

Estimating the abundance and effective population size of Māui dolphins using microsatellite genotypes: Report on the 2026 biopsy sampling survey

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SUMMARY

Here, we report on the second year of a two-year project intended to replicate the three previous two-year synoptic surveys to collect tissue samples for a genotype mark-recapture estimate of Māui dolphin abundance. From the 5th February to 7th March 2026, we conducted a total of 18 small-vessel surveys on 13 days along the west coast of the North Island from just north of Kaipara in the north to the Tongaporutu, Taranaki in the south. On 5 of the survey days, we had two vessels surveying different parts of the coast. During 2,019 km of survey effort, we encountered a total of 56 groups of Māui dolphins, with an average of 4.3 groups per day (ranging from 0-10 groups per day). No dolphins were sighted on 3 survey days. Group sizes ranged from 1-12 dolphins (average of 3.4-3.8 dolphins using minimum and maximum estimates). Dolphins were encountered between south of Kaipara and Gibson's Beach, north of Whaingaroa / Raglan. A total of 32 biopsy samples were collected (average = 2.5, ranging = 0-8 samples per day). Consistent with previous years, the dolphins showed little behavioural response following the biopsy event. DNA profiles were successfully generated for all 32 samples, representing 17 individual dolphins (10 males, 7 females). All 17 individuals are confirmed as Māui dolphins (haplotype G). As in previous surveys, we will use the genotype data from 2025 and 2026 field seasons to generate a new abundance estimate.

INTRODUCTION

Māui dolphins, a sub-species of the endemic Hector's dolphin, are listed by the IUCN as Critically Endangered (Constantine 2023) and Nationally Critical in New Zealand (Lundquist et al. 2025). Based on recent genomic analyses, the sub-species have been separated for around 20,000 years (Alvarez-Costes et al. 2025) with no evidence to date of hybridization (Constantine et al. 2021). 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.

This study is the second year of the 2025-2026 synoptic survey; representing the "re-capture" phase of the mark-recapture estimate. The biopsy samples will also allow us to genetically

confirm whether Hector's dolphins are present among Māui dolphins as revealed in previous surveys (Hamner et al. 2014; Baker et al. 2016; Constantine et al. 2021). All surveys were conducted using the same protocols reported in Constantine et al. (2021).

EFFORT

Coastal boat surveys on the DOC vessels *Tuatini* (5.9m alloy boat powered by twin 90 hp 4-stroke outboard engines) and *Orca* (7.8m alloy boat powered by twin 150 hp 4-stroke outboard engines) were undertaken from the 5th February to the 7th March 2026 (Figure 1). There were 13 survey days along the west coast of the North Island from south Kaipara in the north to Tongaporutu in the south (Table 1). As per previous surveys, effort was concentrated alongshore with occasional transects offshore in locations with historically higher numbers of dolphin sightings (Waimatuku / Hamilton's Gap, Te Ara o Te Po / Cochrane's Gap, Karioitahi Beach, Port Waikato) to maximise the success of group encounters.

One key difference in the 2026 surveys was the increased daily coverage on five days when both boats were on the water. On these days one vessel would head north and one south of Manukau Harbour. To ensure we were able to conduct multiple surveys to the northern and southern regions, i.e. Kaipara and south towards Taranaki, the vessel would survey in a single direction only. When this occurred, the research team travelled rapidly and off survey to the start or end point. The boat was launched from three different locations for the 13 survey days: Clarks Beach, Manukau Harbour with dedicated survey effort starting at Cornwallis (n = 10), Whaingaroa / Raglan (n = 2) and Ngā Motu / New Plymouth (n = 1) surveying to the north and south of these locations.

In total, 88 hours and 47 minutes were spent on the water covering 2,019 km. Weather conditions were good overall, with most surveys conducted in a Beaufort 1-2 sea state although the conditions ranged from Beaufort 1-4.

