Foraging distribution and behaviour of flesh-footed shearwaters (*Puffinus carneipes*) breeding on Lady Alice Island – February 2017.

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Foraging distribution and behaviour of flesh-footed shearwaters (*Puffinus carneipes*) breeding on Lady Alice Island –February 2017

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ABSTRACT

The flesh-footed shearwater (*Puffinus carneipes*) breeds around New Zealand and Australia and is currently at risk from a range of threats, including fisheries by-catch and plastic ingestion. Recent population estimates indicate that this species is declining globally. New Zealand is a key population centre for this species, with many breeding colonies located on off-shore islands, including Lady Alice Island. The results presented here are initial findings at the start of a longer tracking project aimed at building a comprehensive understanding of flesh-footed shearwaters spatial distribution around New Zealand. This study is being carried out under the Conservation Services Programme project POP2015-02. GPS devices, combined with saltwater immersion loggers, were deployed on over 40 individual birds breeding on Lady Alice Island in February 2017. Combined tracking allowed identification of key areas used for foraging behaviour during the early chick rearing period. Many individuals travelled to areas within 400km of the breeding colony, along the east coast of North Island, but some flew more than 1000km away from New Zealand in single foraging trips. During these excursions, the majority of time was spent resting on the surface of the water, indicating efficient transit times between foraging areas. Future combined tracking work at different parts of the breeding season will provide more accurate estimates of key areas utilised by flesh-footed shearwaters, and hopefully help prioritise conservation policies for this species.

Keywords: seabirds, Lady Alice Island, tracking, foraging

1. INTRODUCTION

Like many seabird species, flesh-footed shearwater (*Puffinus carneipes*) populations are currently declining at an alarming rate. Reclassified from “not threatened” to “nationally vulnerable” in 2012 and remains so in 2017 (Robertson et al., 2017), the global population has continued to steadily decrease (Jamieson & Waugh, 2015; Lavers, 2015). Flesh-footed shearwaters are vulnerable to a range of threats, in particular fisheries bycatch and plastic ingestion (Priddel, et al., 2006). Recent studies have identified longline fishing as having a major impact on flesh-footed shearwater populations, possibly contributing to future quasi-extinction levels of population reduction (Baker & Wise, 2005). Fisheries conflict is likely to be responsible for population declines seen at breeding colonies in both New Zealand (Barbraud, et al., 2014) and Australia (Lavers, et al., 2014). High levels of plastic ingestion by seabirds have steadily gained recognition in recent years, and flesh-footed shearwaters have been identified as one of the species most at risk from this (Lavers, Bond, & Hutton, 2014). Whilst plastic ingestion has obvious risks for adult mortality, its effect on chick survival has particularly long-reaching implications for population decline (Lavers et al., 2013; Lavers et al., 2014).

Focussed studies into the movement ecology and population dynamics are urgently needed, due in part to these threats, but also to a lack of understanding with regards to the at-sea distribution of flesh-footed shearwaters. Some evidence suggests that these birds are vulnerable to by-catch due to their propensity for boat-following (Waugh et al., 2016). However, more information about their foraging behaviour is necessary for efficient conservation strategies in the future (Thaxter et al., 2012).

1.1 Lady Alice Island

Lady Alice Island/Mauima is a 155ha Nature Reserve located 40km southeast of Whangarei, part of the chain of islands known as the “Hen and Chickens”. The island is closely vegetated with a range of plant species, most notably pohutukawa (*Metrosideros excelsa*) in areas with a dense population of flesh-footed shearwater burrows. The population of flesh-footed shearwaters on Lady Alice Island has been studied in varying detail since 2000 (A. Booth pers. comm.). An island-wide survey in 2009/10 estimated a population size of 921 breeding pairs (Baker et al., 2010). This initial estimate was updated between 2011 and 2012 to 720 breeding pairs (Waugh et al., 2014). Between 2016 and 2017 a new demographic study established 158 study burrows on the island, with 379 adults banded during December 2016 and 94 chicks in April 2017 (Crowe et al. 2017).

GPS tracking of flesh-footed shearwaters had previously been undertaken on Lady Alice Island in December 2012 (Waugh et al., 2014). During this incubation period 16 GPS devices were deployed, however, only one functioning tag was recovered. This information was used in conjunction with tracking data collected from other Flesh-footed shearwater breeding colonies in an initial attempt at mapping overlap between bird and fisheries distributions (Waugh et al., 2016). Given the paucity of data collected from Lady Alice Island in 2012, and that only incubating birds were tracked, the results reported here fill an important knowledge gap.

This research was carried out as part of the Flesh-footed Shearwater: Various Locations Population Project (POP2015-02) funded through the Conservation Services Programme. The key objective we were funded to complete was:

3. To describe the at-sea distribution of flesh-footed shearwater breeding at Northland breeding sites.

Therefore a major aim of this study was to build an accurate foraging distribution for flesh-footed shearwaters breeding on Lady Alice Island. This report describes preliminary results from the first of several GPS tracking expeditions, with future trips scheduled to cover different periods of the flesh-footed shearwater breeding season. Like many seabird species (Hatch, 1990); (Weimerskirch, Chastel, & Ackermann, 1995; Weimerskirch et al., 1997; Lascelles et al., 2012; Patrick et al., 2014; Fayet et al., 2015; Kadin et al., 2016), flesh-footed shearwaters have different constraints on their foraging behaviour at different parts of the breeding cycle. This study takes place in the chick rearing period, during which the adults must return to the burrow regularly in order to provision the chick, potentially placing constraints on the time an adult can spend away from the colony (Wakefield, Phillips, & Matthiopoulos, 2009; Weimerskirch et al., 2014; Shoji et al., 2015; Mendez et al., 2015). The work undertaken here builds on previous findings from this species as the GPS devices were deployed in combination with saltwater immersion loggers, allowing a measure of at-sea behaviour and therefore a more accurate record of foraging distribution (Phillips & Croxall, 2008; Dean et al., 2012; Hunt & Wilson, 2012; Dean et al., 2015; Chimienti et al., 2016).

2. METHODS

Field work took place on Lady Alice Island, North Island (35.89°S, 174.71°E) between 31st January and 22nd February 2017. Two researchers stayed on the island for 22 consecutive nights, arriving by boat charter from Whangarei (quarantine was carried out at the DOC office in Whangarei before departure). During December 2016 work was carried out to identify flesh-footed shearwater breeding burrows and to band the attending adults. Burrows which were too long to retrieve birds by hand were made accessible by digging a small hatch into the nest chamber. This hole was covered by either a piece of plywood, or a small rock. A subset of these burrows was used during this tracking study.

2.1 Device attachment and retrieval

Flesh-footed shearwater burrows were marked during an earlier trip (Crowe et al. 2017) and grouped into areas within a dense colony positioned to the west of the DOC hut, historically known as LA1. During the day time each study burrow was checked for breeding activity and adult presence. After performing checks, a set of three or four small sticks were set upright in the entrance(s). These were then used during the night to alert field workers to the presence of an adult in the burrow. If a burrow was being checked for the first time (at the start of this trip) it was thoroughly checked for extra entrances and extra access holes dug if required. Any un-banded adults caught during this study were banded and processed in order to add them to the existing banded population on Lady Alice Island (Crowe et al. 2017).

