

TĀKOKETAI/BLACK PETRELS



*Summary report for at-sea capture work for tākoketai/black petrels
2022*



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Summary report for at-sea capture work for tākoketai/black petrels 2022

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This report was prepared by Wildlife Management International Limited (WMIL) for the Department of Conservation as fulfilment of the contract 'DOC-6751085: POP2021/01-Black petrel research – at-sea component' dated 13/1/2022.

2 December 2022

Version History:

VERSION	DATE	AUTHOR	REASON FOR CHANGE
1	19 May 2022	WMIL: Burgin, D.	First draft version
2	7 November 2022	WMIL: Burgin, D.	Second draft version
3	2 December 2022	WMIL: Burgin, D.	Final version including final November 2022 trip.

Citation:

This report should be cited as:

Burgin, D. 2022. Summary report for at-sea capture work for tākoketai/black petrels 2022. Unpublished Wildlife Management International Technical Report to the Department of Conservation, Wellington. 18p.

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Cover image: *Tākoketai/black petrel (Procellaria parkinsoni) at sea* © Dan Burgin

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EXECUTIVE SUMMARY

This summary report covers the results from the at sea capture work targeting tākoketai/black petrels (*Procellaria parkinsoni*) (Threat Classification: Nationally Vulnerable) for research under the Department of Conservation's Conservation Services Programme, project *POP2021/01-Black petrel research – at-sea component*. Here we report on all of the catching trips undertaken in 2022, including January, March and November, and present the results in relation to previous work undertaken in April 2021. Key results are presented, as well as a discussion of the findings before key recommendations are provided for future work.

In January 2022 WMIL staff were only able to undertake a one-day catching trip out in the waters north-east of the Marotere (Chicken) Islands group, and north of the Mokohinau Islands group. Poor weather prevented a longer trip. A total of 17 black petrels were caught from the back of the boat using a hand cast net and were all un-banded birds. Additional species caught were 18 toanui/flesh-footed shearwater (*Ardenna carneipes*) (Threat Status - At Risk: Relict).

In March 2022 WMIL staff were able to undertake a longer three-day catching trip, targeting the same areas, but particularly north of the Mokohinau Islands group. A total of 130 black petrels were caught from the back of a boat using the same hand cast net method. This total included 5 already banded birds from WMIL study colonies on Aotea/Great Barrier Island and Te Hauturu-o-Toi/Little Barrier Island, as well as 3 banded birds from the at-sea capture work. Additional species caught and banded were 78 flesh-footed shearwater, two New Zealand storm petrel (*Fregetta maoriana*) (Threat Classification: Nationally Vulnerable) and one rako/Buller's shearwater (*Ardenna bulleri*) (Threat Classification: At Risk: Declining).

In November 2022 WMIL staff were able to undertake a two-day catching trip, targeting the same areas as previously. A total of 39 black petrels were caught using the hand cast net method. This total included 2 already banded birds from the WMIL study colony on Aotea/Great Barrier Island. Additionally, 30 flesh-footed shearwaters were also caught and banded, one of which was already banded, having been banded at a WMIL study colony on Lady Alice Island in 2017. Finally one ōi/grey-faced petrel (*Pterodroma gouldi*) (Threat Classification: Not Threatened) was also caught and banded.

Over all trips undertaken by WMIL (April 2021, January 2022, March 2022 and November 2022), a total of 383 seabirds were captured altogether (April 2021: $n=67$, January 2022: $n=35$, March 2022: $n=211$, November 2022: $n=70$). A total of 176 (January 2022: $n=17$, March 2022: $n=122$, November 2022: $n=37$) black petrels were newly banded over all 2022 trips. Including the April 2021 preliminary trial captures, a total of 241 black petrels have been caught over the cumulative 9 days (April 2021: $n=55$ over 3 days, January 2022: $n=17$ on 1 day, March 2022: $n=130$ over 3 days, November 2022: $n=39$ over 2 days). Of these, 8 were previously banded at a terrestrial colony, representing 3% of total captures. The average daily capture rate of tākoketai/black petrel for each trip is highly variable; 18 per day in April 2021, 17 per day in January 2022, 43 per day in March 2022, and 20 per day in November 2022, with the average daily capture rate of black petrels for all trips being 27. The highest average catches were in the first and last light periods of the day (7-9am and 5-7pm).

Key recommendations for future work are:

- Trips need to be undertaken towards the start of the breeding season, i.e., mid-November through to early February, with several trips throughout the breeding season to allow WMIL staff to capture more birds.
- A large amount of bait should be taken to facilitate creating more feeding frenzies and theoretically more birds behind the back of the boat for capture.
- Future work should be clarified much further in advance to increase the success of this work particularly dealing with ever changing weather and swell conditions, COVID disruptions, moon phases, and aligning the WMIL team and the skipper's schedules.

- Undertake future work around the dimmest phases of the moon.
- Undertake work further north with either the same skipper (El Pescador Charters) or another suitable vessel (i.e., with a duckboard), to target other areas of this species range.
- Future work should budget for a team of three (minimum) to have flexible flying and accommodation costs, as well as the rising costs of diesel fuel for boat charters and covering the cost of higher bait use.

