/06 cohorts were each only represented by a single individual.

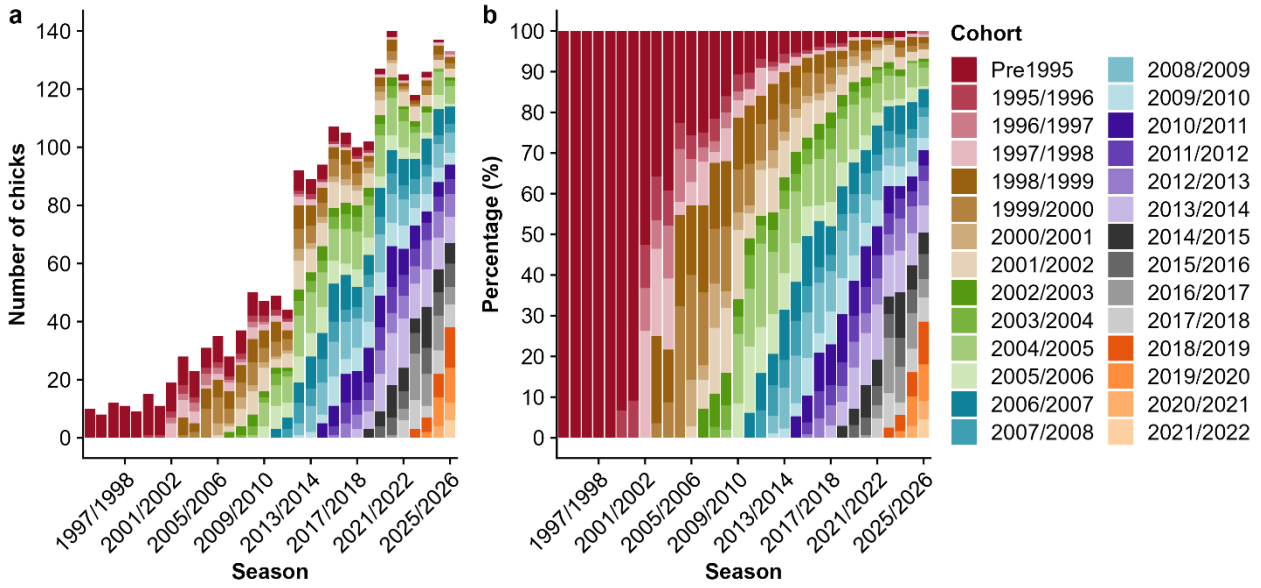

Figure 10: a) the number and b) percentage of tākoketai/black petrel (*Procellaria parkinsoni*) returned chicks (banded as chicks and re-observed as adults) at Hirakimata/Mt Hobson on Aotea/Great Barrier Island during each breeding season (from 1995/96 to 2025/26), categorised by the breeding season the bird was born in (i.e., breeding season cohort). Note: the number of chicks banded, and percentage returned before 1995 was intentionally not plotted. There were 581 chicks banded before 1995 and of these 6.0% have been re-observed as adults.

The minimum age at which tākoketai are generally first detected back at the at the Hirakimata colony after fledging is from four years of age onwards, though a small proportion have been resighted as young as three years of age (Figure 11a). The median age at first detection at the colony was six years old (mean 6.9 ± 3.4 (sd); min and max 3-35 years). Age at first detected breeding is observed in birds as young as four years old but detections generally peak at birds that detected at six or seven years old. The median age of breeding at first detection was seven years old (mean 8.1 ± 3.3 (sd); min and max 4-27 years). Similarly, for birds that are detected breeding successfully for the first time, age at first detection can also be as young as four years old, but detections also generally peak around seven years of age. The median age of successful breeding at first detection was eight years old (mean 8.4 ± 3.1 (SD); min and max 4-27 years).

Among birds whose breeding status could be determined at first detection after fledging, the youngest individuals were mostly comprised of non-breeders (Figure 11b). As age at first detection increased, the proportion of birds that were identified as non-breeders declined, and birds identified breeding at first detection increased. By eight years post-fledging, the majority of birds were classified as breeders upon their first detection at the colony.

Despite the ongoing bi-annual visits to the study colony since 1995/96, some birds can remain undetected for many years. The oldest tākoketai recaptured for the first time since being banded as a chick, occurred during the 2022/23 season when a 35-year-old was caught on the surface clacking (mate attraction call made by the male) outside a non-monitored burrow.