When an adult with a chick was caught inside the breeding burrow a GPS and a saltwater immersion logger were attached to the bird. Twenty of the GPS loggers used in this study were the GiPSy-5 model made by TechnoSmArt. The GiPSy-5 devices were set to “long period mode" recording position every ten seconds. A smaller number of unpackaged i-gotU GPS loggers (six GT-120 models, made by Mobile Action) were also used. Due to power consumption constraints the i-gotU devices were set to record position every one minute. Both models of GPS device were sealed in heat-shrink plastic. Both GPS devices weighed 17g (including heat shrink and tape). On average this was 2.5% (range 2.1% - 2.9%) of the birds' body weight which is below the 3% threshold suggested by Phillips et al. (2003) for albatrosses and petrels. All the saltwater immersion loggers used in this study were Intigeo-C330 geolocators from Migrate Technology. The Intigeo-C330 loggers recorded saltwater immersion every 30 seconds and then binned this data every five minutes to give a count of the number of 30 second periods that were "wet" (conductivity measured over 63, called the "wet count"). If the bird stayed on the water for the entire five minutes, the wet count was 10. If the logger was wet for only 30 seconds the recorded wet count was one.

On finding a previously un-tracked adult, the bird was initially weighed and the band number noted. A GPS device was fitted to the shearwater's back feathers using marine Tesa tape (Phillips et al., 2003; Guilford et al., 2008) and super glue. The Intigeo-C330 saltwater immersion loggers were attached to the metal leg band using two small cable ties. Once both devices were fitted, the bird was returned to its burrow. Deployment usually took no more than 10 minutes of handling time.

Burrows were checked approximately every hour during the night, more frequently at peak times of shearwater arrival and departure from the colony. If a bird with devices was recaptured, the loggers would be removed and the bird weighed again (retrieval usually took less than 10 minutes). If the back feathers appeared to be in good condition, a new device would be deployed on the same bird. The majority of deployments and retrievals took place on the surface of the colony, with one worker holding the bird and the other attaching the loggers. All timings, bird information and logger numbers were recorded in situ.

2.2 Data analysis and processing

Data were downloaded from all devices every time loggers were retrieved from a bird. There were a few deployments where the GPS failed or was not retrieved and these are noted in Table 1. Once the data were downloaded some pre-processing was required. This involved the removal of regular status updates from the GPS files in addition to the removal of logs taken before the devices were attached to the birds. All data processing and analysis took place in R (version 3.1.1), with some plotting of maps in QGIS (version 2.10.1).

GPS locations were matched up with a corresponding saltwater immersion value by using the date-time stamp on the saltwater immersion log to find the corresponding position. GPS locations were recorded every 10 seconds, and the saltwater immersion logged every 5 minutes. In order to match immersion to position, the GPS locations 150 seconds either side of the matching time stamp were averaged to provide one latitude and longitude to each saltwater immersion record.

A simple classification method was then used to identify locations where one of three types of behaviour were taking place: flight, resting or foraging. Flight was classified as positions with a "wet count" of less than two (mostly dry), resting positions had a "wet count" of more than nine (mostly wet) and foraging behaviour was classified as positions with an intermediate "wet count" between two and nine. This resulted in a GPS track with a fix every five minutes classified as flight, foraging or resting.

The proportion of time spent doing each at-sea behaviour was calculated for every combined GPS track, in addition to the distance travelled on each trip. Occupancy kernels were calculated at the 50%, 75% and 95% levels in R using the `adehabit` (version 1.8.18, Calenge, 2006) and `raster` (version 2.5-8, Hijmans et al., 2016) packages.

Table 1. Summary of all birds tracked during February 2017 on Lady Alice Island. Distance travelled, and proportion of time spent in each behaviour was calculated for birds carrying both GPS and GLS loggers. Mean distance travelled (km) was calculated for each trip.

Bird	Burrow	Number of Deployments	Number of trips	Mean distance travelled	Proportion of time Flight	Proportion of time Rest	Proportion of time Foraging	Notes
Z46063	F4	1	3	179.6	0.10	0.71	0.19	
Z46083	D6	1	2					Deployed without saltwater immersion logger
Z50335	E1	2	6					Deployed without saltwater immersion logger
Z50340	E1	1	2					Deployed without saltwater immersion logger
Z53650	E5	1	2	257.9	0.27	0.51	0.22	
Z53668	E5	1	1	811.5	0.43	0.42	0.15	
Z53674	F10	2	3	820.1	0.37	0.47	0.16	
Z53677	D6	1	1	295.8	0.20	0.59	0.21	
Z53679	C1	2	2	242.7	0.17	0.61	0.22	First deployment GPS malfunctioned
Z53694	E8	1	1	649.0	0.31	0.51	0.18	
Z53719	E6	2	3	177.6	0.17	0.65	0.18	
Z53754	E6	3	4	412.8	0.22	0.57	0.20	
Z53917	F3	1	0					Bird Found Dead at Whananaki Beach, GPS Not Recovered
Z55617	F1	1	0					GPS Lost
Z55618	F5	2	4	269.0	0.20	0.61	0.20	
Z55620	F8	1	1	161.5	0.24	0.57	0.19	
Z55633	D5	3	3	222.5	0.25	0.57	0.18	GPS Battery Failed, tracks not yet recovered
Z55635	F9	2	3	639.0	0.19	0.61	0.20	Second combined trip GLS malfunctioned
Z55659	C3	1	2	302.3	0.17	0.54	0.29	
Z55660	C4	1	1					Deployed without saltwater immersion logger
Z55671	F10	2	3	402.1	0.51	0.33	0.16	
Z55685	L1	2	5	130.4	0.30	0.46	0.25	
Z55687	L5	1	0					GPS Lost
Z55689	A5	1	2					Deployed without saltwater immersion logger
Z55731	F6	1	1	794.7	0.22	0.62	0.15	
Z55732	F5	1	1	1025.4	0.32	0.55	0.13	
Z55737	C1	1	1	846.2	0.26	0.52	0.21	
Z55738	C4	2	2	390.7	0.43	0.18	0.39	
Z55739	C5	1	3	545.9	0.45	0.41	0.14	
Z55740	D12	1	1	394.1	0.24	0.48	0.28	
Z55752	L5	1	0					GPS Lost
Z55753	F8	1	1	126.5	0.29	0.41	0.30	
Z55754	A5	2	3	71.6	0.11	0.75	0.14	
Z55756	F3	3	4	431.1	0.30	0.59	0.12	
Z55757	C3	1	1					Deployed without saltwater immersion logger
Z55758	L1	1	2	385.4	0.46	0.32	0.22	
Z55759	D12	2	3	2262.6	0.51	0.41	0.08	
Z57276	E3	1	1	933.7	0.64	0.28	0.08	
Z57403	E3	1	1	478.0	0.32	0.51	0.17	
Z59525	D8	1	0					GPS wet, no tracks recovered
Z59553	D8	3	5	508.0	0.38	0.46	0.16	GPS not recovered on final deployment
Z59556	D5	1	2	312.0	0.29	0.47	0.25	
Z59557	F6	2	3	120.0	0.32	0.56	0.52	Saltwater immersion data did not work for 1 trip
43	24	63	89	487.5	0.3	0.5	0.2	Total/Mean
				±416.2	±0.13	±0.12	±0.09	SD

3. RESULTS

During the 22 days on Lady Alice Island, 43 individual flesh-footed shearwaters were tracked from 24 burrows (19 pairs where the both of the adults were tracked). A total of 43 logger deployments took place, however not all of these deployments were included in the analysis below. The analysis is limited to 42 foraging trips across 32 individual birds where the individuals were carrying both GPS and saltwater immersion loggers. One birds' GPS battery failed when acid leaked from the battery. All acid was contained within the heat-shrink plastic and the bird was unharmed. More details regarding the outcome of individual deployments (e.g. lost GPS) are given in table 1.

