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# Estimating the abundance of Mui dolphins using microsatellite genotypes: Report of the 2016 biopsy sampling survey

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# Estimating the abundance of Māui dolphins using microsatellite genotypes: Report of the 2016 biopsy sampling survey

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**SUMMARY**

This report summarises the second field season of a two-year project intended to update the 2010-2011 genotype mark-recapture surveys of Māui dolphins. From the 10th February to 5th March 2016, we conducted a total of 13 small-vessel surveys along the west coast of the North Island from south Kaipara in the north to Tirua Point, south of Kawhia Harbour. During 1,552 km of survey effort we encountered a total of 66 groups of Māui dolphins, with an average of 5.1 groups per day (ranging from 0-10 groups per day). Group sizes ranged from 1-15 dolphins (average of 3.6-4.8 dolphins) with calves accounting for 4.3% (n = 10) of the sightings. Dolphins were encountered along the coast between south of Kaipara Harbour and north of Raglan. A total of 44 biopsy samples were collected (ranging from 0-11 samples per day). As in previous years, the dolphins showed little or no behavioural response to biopsy sampling.

## INTRODUCTION

Māui dolphins (*Cephalorhynchus hectori maui*), a subspecies of the endemic Hector's dolphin (*C. h. hectori*), are listed by the IUCN as critically endangered. The recent 2010-2011 abundance estimate and analysis of distribution (Oremus et al. 2012, Hamner et al. 2014a) were valuable tools for the implementation of further conservation measures intended to protect this subspecies. 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. Instead, individual identification using DNA profiling or microsatellite genotyping is increasingly used to undertake capture-recapture estimates of abundance.

This study is the second year of a two-year project intended to replicate the 2010-11 surveys; representing the "recapture" phase of the mark-recapture estimate. The genetic samples will also allow us to confirm whether Hector's dolphins are present among Māui dolphins as revealed in the 2010-11 and 2015 surveys (Hamner et al. 2014b; Constantine et al. 2015). All surveys were conducted using the same protocols reported in Hamner et al. (2012).

## EFFORT

Coastal surveys were undertaken with the DOC vessel MV *Tuatini* from the 10th February to 5th March 2015 (Figure 1). We conducted 13 surveys along the west coast of the North Island from south Kaipara in the north to Tirua Point (south of Kawhia Harbour) in the south (Table 1). All surveys were conducted in a similar manner to past surveys in order to maintain consistency and increase the likelihood of encountering dolphins. The boat was launched from two different locations: Onehunga wharf (n = 9) and Raglan

wharf (n = 4). When launching from Onehunga wharf, the 'on effort' component of the surveys was considered to start and end at Cornwallis (Puponga Point). While on effort, in generally good (Beaufort 1-2) weather conditions, the *Tuatini* covered a total distance of 1,552 km. In comparison to 2015, however, the 2016 surveys experienced larger coastal swell. This made the surveys challenging at times as the dolphins were often encountered near or in the surf break.

The survey team included:

- Skipper: Garry Hickman (DOC), Karl McLeod (Auckland Council).
- Biopsy sampler: Scott Baker (OSU-UoA).
- Photographers: Sahar Izadi (UoA), Pippa Low (UoA), Rebecca Hamner (UoA), Olivia Hamilton (UoA)
- Data recorders: Andrew Wright (DOC), Erin Breen (MPI), Hannah Hendriks (DOC), Rohan Currey (MPI)

**Table 1.** Boat surveys (n = 13) conducted along the west coast, North Island between the 10th February and 5th March 2016.

| # | Date | Location | Launch | Time start | Time end | Time on water | Distance km | # groups | # samples |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 10-Feb | South Manukau | Onehunga | 7:40 | 11:10 | 3:30 | 38.22 | 2 | 0 |
| 2 | 11-Feb | South Manukau | Onehunga | 8:19 | 16:07 | 7:48 | 86.22 | 6 | 2 |
| 3 | 12-Feb | South Manukau | Onehunga | 8:37 | 16:06 | 7:29 | 90.66 | 4 | 4 |
| 4 | 13 Feb | South Manukau | Onehunga | 7:27 | 16:18 | 8:51 | 117.7 | 5 | 1 |
| 5 | 14-Feb | South Manukau | Onehunga | 7:50 | 17:22 | 9:32 | 85.46 | 10 | 11 |
| 6 | 15-Feb | South Manukau | Onehunga | 8:00 | 13:42 | 5:42 | 65.47 | 5 | 10 |
| 7 | 24-Feb | North Raglan | Raglan | 7:30 | 17:14 | 9:44 | 134.44 | 6 | 4 |
| 8 | 25-Feb | South Raglan | Raglan | 7:53 | 15:50 | 7:57 | 169.7 | 0 | 0 |
| 9 | 26-Feb | North Raglan | Raglan | 7:30 | 17:11 | 9:41 | 185.59 | 4 | 0 |
| 10 | 27-Feb | North Raglan | Raglan | 7:48 | 18:04 | 10:16 | 186.2 | 6 | 3 |
| 11 | 3-Mar | South Manukau | Onehunga | 8:17 | 17:50 | 9:33 | 108.7 | 8 | 2 |
| 12 | 4-Mar | North Manukau | Onehunga | 8:07 | 16:39 | 8:32 | 178.37 | 3 | 1 |
| 13 | 5-Mar | South Manukau | Onehunga | 7:52 | 17:15 | 9:23 | 105.56 | 7 | 6 |
| | | | | **Total** | | 107:58 | 1,552 | 66 | 44 |
| | | | | **Average** | | 8:18 | 119.4 | 5.1 | 3.4 |

