Small-Boat Surveys and Satellite Tagging of Cetaceans on the Pacific Missile Range Facility, Kaua‘i, in February 2024

Field survey report to NAVFAC Pacific
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Summary

As part of the long-term United States (U.S.) Navy-funded Marine Species Monitoring Program, from 11–19 February 2024, Cascadia Research Collective (CRC) carried out a vessel-based field effort in conjunction with passive acoustic monitoring undertaken by the U.S. Navy (Navy) scientists on and around the underwater hydrophone ranges of the Pacific Missile Range Facility (PMRF). The effort was timed to occur immediately prior to the start of a Submarine Command Course (SCC) to allow for collection of movement and dive data that could be used to examine exposure and response of cetaceans to Navy mid-frequency active sonar (MFAS; see Henderson et al. 2021). Eight days of field effort were funded by the Navy, and one day of field work was funded by National Oceanic and Atmospheric Administration (NOAA) Fisheries. Wildlife Computers SPLASH10-F satellite tags were funded by the Navy for deployment on Navy-priority species, and additional tags were provided by Wildlife Computers or CRC for deployment on other species (e.g., humpback whales [*Megaptera novaeangliae*]). Tags were programmed to collect dive behavior and Fastloc®-Global Positioning System (GPS) data from the time deployed until three and a half days after the end of the SCC and continue to transmit the dive and Fastloc®-GPS data for an additional six days. Starting on either May 2nd or May 3rd, the tags were duty cycled to transmit only every second day, to provide longer-term tracks of individual movements. During the period that tags were collecting dive and Fastloc®-GPS data, tags were programmed to try to obtain Fastloc®-GPS locations only for the 12 hours of the day when there were no or limited satellite overpasses. This programming change from previous Kaua‘i field efforts was taken to minimize temporal gaps in location data during the period that overlapped with and immediately followed the SCC. Field efforts were undertaken out of Kikiaola small boat harbor when conditions allowed for working on or near PMRF, or out of Port Allen when conditions on or near PMRF were not workable.

This interim field survey report provides a summary of small boat-based survey methodology (Appendix 1), survey effort (Figure 1), encounters (Table 1), and satellite tags deployed (Table 2; Figures 2-13). Weather forecasts over the nine days ranged from variable <10 knots (two

days), west 15 knots (one day), southwest 20 knots (one day), northeast 20 knots (one day), east 20 knots (one day), northeast 25 knots (two days), and north 25 knots (one day). Surveys were undertaken on eight days, with one day lost due to unworkable weather conditions (i.e., forecast southwest 20 knots). Overall, we covered 850 kilometers of trackline over 51 survey hours. Survey effort was spread broadly across the southernmost part of the PMRF, and included areas to the southeast of the range, off south Kaua‘i (on days when the area to the west was unworkable), and one day off eastern Kaua‘i, when conditions off the south shore were unworkable (Figure 1).

There were 20 encounters (i.e., groups approached) of seven different cetacean species, and one sighting of a Hawaiian monk seal, *Neomonachus schauinslandi* (Table 1). Cetacean encounters included six sightings of humpback whales, six sightings of short-finned pilot whales (*Globicephala macrorhynchus*), three sightings of rough-toothed dolphins (*Steno bredanensis*), two sightings of spinner dolphins (*Stenella longirostris*), and one sighting each of Blainville's beaked whales (*Mesoplodon densirostris*), common bottlenose dolphins (*Tursiops truncatus*), and pygmy killer whales (*Feresa attenuata*). Groups of humpback whales that were not approached were tallied throughout the day but were not included in encounter totals.

Six of the 20 total cetacean sightings (30%) were cued by analysts interpreting acoustic detections from the Navy's hydrophone range, including four of the six total short-finned pilot whale sightings, the Blainville's beaked whale sighting, and the common bottlenose dolphin sighting. In total, 23,558 photographs were taken of all seven encountered cetacean species for individual and species identification. There were 16 tagging attempts, resulting in 13 tag attachments onto four different species (Table 2). Of the three failed tagging attempts, two tags were lost, and one was recovered. Tags were deployed onto eight short-finned pilot whales (SPLASH10-F tags), three humpback whales (including two SPLASH10-F tags and one Argos location-only SPOT6 tag), one Blainville's beaked whale (SPLASH10-F tag), and one bottlenose dolphin (SPLASH10-F tag). All tags except for the Blainville's beaked whale tag successfully transmitted location data[1], including high-quality Fastloc®-GPS locations from all SPLASH10-F tags (Figures 2-13). Additionally, dive behavior data was received from all SPLASH10-F tags, with the exception of the Blainville's beaked whale tag (Figure 14). Six of the tag deployments overlapped temporally with Phase A of the SCC, and 12 overlapped temporally with Phase B (Table 2). All odontocete tags that successfully transmitted, and one of the humpback whale tags, remained on or in close proximity to the PMRF for the duration of the SCC (Figures 2-13). Data from all individuals have been provided to collaborating researchers with Naval Information Warfare Center Pacific (NIWCPAC) for analyses of received levels of MFAS, and for examination of potential behavioral changes associated with MFAS exposure. In addition, we collected one eDNA sample from the pygmy killer whale group, and seven biopsy samples from two different species (four from humpback whales, and three from rough-toothed dolphins). The biopsy samples have been shared with collaborators at the Southwest Fisheries Science Center for genetic analysis.

Preliminary photo-identification results are available for two species. The pygmy killer whale sighting represents only the fourth time that CRC has documented this species off Kaua‘i in field

[1] Details on location data processing are available in Kratofil et al. (2023).

efforts over 16 years, with approximately 27,000 km of survey effort off Kaua‘i and Ni‘ihau. A comparison of the 23 individuals from this encounter to CRC's long-term photo-identification catalog of pygmy killer whales (Baird et al. 2024) revealed that none of the individuals documented in this encounter had been previously identified, supporting previous work indicating that pygmy killer whales off the island are not part of a resident, island-associated population. The Blainville's beaked whale encounter was only the 10th encounter of this species off Kaua‘i or Ni‘ihau by CRC. All five individuals were photo-identified and compared to CRC's long-term photo-identification catalog (Baird 2019; McSweeney et al. 2007), two of which were re-sightings of individuals seen off Kaua‘i in 2019 and 2021, including a previously satellite tagged adult male.

Acknowledgements

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Literature Cited

Baird, R.W. 2019. Behavior and ecology of not-so-social odontocetes: Cuvier's and Blainville's beaked whales. In: Ethology and Behavioral Ecology of Toothed Whales and Dolphins, the Odontocetes. Edited by B. Würsig. Springer. https://doi.org/10.1007/978-3-030-16663-2_14

Baird, R.W., S.D. Mahaffy, B. Hancock-Hanser, T. Cullins, K.L. West, M.A. Kratofil, D.M. Barrios, A.E. Harnish, and P.C. Johnson. 2024. Long-term strategies for studying rare species: results and lessons from a multi-species study of odontocetes around the main Hawaiian Islands. Pacific Conservation Biology 30:PC23027. https://doi.org/10.1071/PC23027

Henderson, E.E., C.R. Martin, R.W. Baird, M.A. Kratofil, S.W. Martin, and B.L. Southall. 2021. FY20 Summary Report on the Received Level Analysis of Satellite Tagged Odontocetes at the Pacific Missile Range Facility. Naval Information Warfare Center Pacific. March 2021. Available from https://www.cascadiaresearch.org/files/publications/Hendersonetal2021.pdf

Kratofil, M.A., A.E. Harnish, S.D. Mahaffy, E.E. Henderson, A.L. Bradford, S.W. Martin, B.A. Lagerquist, D.M. Palacios, E.M. Oleson, and R.W. Baird. 2023. Biologically important areas II for cetaceans within U.S. and adjacent waters — Hawai‘i region. Frontiers in Marine Sciences 10:1053581. https://doi.org/10.3389/fmars.2023.1053581

McSweeney, D.J., R.W. Baird, and S.D. Mahaffy. 2007. Site fidelity, associations and movements of Cuvier's (*Ziphius cavirostris*) and Blainville's (*Mesoplodon densirostris*) beaked whales off the island of Hawai‘i. Marine Mammal Science 23(3):666–687. https://doi.org/10.1111/j.1748-7692.2007.00135.x

Table 1. Details of encounters with marine mammals during the February 2024 Kauaʻi field effort, sorted by species and date. Times are in Hawaiian Standard Time (HST).