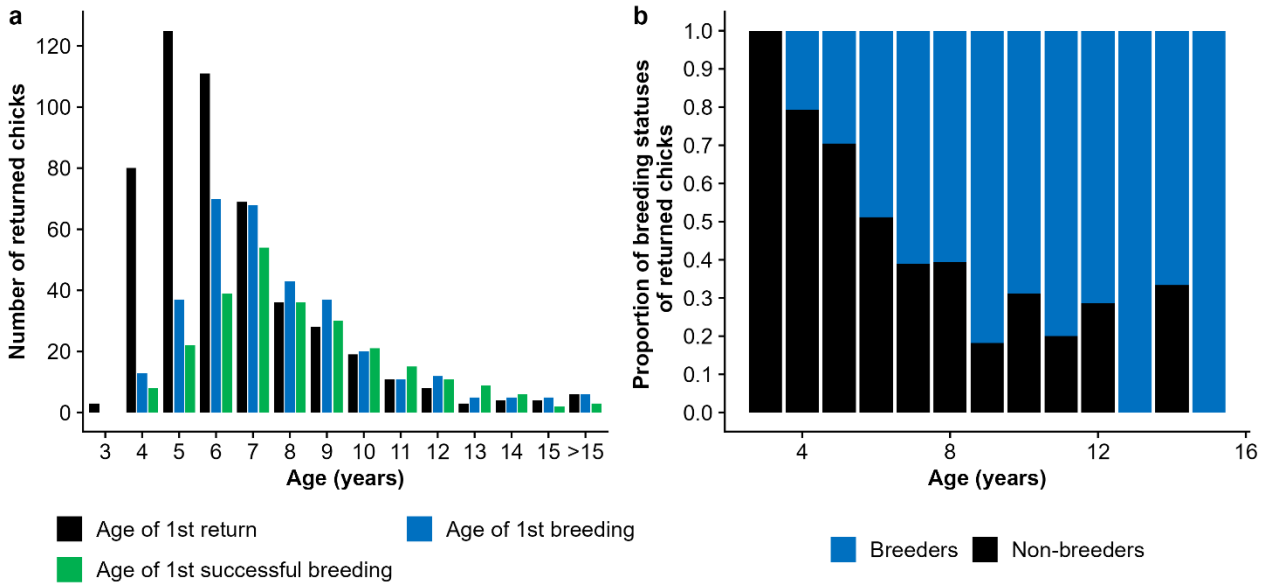

Figure 11: a) the age of tākoketai/black petrels that were banded as chicks that have been resighted back at the colony as adults (returned chicks) for the first time (black bars), when they were first detected breeding (blue bars) and when they were first detected successfully breeding (green bars) on Aotea/Great Barrier Island b) the proportion of non-breeders (black bars) and breeding (blue bars) of returned tākoketai/black petrel chicks at the age of first detection on Aotea/Great Barrier Island. Note, birds older than 15 years were excluded.

Population age structure of known aged birds in census grids

Of the 134 tākoketai of known age (i.e., birds banded as chicks and subsequently resighted at the colony) sighted during the 2025/26 season, 56 were recorded in census grid burrows. Birds occupying census grid burrows were a median age of 13 years (range: 4–28 years; Figure 12a).

There was a distinct separation in the age distributions of breeding and non-breeding birds. Non-breeding birds represented a relatively small proportion (12.5%) of known-age birds in the census grids during 2025/26, and their age distribution was strongly concentrated towards younger birds (median: 7 years; range: 4–28 years). In contrast, breeding birds had a broader and more symmetrical age distribution (median: 13 years; range: 6–26 years), peaking at approximately 12–14 years.

A concentration of younger, non-breeding birds within the census grids has been evident in most seasons since 2001/02 (Figure 12b). Prior to this, the age distributions of breeding and non-breeding birds either overlapped considerably, or no non-breeding birds were recorded. The concentration of older breeding birds during the early years of the study, through to 2003/04, largely reflects the continued presence of known-age birds banded during earlier studies. This pre-1995 cohort has progressively diminished over time, and no birds from this cohort were sighted during the 2025/26 season.

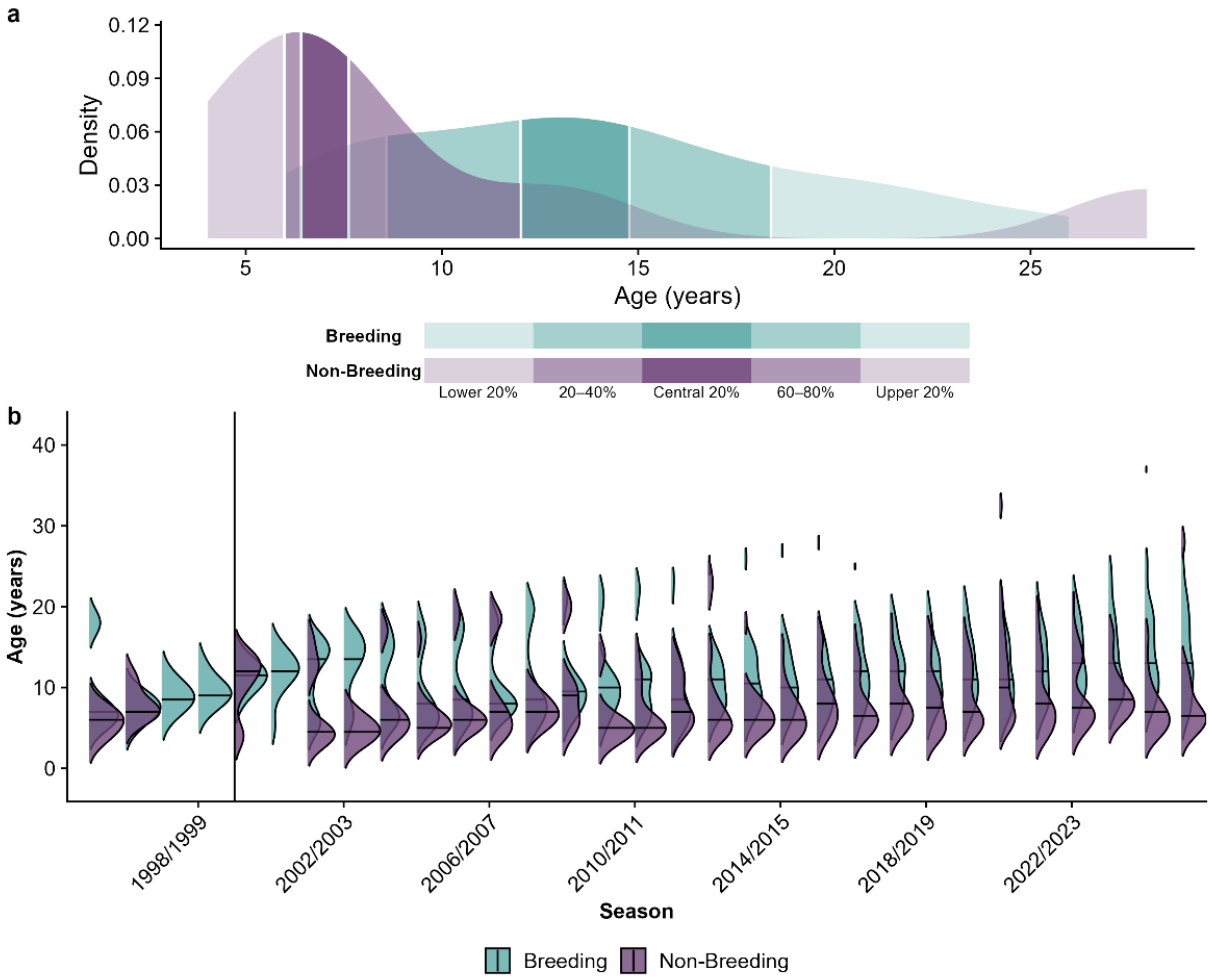

Figure 12: a) the age distribution of breeding and non-breeding tākoketai/black petrel adults of known age (banded as chicks) within census grids during the 2025/26 season and b) the age distribution of breeding and non-breeding tākoketai/black petrel adults of known age (banded as chicks, black lines within the distribution indicate the medians) within census grids over the course of the study (1995/96 to 2025/26) at Hirakimata/Mt Hobson on Aotea/Great Barrier Island. The vertical line indicates in b) indicates when all 9-census grids were established. Note, known age birds in census grid burrows at the start of the study are those birds banded in previous studies.

