Estimating the abundance and effective population size of Maui's dolphins using microsatellite genotypes: Report on the 2021 biopsy sampling survey

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SUMMARY

Here, we report on the second year of a two-year project intended to replicate the 2010-2011 and 2015-2016 genotype mark-recapture surveys of Māui dolphins. From the 13th February – 15th March 2021, we conducted a total of 11 small-vessel surveys along the west coast of the North Island from the south head of the Kaipara Harbour in the north to south of Kawhia Harbour in the south. During 1,380.9 km of survey effort we encountered a total of 29 groups of Māui dolphins, with an average of 2.6 groups per day (ranging from 0-6 groups per day). Group sizes ranged from 1-12 dolphins (average of 4.4-4.7 dolphins using minimum and maximum visual estimates). Dolphins were encountered between the south head of Kaipara and half way between Port Waikato and Raglan. A total of 34 biopsy samples were collected (ranging from 0-15 samples per day; average of 3.1 per day). Consistent with previous years, the dolphins showed little behavioural response following the biopsy event. There were 34 samples of 24 individual Māui dolphins (as identified by mtDNA haplotype G) and no samples of Hector's dolphins. There was a dolphin carcass recovered from north Muriwai Beach on 25th February 2021 and identified genetically as a Māui dolphin. The initial DNA profiling of this carcass did not indicate a match with any previously sampled individuals in the DNA register, including those sampled in 2020 2021.

EFFORT

Coastal boat surveys on the DOC vessel *Tuatini* were undertaken from the 13th February to 15th March 2021 (Figure 1). There were two interruptions from COVID-19 lockdown periods during the survey but they had minimal disruption to the survey period which was comparable to previous years. During this time, 11 surveys were conducted along the west coast of the North Island from the southern edge of Kaipara Harbour to south of Kawhia Harbour (Table 1). As per previous surveys, effort was concentrated alongshore with occasional transects offshore in locations with historically higher numbers of dolphin sightings (Hamilton's Gap, Cochrane's Gap, Karioitahi Beach, Port Waikato, Crayfish Point) in order to maximise the success of group encounters. The boat was launched from two different locations: Clarks Beach, Manukau Harbour with dedicated survey effort starting at Cornwallis (n = 7) and Raglan wharf (n = 4), surveying to the north and south of these locations.

In total, 92 hr 59 min were spent on effort surveying 1,380.9 km on the *Tuatini*. Weather conditions were good overall, with most surveys conducted in a Beaufort 1-2 sea state although the conditions ranged from Beaufort 1-3.

Research team was as follows:
Skippers: Pearson Tukua and Cara Hansen (DOC)
Biopsy samplers: Mike Ogle and Callum Lilley (DOC)
Photographers: Rochelle Constantine (UoA) and Cara Hansen (DOC)
Data recorders: Pearson Tukua, Kristina Hillock, Cara Hansen, Garry Hickman (DOC), Rochelle Constantine and Courtney Ogilvy (UoA)
Observer: Anton van Helden (DOC)

