

Estimating the abundance and effective population size of Māui dolphins using microsatellite genotypes: Report on the 2025 biopsy sampling surveys

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SUMMARY

This report summarises the first year of a two-year project replicating previous genotype mark-recapture surveys of Māui dolphins. From 11th February to 11th March 2025, we conducted a total of 12 small-vessel surveys along the west coast of Te Ika-a-Māui / North Island from south of the Kaipara Harbour entrance in the north to Marokopa, south of Kawhia Harbour. During 1,487.9 km of survey effort, we encountered a cumulative total of 23 groups of Māui dolphins, with an average of 2 groups per day (ranging from 0-5 groups per day). Group sizes ranged from 1-10 dolphins (average of 4.0-5.1 dolphins using minimum and maximum estimates). Dolphins were encountered between south of the Kaipara Harbour entrance and near Crayfish Point, north of Whāingaroa / Raglan. We collected a total of 41 small tissue biopsy samples (ranging from 0-14 samples per day; average of 3.8 per day). Consistent with previous years, the dolphins showed very low-level behavioural responses following a biopsy event. Genotyping of individuals is underway to confirm sex, sub-species and individual identification. Further analysis will be undertaken once the 2026 field season is complete and these data will be used to generate a new abundance estimate.

INTRODUCTION

Māui dolphins (*Cephalorhynchus hectori maui*), a sub-species of the endemic Hector's dolphin, are listed by the IUCN as Critically Endangered and Nationally Critical in New Zealand (Lundquist et al. 2025). Recent research has provided a comprehensive understanding of the population demographics, abundance, distribution and foraging ecology of these dolphins to inform conservation measures (Cooke et al. 2018, Roberts et al. 2019a, 2019b, Constantine et al. 2021, Ogilvy et al. 2022, Hernandez et al. 2023). Capture-recapture analyses have proven to be a powerful method for estimating the abundance of cetaceans. However, the usual methods of individual identification using photographic documentation of natural markings are inefficient for Māui dolphins, which show few distinctive, long-term marks on their dorsal fin (Garg 2017). Instead, individual identification using DNA profiling or

microsatellite genotyping is the most effective method for capture-recapture estimates of abundance for Māui and Hector's dolphins.

This study is the first year of a two-year project intended to replicate the previous synoptic surveys undertaken every five years (Hamner et al. 2012, Baker et al. 2016, Constantine et al. 2021) with the first year representing the “capture” phase of the mark-recapture estimate. The biopsy samples will also allow us to confirm whether Hector's dolphins are present among Māui dolphins as revealed in previous surveys (Constantine et al., 2021). All surveys were conducted using the same protocols reported in Constantine et al. (2021).

EFFORT

Coastal boat surveys were conducted daily between 11th February and 11th March 2025 and led by the Department of Conservation (DOC). The DOC vessel *Tuatini* was the primary survey vessel from 12th February – 11th March 2025. The second DOC vessel *Orca* conducted surveys on the 11th – 13th February, with both vessels surveying different coastal areas on the 12th and 13th February (Figure 1). There was a cumulative total of 12 surveys conducted along the west coast of the North Island (*Tuatini* n = 9; *Orca* n = 3) covering coastal waters from south of the Kaipara Harbour to Marokopa, south of Kawhia Harbour (Table 1; Figure 1). As with previous surveys (Baker et al 2016, Constantine et al 2021), effort was concentrated alongshore to maximise the success of group encounters. The boats were launched from three different locations: Clarks Beach, Manukau Harbour with dedicated survey effort starting at Cornwallis (n = 10), Manu Bay (n=1) and Raglan wharf (n = 2), surveying to the north and south of these locations. On 13th February, *Orca* was launched at Clarks Beach and travelled south to Port Waikato where they initiated the survey from that point surveying north back to Manukau Harbour.

In total, 99 hours and 30 minutes were spent on the water and 1,487.9 km was surveyed. Weather conditions were good overall, with most surveys conducted in a Beaufort 1 - 2 sea state although the conditions ranged from Beaufort 1 - 4. Poor weather conditions in early March meant the final survey was conducted on 11th March 2025 out of Whāingaroa/Raglan.