At-Sea Capture work for tākoketai/black petrels 2022

1. INTRODUCTION

In 2022 Wildlife Management International Ltd. (WMIL) staff undertook two at-sea catching trips targeting tākoketai/black petrels (*Procellaria parkinsoni*) in the waters north-east of the Marotere (Chicken) Islands group, and north of the Mokohinau Islands group (Figure 1). Black petrels have a Threat Classification of Nationally Vulnerable (Robertson et al. 2021) and have been monitored continuously by WMIL since 1995/1996 at their primary breeding colony on Aotea/Great Barrier Island (Bell et al. 2022).

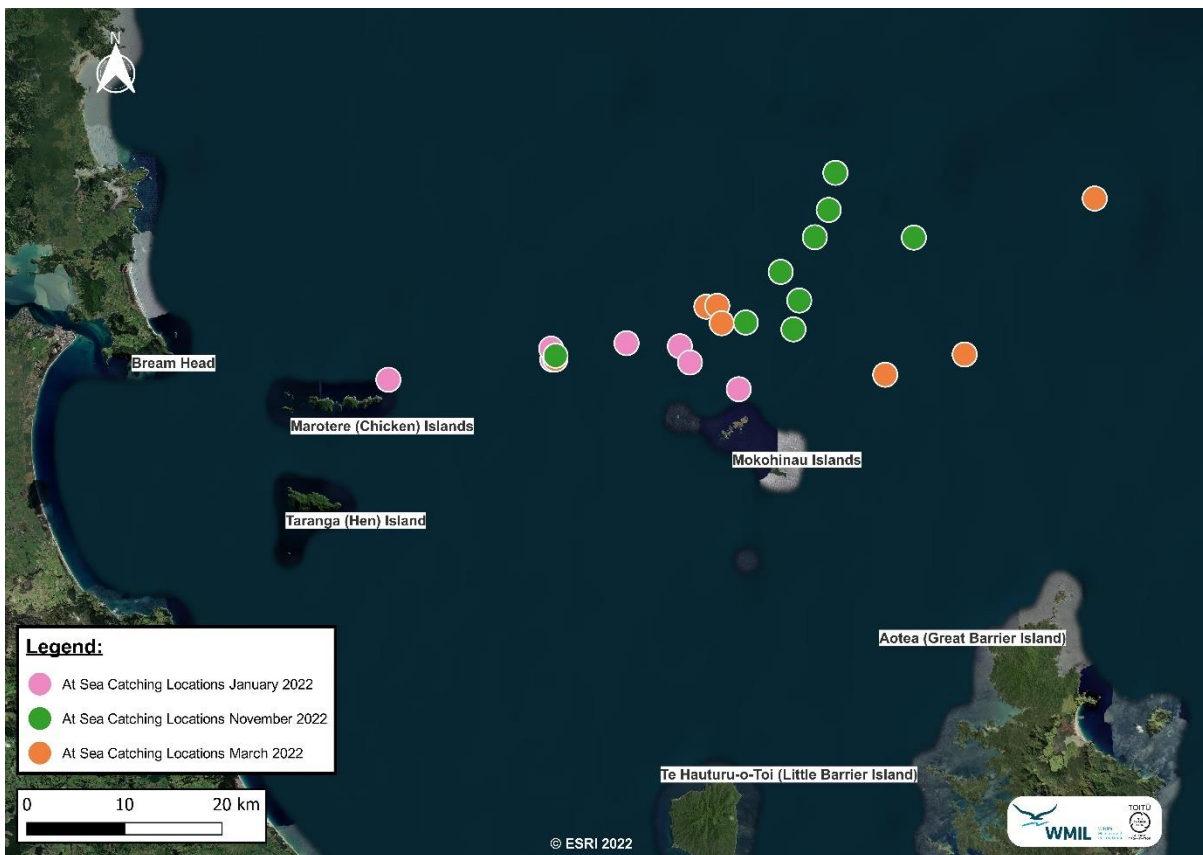


Figure 1: At-sea catching locations for January, March and November 2022 within the waters north of the known breeding sites of tākoketai/black petrels on Te Hauturu-o-Toi/Little Barrier Island and Aotea/Great Barrier Island.

1.1 Trip Dates

1.1.1 January 2022

A catching trip was undertaken on 26 January 2022 but was limited to just one day due to poor weather and swell conditions either side of this date. Personnel involved; Dan Burgin (WMIL), Keegan Miskimmin (WMIL), Lydia Titterton (WMIL) and Trevor Jackson (El Pescador Charters).

1.1.2 March 2022

A three-day catching trip was undertaken from 16 to 19 March 2022 and could not be extended due to poor weather and swell conditions the following day. Personnel involved; Dan Burgin (WMIL), Hinewai Bell (WMIL), Mike Bell (Toroa Consulting) and Trevor Jackson (El Pescador Charters).

1.1.3 November 2022

A two-day catching trip was undertaken from 13 to 14 November 2022 and could not be extended due to Trevor Jackson (Skipper of El Pescador) becoming ill, as well as poor weather and swell conditions later that week. Personnel involved; Dan Burgin (WMIL), Simon Lamb (WMIL), Mike Bell (Toroa Consulting) and Trevor Jackson (El Pescador Charters).