Satellite tracking

Tracking devices were deployed on 47 tākoketai chicks prior to fledging in early-mid May (Table 5). Four devices failed to collect position data due to a programming error. All other devices collected position data.

Table 5*: Summary of the satellite device deployment on tākoketai/black petrel (Procellaria parkinsoni) chicks at pre-fledging at Hirakimata/Mt Hobson on Aotea/Great Barrier Island and Te Hauturu-o-Toi/Little Barrier Island, 2026.*

Island	Still transmitting	Number of devices	Fledging date	Transmission duration (days) average ± sd (min-max)	Cumulative distance travelled (km) average ± sd (min-max)	Number that crossed Aotearoa New Zealand
LBI	No	5	4 to 17 May	46 ± 23 (29-105)	14,100 ± 5060 (2252-25,536)	3 (50%)
	Yes	1	17 May	98 days+	19897.29	0

GBI	No	35	8 May to 9 June	40 ± 22 (5-88)	11,866 ± 5339 (2252-25,537)	9 (24%)
	Yes	2	14 & 21 May	97 ± 6 (93 & 101)	18,419 ± 1695 (17,220-19,617)	1 (50%)
All		**43**	**4 to 9 June**	**47 ± 26 (5-105)**	**12,791 ± 5503 (2252-25,537)**	**13 (30.2%)**

One chick (H46634, A57) carrying a mis-programmed device from Hauturu was sighted on the ground at Mangawhai Heads by a member of the public (14 May 2026), likely having crash-landed after fledging. There were no further sightings of this bird, and it is likely that it did not survive being grounded. Another fledging from Aotea crash-landed off the east coast of Australia, with its last known location transmitting from the North Stradbroke Island, Brisbane.

Figure 13: Photo of crash-landed chick (H46634, A57) taken by a member of the public at Mangawhai Heads, 14 May 2026.

All remaining chicks fledged successfully and migrated towards South America (Figure 14).

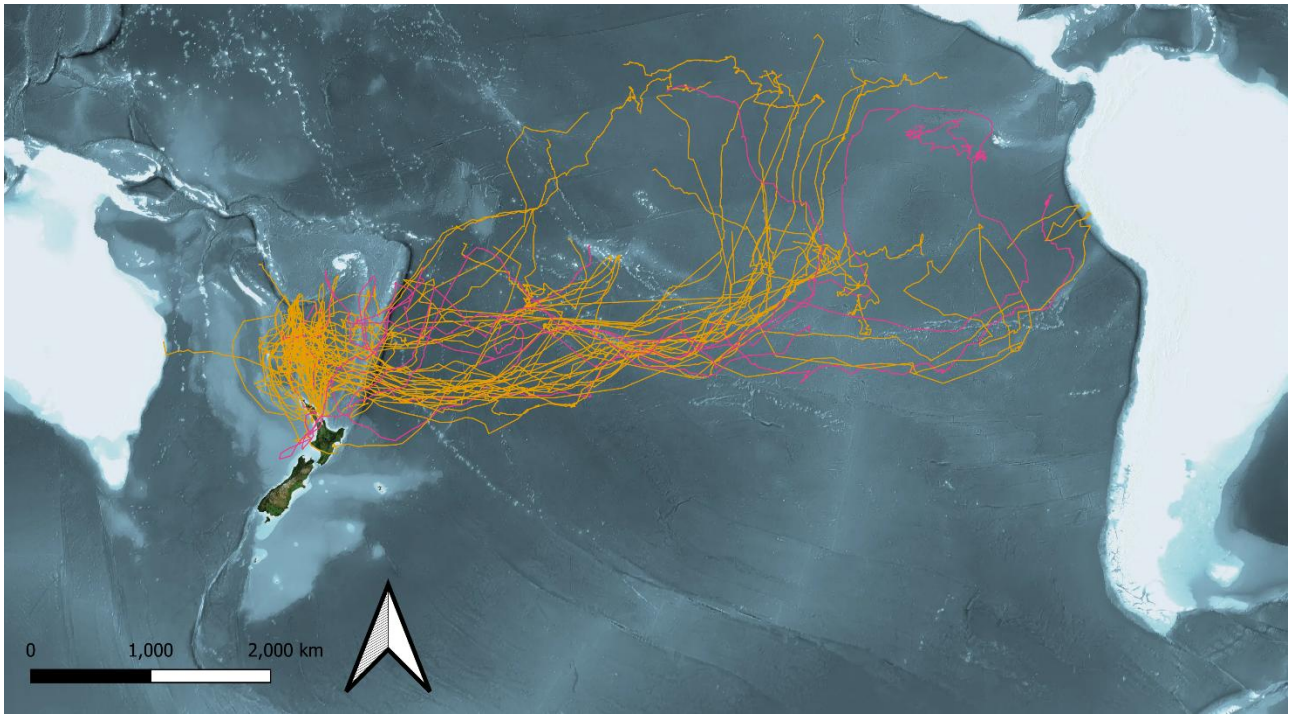

Figure 14: Tākoketai/black petrel (*Procellaria parkinsoni*) chick tracks post-fledging from Aotea/Great Barrier Island (orange) and Te Hauturu-o-Toi/Little Barrier Island (magenta), 2026.

The chicks are also being live tracked on the Live Ocean website (https://liveocean.org/project/tracking-the-takoketai/) (Figure 15).