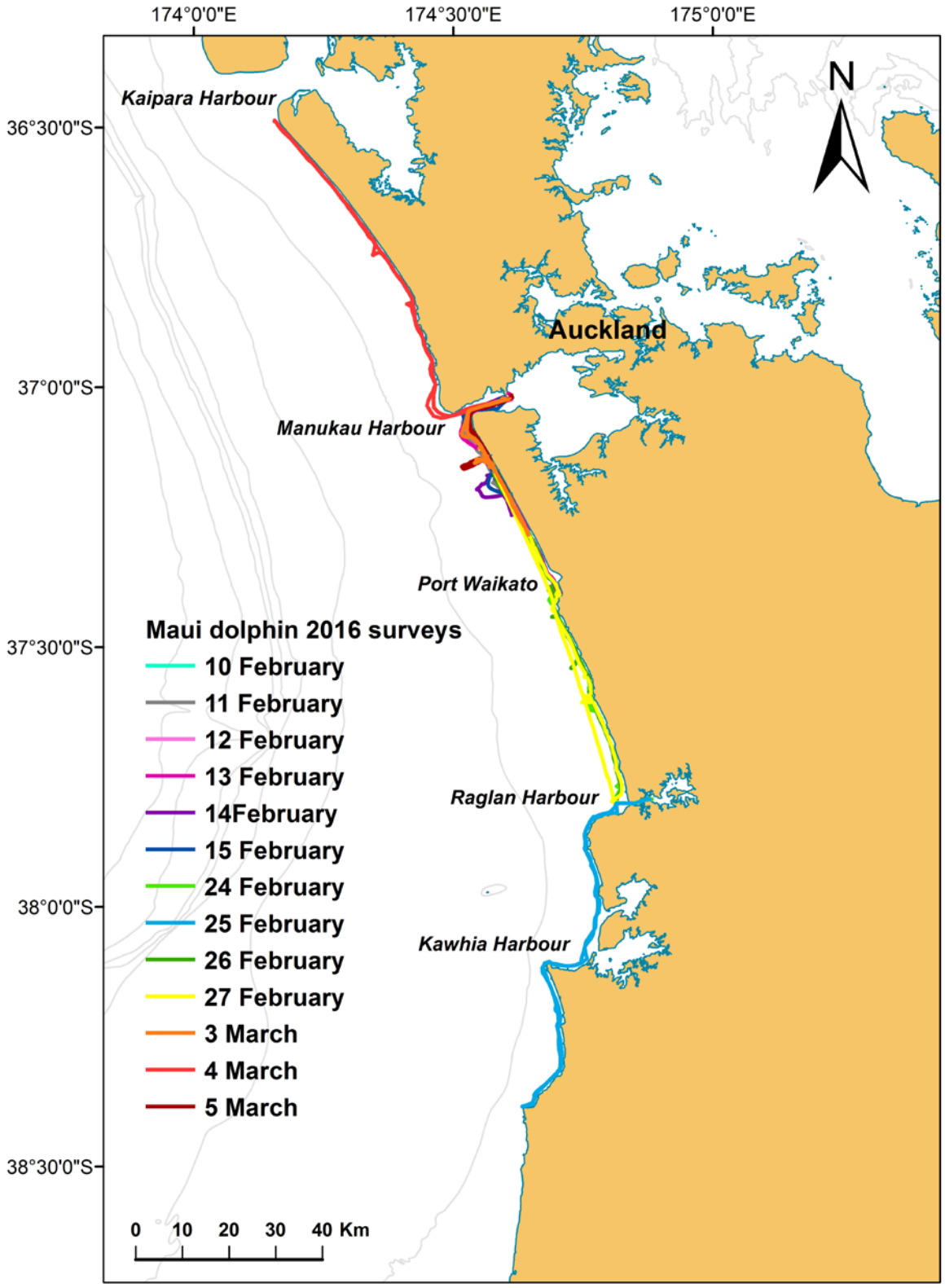


Figure 1. Map of the study area and GPS tracks for the 13 surveys conducted from 10th February to 5th March 2016.

In addition to sightings of Māui dolphins, we had two observations of killer whales (*Orcinus orca*) and six observations of common dolphins (*Delphinus delphis*) during six of our surveys (Table 2). We encountered a pod of seven killer whales (1 adult male, 4 females and 2 calves) on the 11th February near Kariotahi Beach and 12th February at South Head, Manukau. Common dolphins were encountered during three surveys based out of Raglan and one group was encountered south of Kaipara Harbour.

Table 2. Summary of sightings of other cetacean species during the 2016 Māui dolphin surveys.

| | | Position | | |
|---|---|---|---|---|
| **Date** | **Species** | **Latitude** | **Longitude** | **Group size** |
| 11-Feb-16 | killer whale | -37.2870 | 174.6457 | 7 |
| 12-Feb-16 | killer whale | -37.0438 | 174.5323 | 7 |
| 25-Feb-16 | common dolphin | -38.1835 | 174.6971 | 50-60 |
| 25-Feb-16 | common dolphin | -38.2639 | 174.7032 | 2-3 |
| 25-Feb-16 | common dolphin | -38.1292 | 174.6735 | 6-12 |
| 26-Feb-16 | common dolphin | -37.3904 | 174.6833 | 30 |
| 27-Feb-16 | common dolphin | -37.7973 | 174.8054 | 20 |
| 04 Mar-16 | common dolphin | -36.7453 | 174.3371 | 50-75 |

## GROUP ENCOUNTERS

We encountered a total of 66 groups of Māui dolphins during the surveys (Table 3, Figure 2), with an average of 5.1 groups encountered per survey (range = 0-11 groups per survey). We encountered Māui dolphins on 12 of the 13 surveys conducted (92%) with the majority of groups sighted south of the Manukau Harbour (Figure 2). Using the minimum count of group size, there were 231 dolphin sightings during the 13 surveys, including multiple sightings of individual dolphins. Group sizes ranged from 1-18 dolphins with an average of 3.6-4.8 dolphins per group using the minimum and maximum group estimates based on visual counts (Table 3). Calves (i.e., individuals approximately one-half or less the size of an adult) were observed in 13.6% of groups and accounted for 4.3% (n = 10; range 0-2 calves/group) of the cumulative minimum count (n = 231). There was no count available for juveniles given the difficulty of categorising this age class by observations at sea, but their likely presence was noted in 10.6% of groups.