The core research team was as follows:

Skippers: Cara Hansen, Rebekah Gee, Cameron Hunt, Pearson Tukua (DOC)

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

Photographers: Chloe Corne, Cara Hansen, George McLellan, Hannah Zwalve (DOC);

Rochelle Constantine, Toni Schebek-Fuerstenberg (UoA)

Data recorders: Hannah Hendriks, Nikki Grist, Kristina Hillock, Malene Felsing (DOC); Emma Carroll, Rochelle Constantine, Jasmin Manning (UoA); Hannah Williams (Volunteer)

Mana whenua: Sky Flavell & Lyall Flavell (Ngaati Te Ata); Davis Apiti (Ngāti Te Wehi)

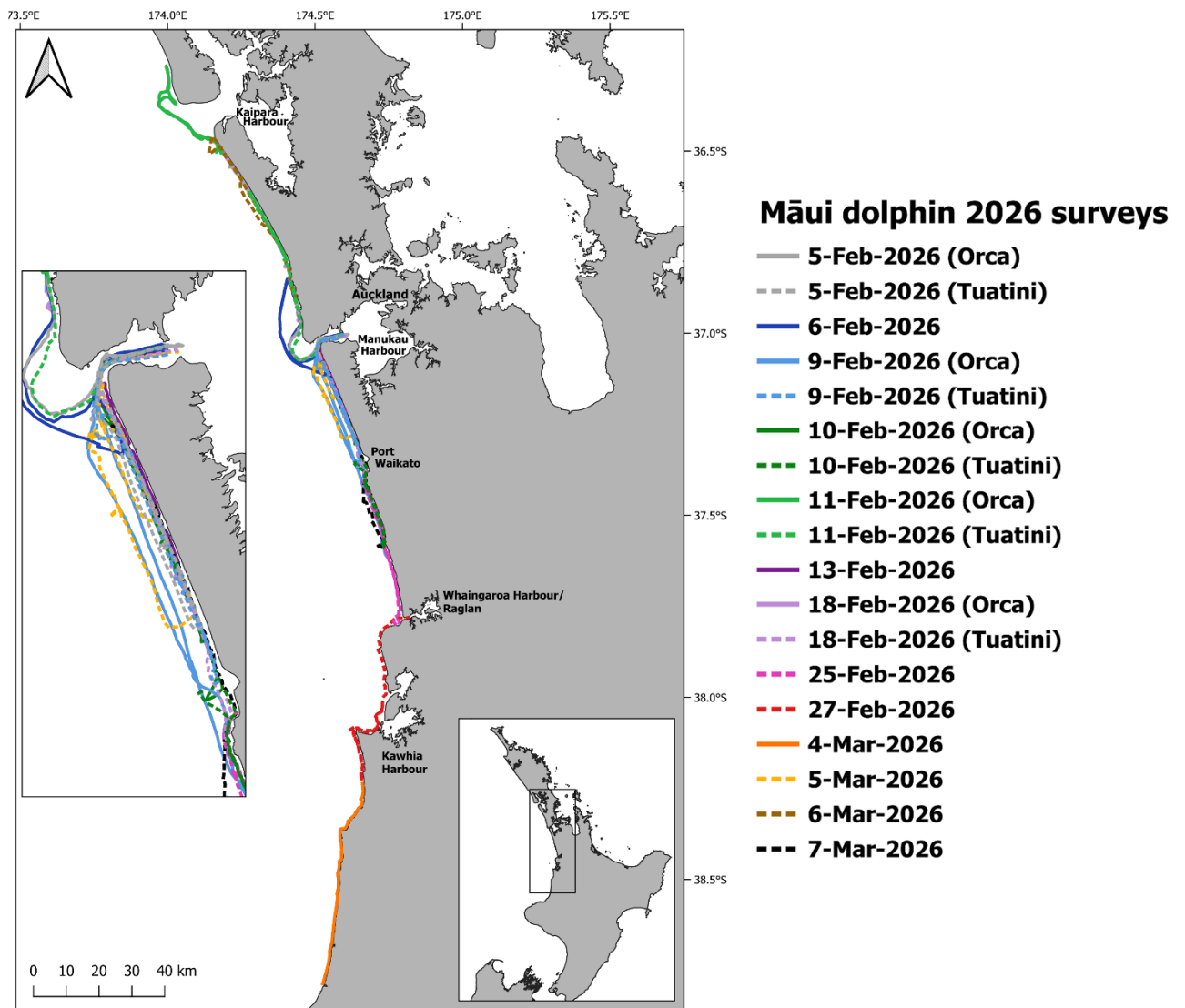


Figure 1. Map of the study area and GPS tracks for the 13 survey days conducted along the west coast, North Island between 5th February and 7th March 2026. The vessel *Tuatini* is denoted by dotted lines and the vessel *Orca* is denoted by solid lines. The vessel track is named on the days when two vessels were surveying. See Table 1 for further information.