Each tracked bird was weighed before and after deployment and lost on average 15g (±62g SD). The breeding success results from Crowe et al. (2017) were used to determine if there was an effect of our tracking on chick survival. There was very little or no apparent effect of tracking on breeding success. Of the chicks from burrows with adults tracked, 74% (n = 17) survived to fledging (i.e. 26% failed post-hatching). Of all other burrows on Lady Alice Island, 22% (n = 30) failed post-hatching. This was calculated under the assumption that half of all unknown burrow failures were post-hatching while the other half were pre-hatching.

3.1 Spatial distribution

The majority of the tracked flesh-footed shearwaters breeding on Lady Alice Island spent time around the north-east coast of North Island, New Zealand, with some individuals flying around the far north tip to visit the west coast (Figure 1). A small number of birds also flew out to an area around 168°E, -33°S, in the Tasman Sea approximately 600km east of Lord Howe Island, Australia (Figure 1, inset). Some individuals also flew southwards from Lady Alice Island into the Hauraki Gulf. Other individuals were recorded flying in a south-easterly direction, around the East Cape and into pelagic waters in the South Pacific, around 300km east of North Island.

The distance flown during foraging trips varied (Figure 2), the shortest trip being only 71.6km, the longest was 2262.6km. Average trip distance was 487.5km (±416.2 SD), with the majority being less than 500km (Figure 2). Trip length and route varied both between and within individual birds, with many birds alternating between short and long foraging trips. This is illustrated in Appendix 7.1 where each panel shows multiple trips taken by one individual bird.

Figure 1. All foraging trips recorded during February 2017 from flesh-footed shearwaters breeding on Lady Alice Island. Each line represents one foraging trip, with the inset map shown at a greater scale to allow plotting of longer trips.

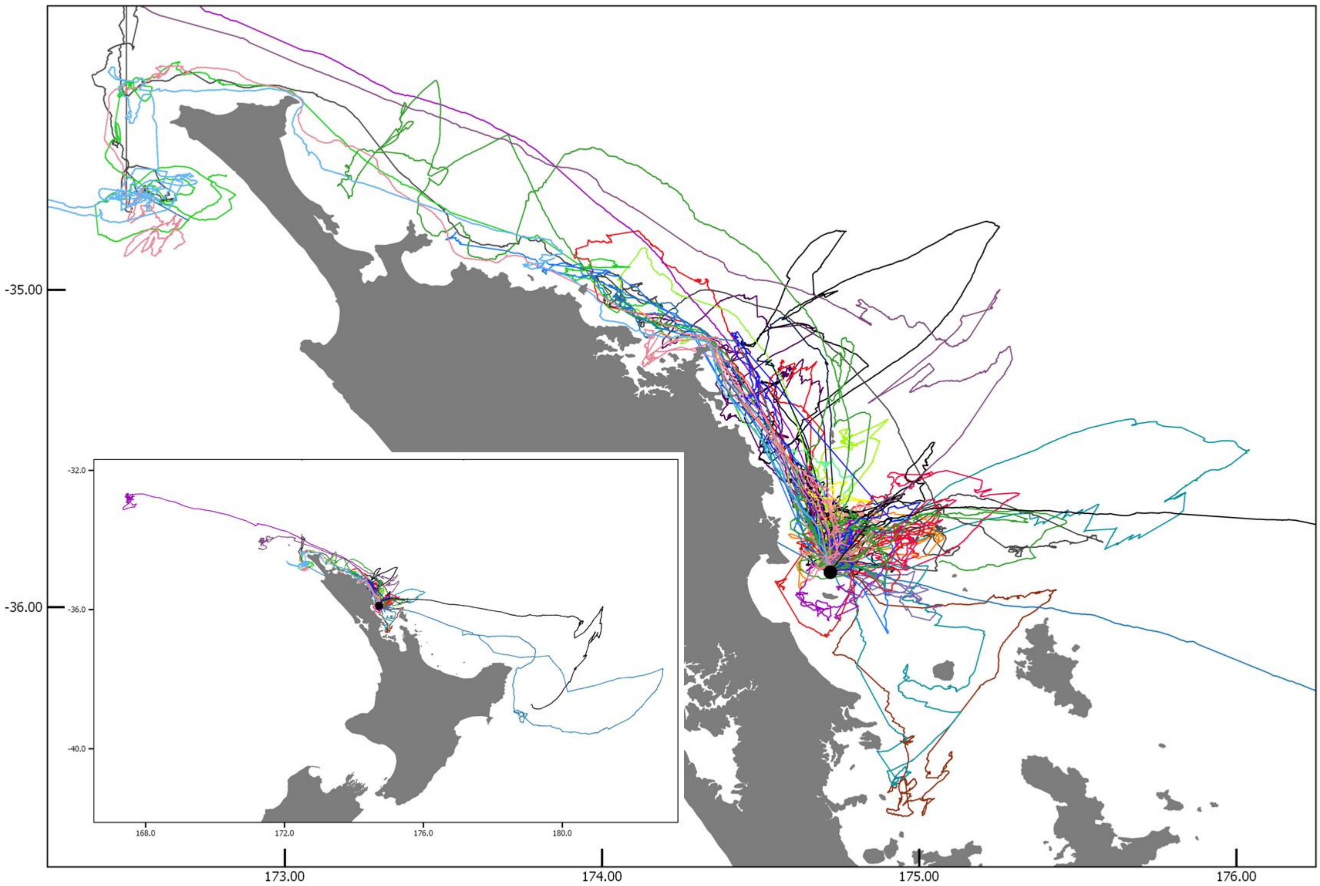
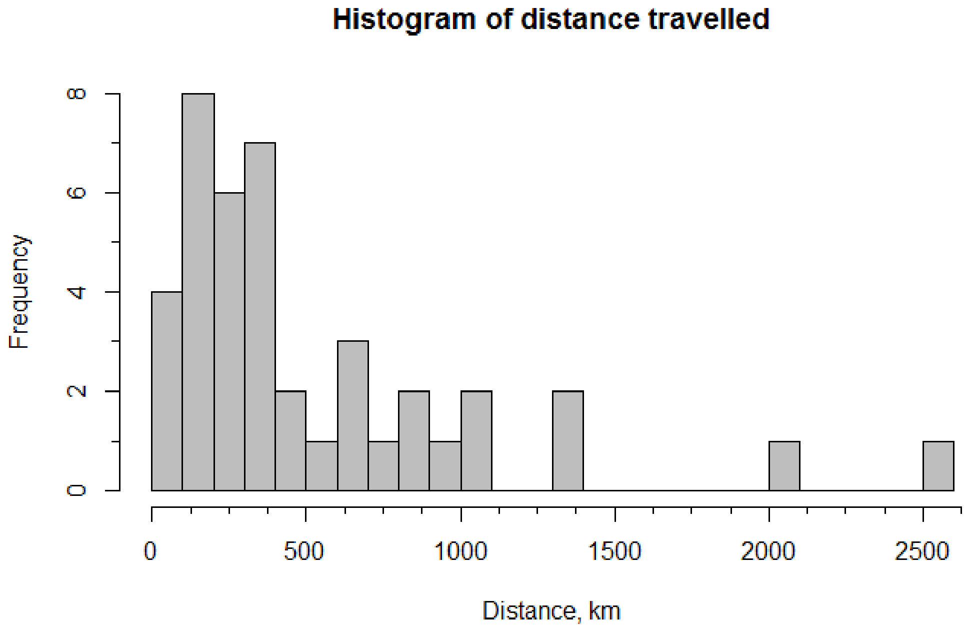