Research team included:

Skippers: Cara Hansen, Pearson Tukua, Jess Hoepker and Oscar Cotter (DOC)

Biopsy samplers: Mike Ogle, Cameron Hunt, Rebekah Gee, Cara Hansen (DOC)

Photographers: Jess Hoepker, Cameron Hunt, Rebekah Gee, Michelle Boyle, Lizzie Sharp (DOC)

Data recorders: Hare Goldsmith, Jack Manson, Cameron Hunt, Anton van Helden, Kristina Hillock, Brent Shaw & Perry Griffin (DOC); Sky Flavell & Selwyn Herewini (Ngaati Te Ata); Emma Carroll & Catherine Meyer (UoA); and Tane van der Boon (MAUI63)

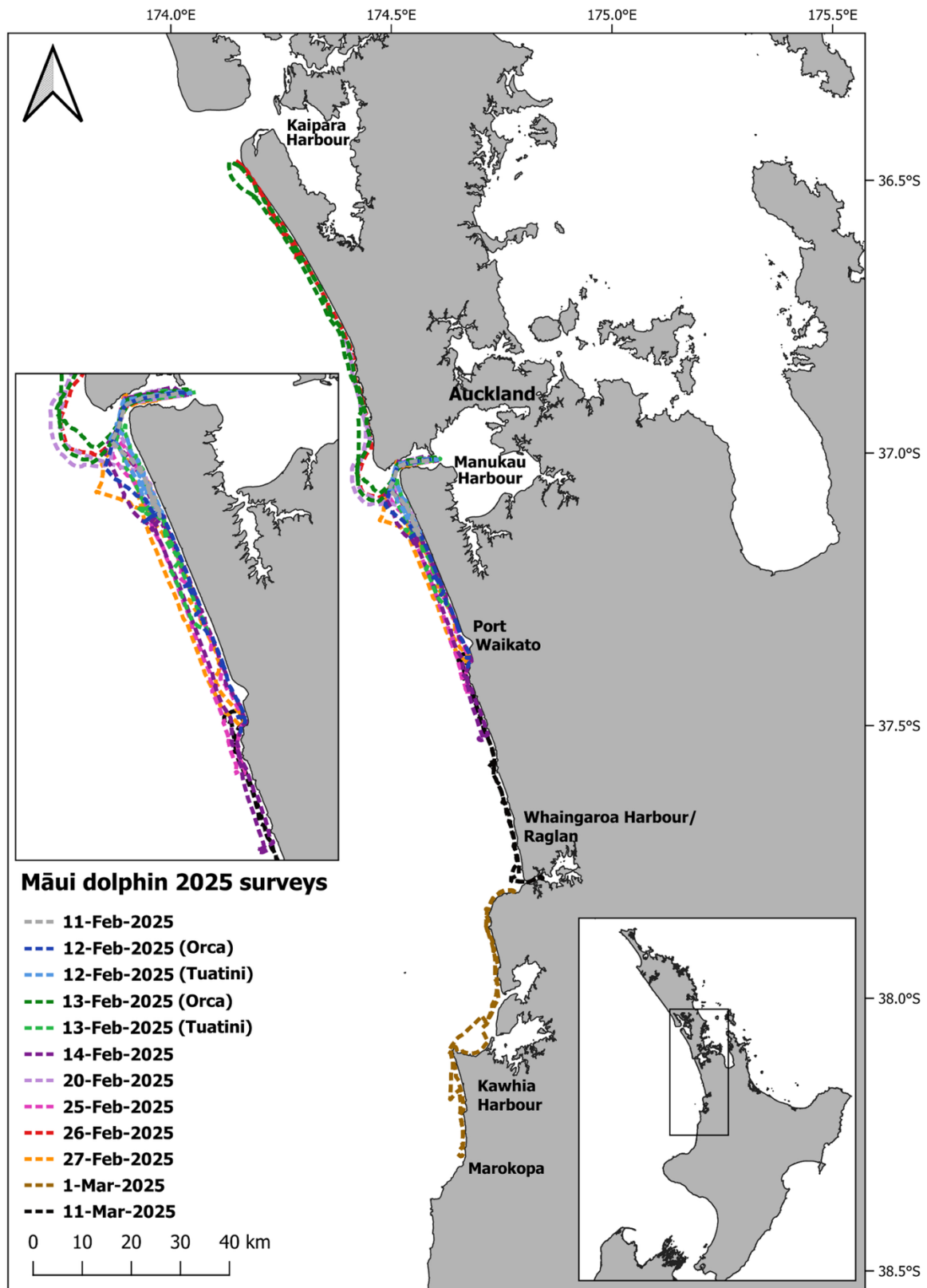


Figure 1. Map of the study area and GPS tracks for the 12 surveys conducted between 11th February and 11th March 2025. On 12th and 13th February there were two vessels surveying (*Orca* and *Tuatini*). See Table 1 for further information.