Table 1. Summary of boat surveys conducted along the west coast, North Island between 5th February and 7th March 2026 (n = 13 days). A * denotes the five days when two vessels were on survey.

Date	Vessel	Time start	Time end	Time on survey hh:mm	Survey distance km	# groups	# biopsies
5-Feb-26*	Tuatini	10:52	18:11	7:19	100.05	6	3
5-Feb-26*	Orca	10:47	16:30	5:43	174.46	3	0
6-Feb-26	Orca	8:38	12:40	4:02	103.03	0	0
9-Feb-26*	Tuatini	7:47	16:47	9:00	170.51	4	4
9-Feb-26*	Orca	7:35	16:12	8:37	112.6	3	1
10-Feb-26*	Tuatini	8:25	16:36	8:11	103.1	6	0
10-Feb-26*	Orca	10:05	15:30	5:25	67.8	4	8
11-Feb-26*	Tuatini	8:53	14:46	5:53	99.6	2	1
11-Feb-26*	Orca	6:49	14:30	7:41	122.5	1	2
13-Feb-26	Orca	7:53	14:36	6:43	58.1	5	2
18-Feb-26*	Tuatini	7:02	14:10	7:08	77.6	4	0
18-Feb-26*	Orca	9:19	15:41	6:22	90.2	3	0
25-Feb-26	Tuatini	9:27	17:00	7:33	110.1	4	1
27-Feb-26	Tuatini	8:45	16:21	7:36	102.6	0	0
4-Mar-26	Orca	11:55	15:00	3:05	67.4	0	0
5-Mar-26	Tuatini	7:23	17:27	10:04	133.9	4	4
6-Mar-26	Tuatini	7:53	18:07	10:14	220.9	5	3
7-Mar-26	Tuatini	10:06	17:25	7:19	104.7	2	3
Total				88:47	2019.2	56	32
Average				8:07	112.2	4.4	2.5

GROUP ENCOUNTERS

We encountered a total of 56 groups of Māui dolphins during the surveys (Figure 2, Table 2), with an average of 4.3 groups encountered per survey day (range = 0-10 groups). The average was 2.5 groups per survey day when there was one vessel and 7.2 groups when there were two vessels. We encountered Māui dolphins on 10 of the 13 survey days (77%). The dolphins were mainly found in the remnant 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 but there were clusters of sightings south of South Kaipara and near Gibson's and Carters Beach north of Whaingaroa / Raglan (Figure 2).

Group sizes ranged from 1-12 dolphins with an average of 3.4 – 3.8 dolphins per group (using the minimum and maximum group estimates based on visual counts; Table 2). The maximum number sighted during a survey was an estimated 39 dolphins when there was one vessel on survey (7 March). Calves (i.e., individuals approximately one-half or less the size of an adult) accounted for 9.3% (n = 20; range = 0-2 calves/group) and juveniles (i.e., individuals approximately two-thirds the size of adults) accounted for 2.3% (n = 5; range = 0-1) of all dolphins sighted using the maximum count. Calves and juveniles were found in 32% (n = 18) and 8.9% (n = 5) of groups, respectively. We spent an average of 36 minutes with dolphin groups for a cumulative total of 9 hours 43 minutes with dolphins during the 13 survey days.