Figure 2. Histogram showing the variation in foraging trip distances (km) during the 2017 chick rearing period.



3.2 Behaviour during chick rearing

Although the classification method used here was very simple, Figure 3 demonstrates that using these thresholds of saltwater immersion ("wetness") can efficiently distinguish between directed flight, relatively more meandering foraging behaviour, and resting (or rafting) where the birds are generally moving with tidal currents. By separating out these three behaviours and comparing the spatial distribution it becomes possible to identify areas that are more likely being used for foraging (Figure 4.A and 4.B). Key locations for foraging are illustrated by the darkest shade of green (Figure 4.B) and occur in three main areas: directly north of Lady Alice Island, an area further up the coast around the Cavalli Islands and lastly a zone around Cape Reinga and on the north-west coast. The shearwaters breeding on Lady Alice Island also seem to be using a range of smaller, more pelagic locations, some in the Tasman Sea and others to the east of New Zealand.

The proportion of time spent in different behaviours varied across all trips and between individuals (figure 5). Overall, more time was spent in rest, on average 50% (±0.12 SD) of the locations for each trip were classified as resting behaviour. The rest of the locations were generally split more evenly between flight (30% of locations, ±0.13 SD) and foraging behaviour (an average of 20% of trip locations, ±0.09 SD). The amount of time foraging during trips of different lengths ranged from 8% of locations, to 52%.

Figure 3. Two example foraging trips (from different flesh-footed shearwaters) with each GPS point classified as either flight (red), rest (blue) or foraging behaviour (green). Black dot shows the position of Lady Alice Island

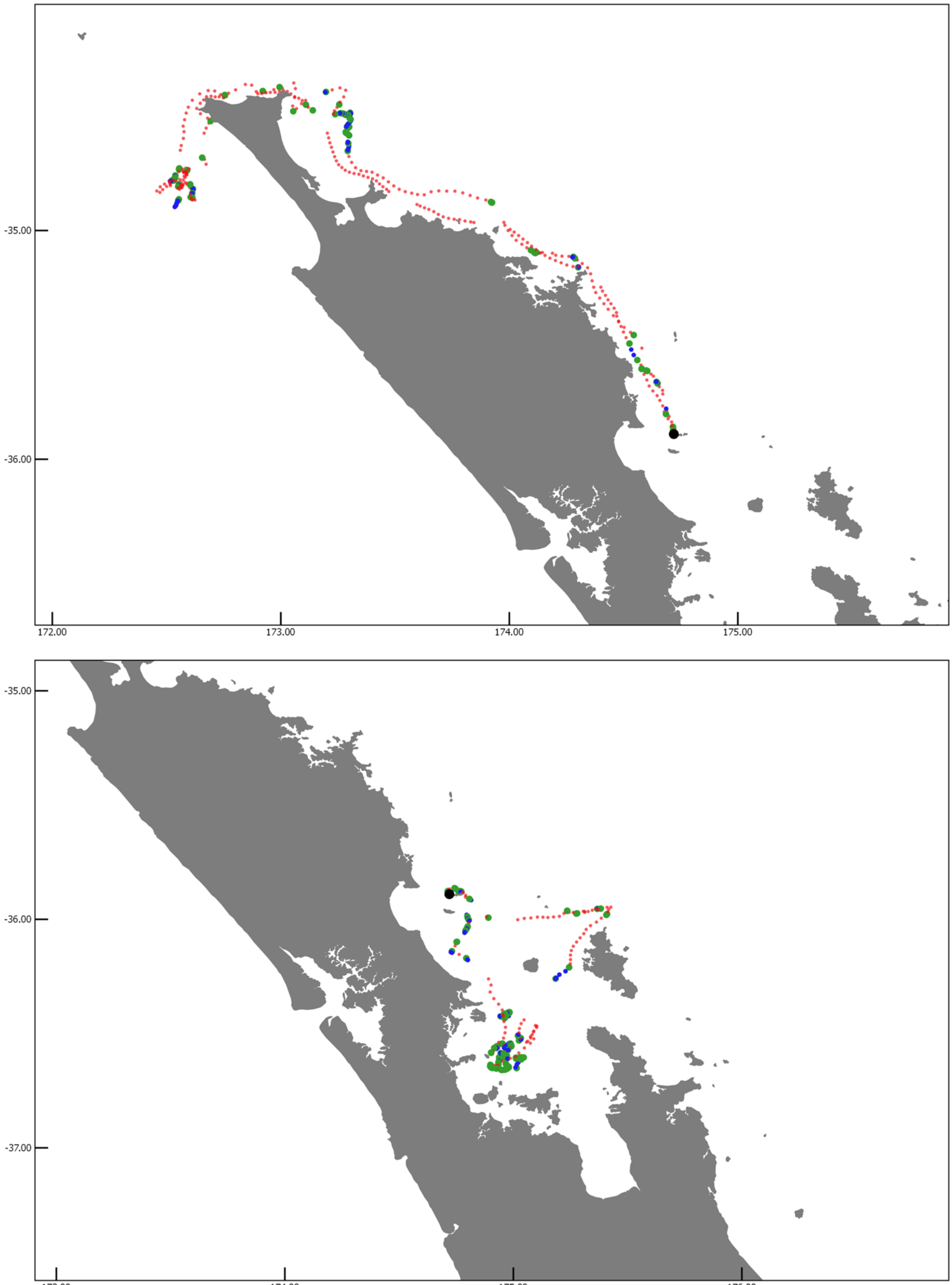


Figure 4. Behavioural distributions of flesh-footed shearwaters tracked from Lady Alice Island in February 2017. A – 95% occupancy kernels for flight (red), rest (blue) and foraging (green line) behaviour. B, C and D – Occupancy kernels for each behaviour at the 50%, 75% and 95% levels (foraging behaviour is green, resting blue and flight red). Location of Lady Alice Island is shown with a black dot.