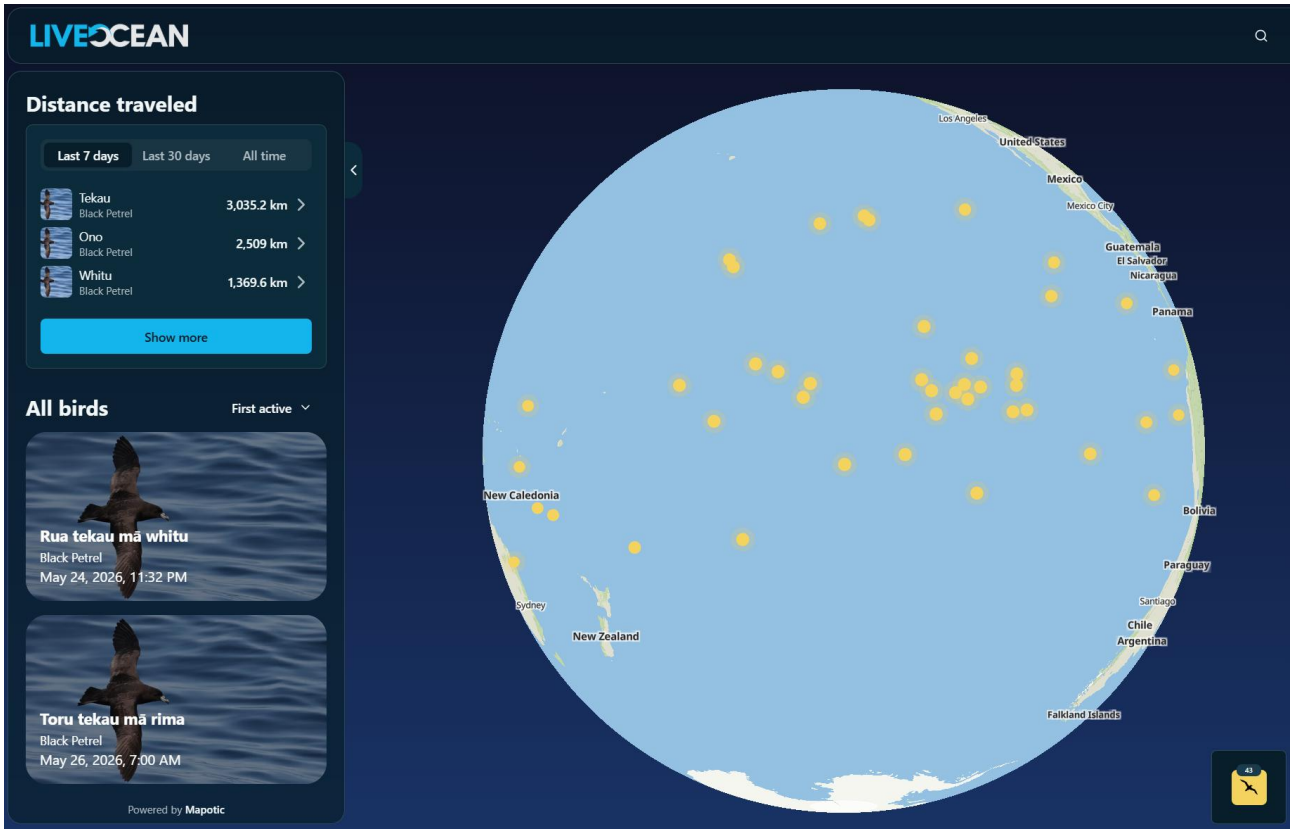

Figure 15: Tākoketai/black petrel (*Procellaria parkinsoni*) chick current positions (as 30 June 2026) as shown on the Live Ocean website (https://liveocean.org/project/tracking-the-takoketai/) post-fledging from Aotea/Great Barrier Island and Te Hauturu-o-Toi/Little Barrier Island, 2026.

For 13 chicks (ten from Aotea and three from Hauturu, 30% of the 43 birds with tracking data), they headed west and crossed Aotearoa instead of flying directly east into the Pacific Ocean (Figure 16). These flight paths ranged from as far north as Paihia (Northland) to as far south as the Firth of Thames (Coromandel). After reaching the Tasman Sea, several went as far south as Taranaki and one as far south as the Westcoast. Once in the Tasman Sea, the majority of these chicks then flew northward until just southeast of New Caledonia, before turning east to continue their migration towards South America. Three birds instead of continuing north, crossed back over Aotearoa, two transiting over Auckland. The third crossed near Whanganui, passing over the southern tip of the Ruahine Range and back into the Pacific Ocean. It then circled back into Hawke's Bay before continuing its migration eastward.