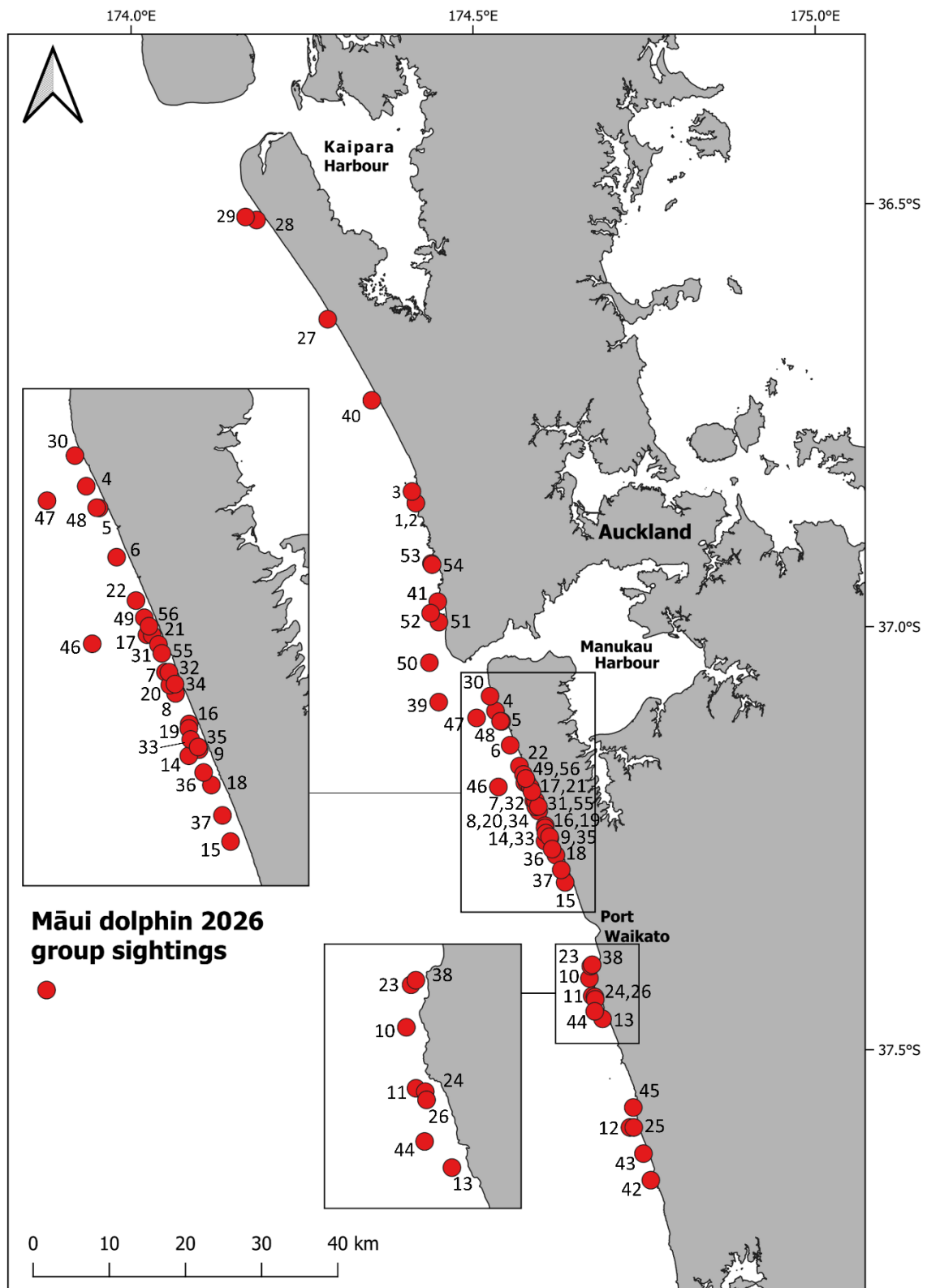


Figure 2. The geographic positions of group encounters ($n = 56$) between the 5th February and 7th March 2026. Inserts show group numbers in areas of higher density sightings (see Table 2 for further information).

Table 2. Summary of dolphin group encounters (n = 56) between the 5th February and 7th March 2026.