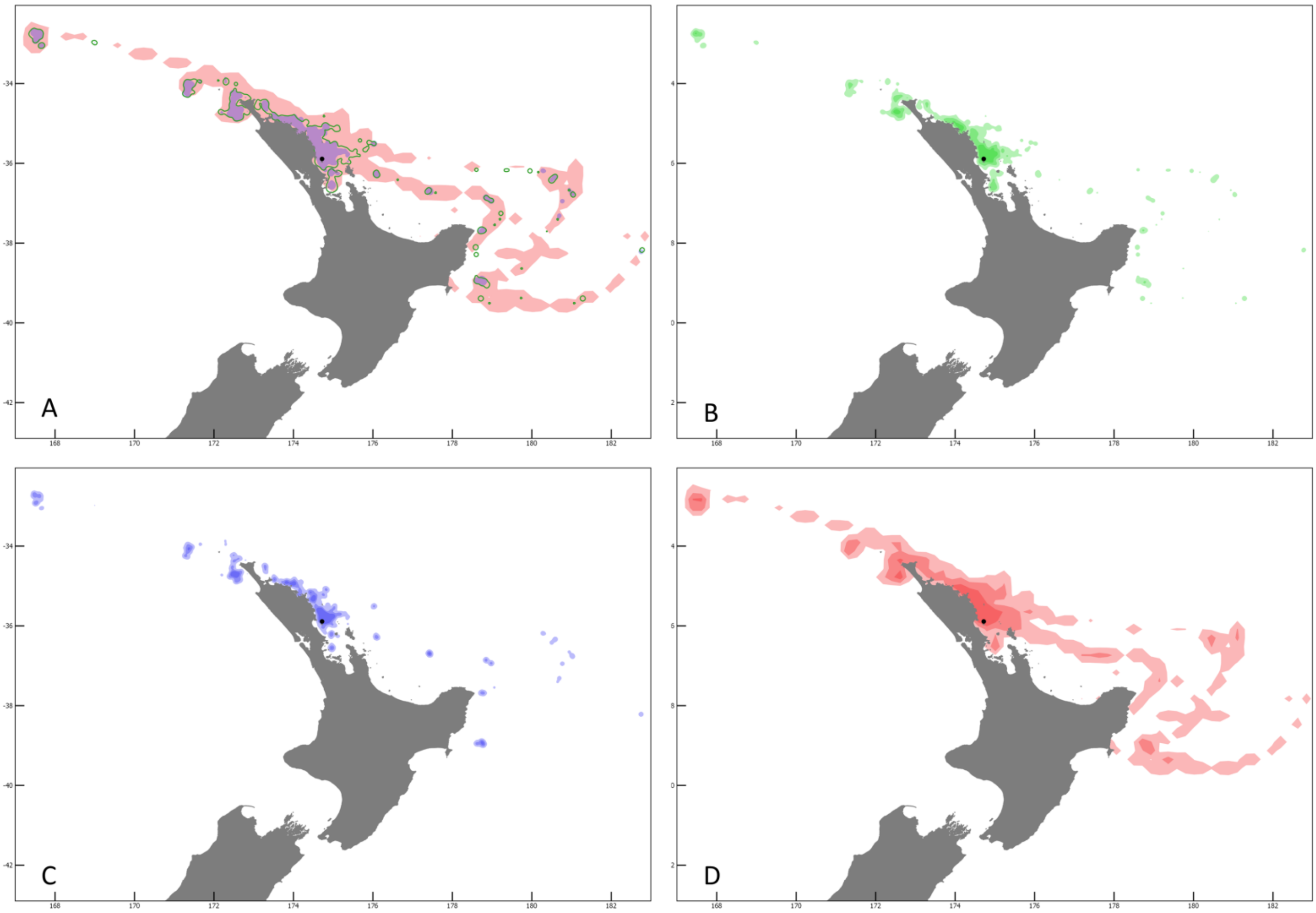
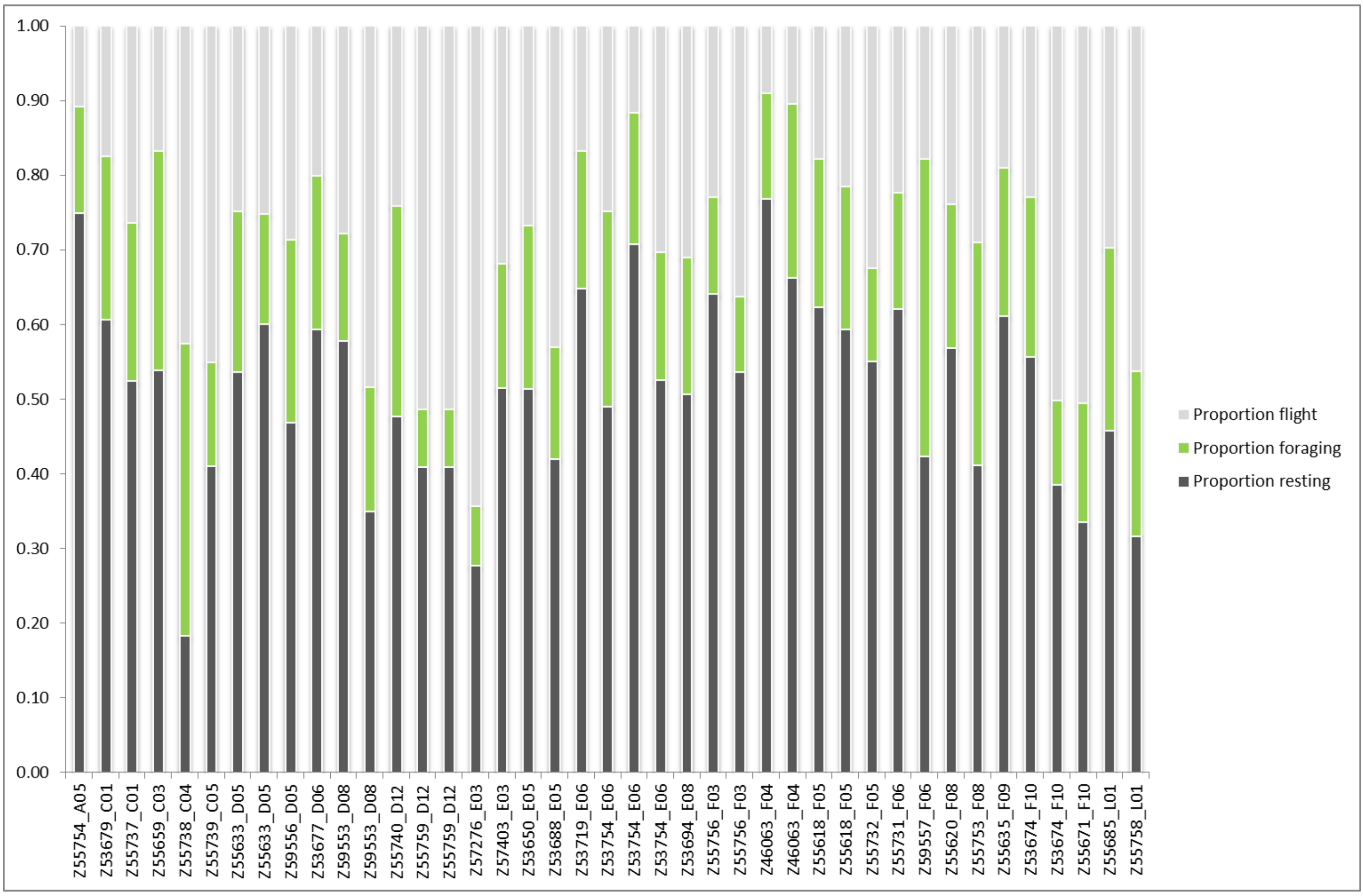


Figure 5. Bar chart showing the variation in time spent in the three different behaviours during each foraging trip. Foraging behaviour is the green band across the centre. Each column represents one trip away from the breeding colony, with the bird identification and burrow number shown.