2. METHODS

Seabirds were lured in initially using a mixture of fish burley which was sealed in a netted bag or plastic case and placed in the water off the back of the boat once the engine had been turned off. It was connected by a rope and left to create a 'slick' of fish oil as an attractant to seabirds in the area. This attracted not just black petrels, but other species (threat status from Robertson et al. 2021 and taxonomy from Checklist Committee OSNZ 2022) including:

- Toanui/flesh-footed shearwater (*Ardenna carneipes*) (Threat Status - At Risk: Relict),
- Takahikare-raro/New Zealand storm petrel (*Fregetta maoriana*) (Threat Classification: Nationally Vulnerable),
- Rako/Buller's shearwater (*Ardenna bulleri*) (Threat Classification: At Risk: Declining),
- Wilson's storm petrel (*Oceanites oceanicus*),
- Tītī Wainui/Fairy prion (*Pachyptila turtur*) (Threat Status - At Risk: Relict),
- Tītī/Cook's petrel (*Pterodroma cookii*) (Threat Status - At Risk: Relict),
- Ōi/Grey-faced petrel (*Pterodroma gouldi*) (Threat Status – Not Threatened) and,
- Campbell Island mollymawk (*Thalassarche impavida*) (Threat Status – Naturally Uncommon).

Once the birds were flying around the back of the boat chopped up pilchards, and small pieces of fish burley were then thrown on to the surface of the ocean. This allowed targeted throws to lure black petrels in closer to the back of the boat to ensure they were within range of the cast net thrower.

A hand cast net (6ft) was used as the primary method of catching birds. This was thrown by one person (Dan Burgin) from the back of the boat over the top of a black petrel, whilst the other team members threw bait and/or helped with processing the birds. One bird was targeted with bait luring it in until it was close enough in range of the cast net thrower. The cast net was pulled tight once over the bird(s) to seal them inside and pulled back on to the boat. The bird(s) was carefully retrieved from the net by hand (Figure 2), and then each bird placed into an individual drawstring bag for processing later. Each bird was given a unique metal band if not already banded, marked with correction fluid to help distinguish it as a captured bird, and then carefully released over the side of the boat. Any banded birds had their unique band number taken, were marked with correction fluid, and released as above.



Figure 2: Tākoketai/black petrel in hand after retrieval from the cast net.

Accurate counts were taken of all bird species seen at all locations and uploaded to eBird (Sullivan et al. 2009) as part of complete checklists via the eBird app. These were all uploaded to the [New Zealand Bird Atlas eBird portal online](#) to support wider ornithological datasets and research.

3. RESULTS

Key results are presented below for both trips with all bird checklists summarised online and in separate eBird Trip Reports.

3.1 Capture Locations

Capture locations are summarised below in Table 1 with coordinates for each point for reference (WGS84 projection).

Table 1: Capture location ID and coordinates for January, March and November 2022 trips.

Location ID	Latitude	Longitude	Date Utilised
21	-35.873	174.789	January 2022
22	-35.858	174.940	January 2022

23	-35.880	175.112	January 2022
24	-35.860	175.067	January 2022
25	-35.848	175.058	January 2022
26	-35.845	175.009	January 2022
27	-35.849	174.939	January 2022
29	-35.857	174.943	March 2022
31	-35.818	175.082	March 2022
32	-35.869	175.247	March 2022
33	-35.854	175.320	March 2022
34	-35.817	175.092	March 2022
35	-35.830	175.096	March 2022
36	-35.737	175.440	March 2022
41	-35.767	175.273	November 2022
42	-35.830	175.118	November 2022
43	-35.835	175.162	November 2022
46	-35.776	175.175	November 2022
47	-35.746	175.195	November 2022
50	-35.718	175.201	November 2022
52	-35.792	175.151	November 2022

3.2 January 2022

Catch totals are summarised in Table 2 below for black petrels. Black petrel captures are presented in Figure 3, which shows the locations overlaid on a map of the surrounding area. No previously banded birds were captured on this trip, and no additional species were caught. An eBird Trip report for all at-sea sightings can be viewed [here](#).

Table 2: Capture totals for tākoketai/black petrels in January 2022.

Location ID	Number of tākoketai/black petrels caught
21	0
22	13
23	0
24	1
26	2
27	1
TOTAL	17