Group #	Date	Position start		Group size		Number	Time with dolphins
		Latitude	Longitude	Min	Max	Calves/ juvs	hh:mm
1	5-Feb-26	-36.8637	174.4265	2	1	0/0	0:31
2	5-Feb-26	-36.8637	174.4265	1	1	0/0	0:17
3	5-Feb-26	-36.8501	174.4206	3	4	0/0	0:20
4	5-Feb-26	-37.1080	174.5488	2	2	0/0	0:10
5	5-Feb-26	-37.1203	174.5582	2	2	0/0	0:12
6	5-Feb-26	-37.1482	174.5713	2	2	0/0	0:20
7	5-Feb-26	-37.2133	174.6075	3	3	1/0	0:26
8	5-Feb-26	-37.2254	174.6150	3	3	1/0	0:45
9	5-Feb-26	-37.2573	174.6324	2	2	0/0	0:18
10	9-Feb-26	-37.4223	174.6946	3	3	0/0	0:35
11	9-Feb-26	-37.4430	174.6992	4	5	0/0	0:59
12	9-Feb-26	-37.5976	174.7588	5	7	0/0	0:46
13	9-Feb-26	-37.4699	174.7152	3	3	0/0	0:24
14	9-Feb-26	-37.2608	174.6252	1	2	0/0	0:38
15	9-Feb-26	-37.3094	174.6561	1	2	0/0	0:34
16	9-Feb-26	-37.2427	174.6251	5	6	2/0	0:53
17	10-Feb-26	-37.1922	174.5939	4	5	1/0	0:26
18	10-Feb-26	-37.2773	174.6417	1	1	0/0	0:13
19	10-Feb-26	-37.2453	174.6249	2	2	0/0	0:39
20	10-Feb-26	-37.2207	174.6108	1	2	0/0	0:15
21	10-Feb-26	-37.1923	174.5976	5	6	1/0	0:54
22	10-Feb-26	-37.1728	174.5856	2	2	0/0	0:11
23	10-Feb-26	-37.4071	174.6963	1	1	0/0	0:11
24	10-Feb-26	-37.4440	174.7032	5	6	0/0	0:42
25	10-Feb-26	-37.5974	174.7645	7	8	1/0	0:34
26	10-Feb-26	-37.4469	174.7038	5	5	0/0	0:29
27	11-Feb-26	-36.6478	174.2931	3	3	0/0	0:18
28	11-Feb-26	-36.5316	174.1869	7	7	1/0	5:22
29	11-Feb-26	-36.5282	174.1706	1	1	0/0	0:11
30	13-Feb-26	-37.0906	174.5404	2	2	0/0	0:36
31	13-Feb-26	-37.1976	174.6022	6	8	1/0	0:57
32	13-Feb-26	-37.2134	174.6100	1	1	0/0	0:10
33	13-Feb-26	-37.2515	174.6264	5	5	0/0	0:26
34	13-Feb-26	-37.2201	174.6145	8	8	1/0	1:17
35	18-Feb-26	-37.2557	174.6318	6	9	0/0	1:02
36	18-Feb-26	-37.2702	174.6360	7	8	1/0	0:30
37	18-Feb-26	-37.2945	174.6500	5	5	2/0	0:40
38	18-Feb-26	-37.4061	174.6983	2	3	0/0	0:16
39	18-Feb-26	-37.0986	174.4647	1	1	0/0	0:07

40	18-Feb-26	-36.7430	174.3595	1	1	0/0	0:10
41	18-Feb-26	-36.9799	174.4610	6	6	0/1	1:02
42	25-Feb-26	-37.6595	174.7913	1	1	0/0	0:20
43	25-Feb-26	-37.6282	174.7796	1	1	0/0	0:16
44	25-Feb-26	-37.4611	174.7033	4	4	0/0	0:21
45	25-Feb-26	-37.5739	174.7632	1	1	0/0	0:07
46	5-Mar-26	-37.1979	174.5549	2	2	0/0	0:16
47	5-Mar-26	-37.1166	174.5210	4	5	1/0	0:57
48	5-Mar-26	-37.1202	174.5565	6	7	1/0	0:55
49	5-Mar-26	-37.1825	174.5917	1	1	0/0	0:18
50	6-Mar-26	-37.0522	174.4501	3	3	1/1	0:29
51	6-Mar-26	-37.0041	174.4632	7	7	1/1	0:31
52	6-Mar-26	-36.9936	174.4508	7	7	1/1	0:17
53	6-Mar-26	-36.9349	174.4508	2	2	0/0	0:21
54	6-Mar-26	-36.9362	174.4519	7	7	1/1	0:50
55	7-Mar-26	-37.2026	174.6047	1	1	0/0	0:34
56	7-Mar-26	-37.1873	174.5952	10	12	1/0	1:25

Cumulative total	193	215	20/5	09:43
Average	3.4	3.8		00:36

BIOPSY SAMPLING

A total of 32 biopsy tissue samples were collected using the Paxarms™ dart and veterinary capture rifle. Samples were collected on all 9/10 survey days during which dolphins were encountered (Table 1) with sampling reflecting the location of group encounters (Figure 3, Table 3). There was an average of 3.8 samples per day when both boats were on survey compared to 1.6 samples per day when only a single boat was on survey. Skin samples were labelled in the field, transferred to vials filled with 90% ethanol and then stored at -20°C at the New Zealand Cetacean Tissue Archive curated at the University of Auckland.