Table 3. Summary of Māui dolphin group encounters between the 10th February and 5th March 2016.

| | | Position start | | Group size | | Number |
|---|---|---|---|---|---|---|
| Gp # | Date | Latitude | Longitude | Min | Max | calves |
| 1 | 10-Feb-16 | -37.1290 | 174.5630 | 4 | 6 | 0 |
| 2 | 10-Feb-16 | -37.0961 | 174.5338 | 3 | 3 | 0 |
| 3 | 11-Feb-16 | -37.0870 | 174.5215 | 1 | 1 | 0 |
| 4 | 11-Feb-16 | -37.2313 | 174.6152 | 1 | 3 | 0 |
| 5 | 11-Feb-16 | -37.1634 | 174.5823 | 2 | 2 | 0 |
| 6 | 11-Feb-16 | -37.1363 | 174.5663 | 1 | 3 | 0 |
| 7 | 11-Feb-16 | -37.1154 | 174.5528 | 4 | 4 | 1 |
| 8 | 11-Feb-16 | -37.1013 | 174.5270 | 1 | 1 | 0 |
| 9 | 12-Feb-16 | -37.1767 | 174.5839 | 7 | 9 | 0 |
| 10 | 12-Feb-16 | -37.1953 | 174.5975 | 5 | 7 | 1 |
| 11 | 12-Feb-16 | -37.1227 | 174.5599 | 2 | 3 | 0 |
| 12 | 12-Feb-16 | -37.1159 | 174.5549 | 2 | 2 | 0 |
| 13 | 13-Feb-16 | -37.1901 | 174.5908 | 9 | 16 | 1 |
| 14 | 13-Feb-16 | -37.1925 | 174.5930 | 4 | 6 | 0 |
| 15 | 13-Feb-16 | -37.3056 | 174.6563 | 2 | 2 | 0 |
| 16 | 13-Feb-16 | -37.1437 | 174.5716 | 2 | 3 | 0 |
| 17 | 13-Feb-16 | -37.1286 | 174.5662 | 3 | 3 | 0 |
| 18 | 14-Feb-16 | -37.1249 | 174.5608 | 2 | 2 | 0 |
| 19 | 14-Feb-16 | -37.1423 | 174.5662 | 2 | 2 | 0 |
| 20 | 14-Feb-16 | -37.1424 | 174.5672 | 2 | 2 | 0 |
| 21 | 14-Feb-16 | -37.1694 | 174.5779 | 12 | 15 | 1 |
| 22 | 14-Feb-16 | -37.1670 | 174.5778 | 5 | 8 | 0 |
| 23 | 14-Feb-16 | -37.1717 | 174.5693 | 4 | 15 | 0 |
| 24 | 14-Feb-16 | -37.1958 | 174.5457 | 1 | 1 | 0 |
| 25 | 14-Feb-16 | -37.1663 | 174.5825 | 9 | 10 | 0 |
| 26 | 14-Feb-16 | -37.1515 | 174.5762 | 1 | 1 | 0 |
| 27 | 14-Feb-16 | -37.1282 | 174.5984 | 9 | 9 | 0 |
| 28 | 15-Feb-16 | -37.1077 | 174.5479 | 1 | 1 | 0 |
| 29 | 15-Feb-16 | -37.1544 | 174.5718 | 12 | 18 | 1 |
| 30 | 15-Feb-16 | -37.1884 | 174.5918 | 6 | 8 | 0 |
| 31 | 15-Feb-16 | -37.1389 | 174.5639 | 5 | 8 | 1 |
| 32 | 15-Feb-16 | -37.1181 | 174.5543 | 1 | 1 | 0 |
| 33 | 24-Feb-16 | -37.6063 | 174.7672 | 1 | 1 | 0 |
| 34 | 24-Feb-16 | -37.5983 | 174.7643 | 2 | 2 | 0 |
| 35 | 24-Feb-16 | -37.5832 | 174.7634 | 1 | 1 | 0 |
| 36 | 24-Feb-16 | -37.5768 | 174.7619 | 1 | 1 | 0 |
| 37 | 24-Feb-16 | -37.4065 | 174.6936 | 5 | 7 | 1 |
| 38 | 24-Feb-16 | -37.5984 | 174.7660 | 3 | 3 | 0 |
| 39 | 26-Feb-16 | -37.4005 | 174.7008 | 1 | 1 | 0 |
| 40 | 26-Feb-16 | -37.1794 | 174.5921 | 2 | 2 | 0 |
| 41 | 26-Feb-16 | -37.1705 | 174.5877 | 1 | 1 | 0 |

| | | Position start | | Group size | | Number |
|---|---|---|---|---|---|---|
| Gp # | Date | Latitude | Longitude | Min | Max | calves |
| 42 | 26-Feb-16 | -37.3627 | 174.6841 | 1 | 1 | 0 |
| 43 | 27-Feb-16 | -37.1714 | 174.5834 | 1 | 1 | 0 |
| 44 | 27-Feb-16 | -37.1558 | 174.5769 | 1 | 1 | 0 |
| 45 | 27-Feb-16 | -37.1436 | 174.5729 | 3 | 5 | 0 |
| 46 | 27-Feb-16 | -37.1258 | 174.5605 | na | na | na |
| 47 | 27-Feb-16 | -37.1219 | 174.5583 | 8 | 9 | 0 |
| 48 | 27-Feb-16 | -37.1495 | 174.5741 | 1 | 2 | 0 |
| 49 | 3-Mar-16 | -37.1361 | 174.5641 | 5 | 12 | 0 |
| 50 | 3-Mar-16 | -37.1363 | 174.5607 | 3 | 3 | 0 |
| 51 | 3-Mar-16 | -37.1526 | 174.5717 | 8 | 12 | 0 |
| 52 | 3-Mar-16 | -37.1385 | 174.5492 | 6 | 8 | 0 |
| 53 | 3-Mar-16 | -37.1499 | 174.5738 | 5 | 6 | 0 |
| 54 | 3-Mar-16 | -37.1424 | 174.5625 | 1 | 1 | 0 |
| 55 | 3-Mar-16 | -37.1562 | 174.5786 | 3 | 4 | 0 |
| 56 | 3-Mar-16 | -37.1165 | 174.5556 | 2 | 2 | 0 |
| 57 | 4-Mar-16 | -36.7471 | 174.3631 | 1 | 1 | 0 |
| 58 | 4-Mar-16 | -36.7050 | 174.3375 | 1 | 1 | 0 |
| 59 | 4-Mar-16 | -36.7194 | 174.3481 | 1 | 1 | 0 |
| 60 | 5-Mar-16 | -37.0924 | 174.5383 | 4 | 4 | 0 |
| 61 | 5-Mar-16 | -37.1038 | 174.5505 | 5 | 5 | 0 |
| 62 | 5-Mar-16 | -37.1159 | 174.5559 | 1 | 1 | 0 |
| 63 | 5-Mar-16 | -37.1410 | 174.5528 | 3 | 3 | 0 |
| 64 | 5-Mar-16 | -37.1485 | 174.5746 | 5 | 8 | 0 |
| 65 | 5-Mar-16 | -37.1160 | 174.5575 | 9 | 12 | 2 |
| 66 | 5-Mar-16 | -37.1204 | 174.5601 | 11 | 15 | 1 |