Species	Date	Start-end time (HST)	Group size (best)	Start latitude (°N)	Start longitude (°W)	# photos	# tags deployed	# & type of samples
Blainville's beaked whale	13-Feb-24	1217-1358	5	22.09255	-159.88779	3,376	1	0
Common bottlenose dolphin	19-Feb-24	0802-0839	3	22.00580	-159.81220	327	1	0
Hawaiian monk seal	12-Feb-24	1202-1208	1	21.95039	-159.32351	1,063	0	0
Humpback whale	13-Feb-24	0936-0937	2	22.02882	-160.10281	109	0	0
Humpback whale	15-Feb-24	1036-1104	2	21.86470	-159.54621	114	0	1 biopsy
Humpback whale	16-Feb-24	1012-1227	5	21.88000	-159.53348	2,373	1	2 biopsy
Humpback whale	17-Feb-24	1115-1135	2	21.88832	-159.64649	243	0	1 biopsy
Humpback whale*	19-Feb-24	0912-1028	5	22.04442	-159.88121	361	1	0
Humpback whale	19-Feb-24	1101-1221	9	22.05444	-159.89053	1,141	2	0
Pygmy killer whale	12-Feb-24	1013-1107	23	22.12688	-159.21358	3,969	0	1 eDNA
Rough-toothed dolphin	16-Feb-24	0732-0746	5	21.87364	-159.63988	145	0	1 biopsy
Rough-toothed dolphin	17-Feb-24	0739-0754	9	21.88599	-159.77032	315	0	1 biopsy
Rough-toothed dolphin	17-Feb-24	0907-0917	20	21.83534	-159.58752	437	0	1 biopsy
Short-finned pilot whale	11-Feb-24	0855-1029	22	22.10772	-159.88586	1,636	2	0
Short-finned pilot whale	11-Feb-24	1104-1140	15	22.12306	-159.88300	618	0	0
Short-finned pilot whale	11-Feb-24	1146-1239	16	22.12309	-159.86828	800	1	0
Short-finned pilot whale	15-Feb-24	0748-0925	34	21.82974	-159.51036	2,875	2	0
Short-finned pilot whale	18-Feb-24	0815-1038	37	21.93096	-159.84010	2,045	1	0
Short-finned pilot whale*	19-Feb-24	0912-1005	15	22.04442	-159.88121	672	1	0
Spinner dolphin	15-Feb-24	1115-1131	23	21.89328	-159.58706	1,069	0	0
Spinner dolphin	17-Feb-24	0657-0701	40	21.93666	-159.70344	33	0	0

Note: eDNA = environmental DNA; Feb = February; HST = Hawaiian Standard Time; °N = degrees North; °W = degrees West.
*Mixed species encounter.

Table 2. Details of satellite tag deployments during the February 2024 Kauaʻi field effort, sorted by species and date.

Species	Date Deployed	Tag Type	Tag ID	# days location data	Comments
Blainville's beaked whale	13-Feb-24	SPLASH10-F	MdTag023	0.00	No location or dive data
Common bottlenose dolphin	19-Feb-24	SPLASH10-F	TtTag044	10.61	Phase B overlap
Humpback whale	16-Feb-24	SPLASH10-F	MnTag001	2.87	Phase A & B overlap
Humpback whale	19-Feb-24	SPLASH10-F	MnTag002	5.30	Phase B overlap
Humpback whale	19-Feb-24	SPOT6	MnTag003	2.97	Phase B overlap
Short-finned pilot whale	11-Feb-24	SPLASH10-F	GmTag251	18.94	Phase A & B overlap
Short-finned pilot whale	11-Feb-24	SPLASH10-F	GmTag252	25.86	Phase A & B overlap
Short-finned pilot whale	11-Feb-24	SPLASH10-F	GmTag253	16.40	Phase A & B overlap
Short-finned pilot whale	15-Feb-24	SPLASH10-F	GmTag254	16.40	Phase A & B overlap
Short-finned pilot whale	15-Feb-24	SPLASH10-F	GmTag255	53.38	Phase A & B overlap
Short-finned pilot whale	18-Feb-24	SPLASH10-F	GmTag256	31.60	Phase B overlap
Short-finned pilot whale	18-Feb-24	SPLASH10-F	GmTag257	42.82	Phase B overlap
Short-finned pilot whale	19-Feb-24	SPLASH10-F	GmTag258	32.85	Phase B overlap