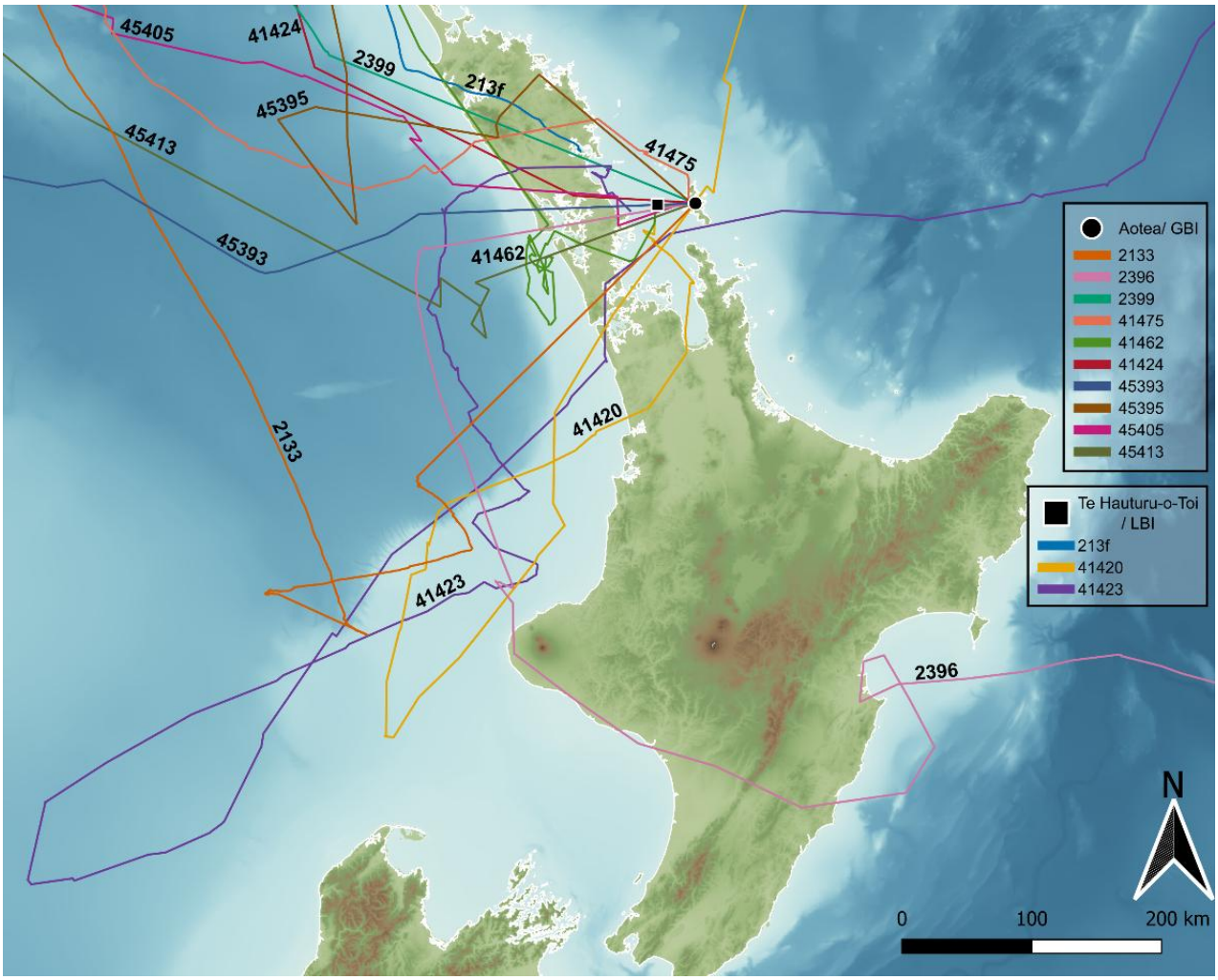

Figure 16: Tracks of tākoketai/black petrel chicks (n=13) that crossed over Aotearoa New Zealand at the start of their migration from Aotea/Great Barrier Island (circle) and Te Hauturu-o-Toi/Little Barrier Island (square), 2026.

Discussion

Breeding success and population demography

The 2025/26 season's tākoketai estimated breeding success was the lowest on record since the start of the study 31-years ago at 51.2%, falling well below the long-term mean of 64.6% by 13.4 percentage points. The low breeding success this year may have been the result of four multi-day heavy rainfall events that occurred over January and February, causing flooding of burrows resulting in drowning of newly hatched chicks or submersion of eggs. Extreme weather events occurred over a similar time period in 2022/23 which resulted at the time also the lowest estimated breeding success on at 56.3%, until this season. Increased frequency of extreme weather events may have implications for the long-term trends of tākoketai on Aotea and continued monitoring of the colony to assess weather and other factors on population trend is recommended.

Breeding occupancy in the census grids was 59.3% this season, marginally below the long-term average of 61.5% by 2.2 percentage points. The number of occupied burrows in census grids continues to steadily increase over time but breeding occupancy has remained remarkably stable over the study, with an interannual standard deviation of 3.9 percentage points around the long-term mean (or coefficient of variation (CV) of 6.3%). On the other hand, breeding success is relatively far more variable with an interannual standard deviation of 15.2 percentage points around the long-term mean (CV of 23.5%). Future studies into a burrow's micro-habitat features

(e.g., substrate, topography) would be useful to gauge what factors may influence its perceived quality how that in terns influences occupancy, breeding success, and their resilience to extreme weather events, which are likely to increase in frequency and in magnitude under climate change (Lunquist et al. 2011, Harrington et al. 2023).

Given the number of census grids only provides monitoring across approximately 2% of the overall tākoketai population on Aotea, adding three addition census grids to the study area would be valuable to increase the representativeness across the colony as well as provide additional insight into abundance and breeding occupancy. It is recommended that three new grids are established within the high-quality (107-ha) habitat around Hirakimata.

The average age of first detection for all birds recaptured on Aotea is six (mean 6.9 ± 3.4 (sd) years. It is interesting to note that tākoketai as young as four-year-olds are successfully breeding at the colony, even if only a small proportion of the returnees (n=6; 1.1%). It poses an interesting question about when the timing of pair-bonding for these young individuals occurs and whether pair-bonds and breeding can co-occur in the same year or pair-bonds for these individuals occurred at a time of the year when routine monitoring is not occurring such as pre-exodus or at the tail end of the breeding season. The detection of birds that are younger than four-years old is extremely rare with seven individuals resighted back at the colony at three-years old over the entirety of the 31-year study. Younger individuals that are re-sighted are made up of proportionally more non-breeders than breeders (when breeding status could be assigned), which then expectedly shifts as age at first detection increases. It still remains unknown whether these young pre-breeding individuals principally stay within the seas around Aotea, only infrequently coming ashore at the colony, during the breeding season before they reach the age in which they would begin prospecting for a mate, or whether they will go further afield. Tracking this age class would be valuable to understand their movements and identify any areas of risk that may impact on this age class.

A trip to the colony during the pre-laying exodus focused on identify recruits may be beneficial to understanding this aspect of tākoketai biology and thus provide more insight in recruitment. Trips during October have occurred in the past, but these trips have primarily focused on assessing birds found during the day in study burrows rather than nocturnal activity. To further identify productive windows to visit the colony, a network of trail cameras set up to record how activity patterns of the population throughout the year at key-launch sites could be beneficial. Focusing recapture effort at launch sites as well as surveys throughout the colony area is also likely to increase recapture rates.

The age structure of known aged tākoketai classified as breeders and non-breeders show a clear distinction that has persisted over time. Each season, known-aged non-breeding tākoketai found within census grid burrows are generally made up of young birds with ages concentrated around six- to eight-years old. The recurring presence of younger aged birds being detected within the census grids likely reflects an ongoing influx of new returnees to the colony. At the same time, breeding occupancy within the census grids has remained remarkably stable over time, despite increases in both the total number of burrows and the number of occupied burrows. Consequently, although the absolute number of breeding pairs within the census grids is increasing, breeding pairs continue to occupy a relatively constant proportion of all available burrows over time.