| | | | |
|---|---|---|---|
| **Total** | 231 | 312 | 10 |
| **Average** | 3.6 | 4.8 | - |

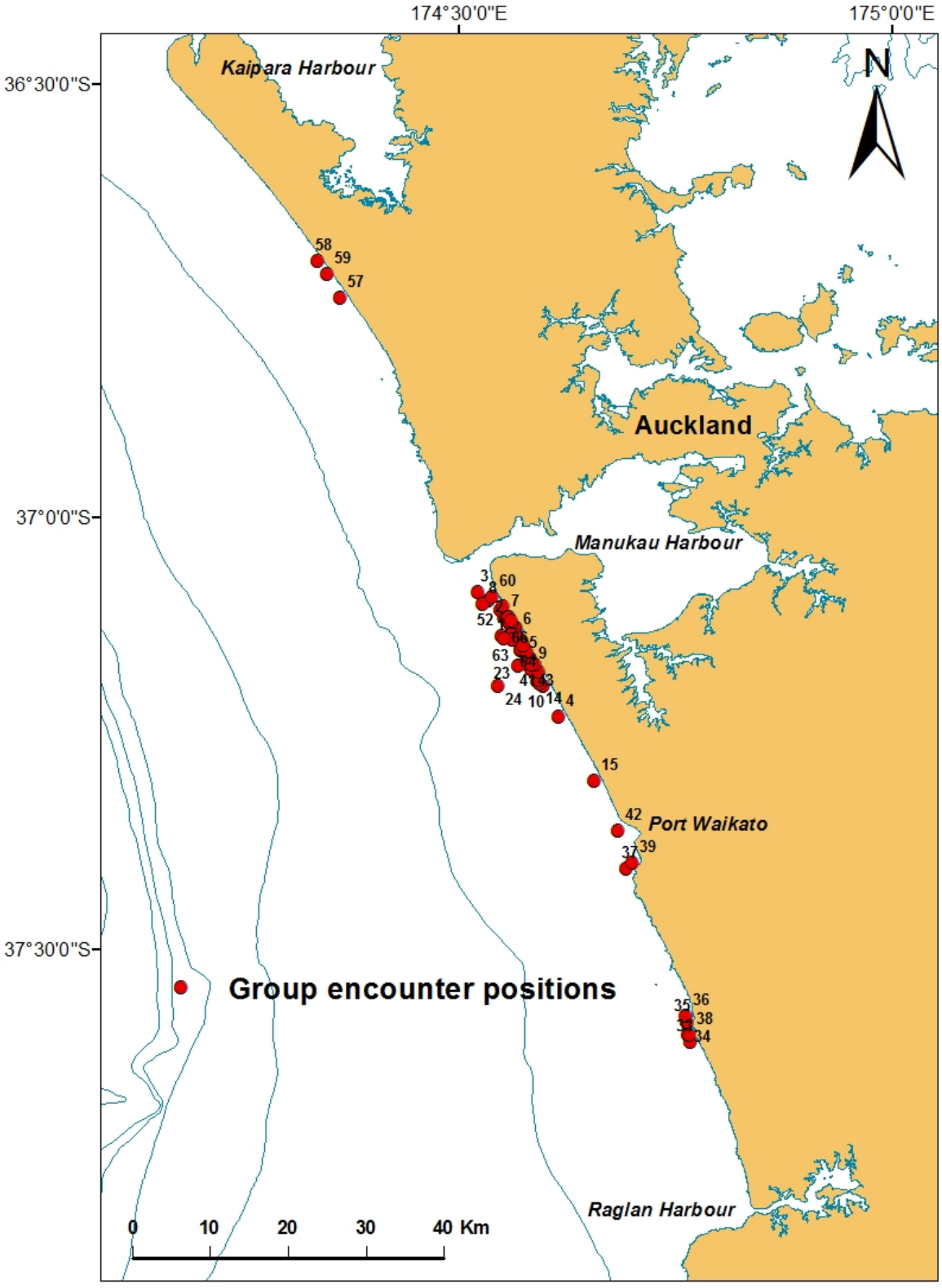


Figure 2. The geographic positions of group encounters (n = 66) from 10th February – 5th March 2016.

**BIOPSY SAMPLING**

A total of 44 tissue biopsy samples were collected from 49 deployments using the Paxarms™ veterinary capture rifle and dart (4x7 mm cutting head). There were five sampling attempts where a tissue sample was not retained in the dart. Samples were collected on nine out of the 12 surveys during which dolphins were encountered (Table 1) with sampling locations reflecting the location of group encounters (Table 4, Figure 3). Skin samples were labelled in the field, transferred to vials filled with 70% ethanol and then stored at -20°C at the University of Auckland's New Zealand Cetacean Tissue Archive.

The behavioural reactions to biopsy sampling were recorded for all but one biopsy event (#45 - Table 4) and were judged using the categories described in Krützen et al. (2002). Of the 48 reactions recorded 13% (n = 6) were category 0 (no visible reaction), 81% (n = 39) were category I (startle response, dolphin moved away (flinch) but stayed in the immediate vicinity of the boat) and 6% (n = 3) were category 2 (splashing during moving away and/or tail slap, with or without return to the boat) (Table 4). Attempts were made to photo-identify dolphins at the same time as they were sampled and these photographs will be reconciled with the genetic data at a later date. Consistent with previous work on this species, dolphins that were biopsied usually re-approached the boat within a short time period (Oremus et al. 2012). Whilst the sea conditions were challenging during many of the 2016 surveys, individuals approaching the boat were checked for previous biopsy marks in an effort to minimise re-sampling during the encounter.