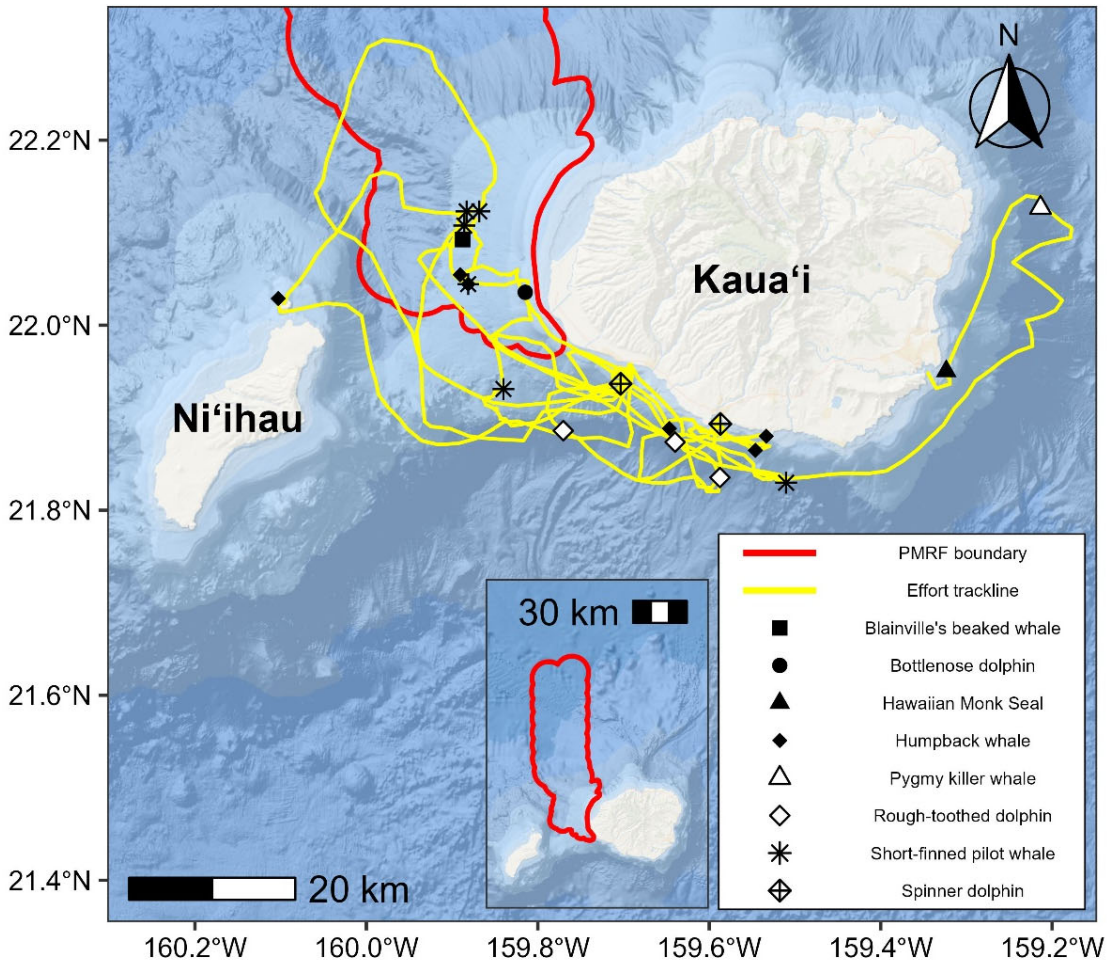

Figure 1. Search effort and odontocete sightings over eight days from 11 to 19 February 2024.

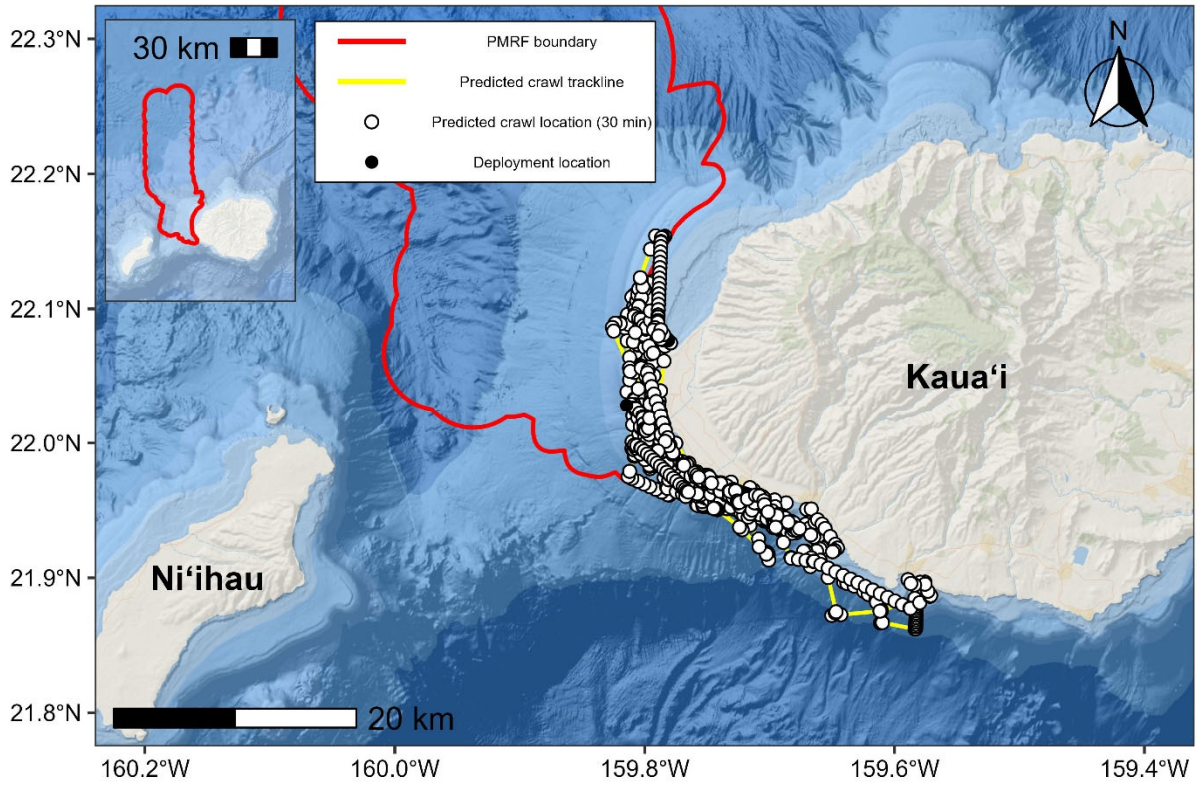

Figure 2. Predicted crawl trackline and 30-minute locations, re-routed around land using a 50-m land buffer for a common bottlenose dolphin (TtTag044) over an 11-day period from 19 February to 1 March 2024.

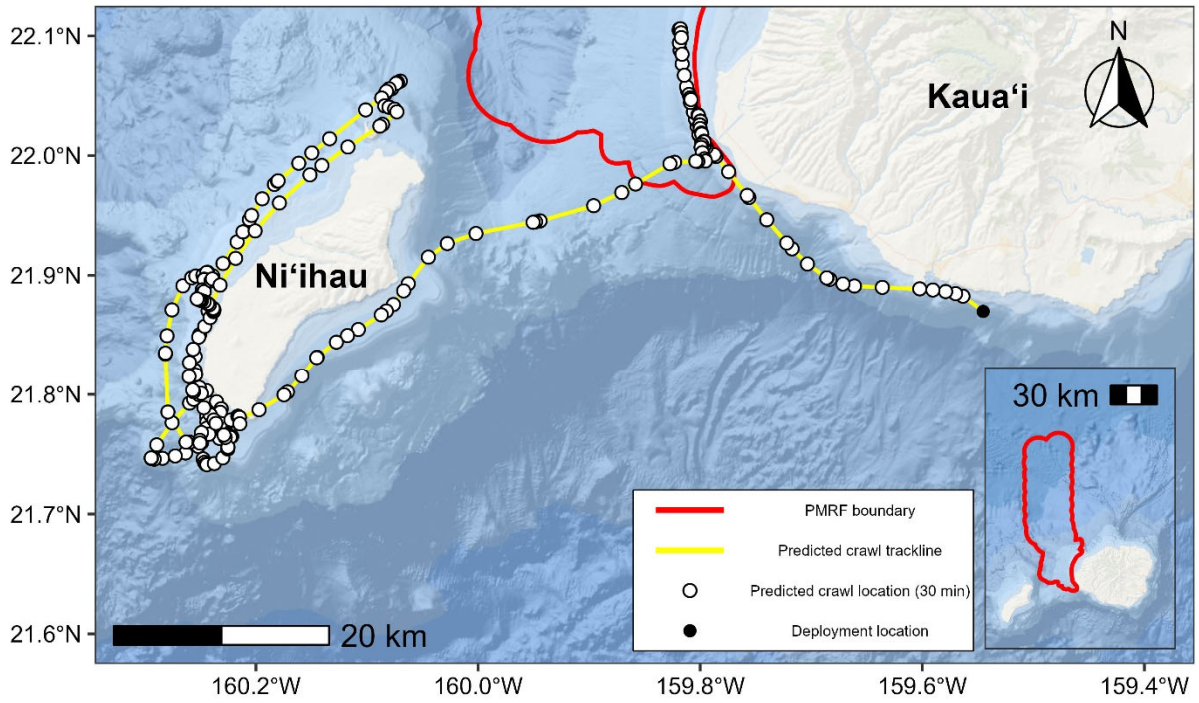

Figure 3. Predicted crawl trackline and 30-minute locations, re-routed around land using a 50-m land buffer for a humpback whale (MnTag001) over a 3-day period from 16 to 19 February 2024.