4. DISCUSSION

Although only a preliminary analysis of the data collected during this fieldwork expedition, the results presented here are different to those identified from previous GPS tracking studies (Waugh et al., 2016). Work conducted on Lady Alice Island and other breeding colonies between 2012 and 2014 indicated flesh-footed shearwaters were mostly using areas of ocean to the east of New Zealand. The birds tracked in 2017 show a more northerly tendency, which could suggest that food sources have moved or changed. Some evidence of similar behaviour has been found in related shearwater species, with populations switching between different areas across several years (Dean et al., 2015). Alternative explanations could be the time of year that the birds were tracked (early chick rearing in this study) or inter-colony variation in preferred foraging areas. The work published by Waugh et al. (2016) reported tracks mainly from Ohinau Island during late chick rearing, of which either or both factors could explain the differences observed here in foraging distribution. Future tracking of flesh-footed shearwaters during the incubation period on Lady Alice Island may reveal similar foraging patterns.

Satellite imagery indicates the presence of several bathymetric features all off the main offshore areas used by shearwaters in 2017. Areas of high marine productivity are often associated with ocean floor “drop-offs” and regions of upwelling (Parsons et al., 2008; McKnight, Allyn, Duffy, & Irons, 2013; Passuni et al., 2016), so the flesh-footed shearwaters may be headed to areas with reliable food sources like other species (Peck et al., 2004; Ceia & Ramos, 2015; Scales et al., 2015). Overlap analysis with remotely sensed sea surface temperature, wind or oceanographic data would allow a clearer understanding of this result as in work on associated species such as Cory’s shearwater (*Calonectris bolearis*, Ramos et al., 2013), Balearic shearwater (*Puffinus mauretanicus*, Meier et al., 2015) and Manx shearwater (*Puffinus puffinus*, Freeman et al., 2013). What this combined tracking study does not show is whether these birds are associating with fishing vessels, however this data could be easily incorporated if made available.

Individual specialisation in behaviour has been identified in a range of seabird species now (Furness et al., 2006; Granadeiro, Brickle, & Catry, 2014; Ceia & Ramos, 2015; Patrick et al., 2015; Dehnhard et al., 2016), and an initial analysis here indicates that flesh-footed shearwaters may show similar variation between individuals. A second or third year of data would help to back up this conclusion, and will allow further understanding of how these birds are choosing where to feed, whether this is driven by prior knowledge, responses to environmental cues or based on the need of the individual or offspring (Ochi, Oka, & Watanuki, 2009). Central place foraging and dual foraging behaviour during chick rearing are commonly seen in a range of seabird species (Orians & Pearson, 1979; Booth & McQuaid, 2013 Berlincourt & Arnould, 2015; Carneiro et al., 2015; Shoji et al., 2015), and if birds are feeding in different locations when feeding chicks to those used when provisioning themselves, this could have survival and recruitment effects. This is particularly true if plastic ingestion causes higher chick mortality, as has been suggested in some studies (Lavers, Bond, et al., 2014; Wilcox, Van Sebille, & Hardesty, 2015).

Although based on a relatively small sample size, in a restricted time period, the findings reported here can be used to drive more detailed questions and structure future data collection. Fully understanding the at-sea foraging behaviour of this species is vital for identifying the reasons why the flesh-footed shearwater population is declining so rapidly.

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7. APPENDICES

7.1 Individual GPS Tracks

Sample of GPS tracks from Flesh-footed shearwaters breeding on Lady Alice Island in February 2017. Each panel shows foraging trips from a single bird, with different trips from the same bird displayed in different colours. The position of the breeding colony is shown with a circle. All birds were feeding chicks.

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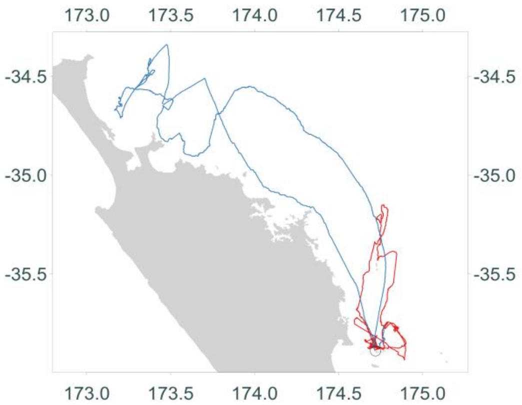

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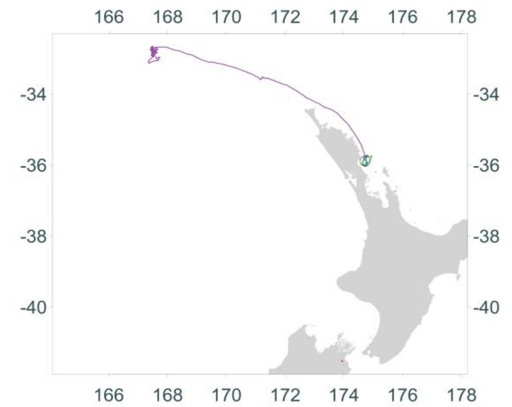