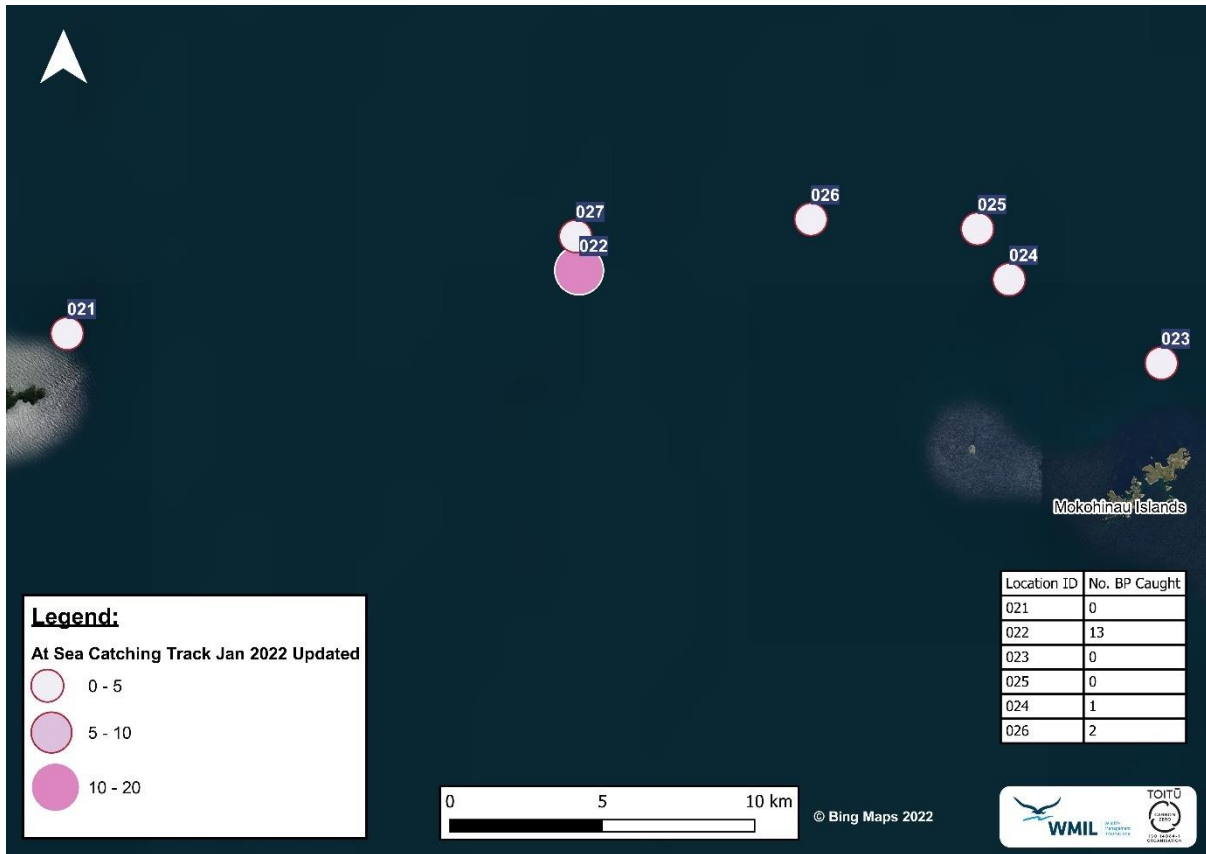


Figure 3: Total tākoketai/black petrel captures in January 2022. Circles are labelled, and their size reflects the number of birds caught. Capture values are presented in the table for each location point.

3.2.1 Additional Species

18 flesh-footed shearwaters were also caught, none of which were previously banded.

3.3 March 2022

Catch totals are summarised in Table 3 below for black petrels, including totals for previously banded birds captured on this trip. Total black petrel captures are presented in Figure 4, which shows the locations overlaid on a map of the surrounding area. Note that locations ‘28’, ‘29’ and ‘30’ were all merged into one as ‘29’ as they were so close together. An eBird Trip report for all at-sea sightings can be viewed [here](#).

Table 3: Capture totals for tākoketai/black petrels in March 2022.

Location ID	Total number of tākoketai/black petrels caught (including recaptures)	Total number of previously banded tākoketai/black petrels caught (not including those banded on this at-sea trip)
29	17	0
31	65	3 (1 on 16/3/22 and 2 on 18/3/22)
32	14	1 (17/3/22)
33	1	0
34	7	0