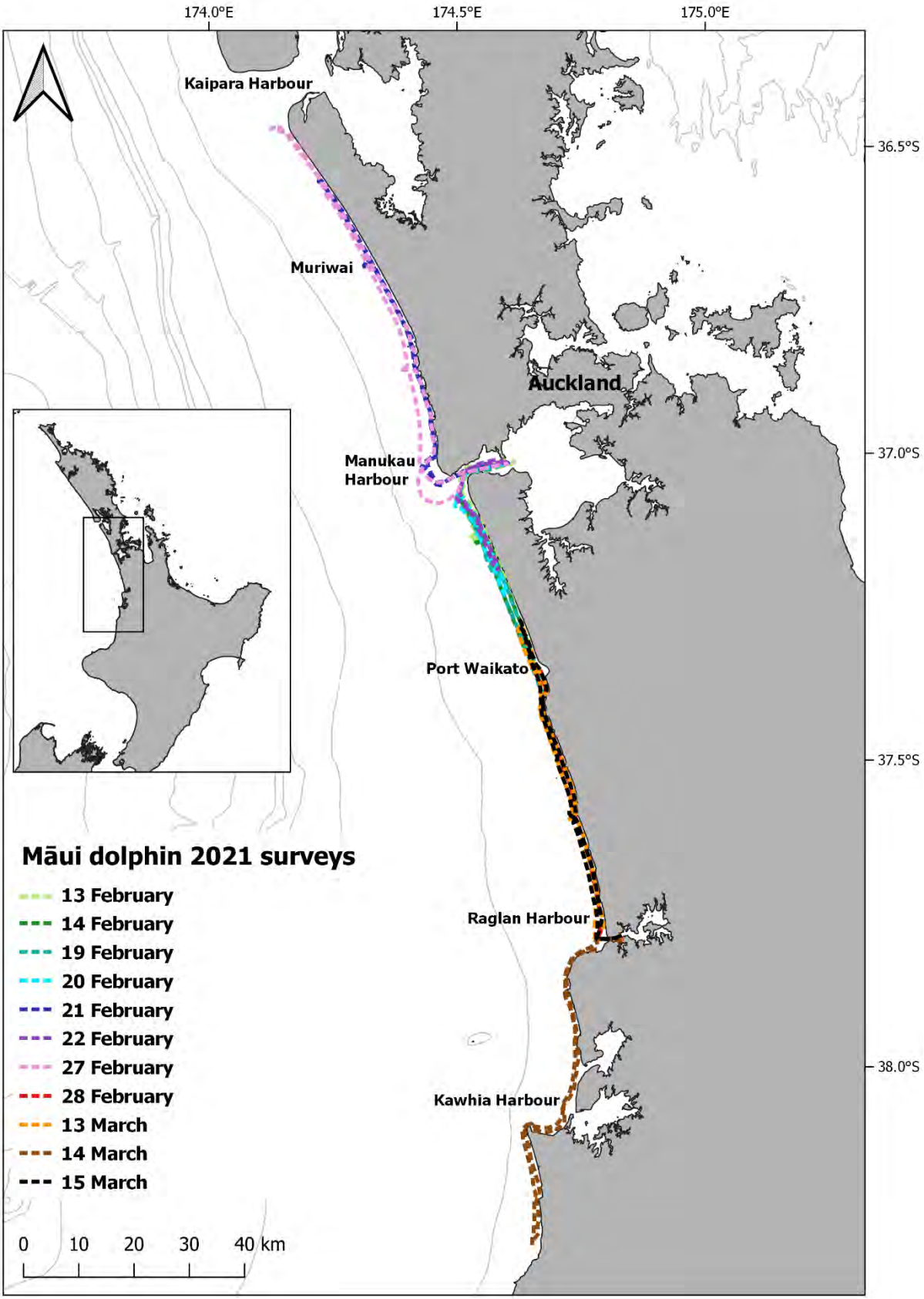

Figure 1. Map of the study area and GPS tracks for the 11 surveys conducted between the 13th February and 15th March 2021. See Table 1 for further information.

Table 1. Summary of boat surveys conducted along the west coast, North Island between the 13th February and 15th March 2021.

	Date	Location	Launch	Time start	Time end	Time on water hh:mm	Distance km	# groups	# biopsies
1	13-Feb-21	Manukau South	Cornwallis	9:05	15:30	6:25	81.3	3	3
2	14-Feb-21	Manukau South	Cornwallis	6:45	16:21	9:36	115.1	6	15
3	19-Feb-21	Manukau South	Cornwallis	8:31	16:04	7:33	127.8	2	0
4	20-Feb-21	Manukau South	Cornwallis	8:20	17:30	9:10	84.3	4	3
5	21-Feb-21	Manukau North	Cornwallis	5:50	16:55	11:05	164.2	1	0
6	22-Feb-21	Manukau South	Cornwallis	8:50	14:50	6:00	66	3	6
7	27-Feb-21	Manukau North	Cornwallis	7:28	17:18	9:50	188.3	1	3
8	28-Feb-21	Raglan North	Raglan	8:43	15:35	6:52	111.6	1	1
9	13-Mar-21	Raglan North	Raglan	7:45	17:30	9:45	157.5	4	1
10	14-Mar-21	Raglan South	Raglan	7:00	15:00	8:00	144.1	0	0
11	15-Mar-21	Raglan North	Raglan	8:00	16:43	8:43	140.7	4	2
				Total		92:59	1,380.9	29	34
				Average		8:27	125.5	2.6	3.1

GROUP ENCOUNTERS

We encountered a total of 29 groups of Māui dolphins during the surveys (Figure 2, Table 2), with an average of 2.6 groups encountered per survey (range = 0-6 groups per survey). We encountered Māui dolphins on 10 of the 11 surveys conducted (91%). The dolphins were mainly found in the remnant core area between Cochrane's Gap and Hamilton's Gap just south of the Manukau Harbour entrance and to the north and south of Port Waikato (Figure 2).