The distribution of known aged breeding birds within census grid burrows appears to be slowly widening over time. This likely reflects a combination of established breeders ageing within the population and a small number of younger birds recruiting into the breeding cohort, thereby producing a broader and more even age distribution. It will be interesting to see if over time, a small proportion of non-breeding birds at the oldest age range will be consistently detected, as this may point to an early indication of the effects of senescence.

Predation

There were two instances of feral cat predation this season; one of a chick in a study burrow and one of an adult suspected to be from a study burrow (but the full carcass was not located). Live cage traps targeting feral cats are located around the Hirakimata summit and run prior to, and throughout the tākoketai breeding season. The Tū Mai Taonga (https://www.tumaitaonga.nz/) project aims to protect and restore native species and ecosystems through feral cat removal and intensified rat control, initially in the Aotea Conservation Park and Northern Aotea area. The

Tū Mai Taonga team are monitoring these feral cat traps across the study colony and surrounding area, and in conjunction with DOC, will target any feral cats that are reported within the tākoketai study colony by the WMIL field team. A feral cat was detected on an automated (sim-enabled) trail camera at the Kauri Dam Launch Rock on 30 May 2026 (Figure 17); within 20 minutes of a tākoketai chick fledging from the rock. The Tū Mai Taonga team successfully removed this feral cat within two days of the video notification.

Figure 17: Feral cat passing the Kauri Dam Launch Rock, Aotea, on 30 May 2026 at 0445 hours. Credit: Tū Mai Taonga.

Returned chicks

The highest number of tākoketai fledging cohorts (n=25) were recorded this season at the Hirakimata colony (represented by at least one individual). Some cohorts were not represented this season (excluding cohorts 2021/22 and above), no birds were re-sighted from the pre-1995, 1995/96 and 2000/01 cohorts. This is the third season in a row where no birds were resighted from the 1995/96 cohort. It is perhaps unsurprising that representation of the 1995/96 has diminished over recent time considering how few chicks were banded that season relative to other cohorts. The reason for the absence of an individual from the 2000/01 cohort is unclear. At least one individual was resighted from the other two absent cohorts in the previous season.

The number of chicks banded each season has ranged from 59 in 1995/96, during the establishment of the study, 379 chicks in 2016/17 (where both demographic monitoring and population survey of the Hirakimata colony took place), averaging at 71 ± 7 chicks banded per year during the first three seasons when only three census grids were established to an average of 174 ± 12 chicks banded per year once all nine census grids were established. However, to date, less than 10% of all tākoketai chicks banded at the Aotea study colony have been re-captured in subsequent field seasons. There is a real lack of understanding whether the low return rates relate either to low juvenile survival or to imperfect detection of banded birds within the 35-ha study site caused by emigration. An integrated population model (IPM) on tākoketai is currently underway (POP2025-02) to help elucidate which mechanism is likely influencing these outcomes. Survival estimates, especially juvenile survival, are vital for accurate population estimates and risk assessments.

Ad-hoc nocturnal surveys have been undertaken throughout the 31-year study period resulting in 108 returned chicks being recaptured over 171 surveys nights whereas focused intensive survey effort over the past five

seasons results in 123 returned chicks caught over 59 survey nights. Results from these intensive surveys were consistently higher that the ad-hoc surveys for percentage of banded tākoketai caught out of all captures (intensive 47.9% vs ad-hoc 45%), percentage of returned chicks captured (intensive 18.8% vs ad-hoc 13.3%), the number of banded tākoketai caught per survey (intensive 5.3 vs ad-hoc 2.1) and for returned chicks caught per survey (2.1 vs 0.6). Although ad-hoc surveys have provided recruitment data, these results highlight the value of focused intensive efforts to recapture returned chicks, and it is recommended that these intensive nocturnal surveys continue.

Of the 15 returned chicks recaptured during the intensive nocturnal surveys, ten (66.7%) were caught for the first time. Of the ten chicks recaptured during the conservation dog surveys, seven (70%) were caught for this first time. Compared to the 35 returned chicks caught for the first time out of the 134 returned chicks (26.1%) caught over the entire 2025/26 season this suggests that the intensive nocturnal effort has increased the detections of returned chicks at the colony. The use of conservation dogs was also highly valuable within, and around, the census grids and dog searches should be repeated every two to three years. The detection rates for pre-1995 birds at the colony are decreasing as these birds age, and the number of recaptures of returned chicks banded before 2000 is also declining. Additional surveys should be factored into subsequent breeding seasons to increase the number of returned chicks being recaptured. An increased team size could allow for more ground at the colony could be covered, which in turn could increase the chance of recapturing returned chicks. Focusing recapture effort at launch sites as well as surveys throughout the colony area is also likely to increase recapture rates.

Previous transect surveys within the high-quality (107-ha) habitat (Bell et al. 2020) and entire core (1019-ha) habitat (Bell et al. 2022) provided information on tākoketai population size, occupancy, and breeding status across the main Hirakimata colony. It would be valuable to repeat these transect surveys to improve on these earlier estimates, particularly within the high-quality habitat as this original survey was only a trial to test the original distance sampling methodology (Bell et al. 2020) as well as provide an opportunity to detect banded birds away from the main study burrows and census grids.

A combination of these recommendations such as intensive night banding, transect surveys int eh high-quality habitat, and conservation dog searches within and around the census grids will work to improve detection probability and more accurately determine adult, and juvenile survival estimates as well as potentially provide insights into movements within the colony and provide an improved population estimate within the main Hirakimata colony.

Satellite tracking of chicks

Preliminary results from the tracking to date, suggests that the chicks have followed a different route this season compared to earlier tracking. Many of the chicks went further northwards from Aotearoa New Zealand into the Pacific before heading eastward towards South American waters. Adult tākoketai favoured a small area along the west coast of Ecuador in earlier tracking studies (Bell et al. 2011). Tākoketai chicks tracked on the maiden voyage in previous years exhibited a strong directional sense on their migration towards South America. After arriving at the Humbolt current the coasts of Chile and Peru, the birds collectively headed northwards towards the Galapagos (Southern Seabird Solutions Trust 2018). Here, the tracked tākoketai chicks varied widely on their migration, and only a few went all the way to Galapagos and the coasts of Ecuador/Peru. The majority either stayed (up until transmissions ceased) in the central Pacific, close to nations such as French Polynesia and Kiribati or crossed the equator up to about 10°N. The ‘super’ El Niño event that is developing within the Pacific is likely a major a contributor to alterative migration routes taken as birds avoid the concentration of warm unproductive waters that have resulted in an extensive range of sea-surface temperature anomalies in their usual wintering grounds (Siddiqi-Davies et al. 2024).