Table 4. Summary of the Māui dolphin skin sample collection and short-term reactions to biopsy sampling. In total, 44 tissue samples were collected. The five sample codes in italics did not retain a tissue sample sufficient for genetic analysis.

| | Sample code | Date | Time | Group # | Latitude | Longitude | Reaction type |
|---|---|---|---|---|---|---|---|
| *1* | *Chem16NZ-01* | *11-Feb-16* | *8:58* | *3* | *-37.08698* | *174.52152* | *0-1* |
| 2 | Chem16NZ-02 | 11-Feb-16 | 14:35 | 7 | -37.11540 | 174.55277 | 0-1 |
| 3 | Chem16NZ-03 | 11-Feb-16 | 15:04 | 7 | -37.11540 | 174.55277 | 1 |
| 4 | Chem16NZ-04 | 12-Feb-16 | 10:40 | 9 | -37.17673 | 174.58388 | 0-1 |
| *5* | *Chem16NZ-05* | *12-Feb-16* | *11:20* | *9* | *-37.17303* | *174.58358* | *0-1* |
| *6* | *Chem16NZ-06* | *12-Feb-16* | *11:26* | *9* | *-37.17425* | *174.58633* | *1* |
| 7 | Chem16NZ-07 | 12-Feb-16 | 11:39 | 9 | -37.17995 | 174.58860 | 1 |
| 8 | Chem16NZ-08 | 12-Feb-16 | 12:06 | 9 | -37.17920 | 174.58277 | 1 |
| 9 | Chem16NZ-09 | 12-Feb-16 | 13:53 | 10 | -37.19525 | 174.59750 | 1 |
| 10 | Chem16NZ-10 | 13-Feb-16 | 9:38 | 13 | -37.19012 | 174.59083 | 1 |
| 11 | Chem16NZ-11 | 14-Feb-16 | 10:23 | 21 | -37.16675 | 174.57877 | 1 |
| 12 | Chem16NZ-12 | 14-Feb-16 | 10:42 | 21 | -37.16372 | 174.58240 | 1 |
| 13 | Chem16NZ-13 | 14-Feb-16 | 11:39 | 22 | -37.16727 | 174.57667 | 1 |
| 14 | Chem16NZ-14 | 14-Feb-16 | 12:13 | 23 | -37.17220 | 174.56895 | 1 |
| 15 | Chem16NZ-15 | 14-Feb-16 | 12:33 | 23 | -37.17852 | 174.56610 | 1 |
| 16 | Chem16NZ-16 | 14-Feb-16 | 12:38 | 23 | -37.18197 | 174.56578 | 1 |
| 17 | Chem16NZ-17 | 14-Feb-16 | 14:39 | 25 | -37.16655 | 174.58230 | 1 |
| 18 | Chem16NZ-18 | 14-Feb-16 | 14:41 | 25 | -37.16717 | 174.58217 | 1 |
| 19 | Chem16NZ-19 | 14-Feb-16 | 15:07 | 25 | -37.16487 | 174.58202 | 1 |
| 20 | Chem16NZ-20 | 14-Feb-16 | 15:56 | 26 | -37.15392 | 174.57800 | 1 |

| | Sample code | Date | Time | Group # | Latitude | Longitude | Reaction type |
|---|---|---|---|---|---|---|---|
| 21 | Chem16NZ-21 | 14-Feb-16 | 14:43 | 27 | -37.12740 | 174.56427 | 1 |
| 22 | Chem16NZ-22 | 15-Feb-16 | 9:40 | 29 | -37.14997 | 174.57192 | 1 |
| 23 | Chem16NZ-23 | 15-Feb-16 | 9:42 | 29 | -37.15002 | 174.57225 | 1 |
| 24 | Chem16NZ-24 | 15-Feb-16 | 9:48 | 29 | -37.15175 | 174.57302 | 1 |
| 25 | Chem16NZ-25 | 15-Feb-16 | 10:01 | 29 | -37.15102 | 174.57232 | 1 |
| 26 | Chem16NZ-26 | 15-Feb-16 | 10:39 | 29 | -37.16065 | 174.57645 | 1 |
| 27 | Chem16NZ-27 | 15-Feb-16 | 10:46 | 29 | -37.16167 | 174.57725 | 1 |
| 28 | Chem16NZ-28 | 15-Feb-16 | 11:01 | 29 | -37.16490 | 174.57673 | 1 |
| 29 | Chem16NZ-29 | 15-Feb-16 | 11:52 | 30 | -37.18867 | 174.59102 | 1 |
| 30 | Chem16NZ-30 | 15-Feb-16 | 12:17 | 30 | -37.18117 | 174.58485 | 1 |
| 31 | Chem16NZ-31 | 15-Feb-16 | 12:33 | 30 | -37.17370 | 174.58315 | 1 |
| 32 | Chem16NZ-32 | 24-Feb-16 | 12:57 | 37 | -37.41277 | 174.68930 | 1 |
| 33 | Chem16NZ-33 | 24-Feb-16 | 13:19 | 37 | -37.41402 | 174.68940 | 1 |
| 34 | Chem16NZ-34 | 24-Feb-16 | 15:01 | 38 | -37.59573 | 174.76562 | 1 |
| 35 | Chem16NZ-35 | 24-Feb-16 | 15:10 | 38 | -37.59615 | 174.76553 | 1 |
| 36 | Chem16NZ-36 | 27-Feb-16 | 13:40 | 45 | -37.13897 | 174.56950 | 1 |
| 37 | Chem16NZ-37 | 27-Feb-16 | 13:48 | 45 | -37.13705 | 174.56790 | 1 |
| 38 | Chem16NZ-38 | 27-Feb-16 | 14:30 | 46 | -37.12525 | 174.55843 | 1 |
| 39 | Chem16NZ-39 | 3-Mar-16 | 13:00 | 52 | -37.13853 | 174.54922 | 2 |
| 40 | Chem16NZ-40 | 3-Mar-16 | 16:27 | 55 | -37.15620 | 174.57860 | 2 |
| 41 | Chem16NZ-41 | 4-Mar-16 | 10:18 | 57 | -36.74713 | 174.36310 | 1 |
| 42 | Chem16NZ-42 | 5-Mar-16 | 8:38 | 60 | -37.09238 | 174.53830 | 0-1 |
| 43 | Chem16NZ-43 | 5-Mar-16 | 11:36 | 64 | -37.14847 | 174.57460 | 1-2 |
| 44 | Chem16NZ-44 | 5-Mar-16 | 12:26 | 64 | -37.12102 | 174.55908 | 1 |
| *45* | *Chem16NZ-45* | *5-Mar-16* | *14:30* | *66* | *-37.12037* | *174.56012* | *n.a.* |
| 46 | Chem16NZ-46 | 5-Mar-16 | 15:14 | 66 | -37.12370 | 174.56192 | 0-1 |
| 47 | Chem16NZ-47 | 5-Mar-16 | 15:15 | 66 | -37.12338 | 174.56175 | 1 |
| *48* | *Chem16NZ-48* | *5-Mar-16* | *15:17* | *66* | *-37.12338* | *174.56175* | *1* |
| 49 | Chem16NZ-49 | 5-Mar-16 | 15:29 | 66 | -37.11252 | 174.55862 | 2 |