35	15	0
36	11	1 (17/3/22)
TOTAL	130	5

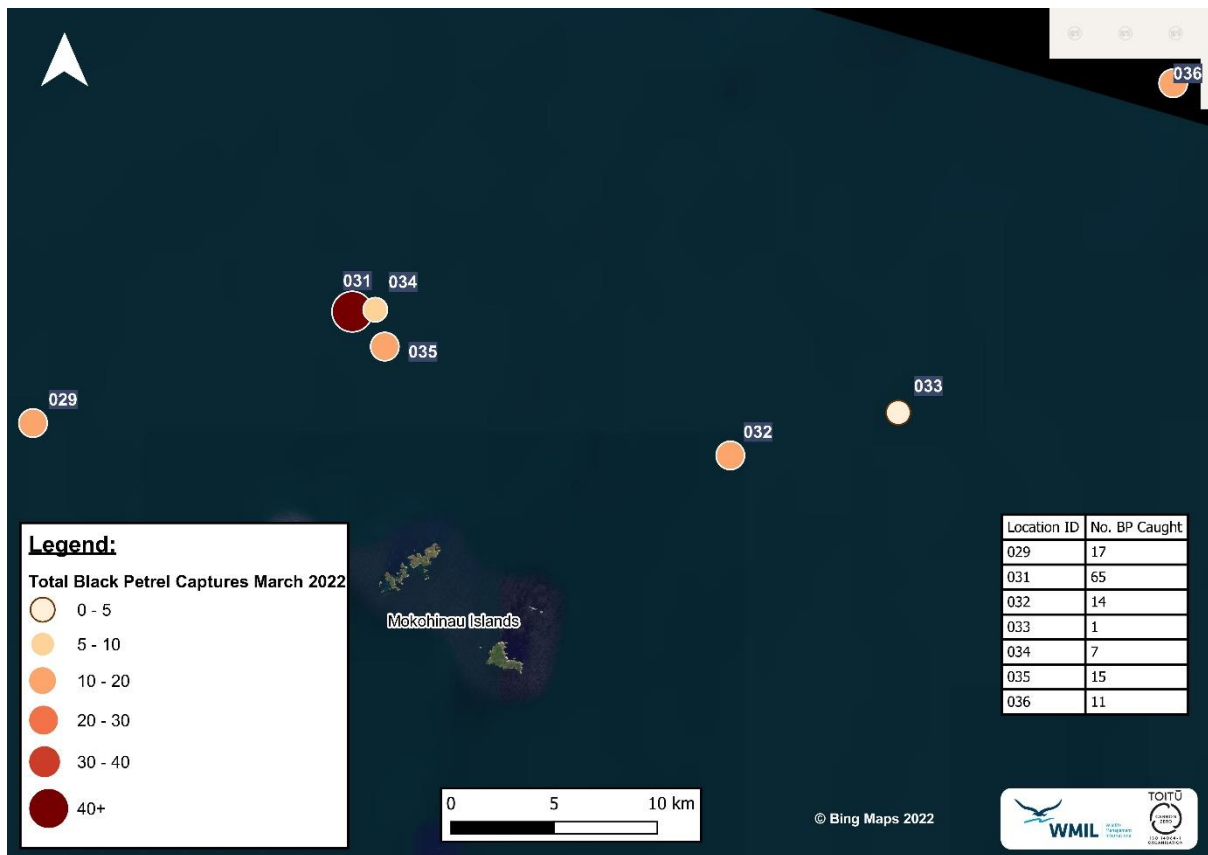


Figure 4: Total tākoketai/black petrel captures in March 2022. Circles are labelled, and their size reflects the number of birds caught. Capture values are presented in the table for each location point.

As part of the total capture value for black petrels, five birds were already banded previously at WMIL study colonies, and an additional three recaptures were banded during this at-sea trip, meaning 122 new birds were banded. Black petrel recaptures are summarised below:

- **H-41175** – This is a 6-year-old individual from Te Hauturu-o-Toi/Little Barrier Island (banded in April 2016 from a study burrow as a chick) and is the first recapture of this individual.
- **H-46254** – This is a newly banded adult non-breeder (sex unknown) from Te Hauturu-o-Toi/Little Barrier Island that was caught and banded by Auckland Council staff when undertaking study burrow monitoring in December 2021.
- **H-42021** – This is an 11-year-old adult breeding male from study burrow 212 on Aotea/Great Barrier Island, that was incubating an egg when WMIL staff were undertaking burrow monitoring on 25 January 2022.
- **H-44567** – This is a newly banded adult breeder (sex unknown) from study burrow 229 on Aotea/Great Barrier, that was with a chick when WMIL staff were undertaking burrow monitoring on 2 February 2022.
- **H-42733** – This individual was banded as a chick in April 2017 in a random burrow towards Kauri Dam colony on Aotea/Great Barrier Island.

3.3.1 Additional Species

In addition, 78 flesh-footed shearwaters (none of which were previously banded), 2 New Zealand storm petrels and 1 Buller’s shearwater were also caught during this trip.

3.4 November 2022

Catch totals are summarised in Table 4 below for black petrels, including totals for previously banded birds captured on this trip. Total black petrel captures are presented in Figure 5, which shows the locations overlaid on a map of the surrounding area. Note that locations ‘50’, ‘47’, ‘46’ and ‘52’ are merged locations from other points as they were so close together. An eBird Trip report for all at-sea sightings can be viewed [here](#).

Table 4: Capture totals for tākoketai/black petrels in November 2022.

Location ID	Total number of tākoketai/black petrels caught (including recaptures)	Total number of previously banded tākoketai/black petrels caught (not including those banded on this at-sea trip)
41	9	0
42	0	0
43	7	0
46	4	0
47	5	0
50	4	1
52	10	1
TOTAL	39	2



Figure 5: Total tākoketai/black petrel captures in November 2022. Circles are labelled, and their size reflects the number of birds caught. Capture values are presented in the table for each location point.

As part of the total capture value for black petrels, two birds were already banded previously at WMIL study colonies meaning 37 new birds were banded. Black petrel recaptures are summarised below:

- **H-42654** – This is an over 10-year-old individual from Aotea/Great Barrier Island (banded in February 2017 from a random burrow during dog searches as an adult) and is the first recapture of this individual.
- **H-42970** – This is a 5-year-old individual from Aotea/Great Barrier Island (banded in May 2017 in study burrow 356 as a chick) and is the first recapture of this individual.

3.4.1 Additional Species

In addition, 30 flesh-footed shearwaters, and a single un-banded ōi/grey-faced petrel were also caught during this trip. A single flesh-footed shearwater was previously banded and the details are below:

- **Z-56090** – This is an over 9-year-old female from Lady Alice Island (banded as an adult in burrow J36 in January 2018). This bird is regularly monitored at its breeding burrow each season by WMIL.

3.5 Total captures of all species

Over all trips undertaken by WMIL (April 2021, January 2022, March 2022, November 2022), a total of 241 black petrels were caught altogether (April 2021: $n=55$, January 2022: $n=17$, March 2022: $n=130$, November 2022: $n=39$) as shown in Table 5. Table 5 also details the 383 seabirds captured altogether over all trips (April 2021: $n=67$, January 2022: $n=35$, March 2022: $n=211$, November 2022: $n=70$). In March 2022, the 211 seabirds captured included the highest species diversity, whereby four species of seabird were caught (Table 5).

Table 5: Total captures of all seabird species during all at-sea trips undertaken by WMIL (April 2021, January 2022, March and November 2022).