Table 1. Summary of boat surveys conducted along the west coast, North Island, survey effort, number of groups encountered and number of biopsy samples collected between 11th February and 11th March 2025.

#	Date <i>Vessel</i>	Survey area	Survey start	Time start	Time end	Time on water hh:mm	Distance km	# groups	# biopsies
1	11-Feb-25 <i>Orca</i>	Manukau South	Cornwallis	8:30	17:15	8:45	60	4	2
2	12-Feb-25 <i>Orca</i>	Port Waikato – Manukau South	Cornwallis	10:47	15:28	4:41	117.8	1	0
3	12-Feb-25 <i>Tuatini</i>	Manukau South	Cornwallis	8:45	16:33	7:48	65	5	12
4	13-Feb-25 <i>Orca</i>	Manukau – Kaipara	Cornwallis	6:30	18:15	11:45	200.6	1	2
5	13-Feb-25 <i>Tuatini</i>	Manukau South	Cornwallis	9:11	16:51	7:40	104.5	4	14
6	14-Feb-25 <i>Tuatini</i>	Manukau South	Cornwallis	7:30	17:53	10:23	158.8	3	13
7	20-Feb-25 <i>Tuatini</i>	Manukau North	Cornwallis	8:40	16:20	7:40	134.8	1	0
8	25-Feb-25 <i>Tuatini</i>	Manukau South	Cornwallis	7:45	16:08	8:23	125.2	1	1
9	26-Feb-25 <i>Tuatini</i>	Kaipara - Manukau	Cornwallis	10:00	16:30	6:30	124.8	0	0
10	27-Feb-25 <i>Tuatini</i>	Manukau – Port Waikato	Cornwallis	8:14	17:03	8:49	132	3	2

11	1-Mar-25 <i>Tuatini</i>	Whāingaroa – Marokopa	Manu Bay	8:20	16:30	8:10	143.6	0	0
12	11-Mar-25 <i>Tuatini</i>	Whāingaroa – Port Waikato	Raglan Wharf	7:45	16:45	9:00	120.8	1	0
						Total	99:30	1,487.9	23
						Average	8:20	124	2
								41	3.8

GROUP ENCOUNTERS

We encountered a total of 23 groups of Māui dolphins during the surveys (Figure 2, Table 2), with an average of 2 groups encountered per survey (range = 0 - 5 groups per survey). We encountered Māui dolphins on 10 of the 12 surveys conducted (83%). The dolphins were mainly found in the core area between Te Ara o Te Po / Cochrane's Gap and Waimatuku / Hamilton's Gap just south of the Manukau Harbour entrance and Karioitahi Beach. The northernmost sighting was a single group encountered south of the Kaipara Harbour entrance, and the southernmost was a single dolphin encountered near Crayfish Point, north of Whāingaroa (Figure 2).

Group sizes ranged from 1 - 10 dolphins with an average of 4.0 - 5.1 dolphins per group, with a total of between 91 and 118 dolphins seen during the surveys (using the minimum and maximum group estimates based on visual counts) (Table 2). The maximum cumulative number of dolphins sighted on a single survey was 30 individuals (11 February). Calves (i.e., individuals approximately one-half or less the size of an adult) accounted for between 8.4% and 9.7% (n = 10; range 0 - 2 calves/group) and juveniles (i.e., individuals approximately two-thirds the size of adults) accounted for between 3.4% and 4.4% (n = 4; range 0 - 2) of all dolphins sighted. Calves and juveniles were found in 34.8% (n = 8) and 13% (n = 3) of groups respectively (Table 2). We spent an average of 43 minutes with dolphin groups for a cumulative total of 16 hours 30 minutes with dolphins across all surveys.

A broad assessment of the dominant behavioural state during each encounter showed a range of behaviours with similar levels of foraging, milling and traveling. This is consistent with previous surveys.