Group sizes ranged from 1-12 dolphins with an average of 4.4 – 4.7 dolphins per group (using the minimum and maximum group estimates based on visual counts) (Table 2). There were four calves and one neonate observed during the 2021 study. These individuals were frequently resighted in association with their mothers over the study period. Calves/ neonates and juveniles were found in 65% (n = 19) and 5% (n = 1) of groups respectively, reflecting the high resight rate of the same individuals throughout the core of their range. We spent an average of 36 minutes with dolphin groups for a cumulative total of 17 hrs 40 mins with dolphins across all surveys. On two surveys (14th and 20th February) we met a DOC charter vessel with iwi, DOC staff and media to observe the research and the dolphins.

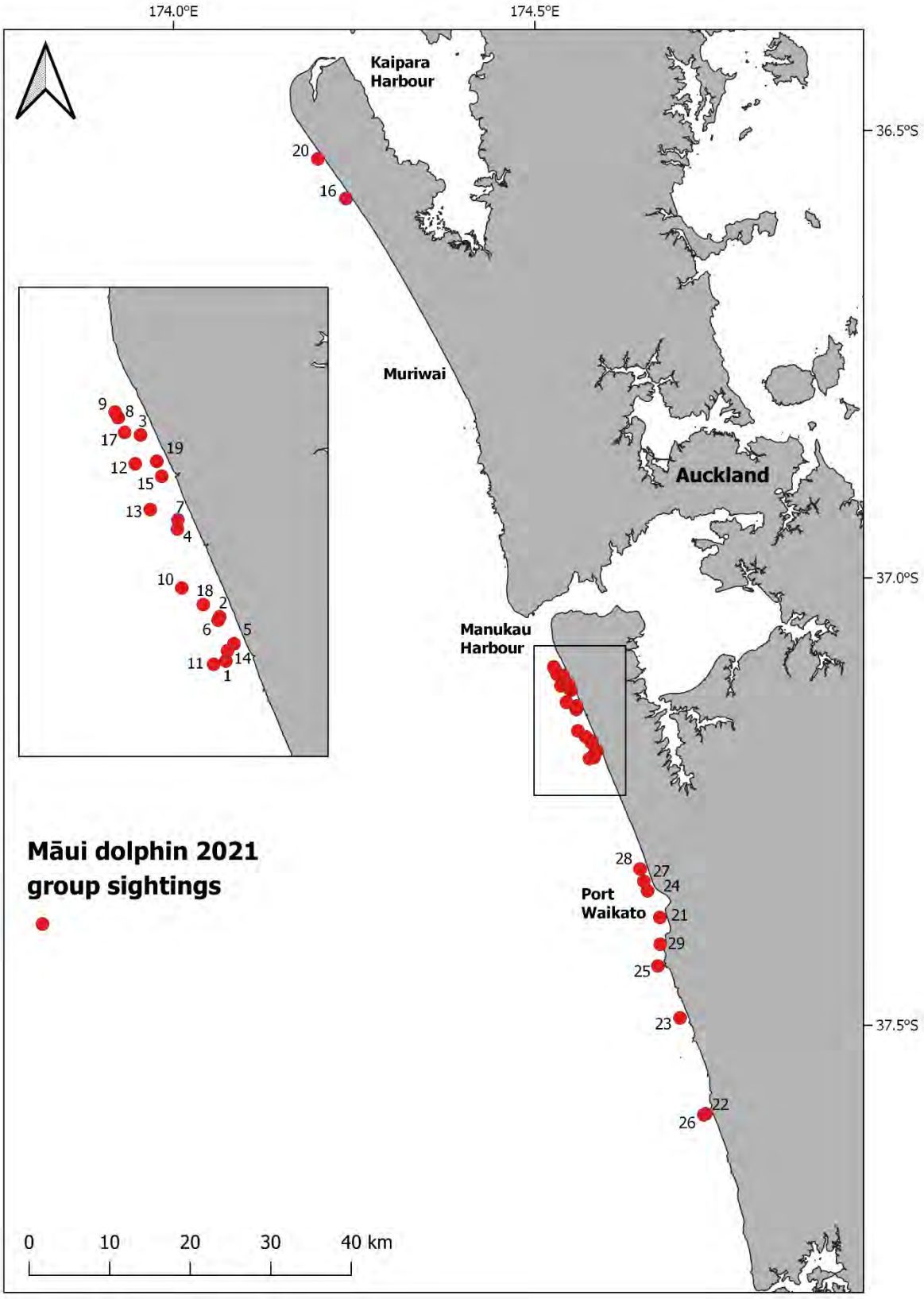

Figure 2. The geographic positions of group encounters (n = 29) between the 13th February and 15th March 2021. Inserts show group numbers in areas of higher density sightings (see Table 2 for further information).

Table 2. Summary of dolphin group encounters between the 11th and 27th February 2020.

Gp #	Date	Position start		Group size		Number calves/ juvs/ neonate	Time with dolphins
		Latitude	Longitude	Min	Max		hh:mm
1	13-Feb-21	-37.206325	174.598504	2	2	0/0/0	0:17
2	13-Feb-21	-37.18837	174.59502	3	3	1/0/0	0:28
3	13-Feb-21	-37.11500	174.55324	5	6	0/0/0	0:33
4	14-Feb-21	-37.15298	174.57277	9	9	0/1/1	1:33
5	14-Feb-21	-37.19923	174.60254	2	2	0/1/0	0:13
6	14-Feb-21	-37.18979	174.59433	6	8	0/0/1	0:19
7	14-Feb-21	-37.14926	174.57298	7	7	0/1/0	0:34
8	14-Feb-21	-37.10809	174.54173	5	5	0/1/0	0:34