Species	April 2021	January 2022	March 2022	November 2022	TOTAL
Tākoketai/black petrel (<i>Procellaria parkinsoni</i>)	55	17	130	39	241
Toanui/flesh-footed shearwater (<i>Ardenna carneipes</i>)	11	18	78	30	137
Campbell Island mollymawk (<i>Thalassarche impavida</i>)	1	0	0	0	1
New Zealand storm petrel (<i>Fregetta maoriana</i>)	0	0	2	0	2
Rako/Buller's shearwater (<i>Ardenna bulleri</i>)	0	0	1	0	1
Ōi/grey-faced petrel (<i>Pterodroma gouldi</i>)	0	0	0	1	1
TOTAL	67	35	211	70	383

3.6 Total captures of tākoketai/black petrels from all at-sea trips

A total of 176 (January 2022: $n=17$, March 2022: $n=122$, November 2022: $n=37$) black petrels were newly banded over all 2022 trips. The highest number was caught during the 3-day trip in March 2022 where a total of 130 black petrels were caught altogether (recaptures included).

Including the April 2021 preliminary trial captures, a total of 241 black petrels have been caught (April 2021: $n=55$, January 2022: $n=17$, March 2022: $n=130$, November 2022: $n=39$) (Table 6). Of these, 8 were previously banded at a terrestrial colony, representing 3% of total captures.

Table 6: Total captures for tākoketai/black petrels during all at-sea capture trips (April 2021 to November 2022).

At-sea trip	Number of tākoketai/black petrels caught		
	Previously Banded	Un-banded	Percentage banded (%)
April 2021	1	54	1.8
January 2022	0	17	0
March 2022	5	122	3.9
November 2022	2	37	5.1
TOTAL	8	230	3.4

3.7 Daily Capture Rates from the four at-sea trips

Table 7 summarises the daily capture rates of tākoketai/black petrel and the averages from all trips undertaken (April 2021, January 2022, March 2022 and November 2022).

The average daily capture rate of tākoketai/black petrel for each trip is highly variable; 18 per day in April 2021, 17 per day in January 2022, 43 per day in March 2022, and 20 per day in November 2022. The average daily capture rate of black petrels over all trips was 27 birds per day (Table 7).

Table 7: Average daily capture rates for tākoketai/black petrels during all at-sea capture trips (April 2021 to November 2022).

Day	April 2021	January 2022	March 2022	November 2022	TOTAL	4-trip average
Day 1	3	17	38	9	67	17
Day 2	7	N/A*	48	30	85	28
Day 3	45	N/A*	44	N/A*	89	44
TOTAL	55	17	130	39	241	27
Trip average	18	17	43	20		

* No catching was undertaken on this day

3.7.1 Capture Rate on March 2022 trip

Data on the success rate of net throws was also collected during the March 2022 trip (Table 8). A tally of successful throws, how many birds were caught in each throw, and the number of missed throws was noted to help calculate a success rate as well as get a gauge on the total number of throws over the majority of the trip. Data was collected over the first, second and the first half of the final day's catching, and so reflects the majority of the capture work for this trip. Table 8 summarises these capture rates.

Table 8. *Throw Catch Rate Analysis for March 2022 Trip.*

Calculation	Value
Total Throws	192
Throw Success Rate (%)	75.0
Bird Catch per Throw Average	1.65

3.7.2 Time of Capture

Data on what time birds were captured was collected during the April 2021, March and November 2022 trips and is summarised in Table 9 and Figure 6. Capture times are merged into hourly brackets and averaged across all days of the trip duration. The highest average catches were in the first and last light periods of the day (7-9am and 5-7pm) during the April 2021 and March 2022 trips, and during the afternoon for the November 2022. The reason for this may be due to the fact that we were unable to target those first and last light slots due to either unsafe weather and swell conditions, or the skipper became too ill during the trip.

Table 9. *Average tākoketai/black petrels capture rates across hourly time periods for April 2021, March 2022 and November 2022 trips.*

Time Period	April 2021	March 2022	November 2022
6am	1	0	0
7am	4	6	0
8am	0	4	3
9am	2	1	1
10am	1	1	1
11am	2	1	3
12pm	0	3	4
1pm	1	2	4
2pm	1	3	8
3pm	1	2	6
4pm	1	4	2
5pm	3	4	5
6pm	2	6	1
7pm	0	6	0