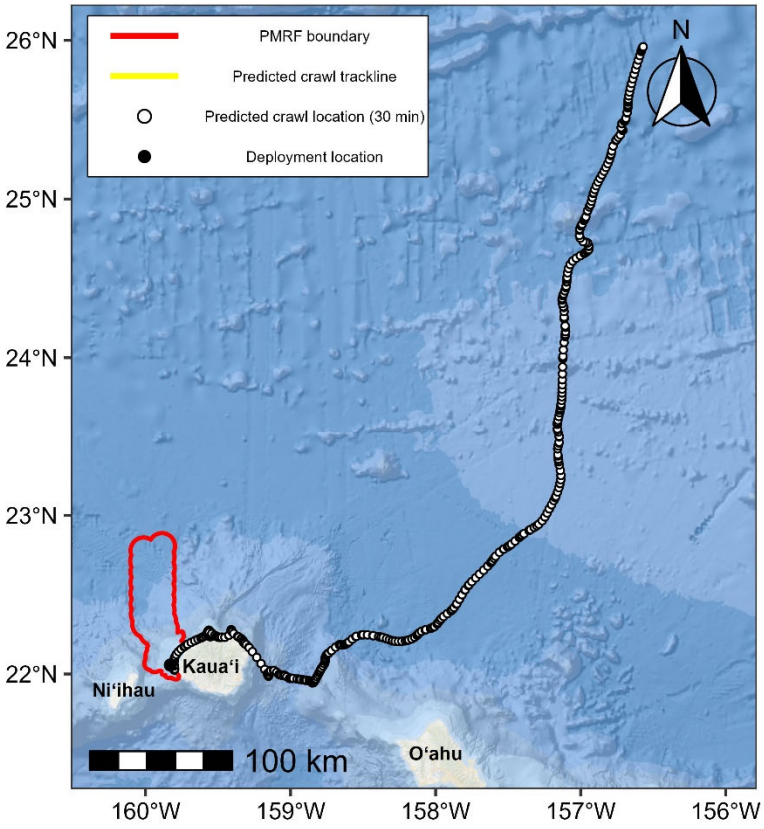

Figure 4. Predicted crawl trackline and 30-minute locations, re-routed around land using a 50-m land buffer for a humpback whale (MnTag002) over a 6-day period from 19 to 25 February 2024.

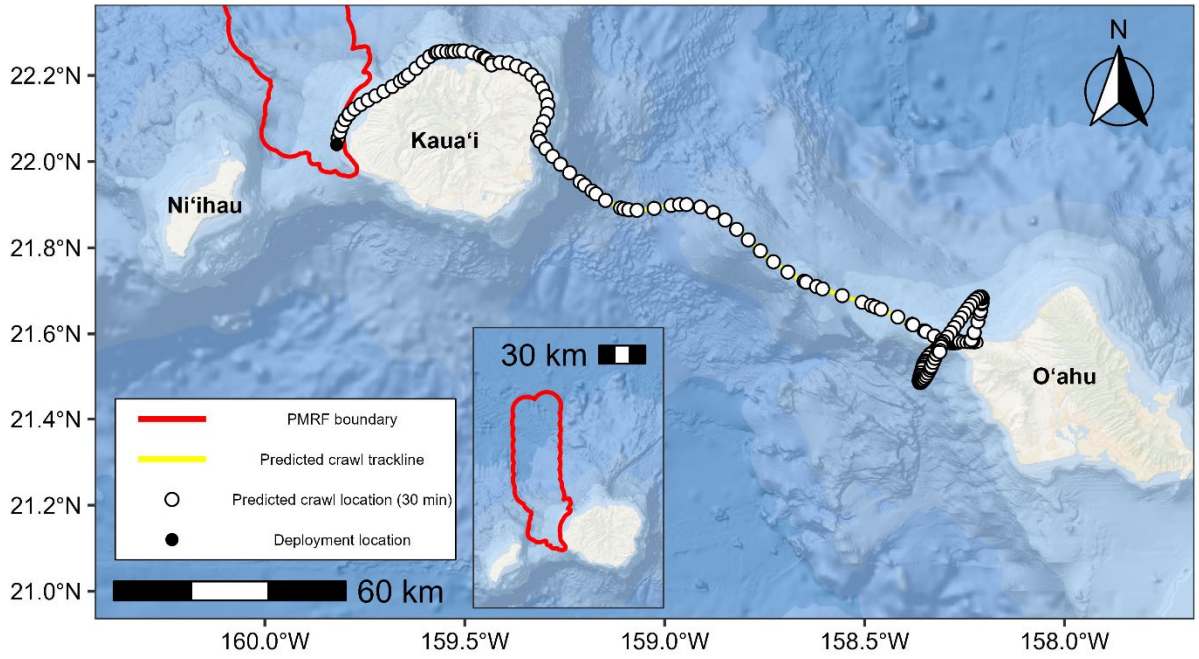

Figure 5. Predicted crawl trackline and 30-minute locations, re-routed around land using a 50-m land buffer for a humpback whale (MnTag003) over a 3-day period from 19 to 22 February 2024.

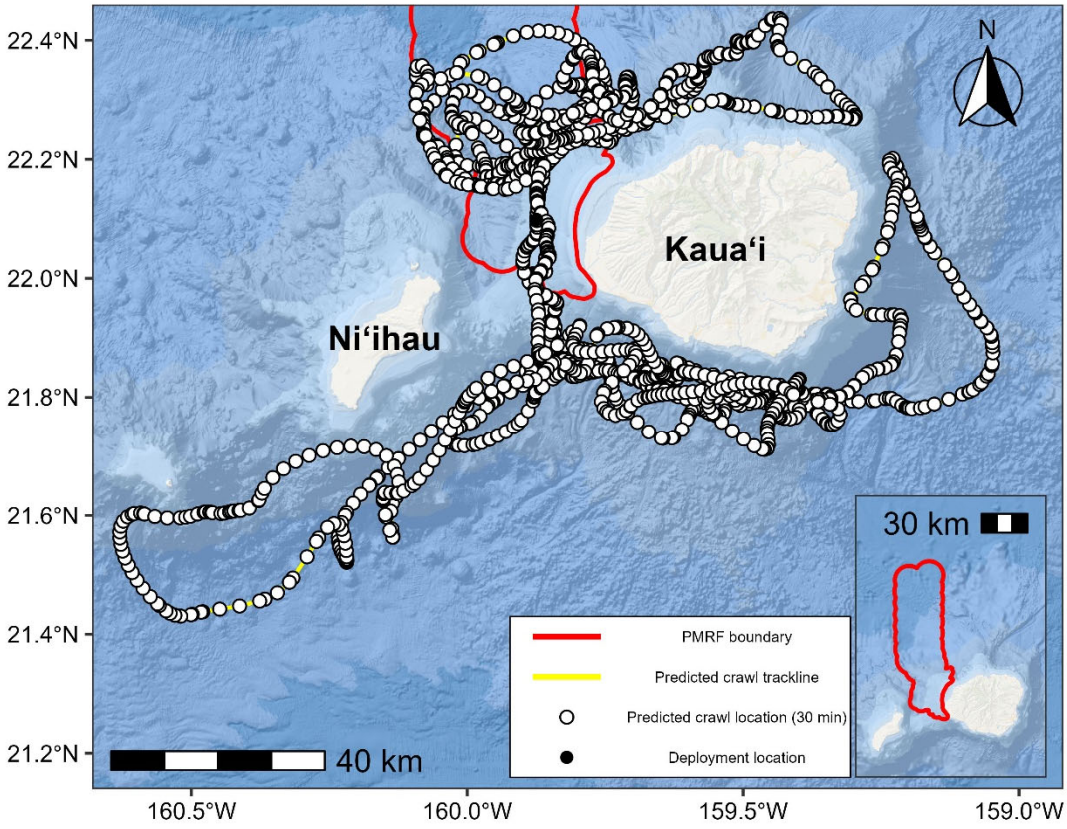

Figure 6. Predicted crawl trackline and 30-minute locations, re-routed around land using a 300-m isobath buffer for a short-finned pilot whale (GmTag251) over a 19-day period from 11 February to 1 March 2024.