This season also showcases there is a continued risk from fall-out by tākoketai chicks on their maiden voyage, with one chick known to have crashed landed on the mainland following fledging. Unfortunately, this device was one of the four devices incorrectly programmed and thus its track and ultimately the fate of the chick is unknown. Another bird appears to have crash-landed off the east-coast of Australia. Fortunately, for the rest of the tracked

birds, no other crash-landings on mainland Aotearoa following fledging were detected. On the otherhand 30% of tracked birds migrated in the wrong direction, going west across Aotearoa and into the Tasman Sea instead of going east into the Pacific. Most birds course corrected by traveling north past Aotearoa and turning east once southeast of New Caledonia, whereas a smaller subset crossed back over the country to get into the Pacific. Although all these birds eventually and successfully entered the Pacific, these unexpected pathways demonstrate a substantial proportion of fledglings may encounter extensive areas of land during their initial migration, potentially exposing them to a greater risk of fall-out than would be expected.

Tracking continues to play an important component of understanding the distribution of tākoketai at sea, both for understanding the risks as by-catch from commercial fisheries and how climatic conditions can appear to alter 'traditional' migration routes and wintering foraging zones, as well as insights into the risk of fallout. Factors that influence the at-sea distribution of tākoketai will in-turn alter the risk-profile tākoketai face by commercial fisheries operating in different parts of the Pacific. This season further shows that migration pathways of tākoketai chicks can be far more variable than expected based on previous tracking. It is recommended that additional tracking of tākoketai chicks is repeated every two to three years to allow comparison with these, and earlier tracking results.

Advocacy

During the 2025/26 field season, the WMIL team continued to engage with the fishing industry, Iwi, local communities and the media to further the advocacy work carried out during previous field seasons. Key components to this work included responding to requests for talks and presentations, and hosting visitors to the Hirakimata study area on Aotea.

Recommendations

WMIL recommends that:

- Intensive population monitoring using the study burrows on Aotea continues with three visits (i.e., at egg-laying (December); at chick hatching/chick guard in late January/early February and at chick fledging in late April/early May) per season to the colony to track population trends and determine impacts to the birds and colony.
- Multiple-night expeditions to focus on recruitment (i.e., nocturnal surveys to capture pre-breeders and returned chicks) to the Aotea study colony continue to determine juvenile survival and recapture probabilities.
- Three additional census grids are added to the study area to increase the proportion of the tākoketai population monitored on Aotea.
- Transect surveys across the high-quality 107-ha tākoketai habitat (or the entire core habitat (1019-ha) around the summit) are undertaken to provide an updated population estimate for Aotea.
- Satellite tracking of chicks to, and in, South American waters is undertaken to determine migration routes and foraging areas to estimate risk in these areas.
- Satellite tracking of returned chicks, especially young (three- to five-year-old) birds caught during the intensive survey period is undertaken to determine behaviour, foraging areas and risk around Aotearoa New Zealand waters
- Genetic sexing of more tākoketai be undertaken to determine sex-related differences in survival. In-depth modelling on the effect of age, age difference in pairs, and experience on breeding success to investigate senescence impacts in tākoketai
- A remote/trail camera monitoring network at key-launch sites around the colony be implemented to identify potential time-windows of peak population activity outside the routinely monitored timeframes

- The possibility of collaborative at-sea capture expeditions in Ecuador is investigated. Discussions between DOC and New Zealand Government with Ecuadorian Government and researchers will have to be conducted to enable this type of collaborative work. At-sea work in Ecuador could determine the level of juvenile tākoketai presence in this area and risk within this area, and this mark/recapture work could provide another population estimate to compare with the New Zealand data.
- Further investigation to determine whether particular areas of the colony are more at risk to rainfall events than others (e.g., burrows in flatter areas being more prone to flooding) as a preliminary assessment on climate resilience.
- In-depth modelling on the effect of age, age difference in pairs, and experience on breeding success is completed to understand this relationship in tākoketai.
- Analysis of, and comparison between, breeding success in public, and non-public, access areas is completed to determine whether human disturbance is a factor at the Aotea colony.
- Investigation into possible deterrence methods of all predators, but specifically feral pigs and feral cats, should be continued at Cooper's Castle.

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Appendices

Appendix 1: Device deployment meta-data

Table 6: Deployment details and meta-data of tracked tākoketai/black petrels chicks fledged from Hauturu-o-Toi/ Little Barrier Island (LBI) and Hirakimata/Mt Hobson on Aotea/Great Barrier Island (GBI) in the 2025/26 season. A '-' indicates the value above it.

Island	Band number	Burrow	Sex	Body mass at deployment (g)	Wing length at deployment (mm)	Device model	Device id	Fix rate	Date deployed	Handling time (mins)
LBI	H46766, A21-O	L134	Female	855	329	Mini C3 UBILINK X1	213f	~3 min	4-May	17
	H46631, A60-O	L37	Male	1000	325	-	2145	-	4-May	20
	H46624, A26-O	L61	Male	855	350	TAV-2917	41423	2 / 10 h	1-May	23
	H46641, A24-O	L69	Male	835	330	-	41420	-	30-April	13
	H46644, A58-O	L49	Male	875	345	-	41340	-	5-May	12
	H46623, A47-O	L66	Female	810	340	-	40938	-	30-April	11
GBI	H47449, A286-R	UB	Female	>1000	347	Mini C3 UBILINK X1	212e	~3 min	12-May	13
	H47407, A143-R	97	Female	940	341	-	2132	-	14-May	16
	H47470, A119-R	177	Male	900	353	-	2133	-	13-May	16
	H47412, A216-R	353	Male	970	334	-	2136	-	10-May	25
	H47442, A238-R	UB	Male	910	352	-	213a	-	11-May	22
	H47436, A236-R	325	Male	900	348	-	213d	-	9-May	18