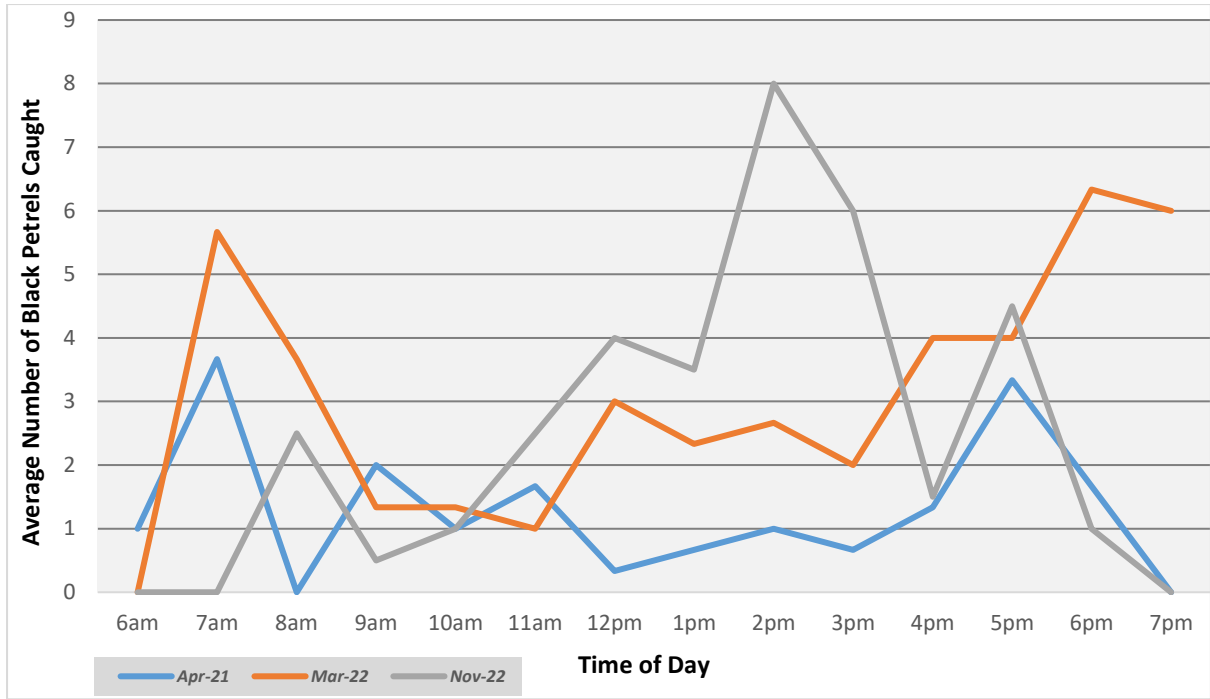


Figure 6. Average capture rate of tākoketai/black petrels over time from the April 2021, March 2022 and November 2022 trips.

3.8 Evidence of fish-hook damage

During the March 2022 trip, three birds were found to have apparent evidence of fish-hook damage to their bills. Figure 7 shows one individual with clear damage to the bill assumed to have been sustained from a fish-hook, potentially from a conflict with a commercial or recreational fishing vessel. This species is known to be at great risk from commercial fisheries within New Zealand's Exclusive Economic Zone (Richard & Abraham 2013; Whitehead et al. 2019). This would align with what has been seen at the breeding colony on Aotea/Great Barrier Island during burrow monitoring (E. Bell, WMIL, pers. comm.).



Figure 7. Assumed evidence of previous fish-hook capture and subsequent damage to bill of tākoketai/black petrel

4. DISCUSSION

A total of 230 (April 2021: $n=54$, January 2022: $n=17$, March 2022: $n=122$, November 2022: $n=37$) black petrels were newly banded over all of these trips. This is a high number of newly banded individuals. However with only 8 previously banded birds caught during 9 days' worth of at sea catching this represents just 3% of all black petrels being already banded over that period. The most successful location for capturing black petrels was location '31' in March 2022, which was north of the Mokohinau Islands, where 65 black petrels were caught. More black petrels were caught in the close vicinity at other locations ('34': $n=7$ and '35': $n=15$), and during other trips; '52' in November 2022 ($n=10$), and at '22' in January 2022 ($n=13$).

A total of 383 seabirds were captured altogether across all trips (April 2021: $n=67$, January 2022: $n=35$, March 2022: $n=209$, November 2022: $n=70$). In March 2022, the 209 seabirds captured included four species of seabird, as detailed above. The second most frequently caught species were flesh-footed shearwaters ($n=134$), with 133 of those receiving a new band. It is important to note that the capture of species other than black petrels was often unavoidable due to their associations with feeding black petrels behind the back of the boat. This will always be a factor of any at-sea work and should be taken into account. We do feel the capture of other species helped provide support for other research and are pleased to see the applicability of this capture method for other species of seabird, notably flesh-footed shearwaters but also including much larger species such as Campbell Island mollymawk, and much smaller species like New Zealand storm petrel, which could help increase understanding about these species at sea ecology.

In March 2022 the average daily capture of black petrels ($n=43$) was much higher than in January 2022 ($n=17$), and November 2022 ($n=20$). The reasons for this are likely numerous. Not only was the March trip longer, and with better weather and swell conditions, but the team had more experience than previous trips, and a better grasp of the cast net method. Additionally, we trialled placing birds straight into a drawstring bag for processing after being caught during the March 2022 trip, something that we had not done previously. This allowed a far more efficient and faster pace of capture during the March and November 2022 trips. Importantly, having undertaken two previous trips we had learnt from mistakes and had a better idea of the optimum capture locations and directed the skipper there at the start and end of each day. Understanding the best times for capture, which appear to be first and last light of the day (Figure 6), also allowed better capture rates for the March 2022 trip we believe. In November 2022, the trip was cut short due to unforeseen circumstances, and we weren't able to target those peak periods of capture (first and last hours of light) due to weather and other factors out of our control.

The most successful times of day for capture was found to be around first and last light, with the afternoon having a slightly slower capture rate (Figure 6). There was great success catching birds in the first 1.5 hours after first light and the last two hours before dark. This was maximised by getting to those locations for first light to be ready to catch birds, particularly in March 2022. It was also found that during the afternoon, if there were few birds around, once most birds around the boat were captured and marked, those and others became far too wary for catching, meaning we often had to move on to a new site or wait for more birds to gather.

Over the first two evenings in March 2022, it was found that numbers of birds steadily grew until dark when there were often high numbers of black petrels, flesh-footed shearwaters, and New Zealand storm petrel around the boat. As found previously, when birds were present in large numbers around the back of the boat (>10), a feeding frenzy ensued, and the birds generally became less aware of the people on the boat as they were focusing on competing with other birds for the food placed on the surface of the ocean. On the final evening in March 2022 however, we did not see this behaviour from black petrels and flesh-footed shearwaters, with much lower numbers around the back of the boat. One hypothesis is that this may well be attributable to the full moon that night, but we cannot be sure. Even so, further work should look to avoid the brightest moon phases where possible.