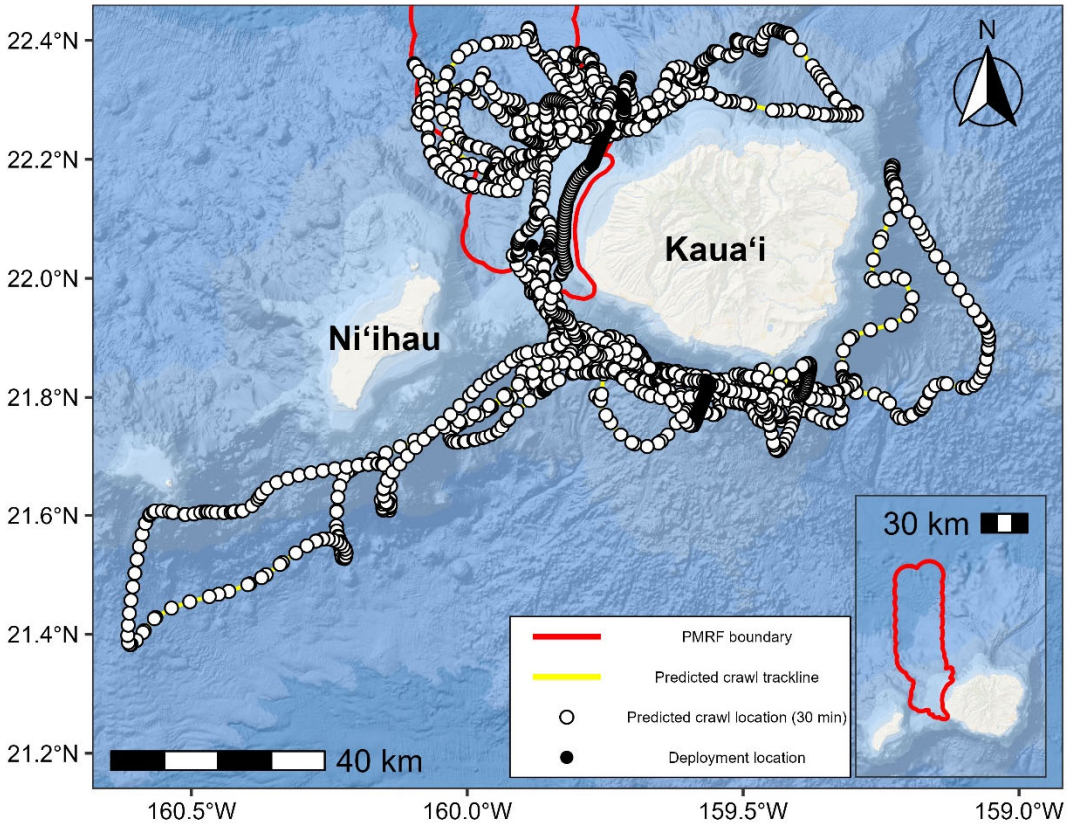

Figure 7. Predicted crawl trackline and 30-minute locations, re-routed around land using a 300-m isobath buffer for a short-finned pilot whale (GmTag252) over a 26-day period from 11 February to 8 March 2024. Note, this tag began duty cycling (transmitting only every second day) on 3 March.

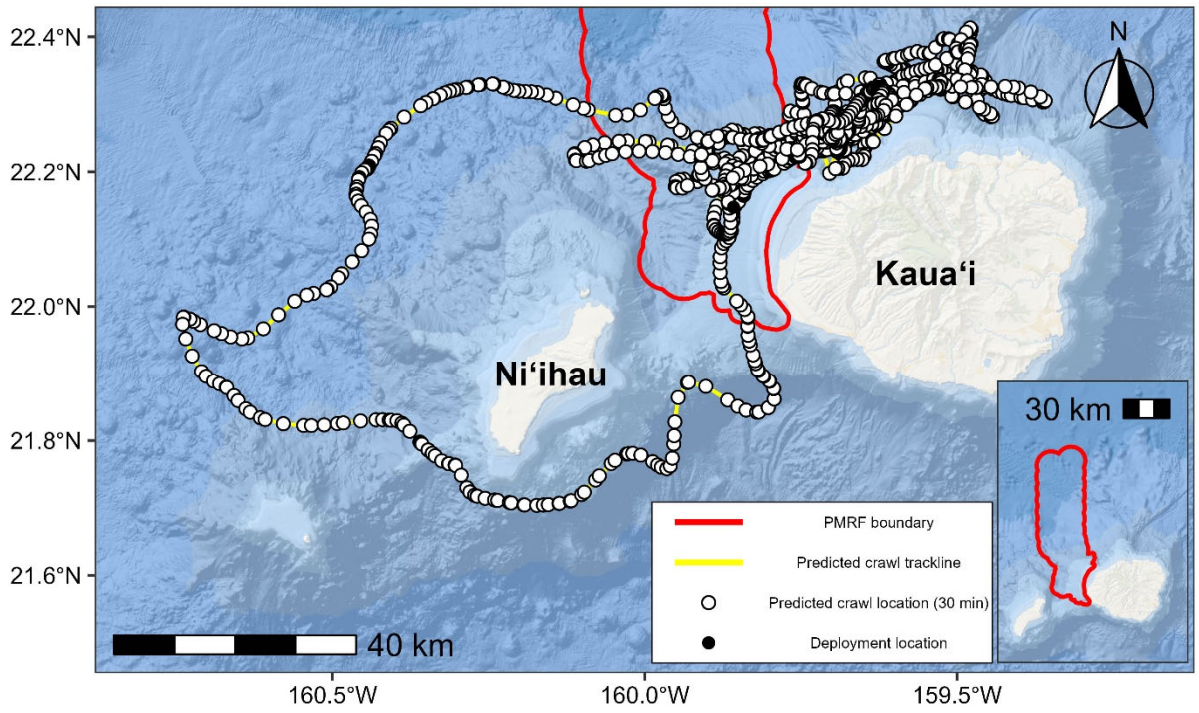

Figure 8. Predicted crawl trackline and 30-minute locations, re-routed around land using a 300-m isobath buffer for a short-finned pilot whale (GmTag253) over a 17-day period from 11 to 28 February 2024.