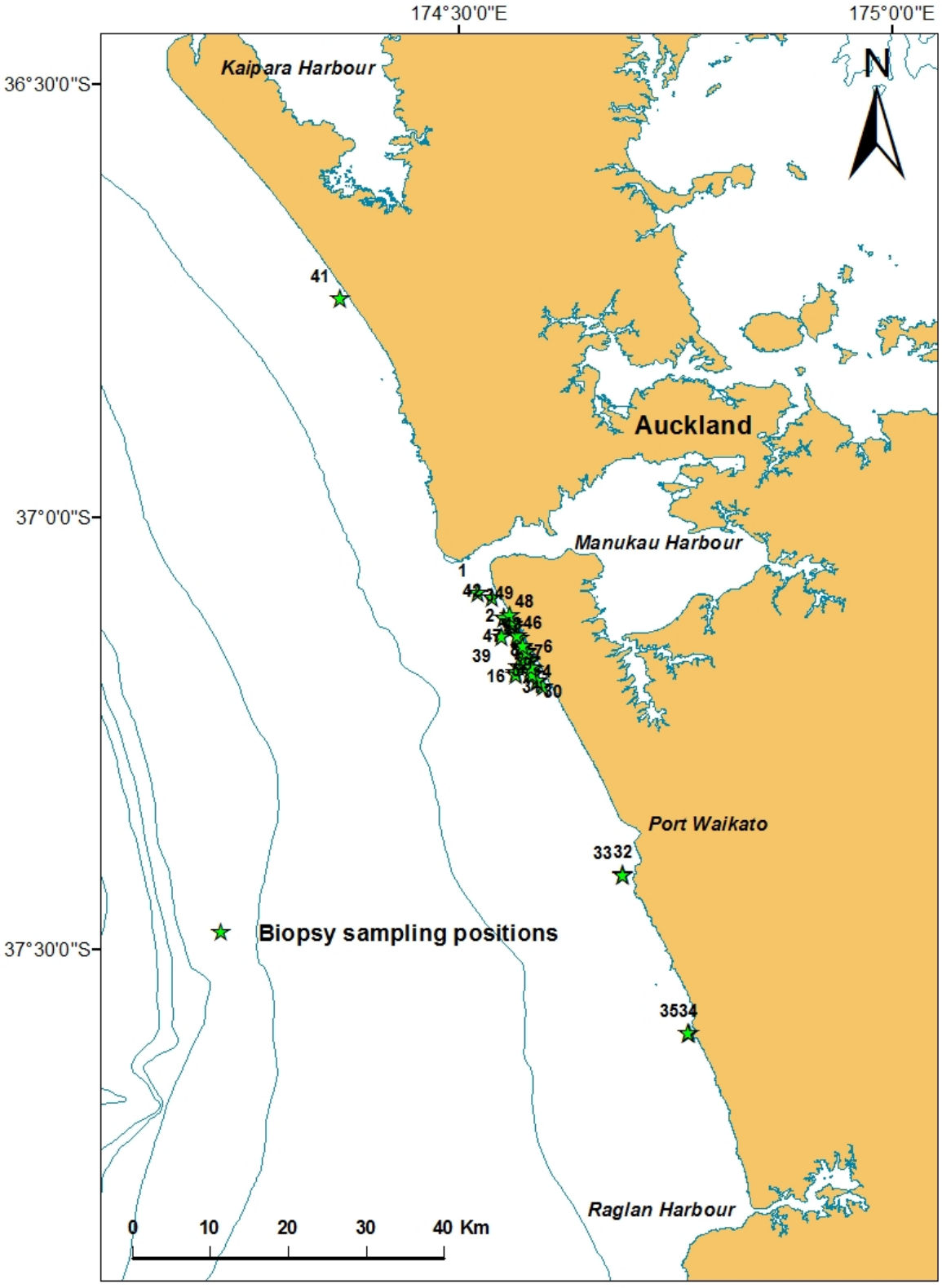


Figure 3. The geographic positions of 49 biopsy samples (44 of which retained tissue) from 10th February – 5th March 2016.

## DISCUSSION

During the 13 dedicated biopsy surveys, we were able to closely match the research effort in 2010, 2011 and 2015 and had good coverage of the Māui dolphin habitat and the edges of their core range. We were unable to survey further south than Tirua Point (south of Kawhia Harbour, Figure 1) due to challenging sea conditions with larger swells than in 2015, but we were successful with surveys north between Manukau and South Kaipara. We collected 44 small tissue biopsy samples (compared to 48 samples of 38 individual Māui dolphins in 2015, 37 samples of 26 individuals in 2010 and 36 samples of 27 individuals in 2011) so the sample size provides a robust platform for the genotype capture-recapture estimate for completion in October 2016. Dolphins were sighted across a wider geographical range than in 2015 but similar to 2010-2011 (Oremus et al. 2012). The core of the range remains south of the Manukau Harbour and north of Port Waikato.