As with previous research (most recently Constantine et al. 2021), the majority (n = 25) of the biopsy events had a category I behavioural reaction (startle response, dolphin moved away (flinch) but stayed in the immediate vicinity of the boat) and the remaining 7 had a category 0 (no visible response) 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 correct assignment of individual sampled and photo identified. Throughout the encounter, the researchers checked individuals approaching the boat for previous biopsy marks to minimise re-sampling during the encounter.

DNA profiling using mitochondrial DNA sequencing and sex (as described in Constantine et al. 2021) showed that all 32 samples yielded sufficient DNA for analysis (Table 3). Of the 32 samples, there were 17 individual dolphins, all identified as Māui dolphins based on mtDNA sequencing (haplotype G; Table 3). Of the 17 individuals, there were 10 males and 7 females, which did not differ from parity based on a chi-squared test ($\chi^2 = 0.53$, df = 1, p-value = 0.47), consistent with previous results (Constantine et al. 2021). There were 12 Māui dolphins

sampled during previous surveys (2010 – 2025) and represent re-captures in 2026, and 5 newly sampled individuals. These findings will be combined with the 2025 data to calculate a genotype mark-recapture abundance estimate for Māui dolphins.

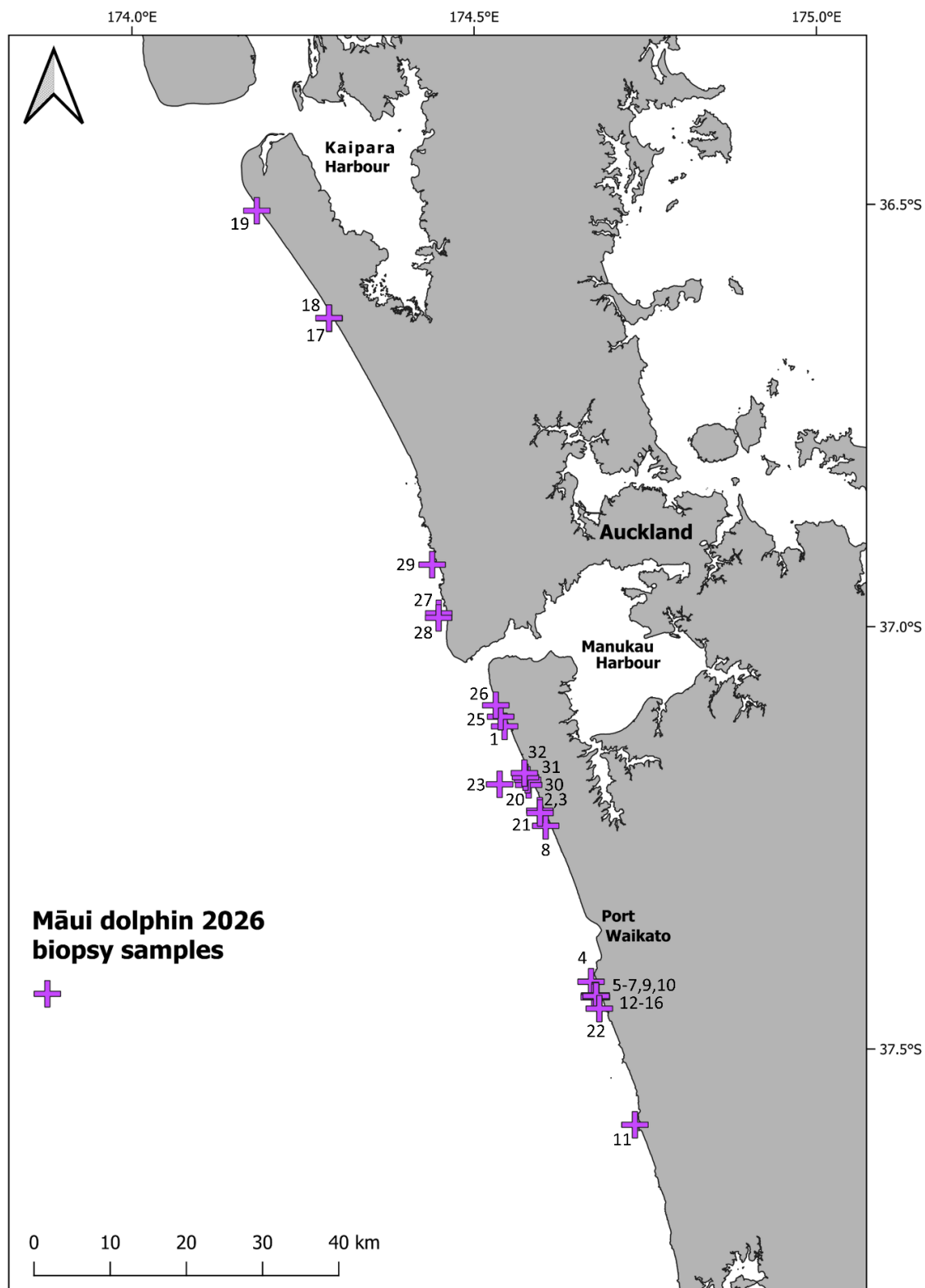


Figure 3. The geographic positions of biopsy samples (n = 32) between the 5th February and 7th March 2026. Inserts show biopsy numbers in areas of higher density sampling (see Table 3 for further information).

Table 3. Summary of the Māui dolphin skin sample collection, short-term reactions to biopsy sampling and sex of individuals (M = male; F = female).