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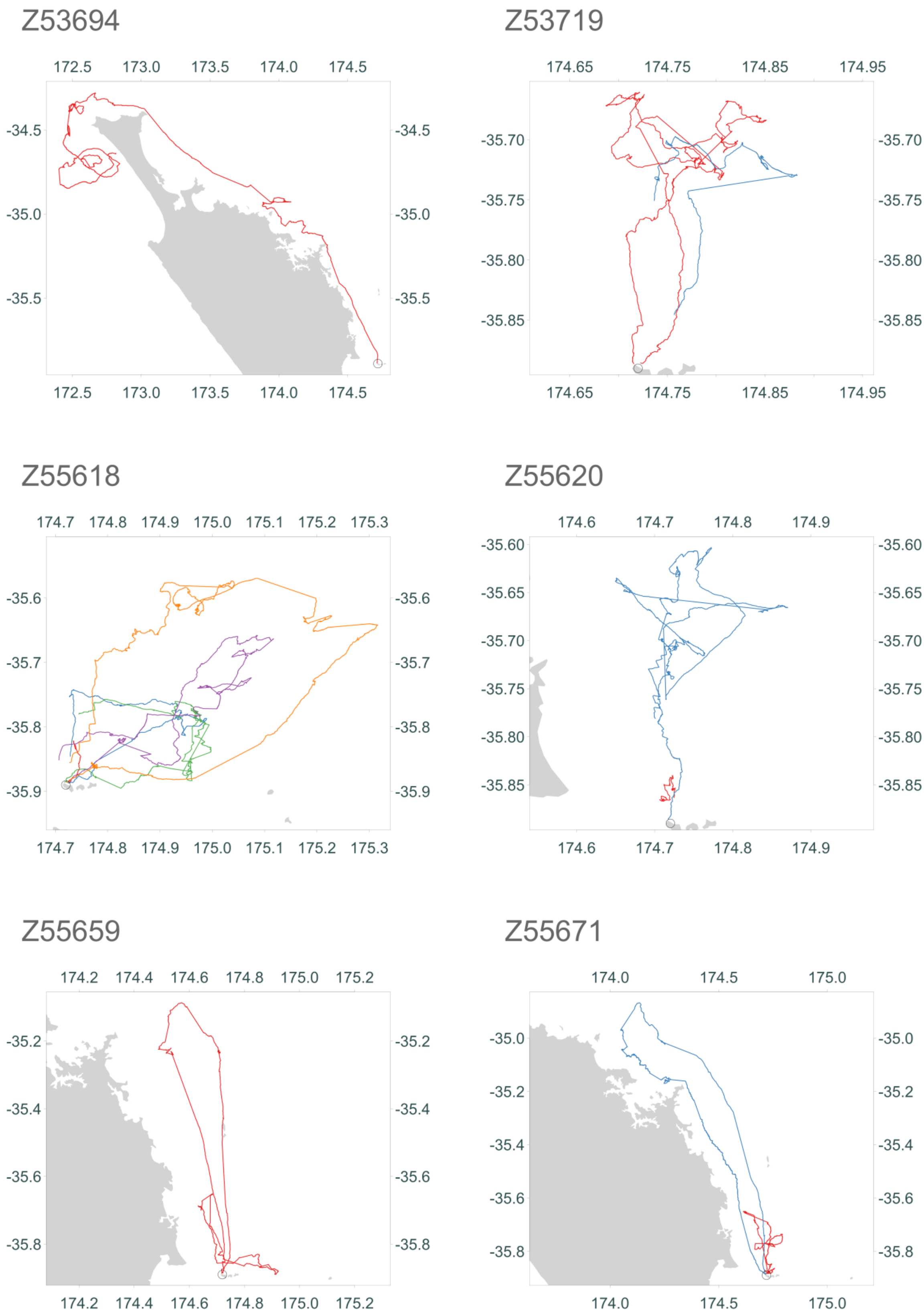
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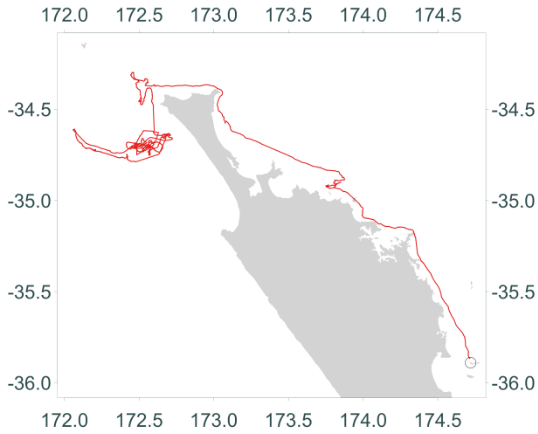
Z55685

Z55731



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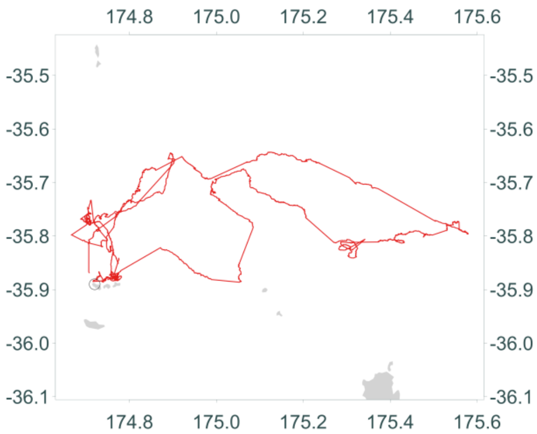

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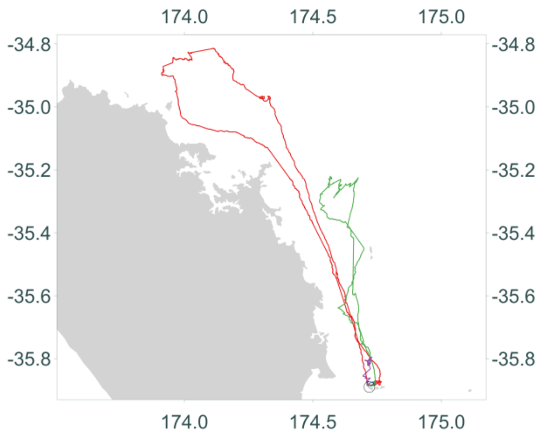