We encountered a greater average number of groups per survey (5.1) than in previous years and had a greater number of surveys when groups were encountered (12/13 surveys) compared to 2015 (7/12 surveys). The average group size (minimum 3.6 – maximum 4.8 individuals) was similar to previous surveys (2010; 5-6 individuals and 2015; 5.0-5.7 individuals). These results continue the trend in reporting higher average group sizes than previous studies (e.g., Slooten et al. 2006, Rayment & Du Fresne 2007, Childerhouse et al. 2008), perhaps reflecting a seasonal tendency for social aggregations. There were often clear differentiations between groups during the surveys but on some occasions we noted splitting and joining of groups when in close proximity to each other, leading to a higher cumulative count.

Calves and juveniles were observed in 13.6% and 10.6% of groups respectively; this was similar to 2015 for the number of groups with calves (2015; 14.6%) but greater than 2015 (4.5%) for groups containing juveniles. Typically there was only a single calf present in a group (range = 0-2).

Dolphin reactions to biopsy sampling events were mild (Krützen et al. 2002, Tezanos-Pinto & Baker 2011), and overall similar to those found in the previous 2010-11 and 2015 surveys (Oremus et al. 2012, Constantine et al. 2015). The tissue biopsy samples are currently being analysed for sex-identification, sub-species confirmation and genotyping; once completed these results will be reconciled with the 2015 genotype data and a new abundance estimate will be generated.

After the completion of the dedicated biopsy surveys conducted aboard the MV *Tuatini*, we conducted four additional surveys in late March aboard a private charter vessel operating out of Raglan. These supplemental surveys focused on photo-identification and were supported by the Harbers Family Foundation. A summary of effort and sightings from these supplemental surveys is presented in Appendix 1, Supplemental Figures 1 and 2.

**ACKNOWLEDGEMENTS**

Garry Hickman and Karl McLeod did a great job handling the boat during some difficult seas whilst still keeping an eye out for the dolphins. Hannah Hendriks and Laura Boren made sure the surveys were possible and Hannah dealt with logistics getting everyone in the field. Thanks to the dedicated field team, Erin Breen, Rohan Currey, Olivia Hamilton, Rebecca Hamner, Hannah Hendriks, Sahar Izadi, Pippa Low and Andrew Wright, and thanks to Becky Lindsay and Leena Riekkola for plotting the data. We are grateful for the support of iwi for our research and thank to DOC in the Waikato and Auckland areas for their help. For generous support of the supplemental photo-identification surveys, we thank the Harbers Family Foundation and the field team, Brigitte Harbers, Renee Harbers, Chris Liddell, Anjanette Baker, Garry Hickman, Ian Angus, Cara Hansen and Craig Bridgman, skipper of the MV *Sea Thief*.

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## APPENDIX 1: Supplemental photo-identification surveys

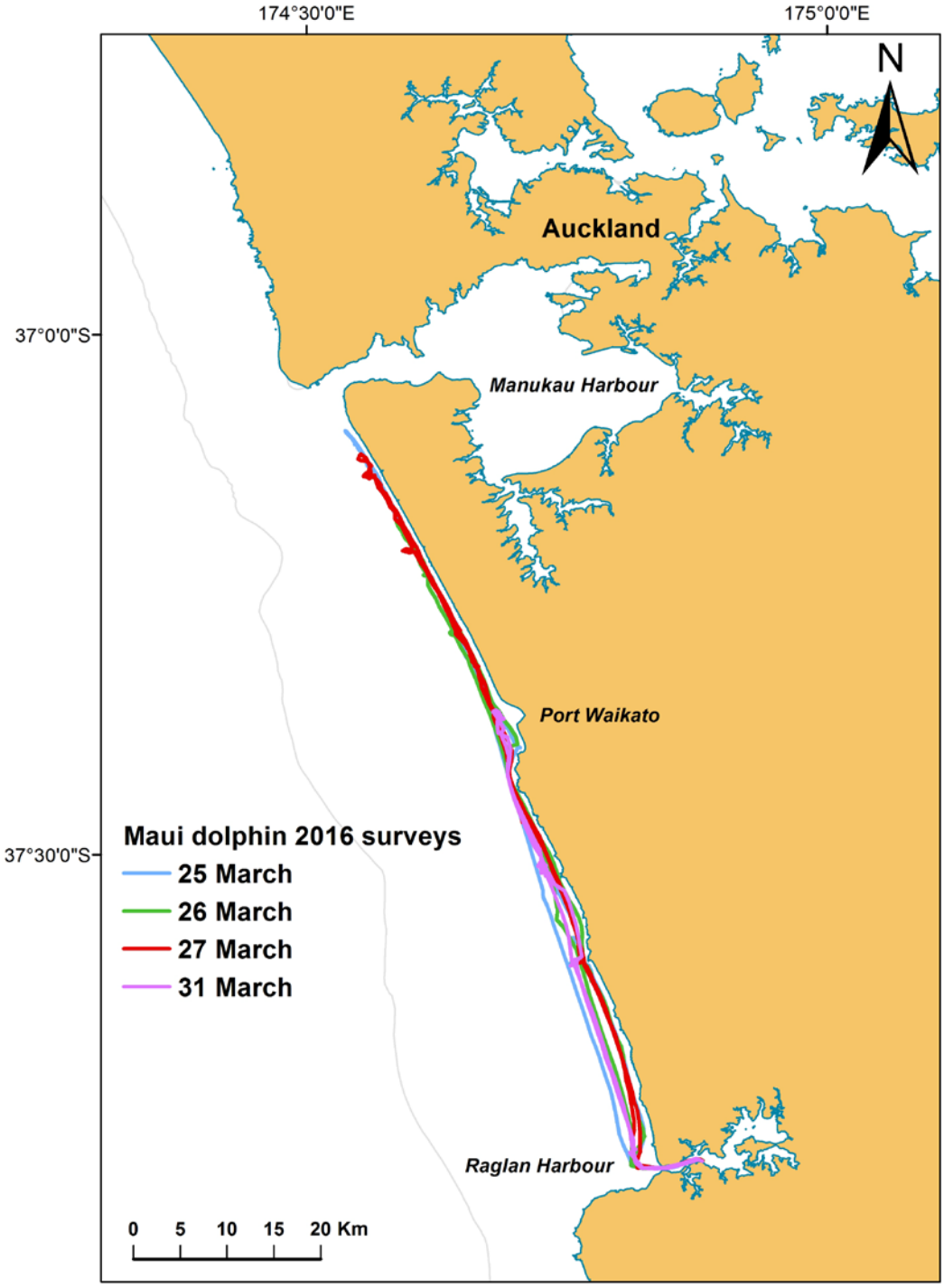
After the completion of the dedicated biopsy surveys, the Harbers Family Foundation provided support for supplemental surveys in late March, aboard the charter vessel MV *Sea Thief*, a 10 m, Westcoaster (powered by a 350 hp, 4-stroke outboard) operating out of Raglan (Supplemental Figure 1). These supplemental surveys focused on photo-identification – no biopsy samples were collected.