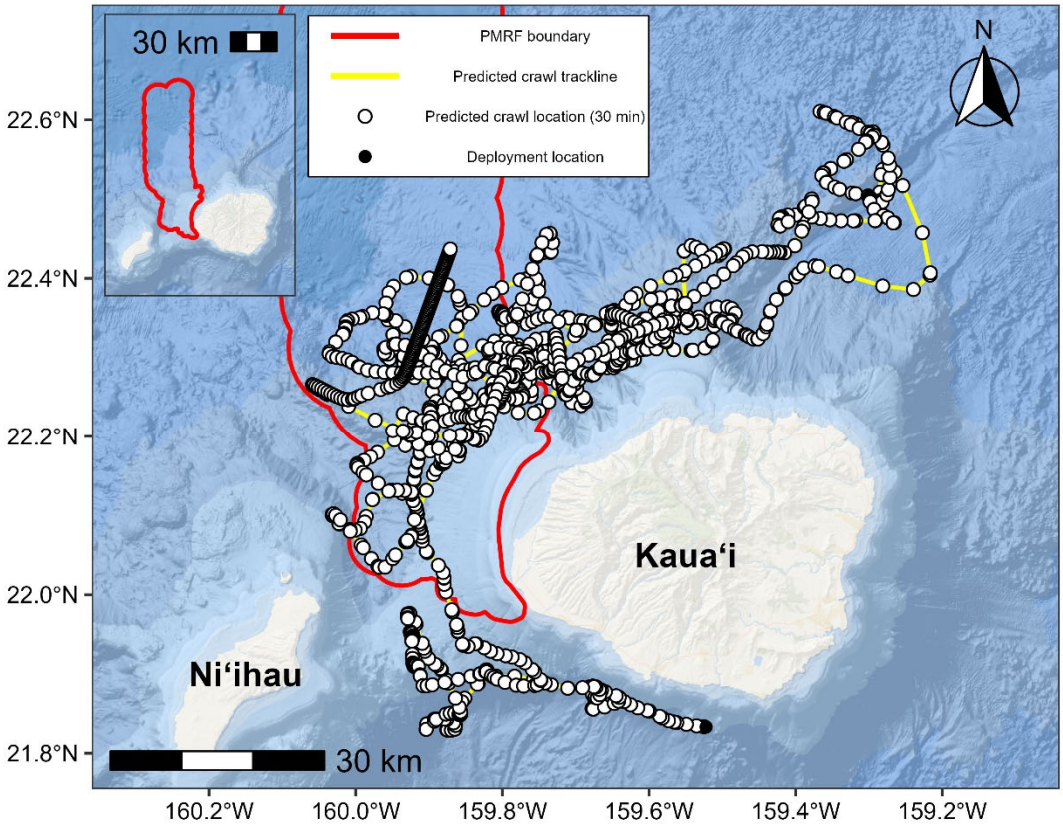

Figure 9. Predicted crawl trackline and 30-minute locations, re-routed around land using a 300-m isobath buffer for a short-finned pilot whale (GmTag254) over a 17-day period from 15 February to 3 March 2024. Note, this tag began duty cycling (transmitting only every second day) on 2 March, thus generating linear series of locations during the periods when the tags were not transmitting.

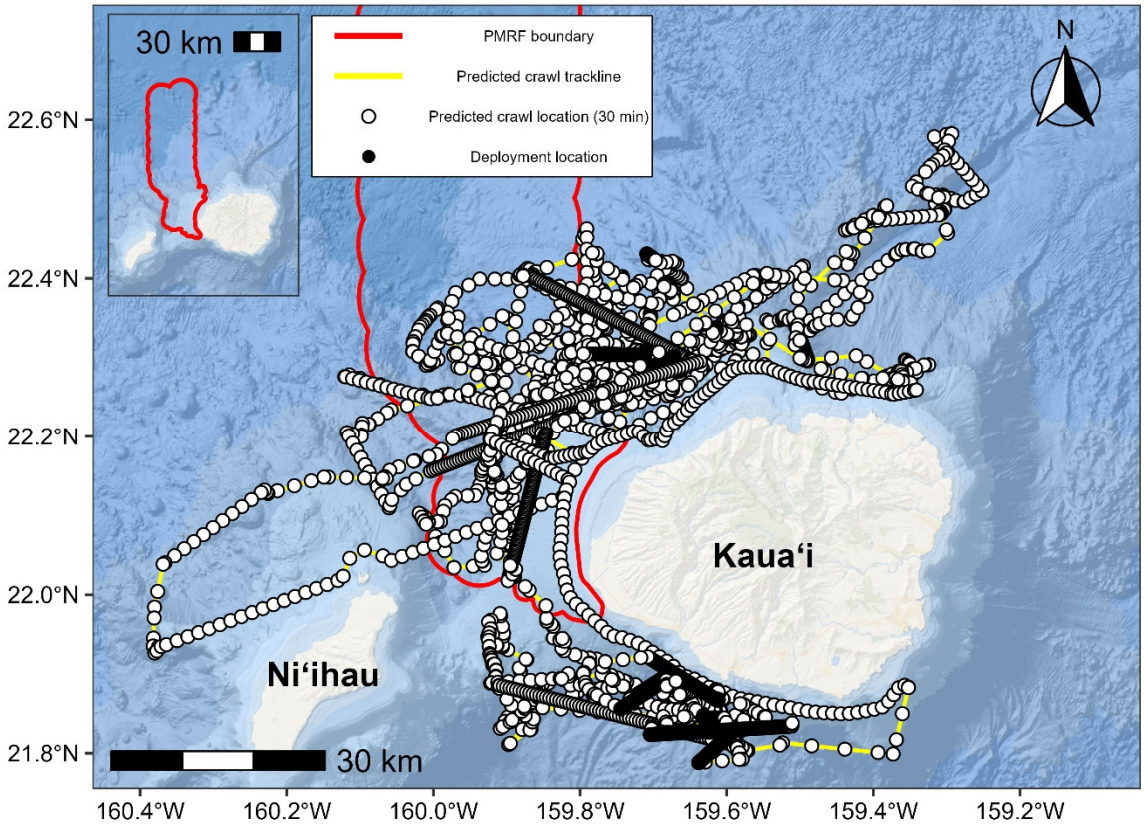

Figure 10. Predicted crawl trackline and 30-minute locations, re-routed around land using a 300-m isobath buffer for a short-finned pilot whale (GmTag255) over a 54-day period from 15 February to 9 April 2024. Note, this tag began duty cycling (transmitting only every second day) on 2 March, thus generating linear series of locations during the periods when the tags were not transmitting.