H47486, A066-R	446	Female	920	344	-	214c	-	14-May	19
H47444, A279-R	UB	Female	950	332	-	2152	-	11-May	16
H47441, A276-R	UB	Male	840	347	-	2392	~30 min	11-May	24
H45979, A008-R	489	Male	890	345	-	2394	-	13-May	20
H45996, A017-R	328	Male	980	346	-	2396	-	13-May	17
H47485, A065-R	260	Female	940	352	-	2399	-	13-May	18
H45973, A012-R	67	Male	900	348	-	239a	-	13-May	20
H45977, A009-R	81	Male	915	349	-	239c	-	13-May	19
H47521, A083-R	272	Female	895	354	TAV-2917	41496	2 / 10 h	7-May	17
H47472, A052-R	190	Female	855	337	-	41477	-	5-May	21
H47415, A146-R	UB	Female	820	350	-	41475	-	10-May	12
H47498, A129-R	324	Female	>1000	347	-	41462	-	7-May	21
H45951, A007-R	480	Male	850	331	-	41458	-	5-May	15
H47520, A082-R	85	Male	935	331	-	41445	-	7-May	11
H47464, A114-R	Surface	Male	950	352	-	41444	-	4-May	33
H47382, A024-R	76	Female	940	336	-	41424	-	9-May	9
H47421, A149-R	123	Female	945	360	-	45383	6 / 24 h	8-May	9
H47496, A127-R	476	Male	950	335	-	45385	-	10-May	11

H47414, A125-R	115	Female	950	368	-	45387	-	8-May	15
H47403, A137-R	192	Male	850	352	-	45388	-	7-May	28
H47416, A225-R	60	Female	970	349	-	45393	-	8-May	13
H47459, A107-R	486	Male	945	350	-	45395	-	10-May	10
H47534, A097-R	15	Male	954	345	-	45398	-	8-May	14
H47538, A226-R	222	Female	890	354	-	45400	-	8-May	10
H47543, A231-R	239	Female	855	340	-	45401	-	9-May	11
H47406, A142-R	UB	Male	910	351	-	45402	-	7-May	27
H47478, A058-R	373	Female	840	330	-	45403	-	10-May	16
H47475, A055-R	470	Female	980	342	-	45405	-	13-May	9
H47544, A233-R	405	Female	910	335	-	45409	-	9-May	10
H47391, A033-R	484	Male	860	349	-	45412	-	9-May	13
H47427, A261-R	468	Male	890	352	-	45413	-	9-May	12

Appendix 2: Feral cat predation log

Table 7: Number of tākoketai/black petrel (*Procellaria parkinsoni*) chicks from study burrows, chicks from non-study burrows and adults predated by ngeru mohoao/feral cats within the Hirakimata/Mt Hobson colony on Aotea/Great Barrier Island between 1995 and 2026.

Season	Number of chicks from study burrows predated	Number of chicks from unmarked burrows predated	Number of adults predated
1995/96	0	1	2
1996/97	0	1	1
1997/98	0	0	1
1998/99	2	1	2
1999/00	2	1	2
2000/01	1	1	1
2001/02	2	1	1
2002/03	3	4	2
2003/04	2	1	1
2004/05	0	0	1
2005/06	2	1	1
2006/07	0	1	0
2007/08	0	0	0
2008/09	0	1	0
2009/10	0	0	0
2010/11	1	0	0
2011/12	0	1	1
2012/13	0	1	0
2013/14	0	1	0
2014/15	0	1	0
2015/16	0	2	0
2016/17	2	3	2
2017/18	0	0	1
2018/19	0	1	1
2019/20	0	1	1
2020/21	0	1	1
2021/22	1	1	1
2022/23	0	1	1
2023/24	0	0	0
2024/25	0	0	1
2025/26	1	0	1
Average	**0.6 ± 0.9 (sd)**	**0.9 ± 0.9 (sd)**	**0.8 ± 0.7 (sd)**

Appendix 3: Night survey recapture details

Table 8: Number of tākoketai/black petrels (*Procellaria parkinsoni*) caught during night surveys within the Hirakimata/Mt Hobson colony on Aotea/Great Barrier Island between 1995 and 2026.

	Ad-hoc on-land surveys (1995/96 to 2020/21)	Intensive on-land night surveys						All on-land night surveys combined (all years)
		2021/22	2022/23	2023/24	2024/25	2025/26	All intensive on-land surveys combined	
Number of days at colony	940	25	28	37	19	**37**	**146**	1086
Number of surveys	171	13	12	16	10	**8**	**59**	230
Percentage of night surveys over trip	18.2%	52.0%	42.9%	43.2%	52.6%	**21.6%**	**40.4%**	21.2%
Total number of birds	811	55	264	108	134	**92**	**653**	1464
Number of new (unbanded) birds	446	24	127	57	68	**47**	**323**	769
Number of banded birds	365	31	137	51	66	**28**	**313**	678
Number of returned chicks	108	13	52	18	23	**17**	**123**	231
Average number of birds caught per survey	4.7	4.2	22.0	6.8	13.4	**11.5**	**11.1**	6.4
Average number of new (unbanded) birds caught per survey	2.6	1.8	10.6	3.6	6.8	**5.9**	**5.5**	3.3
Average number of banded birds caught per survey	2.1	2.4	11.4	3.2	6.6	**3.5**	**5.3**	2.9
Number of returned chicks	0.6	1.0	4.3	1.1	2.3	**2.1**	**2.1**	1.0

	Ad-hoc on-land surveys (1995/96 to 2020/21)	Intensive on-land night surveys						All on-land night surveys combined (all years)
		2021/22	2022/23	2023/24	2024/25	2025/26	All intensive on-land surveys combined	
caught per survey								
Percentage of banded birds out of all birds caught	45.0%	56.4%	51.9%	47.2%	49.3%	**30.4%**	**47.9%**	46.3%
Percentage of new (unbanded) birds out of all birds caught	55.0%	43.6%	48.1%	52.8%	50.7%	**51.1%**	**49.5%**	52.5%
Percentage of returned chicks out of all birds caught	13.3%	23.6%	19.7%	16.7%	17.2%	**18.5%**	**18.8%**	15.8%
Percentage of returned chicks out of banded birds caught	29.6%	41.9%	38.0%	35.3%	34.8%	**60.7%**	**39.3%**	34.1%