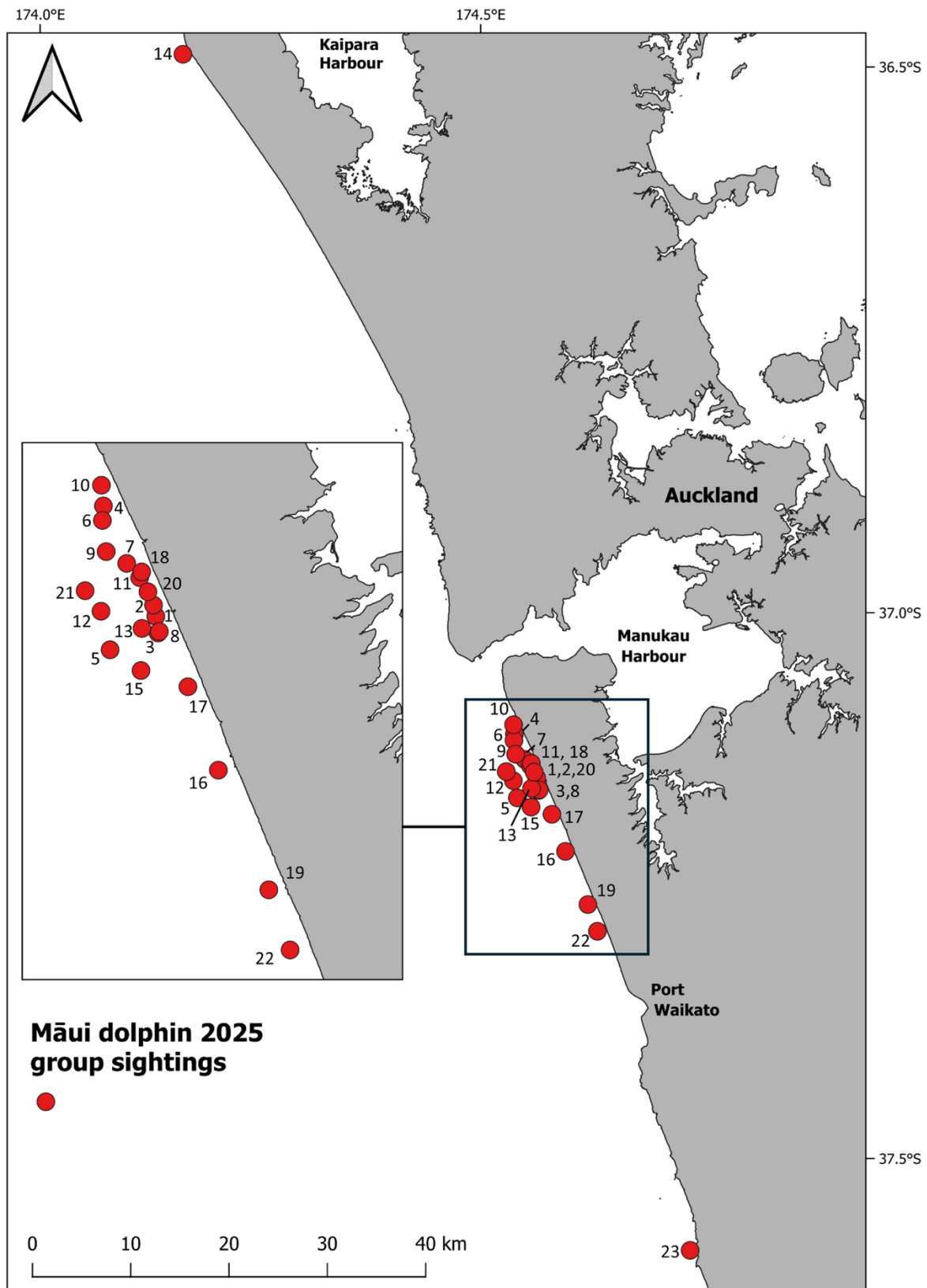


Figure 2. The geographic positions of group encounters ($n = 23$) between 11th February and 11th March 2025. Inserts show group numbers in areas of higher density sightings (see Table 2 for further information).

Table 2. Summary of dolphin group encounters between 11th February and 11th March 2025. The minimum (min.) and maximum (max.) group size estimates and group composition (juv = juveniles) are provided. 'Behav.' = behavioural state assessment from the encounter.