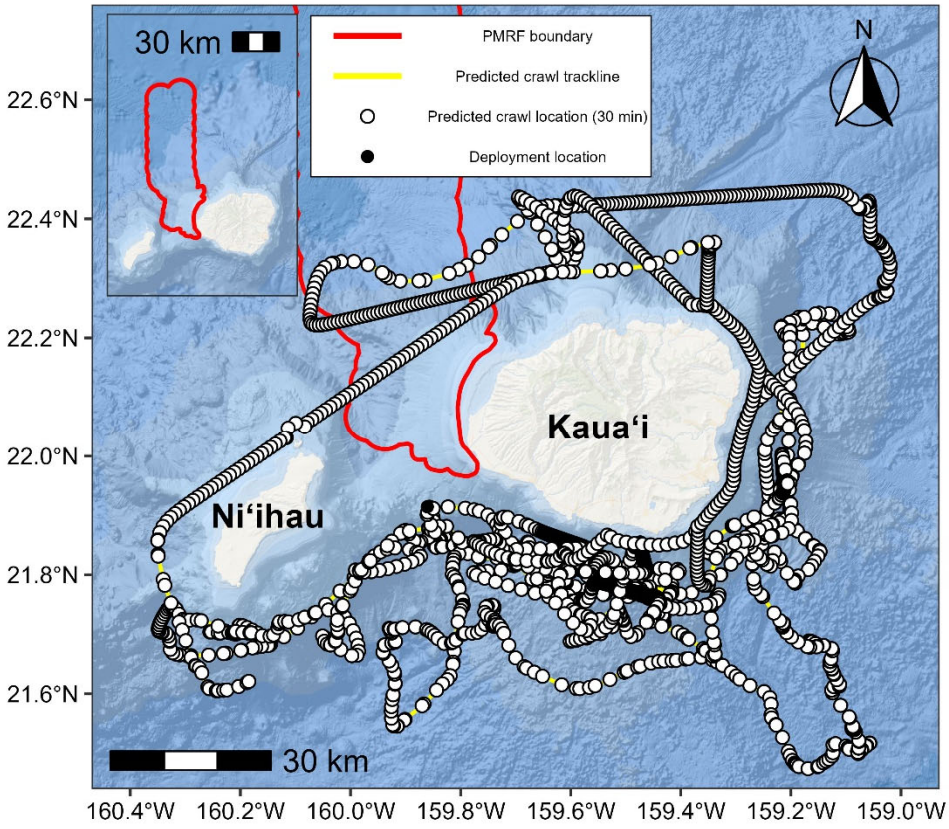

Figure 11. Predicted crawl trackline and 30-minute locations, re-routed around land using a 300-m isobath buffer for a short-finned pilot whale (GmTag256) over a 32-day period from 18 February to 21 March 2024. Note, this tag began duty cycling (transmitting only every second day) on 2 March, thus generating linear series of locations during the periods when the tags were not transmitting.

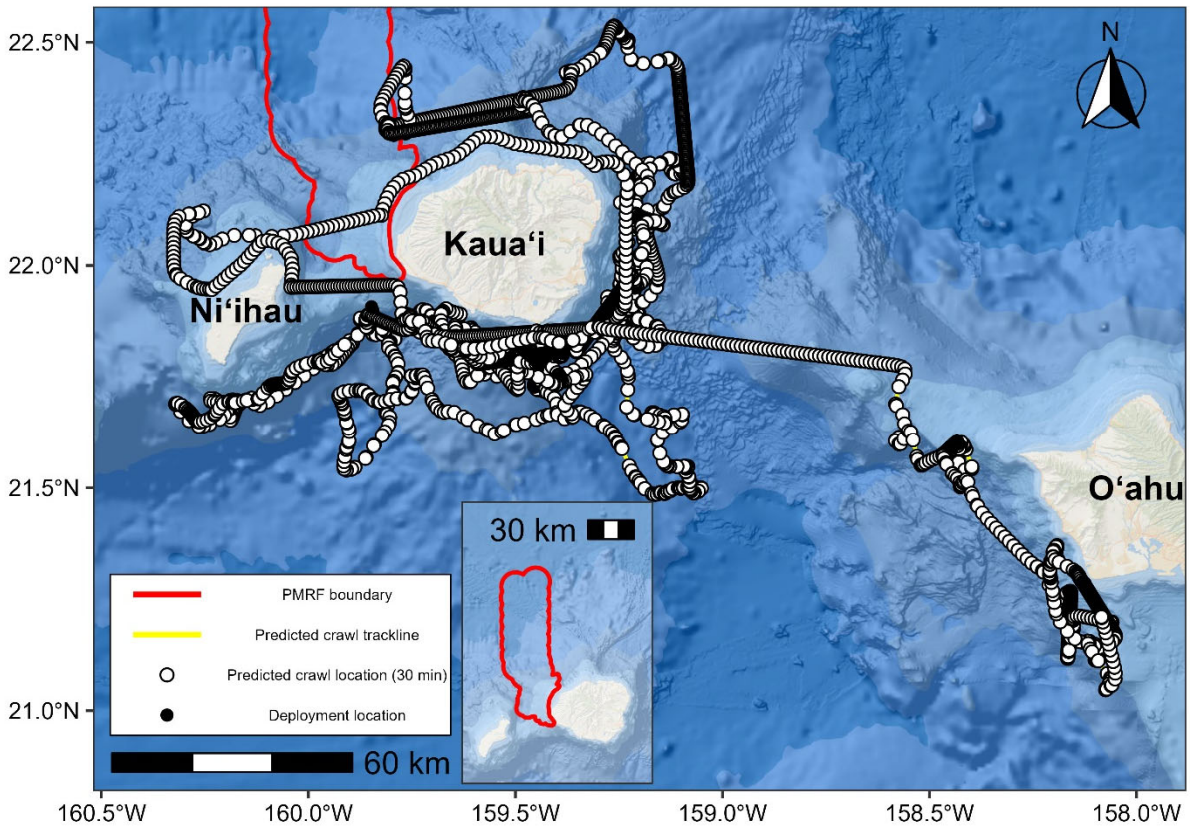

Figure 12. Predicted crawl trackline and 30-minute locations, re-routed around land using a 300-m isobath buffer for a short-finned pilot whale (GmTag257) over a 43-day period from 18 February to 1 April 2024. Note, this tag began duty cycling (transmitting only every second day) on 3 March, thus generating linear series of locations during the periods when the tags were not transmitting.

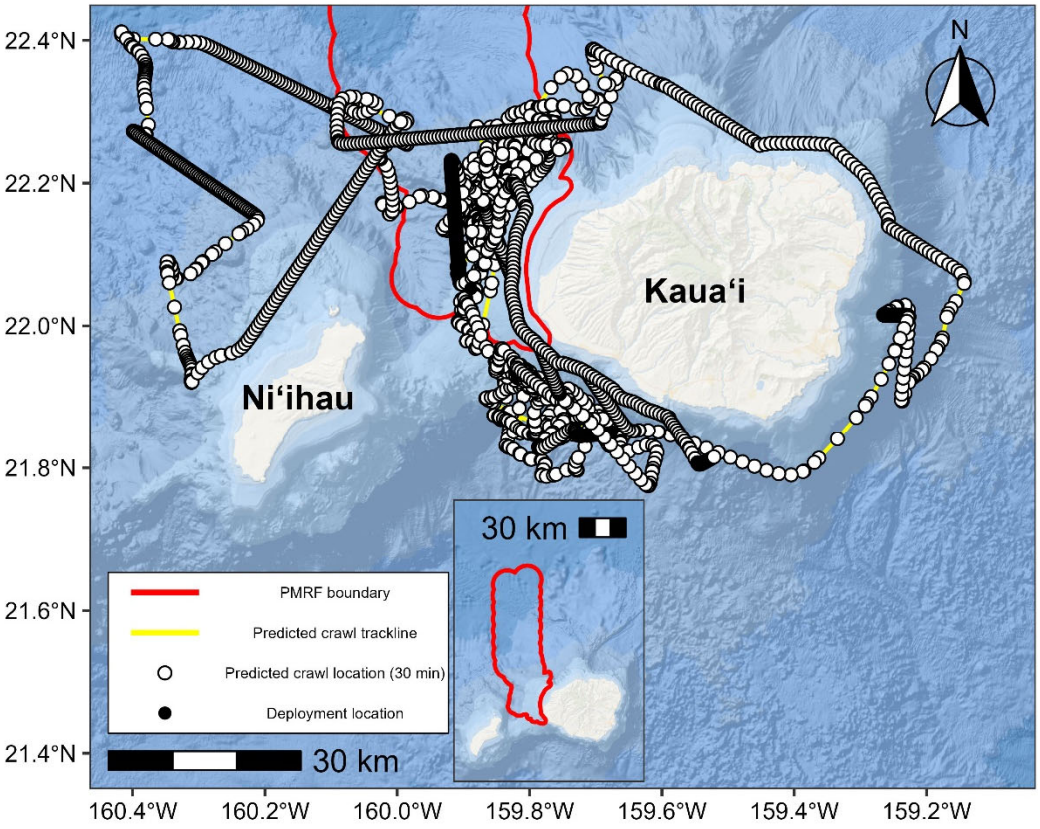

Figure 13. Predicted crawl trackline and 30-minute locations, re-routed around land using a 300-m isobath buffer for a short-finned pilot whale (GmTag258) over a 33-day period from 19 February to 23 March 2024. Note, this tag began duty cycling (transmitting only every second day) on 2 March, thus generating linear series of locations during the periods when the tags were not transmitting.