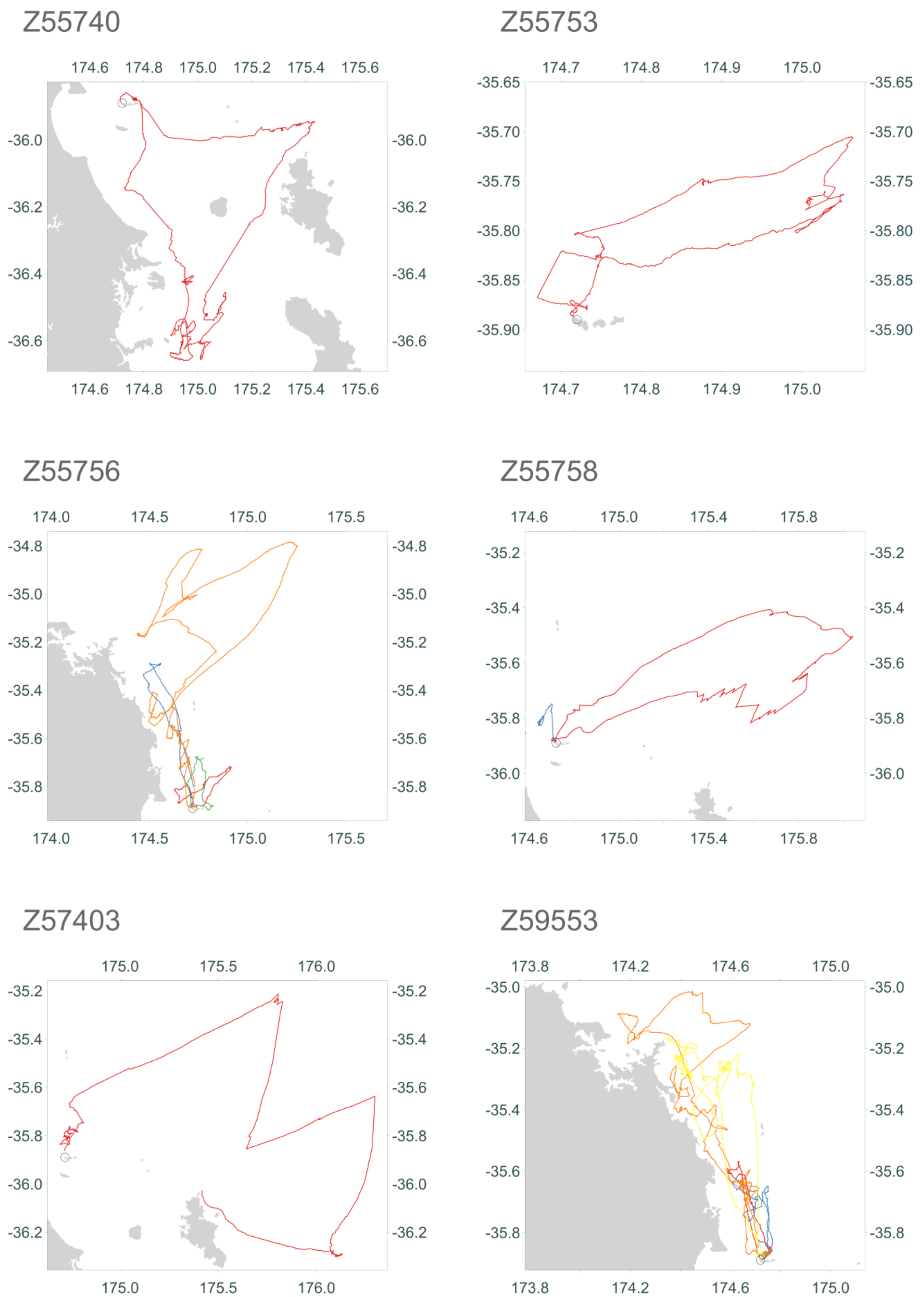
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Z55758
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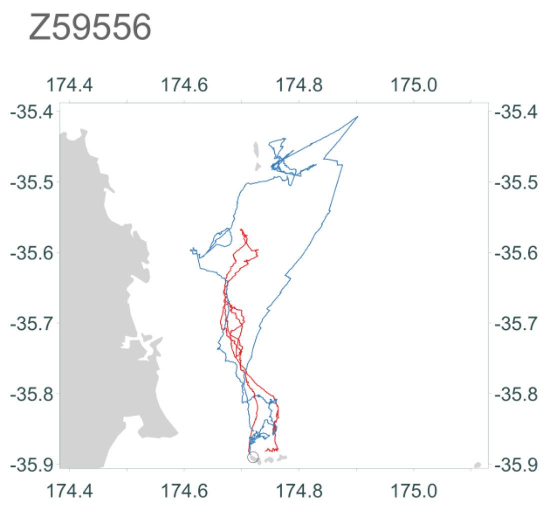
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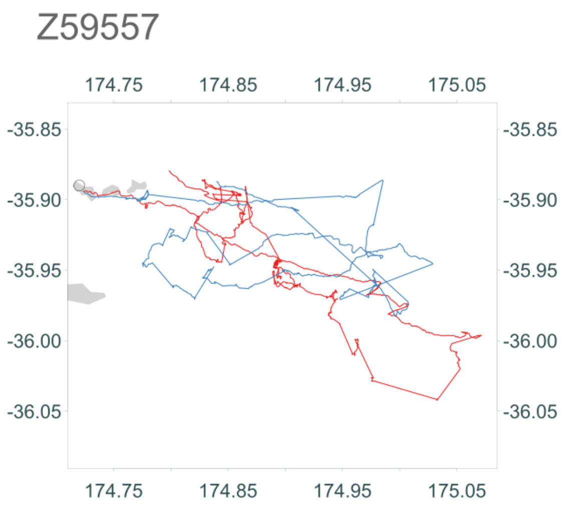
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-36.05

7.2 Metadata of GPS deployments

Burrow	Bird	Sex	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	Number of days with GPS on	Pre-deployment weight (g)	Post-deployment weight (g)	Weight Difference (g)	Number of Deployments	Number of trips with tracks	Notes
A5	Z55754	Female																							4	660	610	-50	2	3	
	Z55689	Male																							3	690	690	0	1	2	
C1	Z55737	Male																							11	610	670	60	1	1	
	Z53679	Female																							4	680	610	-70	2	2	First deployment GPS malfunctioned
C3	Z55659	Male																							4	690	620	-70	1	2	
	Z55757	Female																							2	650	620	-30	1	1	
C4	Z55660	Female																							2	605	700	95	1	1	
	Z55738	Male																							6	685	630	-55	2	2	
C5	Z55739	Male																							7	740	660	-80	1	3	
D12	Z55759	Female																							8	680	680	0	2	3	
	Z55740	Male																							3	750	660	-90	1	1	
D5	Z55633	Female																							17	685	750	65	3	3	GPS Battery failed on third deployment
	Z59556	Male																							3	660	710	50	1	2	
D6	Z46083	Male																							4	660	680	20	1	2	
	Z53677	Female																							3	680	610	-70	1	1	
D8	Z59525	Female																							13	640	760	120	1	0	GPS wet, no tracks recovered
	Z59553	Male																							≥17	730	680	-50	3	5	GPS not recovered on third deployment. Post-deployment weight is after second deployment
E1	Z50340	Female																							5	610	640	30	1	2	
	Z50335	Male																							8	740	700	-40	2	6	
E3	Z57276	Female																							8	640	640	0	1	1	
	Z57403	Male																							3	630	690	60	1	1	
E5	Z53650	Unknown*																							3	755	680	-75	1	2	
	Z53668	Unknown*																							4	720	650	-70	1	1	
E6	Z53754	Unknown*																							11	625	640	15	3	4	
	Z53719	Unknown*																							3	805	790	-15	2	3	
E8	Z53694	Unknown*																							11	630	730	100	1	1	
F1	Z55617	Female																							≤8	705	690	-15	1	0	GPS Lost
F10	Z53674	Female																							11	690	660	-30	2	3	
	Z55671	Male																							4	770	730	-40	2	3	
F3	Z53917	Male																							≤22	660	N/A	N/A	1	0	Bird Found Dead at Whananaki Beach, GPS Not Recovered
	Z55756	Female																							17	690	720	30	3	4	
F4	Z46063	Female																							6	680	550	-130	1	3	
F5	Z55732	Male																							9	630	710	80	1	1	
	Z55618	Female																							5	690	640	-50	2	4	
F6	Z55731	Female																							9	580	640	60	1	1	
	Z59557	Male																							5	760	700	-60	2	3	
F8	Z55753	Female																							3	705	610	-95	1	1	
	Z55620	Male																							2	790	670	-120	1	1	
F9	Z55635	Male																							13	665	670	5	2	3	
L1	Z55685	Male																							12	760	730	-30	2	5	
	Z55758	Female																							4	620	590	-30	1	2	
L5	Z55752	Female																							≤5	Not Measured	N/A	N/A	1	0	GPS Lost
	Z55687	Male																							≤10	760	710	-50	1	0	GPS Lost

*awaiting DNA results

- Deployment 1
- Deployment 2
- Deployment 3