Gp #	Date	Position start		Group size		Number juvs/ calves	Time with dolphins hh:mm	Behav.
		Latitude	Longitude	Min.	Max.			
1	11-Feb-25	-37.1616	174.5787	2	10	0/1	1:00	forage
2	11-Feb-25	-37.1570	174.5775	6	8	0/2	1:40	forage
3	11-Feb-25	-37.1684	174.5800	6	8	0/1	0:42	forage
4	11-Feb-25	-37.1170	174.5511	4	4	0/0	1:10	forage
5	12-Feb-25	-37.1755	174.5557	1	1	0/0	0:17	forage
6	12-Feb-25	-37.1229	174.5507	1	1	0/0	1:27	forage
7	12-Feb-25	-37.1402	174.5635	6	7	1/0	0:49	for/mill
8	12-Feb-25	-37.1677	174.5806	8	10	0/1	1:30	for/mill
9	12-Feb-25	-37.1356	174.5529	4	5	0/0	0:42	surf
10	13-Feb-25	-37.1086	174.5500	4	4	0/0	0:31	mill
11	13-Feb-25	-37.1459	174.5702	9	10	2/0	0:37	mill
12	13-Feb-25	-37.1599	174.5508	1	2	0/0	0:10	mill
13	13-Feb-25	-37.1666	174.5718	3	3	0/0	0:36	mill
14	13-Feb-25	-36.4985	174.1624	3	3	0/0	0:55	mill
15	14-Feb-25	-37.1837	174.5716	7	10	1/0	1:12	mill
16	14-Feb-25	-37.2238	174.6119	2	3	0/0	0:19	mill
17	14-Feb-25	-37.1900	174.5956	6	8	0/2	1:15	social
18	20-Feb-25	-37.1436	174.5711	2	2	0/0	0:13	travel
19	25-Feb-25	-37.2722	174.6386	6	7	0/1	0:36	travel
20	27-Feb-25	-37.1517	174.5745	3	3	0/1	0:06	travel
21	27-Feb-25	-37.1516	174.5425	5	7	0/1	0:14	travel
22	27-Feb-25	-37.2965	174.6500	1	1	0/0	0:11	travel
23	11-Mar-25	-37.5872	174.7632	1	1	0/0	0:18	-
Total				91	118	4/10	16:30	
Average				4.0	5.1	0.2/0.4	00:43	

BIOPSY SAMPLING

A total of 41 biopsy tissue samples were collected using the Paxarms™ veterinary capture system. Samples were collected on seven of the 10 surveys during which dolphins were encountered (Table 1) with sampling reflecting the location of group encounters although there was no sample collected from the southernmost animal encountered near Crayfish Point (Figure 3, Table 3). Skin samples were labelled in the field, transferred to vials filled with 90% ethanol to ensure optimal DNA preservation (Salis et al 2025), and placed in a fridge at 4°C, and then transferred to -20°C storage at the New Zealand Cetacean Tissue Archive (NZCETA) curated at the University of Auckland. When a small blubber sample was also collected, this was transferred into a tube with no preserving agent and frozen at -20°C and

transferred to long-term storage at -80°C in the NZCeTA.

Of the 41 biopsy samples taken, 36 had a behavioural response recorded. Of these, the majority (n = 34) biopsy events had a category 1 (startle response, dolphin moved away (flinch) but stayed in the immediate vicinity of the boat) behavioural reaction to the sample being taken (Table 3) using the categories described in Krützen et al. (2002). Attempts were made to photo-identify dolphins at the same time as they were sampled. The photographs are undergoing final reconciliation with the genetic data to ensure the correct assignment of individual sampled and photo-identified. As reported in previous research, dolphins that were biopsied usually re-approached the boat within a short time-period (Oremus et al. 2012, Baker et al. 2016). Throughout the encounter, the researchers checked individuals approaching the boat for previous biopsy marks to minimise re-sampling during the encounter.