	Sample code	Date	Group #	Latitude	Longitude	Reaction type	Sex
1	Chem26NZ01	5-Feb-26	5	-37.1263	174.5610	1	M
2	Chem26NZ02	5-Feb-26	8	-37.2260	174.6154	0	M
3	Chem26NZ03	5-Feb-26	8	-37.2254	174.6150	1	M
4	Chem26NZ04	9-Feb-26	10	-37.4269	174.6954	0	M
5	Chem26NZ05	9-Feb-26	11	-37.4430	174.7009	1	M
6	Chem26NZ06	9-Feb-26	11	-37.4440	174.7006	1	F
7	Chem26NZ07	9-Feb-26	11	-37.4453	174.7005	1	M
8	Chem26NZ08	9-Feb-26	16	-37.2432	174.6241	0	F
9	Chem26NZ09	10-Feb-26	24	-37.4449	174.7036	1	F
10	Chem26NZ10	10-Feb-26	24	-37.4429	174.7034	1	M
11	Chem26NZ11	10-Feb-26	25	-37.5953	174.7644	1	F
12	Chem26NZ12	10-Feb-26	26	-37.5450	174.7037	0	M
13	Chem26NZ13	10-Feb-26	26	-37.4449	174.7037	0	M
14	Chem26NZ14	10-Feb-26	26	-37.4452	174.7037	1	M
15	Chem26NZ15	10-Feb-26	26	-37.4438	174.1703	1	F
16	Chem26NZ16	10-Feb-26	26	-37.4437	174.7032	1	F
17	Chem26NZ17	11-Feb-26	27	-36.6463	174.2938	1	M
18	Chem26NZ18	11-Feb-26	27	-36.6457	174.2934	1	M
19	Chem26NZ19	11-Feb-26	28	-36.5198	174.1856	1	F
20	Chem26NZ20	13-Feb-26	31	-37.1951	174.5979	1	M
21	Chem26NZ21	13-Feb-26	33	-37.2282	174.6155	1	F
22	Chem26NZ22	25-Feb-26	44	-37.4585	174.7084	1	F
23	Chem26NZ23	5-Mar-26	46	-37.1950	174.5551	0	M
24	Chem26NZ24	5-Mar-26	48	37.1202	174.5565	1	M
25	Chem26NZ25	5-Mar-26	48	-37.1149	174.5549	1	M
26	Chem26NZ26	5-Mar-26	48	-37.1015	174.5474	1	M
27	Chem26NZ27	6-Mar-26	52	-36.9936	174.4612	1	M
28	Chem26NZ28	6-Mar-26	52	-36.9990	174.4611	1	F
29	Chem26NZ29	6-Mar-26	53	-36.9361	174.4503	1	M
30	Chem26NZ30	7-Mar-26	55	-37.1890	174.5962	1	F
31	Chem26NZ31	7-Mar-26	55	-37.1861	174.5931	0	F
32	Chem26NZ32	7-Mar-26	56	-37.1812	174.5914	1	F

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