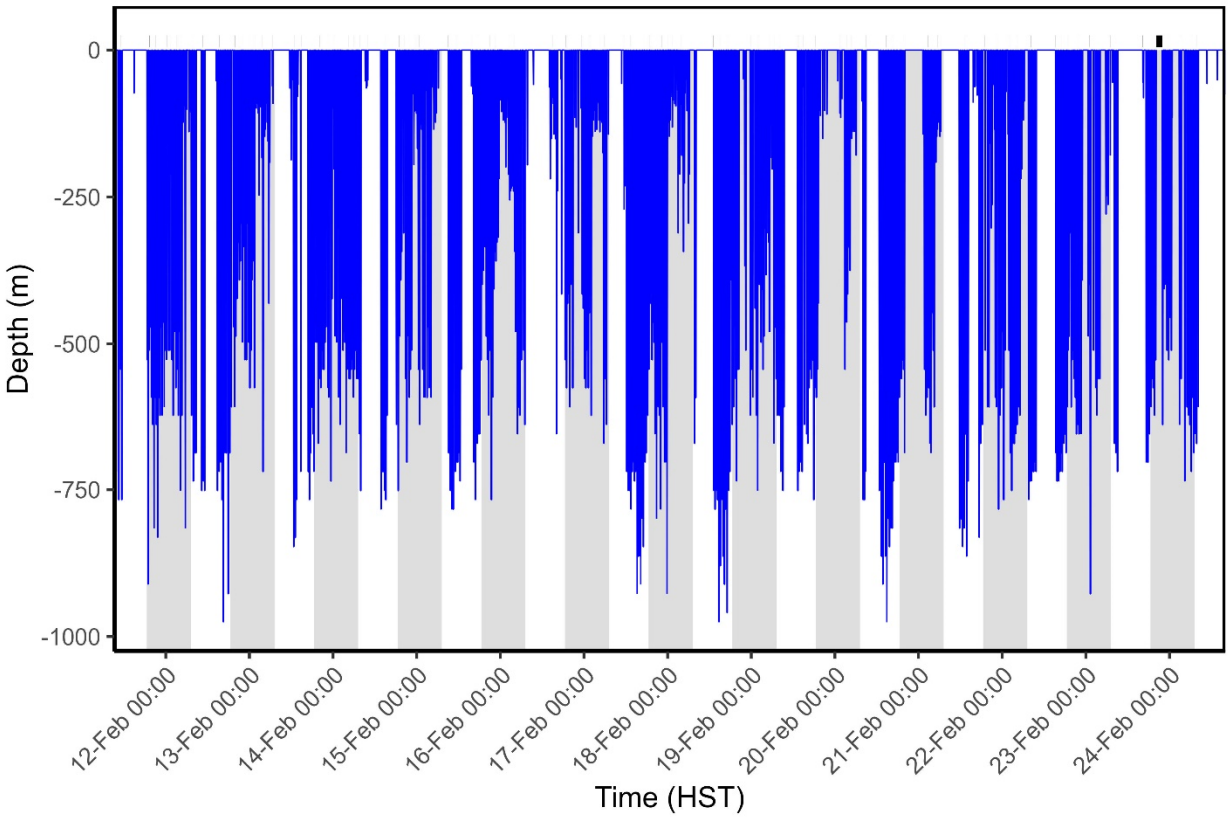

Figure 14. An example of dive behavior data obtained from a short-finned pilot whale (GmTag251) over a 14-day period from 11 to 24 February 2024. Nighttime periods are shaded, and gaps in the data are indicated as black boxes above the dive profiles.

Appendix 1. Field Survey Methods

The field project was timed to occur over a 9-day span immediately prior to a Submarine Command Course (SCC) scheduled to occur in February 2024. One day of field work was lost due to poor weather conditions, but the vessel conducted eight days of dedicated survey effort during this time. Field operations began two days before Phase A of the SCC started. The vessel used was a 24-foot (7.3-meter) rigid-hulled inflatable, powered by twin Yamaha 150 horsepower outboard engines, and with a custom-built bow pulpit for tagging and biopsy operations. The vessel was launched each morning at or prior to sunrise, and operations continued during daylight hours as long as weather conditions were suitable, with a team of five to seven observers scanning 360 degrees around the vessel. Vessel locations were recorded on a Global Positioning System (GPS) unit at 5-minute intervals.

When weather conditions permitted and there were no range access constraints, the primary area of operations was the Pacific Missile Range Facility (PMRF) instrumented hydrophone range, with a focus on deep-water areas to increase the likelihood of encountering high-priority species (see below). Coordination with analysts from Marine Mammal Monitoring on Navy Ranges (M3R) and Naval Information Warfare Center Pacific (NIWC PAC) was undertaken for all days when weather conditions allowed access to the range or areas near the range. When positions from analysts were available, the vessel would transit to specific locations in response to the positions and would survey areas for visual detection of groups. Positions of probable bottlenose dolphins or rough-toothed dolphins, as determined by analysts, were not responded to unless no high-priority species were detected in areas that were accessible. When conditions on the PMRF were sub-optimal and there were better conditions elsewhere, if there was no vocal activity on the range from priority species, or if the range was closed because of Navy activity, the vessel team worked in areas off the range. The vessel team communicated each morning with PMRF Range Control prior to entering the range and remained in regular contact with Range Control throughout the day as needed to determine range access limitations.

Research was undertaken under the National Marine Fisheries Service Marine Mammal Protection Act/Endangered Species Act Scientific Research Permit No. 26596. Each group of odontocetes encountered was approached for positive species identification. When more than one species was present in a group, they were recorded as separate sightings, and details were noted on the spacing and interactions among the species. Decisions on how long to stay with each group and the type of sampling (e.g., photographic, tagging, biopsy) depended on a variety of factors, including current weather conditions and weather outlook, information on other potentially higher-priority species in the area (typically provided by M3R), and the relative encounter rates. Species encountered infrequently (short-finned pilot whales, pygmy killer whales, Blainville's beaked whales) were given higher priority than frequently encountered species (bottlenose dolphins, rough-toothed dolphins, spinner dolphins, humpback whales). Extended work with frequently encountered species was typically only undertaken when no other higher priority species were in areas suitable for working.

In general, species were photographed for species confirmation and individual identification. For each encounter, information was recorded on the start and end time and the location of encounter, group size (minimum, best, and maximum estimates), sighting cue (e.g., acoustic

detection from M3R, splash, radio call from another vessel), start and end behavior and direction of travel, the group envelope (i.e., the spatial spread of the group in two dimensions), the estimated percentage of the group observed closely enough to determine the number of calves and neonates in the group, the number of individuals bow-riding, and information necessary for permit requirements.

For priority species, if conditions were suitable, we attempted to deploy at least one satellite tag per group. Tags used for these species were depth-transmitting SPLASH10-F (Fastloc®-GPS). When more than one tag deployment was attempted within a single group, the second individual to be tagged was not closely associated with the first.

Skin/blubber biopsy samples were collected with a crossbow using an 8-millimeter-diameter dart tip with a stop that prevented penetration greater than approximately 15 millimeters. Biopsy samples were sub-sampled for a number of ongoing studies through the Southwest Fisheries Science Center and the University of Hawai‘i.