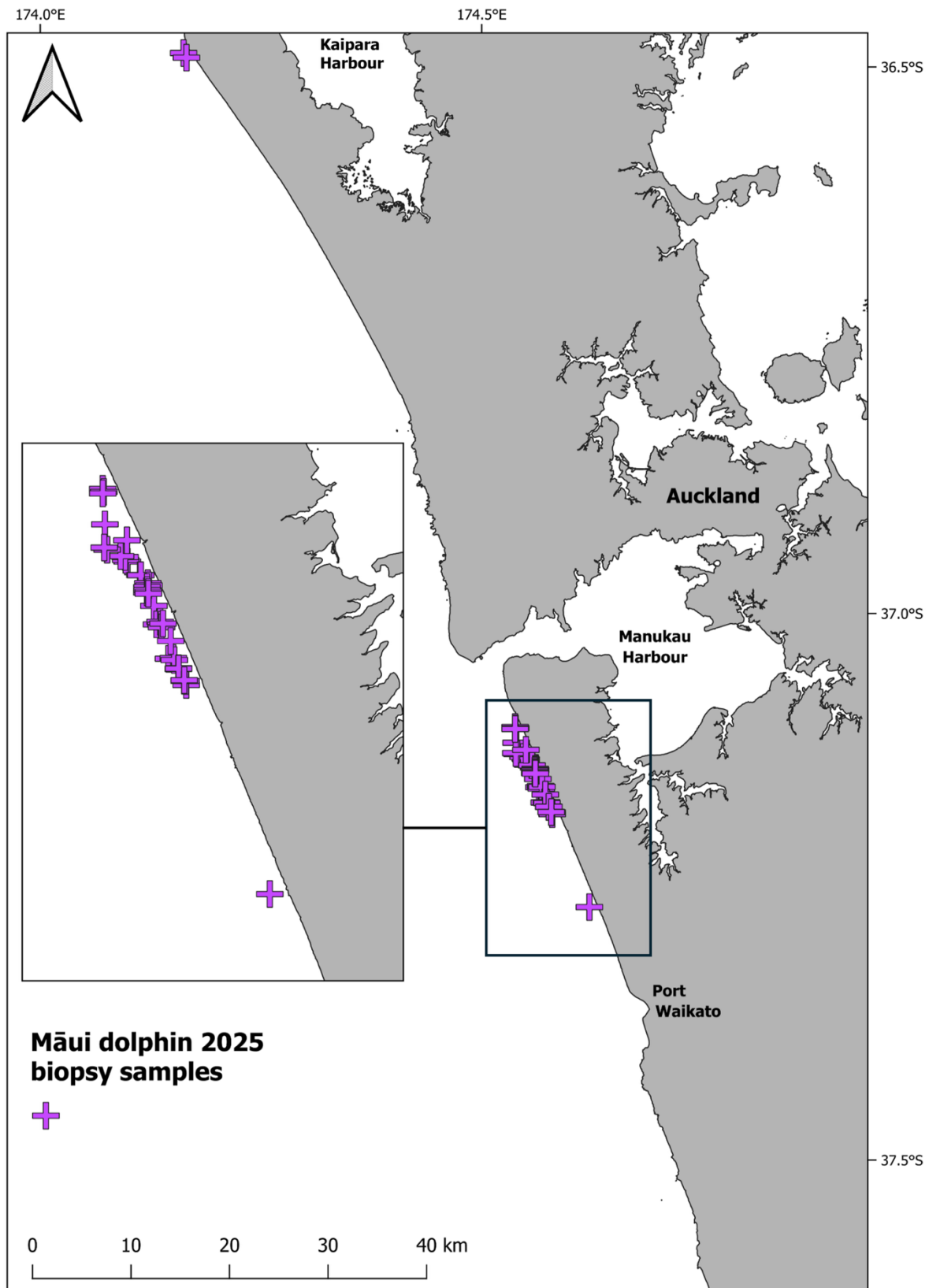


Figure 3. The geographic positions of biopsy samples ($n = 41$) between 11th February and 11th March 2025. Inserts show biopsy numbers in areas of higher density sampling (see Table 3 for further information).

Table 3. Summary of the Māui dolphin skin sample collection and the short-term reaction to biopsy sampling (a ‘-’ indicates the reaction was not recorded).