9	14-Feb-21	-37.10585	174.54016	1	1	0/0/0	0:02
10	19-Feb-21	-37.17694	174.5755	5	7	0/1/1	0:35
11	19-Feb-21	-37.20775	174.59238	5	5	0/1/0	0:47
12	20-Feb-21	-37.12677	174.55081	3	3	0/2/0	0:20
13	20-Feb-21	-37.14524	174.55885	3	3	0/0/1	0:27
14	20-Feb-21	-37.20216	174.59932	11	12	0/2/0	2:22
15	20-Feb-21	-37.13167	174.56439	6	6	0/1/0	0:18
16	21-Feb-21	-36.58553	174.24157	3	3	0/0/0	0:45
17	22-Feb-21	-37.11404	174.54518	3	3	0/1/0	0:51
18	22-Feb-21	-37.18354	174.58661	8	8	0/2/1	1:12
19	22-Feb-21	-37.12560	174.56174	7	8	0/1/0	0:44
20	27-Feb-21	-36.54154	174.20182	9	9	0/1/0	0:35
21	28-Feb-21	-37.38400	174.6949	3	3	0/1/0	0:41
22	13-Mar-21	-37.60265	174.76413	3	3	0/1/0	0:32
23	13-Mar-21	-37.49585	174.72563	2	2	0/1/0	0:26
24	13-Mar-21	-37.35451	174.67693	2	2	0/0/0	0:01
25	13-Mar-21	-37.43827	174.69331	2	2	0/0/0	0:10
26	15-Mar-21	-37.60371	174.76149	1	1	0/0/0	0:14
27	15-Mar-21	-37.34381	174.67149	2	2	0/1/0	0:19
28	15-Mar-21	-37.33020	174.66573	3	3	0/0/0	0:42
29	15-Mar-21	-37.41398	174.69595	7	7	0/2/0	1:03
			Total	128	133		00:36
			Average	4.4	4.7		17:40

BIOPSY SAMPLING

A total of 34 biopsy tissue samples were collected using the Paxarms™ dart and veterinary capture rifle. Samples were collected on seven of the 10 surveys during which dolphins were encountered (Table 1) with sampling reflecting the location of group encounters (Figure 3, Table 3). 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.

Consistent with previous work, all (n = 34) biopsy events had a category I (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). 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.