Black petrels and flesh-footed shearwaters were quick to learn about the novel threat of the cast net. If the net was thrown, and particularly if it missed the target, most birds become very aware of the person with the net. They often avoided coming in too close to the boat when that person was present, unless there were high numbers of birds around. This was especially true when very few birds were around. As was found on previous work undertaken in April 2021 by WMIL (Crowe & Burgin 2021), a lot of additional bait (pilchards and burley) had to be used to lure birds in closer to be able to successfully catch them with the cast net, particularly when they were in low numbers. The optimum time to throw was when the birds dove down or had their head just under the surface of the water when looking for sunken bait. This gave a higher chance of catching them. Many birds would come in with their wings raised ready for a quick escape though, flying off before the net could be thrown, which provided an extra challenge.

Wind was another factor that was certainly prevalent in both the March and November 2022 trips. Strong 14 and 15 knot winds with even stronger gusts made the exposed side of the boat particularly difficult to cast the net effectively. The wind would often partly close the lightweight net, or even divert it slightly off course if strong enough. Additionally, the birds could use strong winds to quickly grab bait and fly off without having to land and swim around. This was taken into account on those days where the winds were high, and didn't entirely hinder successful capture, rather it added an extra challenge that should be taken into consideration during future work.

Overall, despite the challenges, the March 2022 trip was the most successful trip to date undertaken by WMIL, with far more birds caught compared to not just the January and November 2022 trips, but also the work undertaken in April 2021 (Crowe & Burgin 2021). The latter trip was undertaken at the tail end of the black petrel 2020/2021 breeding season, and so it is likely that there were fewer birds around, but we feel that the March 2022 trip was also getting towards this latter stage of the breeding season. As discussed above the success of the March 2022 trip was likely down to more experience and knowledge on this capture technique. This understandably makes WMIL very keen to continue this work around the start and middle of the breeding season to better target black petrels, particularly pre-breeders, when they are known to be in higher numbers in this area.

Undertaking the past four trips with Trevor Jackson on El Pescador has shown us the optimum requirements for a vessel for this type of work, particularly the importance of the duckboard at the back of the vessel being close to the ocean's surface. This is imperative to allow room for the person to throw the cast net as low to the ocean's surface and close to the birds as possible. A potential trip was lined up with the Far Out Ocean Research Collective vessel however didn't occur due to a myriad logistical issues. We feel because this vessel is much larger, and a yacht, it may prove sub-optimal. A trial on the Far Out Ocean Research Collective vessel could be undertaken, however we feel time spent assessing this vessel's suitability could be used on El Pescador which we know is optimum for this work in the future. Importantly, if a trial is required on the Far Out Ocean Research Collective vessel, it is reliant on further iwi consultation by DOC in this area, and WMIL will await further updates regarding whether this work can be undertaken in these northern waters.

5. RECOMMENDATIONS

Key recommendations are summarised below:

- As recommended previously (Crowe & Burgin 2021), these trips need to be undertaken earlier in the breeding season, i.e., November through to early February, with several trips throughout the breeding season to allow WMIL staff to capture more birds.
- A considerable amount of bait is used for this work, and we recommend taking a large amount to facilitate creating more feeding frenzies and theoretically more birds behind the back of the boat

for capture. A considerable amount of bait is needed for 3-to-4-day trips and this should be factored in to planning, particularly budgets.

- A key recommendation surrounding further work is confirming and planning this work much further in advance to increase the success of this work and take into consideration all that has been learnt over these past four trips. With the contract signed in January 2022 and a busy field schedule WMIL staff did their best to quickly fit these trips in, particularly with ever changing weather and swell conditions, COVID restrictions, and aligning theirs and the skipper’s schedules. More time for planning will allow us to align our schedules with other WMIL contractual commitments, El Pescador Charters, as well as look to avoid the brightest moon phases, and worst weather windows where possible.
- We recommend undertaking future work around the dimmest phases of the moon.
- We recommend undertaking work further north with either the same skipper (El Pescador Charters) or another suitable vessel, to target northern areas of this species range.
- Future work should budget for a team of three (minimum) to have flexible flying and accommodation costs, as well as the rising costs of diesel fuel for boat charters and covering the cost of higher bait use.

6. ACKNOWLEDGEMENTS

This project was funded by the Conservation Services Programme, Department of Conservation (partially funded through a levy on the quota owners of relevant commercial fish stocks). Auckland Council also provided funds to support this project.

A huge thanks to Trevor Jackson (El Pescador Charters) for taking us out to these areas and anchoring us safely within the Mokohinau Islands each night, as well as tirelessly assisting with bait preparation and bird processing. Thanks also to Jochen from Far Out Ocean Research Collective for his understanding and patience when previous trips were cancelled. Thank you to Mike Bell (Toroa Consulting), Simon Lamb, Hinewai Bell, Keegan Miskimmin, Patrick Crowe and Lydia Titterton (WMIL) and Gaia Dell’Ariccia (Auckland Council) for their involvement with this fieldwork and braving some rough sea conditions at times. Many thanks to Elizabeth (Biz) Bell (WMIL) for reviewing and providing helpful comments on a previous draft. Finally, thanks to Graeme Taylor (DOC) for his support of this project and review of a previous draft of this report.

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