#	Sample code	Date	Group #	Latitude	Longitude	Reaction type
1	Chem25NZ01	11-Feb-25	1	-37.15704	174.57745	1
2	Chem25NZ02	11-Feb-25	3	-37.16456	174.57894	1
3	Chem25NZ03	12-Feb-25	6	-37.12423	174.5519	1
4	Chem25NZ04	12-Feb-25	7	-37.13922	174.56359	-
5	Chem25NZ05	12-Feb-25	7	-37.13922	174.56359	-
6	Chem25NZ06	12-Feb-25	7	-37.13854	174.56276	-
7	Chem25NZ07	12-Feb-25	7	-37.13737	174.56242	-
8	Chem25NZ08	12-Feb-25	7	-37.13707	174.56015	-
9	Chem25NZ09	12-Feb-25	8	-37.16347	174.58078	1
10	Chem25NZ10	12-Feb-25	8	-37.16095	174.57577	1
11	Chem25NZ11	12-Feb-25	8	-37.16568	174.58154	1
12	Chem25NZ12	12-Feb-25	8	-37.16415	174.58224	0
13	Chem25NZ13	12-Feb-25	9	-37.12699	174.55788	1
14	Chem25NZ14	12-Feb-25	9	-37.13367	174.55177	1
15	Chem25NZ15	13-Feb-25	10	-37.10983	174.5505	1
16	Chem25NZ16	13-Feb-25	10	-37.11103	174.55109	1
17	Chem25NZ17	13-Feb-25	10	-37.11167	174.55058	1
18	Chem25NZ18	13-Feb-25	11	-37.1446	174.57014	1
19	Chem25NZ19	13-Feb-25	11	-37.14468	174.5706	1
20	Chem25NZ20	13-Feb-25	11	-37.14785	174.57418	1
21	Chem25NZ21	13-Feb-25	11	-37.14875	174.57477	1
22	Chem25NZ22	13-Feb-25	11	-37.14946	174.57382	1
23	Chem25NZ23	13-Feb-25	11	-37.15164	174.57381	1
24	Chem25NZ24	13-Feb-25	11	-37.1506	174.57395	1
25	Chem25NZ25	13-Feb-25	11	-37.15144	174.57454	1
26	Chem25NZ26	13-Feb-25	14	-36.49741	174.1626	1
27	Chem25NZ27	13-Feb-25	14	-36.5016	174.16589	1
28	Chem25NZ28	14-Feb-25	15	-37.17853	174.85822	1
29	Chem25NZ29	14-Feb-25	15	-37.17843	174.58532	1
30	Chem25NZ30	14-Feb-25	15	-37.17893	174.58829	1
31	Chem25NZ31	14-Feb-25	15	-37.17119	174.5863	1
32	Chem25NZ32	14-Feb-25	17	-37.18901	174.59454	1
33	Chem25NZ33	14-Feb-25	17	-37.18733	174.59438	1
34	Chem25NZ34	14-Feb-25	17	-37.18731	174.5935	1
35	Chem25NZ35	14-Feb-25	17	-37.18223	174.59052	1
36	Chem25NZ36	14-Feb-25	17	-37.18256	174.59043	1
37	Chem25NZ37	14-Feb-25	17	-37.18237	174.59056	2
38	Chem25NZ38	14-Feb-25	17	-37.18706	174.59349	1
39	Chem25NZ39	25-Feb-25	19	-37.27341	174.63885	1
40	Chem25NZ40	27-Feb-25	20	-37.15212	174.57456	1
41	Chem25NZ41	27-Feb-25	21	-37.13056	174.56324	1

DISCUSSION

The 2025 field season was consistent with previous synoptic survey periods allowing some consistency in the fourth of this series of genetic mark-recapture surveys. The number of surveys, duration of the survey period and coverage of the primary known habitat for Māui dolphins was comparable to these previous surveys. The dolphins were mainly found in the core of their range just south of the Manukau Harbour entrance to Karioitahi Beach, a similar pattern observed in the 2015-16 surveys which also occurred during a La Niña period (Baker et al. 2016). The dolphins were found concentrated close to shore in the small strips of turbid water as a consequence of low rainfall levels (Baker et al. 2016). This pattern of habitat use under La Niña led to a shift in prey targeted by the dolphins (Ogilvy et al. 2022). Therefore, it will be important to determine whether a similar shift occurred in 2025. Despite conducting two alongshore surveys to the Kaipara Harbour with excellent weather conditions, only one group of dolphins was observed and two biopsy samples collected. A few dolphins have been observed in this location during every synoptic period, something of interest will be to examine in the ddRAD research where we are able to identify relatedness patterns between individuals.

The number of groups, group sizes and cumulative counts are within the usual range of previous surveys, noting that these fluctuate. There were no neonates observed this year but 34.8% of groups contained one or two calves, including a few young-of-year individuals. There were fewer groups with juveniles this year (13%). It's important to note that due to the low levels of fin markings, all counts are cumulative. The number of calves and juveniles fluctuates considerably from year to year but with small group sizes and experienced observers, we are confident that we accurately account for these non-adult individuals.

Dolphin reactions to biopsy sampling events continue to be mild and similar to responses reported in previous surveys (Oremus et al. 2012, Constantine et al. 2021). All molecular identification data will be reconciled with the photo-identification data to identify individuals using both methods where possible, and this analysis is being finalised over the next few months in preparation for the 2026 surveys.

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