DNA profiling using mitochondrial DNA sequencing, microsatellite genotyping and sex identification (as described in Baker et al. 2016) showed that all 34 samples yielded sufficient DNA for analysis (Table 3). Based on genotype matching, the 34 samples represented 24 individual Māui dolphins (13 males and 11 females). Unlike most previous years, there were no Hector's dolphins identified in the sampling (Table 3). There were 19 dolphins sampled during previous surveys (2001 – 2020) and five newly sampled individuals (3 males and 2 females). The oldest individual sampled was a male first sampled in 2003. There was no evidence that the sampled dolphins have a Māui dolphin parent and a Hector's dolphin parent (i.e., a hybrid dolphin). Further analysis of the genetic data from 2020 and 2021 will be used to generate the genotype mark-recapture abundance estimate.

In addition to the biopsy surveys of living Māui dolphins, there was a beachcast adult dolphin recovered from ~10 km north of Muriwai Beach on the 25th February 2021 (Chem21NZ35). Genetics confirmed that this was a female Māui dolphin. A necropsy undertaken by Dr Wendi Roe, Massey University (Massey code #59518; DOC code H291) was unable to determine the cause of death due to decay of the carcass. The initial DNA profiling of this carcass did not indicate a match with any previously sampled individuals, including those sampled during the 2020 and 2021 surveys.