During the four surveys, there were 22 encounters with Māui dolphins (Supplemental Figure 2). It was notable that the dolphins were mostly encountered alone or in groups of two or three and showed little interest in approaching the boat or riding the bow. Within the range of the surveys, the dolphins also appeared more dispersed than earlier in the season. The southern-most encounter was a pair of dolphins just offshore of the Raglan bar, observed on 31st March.

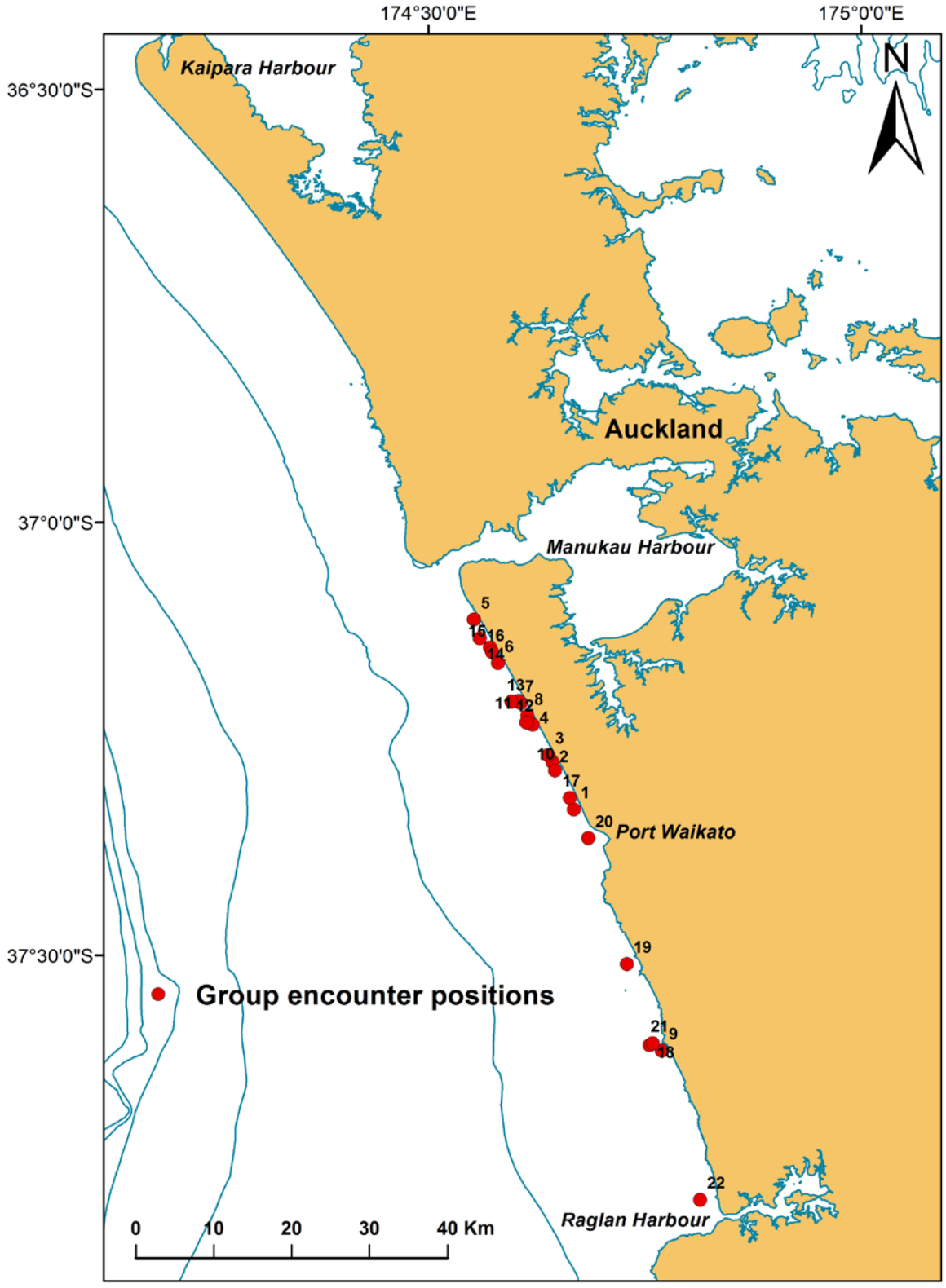
Photographs collected during the supplemental will be reconciled with those collected during the dedicated biopsy surveys and integrated into the photo-identification catalogue maintained at the University of Auckland.

The survey team included:

- Skipper: Craig Bridgman
- Photographers: Renee Harbers, Scott Baker
- Data recorders and observers: Chris Liddell, Anjanette Baker, Garry Hickman, Ian Angus, Cara Hansen




Supplemental Figure 1. Map of the study area and GPS tracks for the four supplemental photo-identification surveys conducted from 25th – 31st March 2016; after the dedicated abundance surveys were completed.




Supplemental Figure 2. The geographic positions of group encounters (n = 22) for a cumulative total of 47 dolphin sightings (including replicates) during supplemental surveys from 25th – 31st March 2016; after the dedicated abundance surveys were completed.