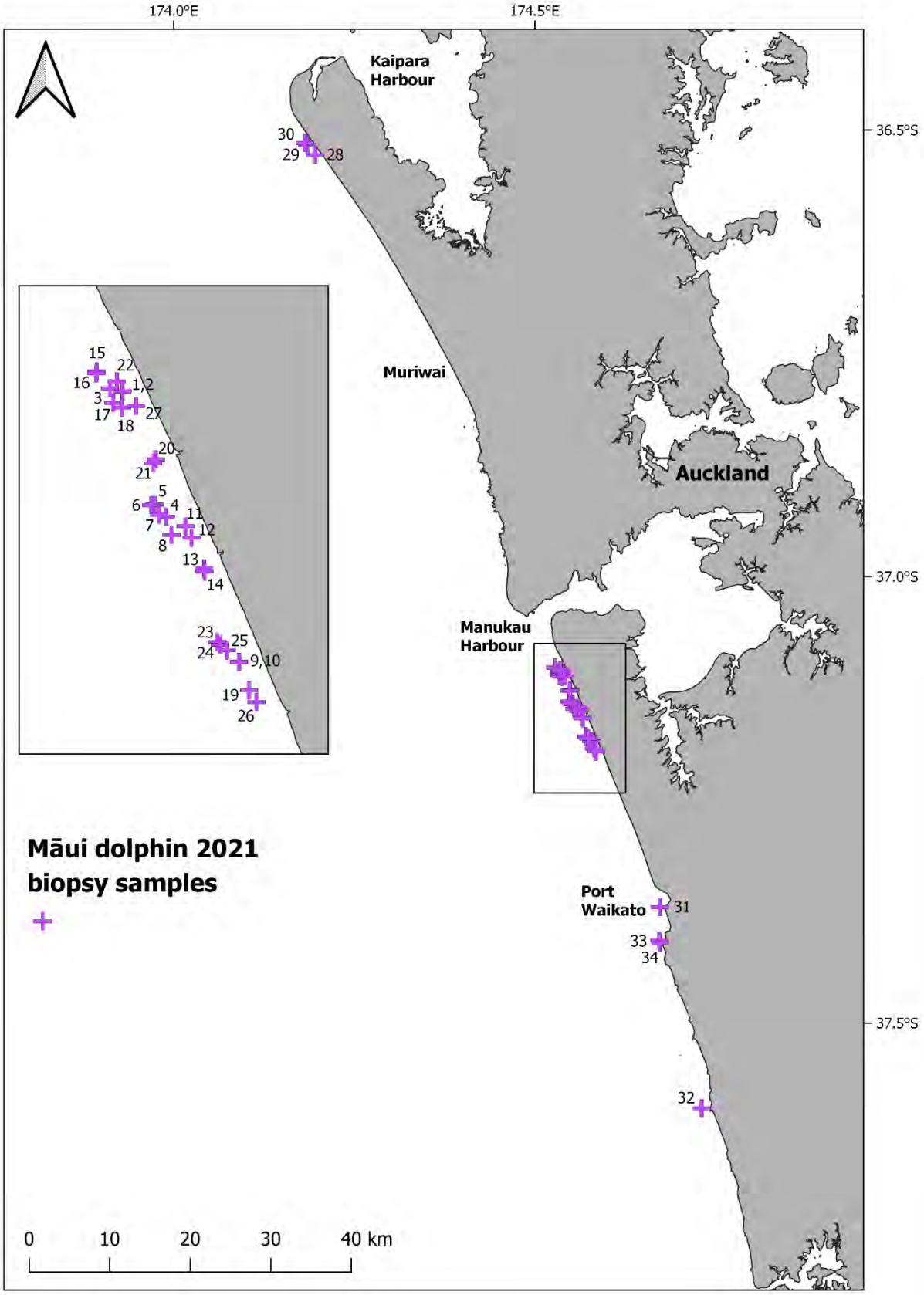

Figure 3. The geographic positions of biopsy samples (n = 34) between the 13th February and 15th March 2021. Inserts show biopsy numbers in areas of higher density sampling (see Table 3 for further information).

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

	Sample code	Date	Group #	Latitude	Longitude	Reaction type	Sex
1	Chem21NZ01	13-Feb-21	3	-37.11389	174.55183	0	M
2	Chem21NZ02	13-Feb-21	3	-37.11362	174.55183	0	M
3	Chem21NZ03	13-Feb-21	3	-37.11293	174.54736	0	M
4	Chem21NZ04	14-Feb-21	4	-37.14924	174.56798	0	F
5	Chem21NZ05	14-Feb-21	4	-37.14587	174.5639	1	F
6	Chem21NZ06	14-Feb-21	4	-37.14603	174.56267	1	F
7	Chem21NZ07	14-Feb-21	4	-37.14875	174.5656	0	F
8	Chem21NZ08	14-Feb-21	4	-37.15438	174.57005	1	M
9	Chem21NZ09	14-Feb-21	6	-37.19030	174.59486	1	M
10	Chem21NZ10	14-Feb-21	6	-37.19041	174.59486	1	M
11	Chem21NZ11	14-Feb-21	7	-37.15192	174.57506	1	F
12	Chem21NZ12	14-Feb-21	7	-37.15512	174.57724	1	F
13	Chem21NZ13	14-Feb-21	7	-37.16378	174.58189	1	M
14	Chem21NZ14	14-Feb-21	7	-37.16475	174.58206	0	F
15	Chem21NZ15	14-Feb-21	8	-37.10813	174.5425	0	M
16	Chem21NZ16	14-Feb-21	8	-37.10871	174.5424	1	M
17	Chem21NZ17	14-Feb-21	8	-37.11702	174.5486	1	M
18	Chem21NZ18	14-Feb-21	8	-37.11840	174.5517	1	M
19	Chem21NZ19	20-Feb-21	14	-37.19834	174.59862	1	F
20	Chem21NZ20	20-Feb-21	15	-37.13297	174.56407	1	M
21	Chem21NZ21	20-Feb-21	15	-37.13409	174.56316	1	M
22	Chem21NZ22	22-Feb-21	17	-37.11096	174.54976	1	F
23	Chem21NZ23	22-Feb-21	18	-37.18478	174.58699	1	F
24	Chem21NZ24	22-Feb-21	18	-37.18555	174.58804	1	M
25	Chem21NZ25	22-Feb-21	18	-37.18710	174.59048	1	M
26	Chem21NZ26	22-Feb-21	18	-37.20167	174.6013	1	F
27	Chem21NZ27	22-Feb-21	19	-37.11784	174.55669	0	M
28	Chem21NZ28	27-Feb-21	20	-36.53804	174.19817	0	M
29	Chem21NZ29	27-Feb-21	20	-36.52720	174.18703	1	M
30	Chem21NZ30	27-Feb-21	20	-36.52465	174.18401	1	M
31	Chem21NZ31	28-Feb-21	21	-37.37444	174.69438	1	F
32	Chem21NZ32	13-Mar-21	22	-37.59925	174.75858	1	M
33	Chem21NZ33	15-Mar-21	29	-37.41197	174.69478	1	F
34	Chem21NZ34	15-Mar-21	29	-37.41452	174.69543	1	F

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