Small-Boat Surveys and Satellite Tagging of Cetaceans on the Pacific Missile Range Facility, Kaua‘i, in February 2025

Field survey report to NAVFAC Pacific under Federal contract number N62470-20-D-0016, Task Order No. 24F0225, issued to HDR

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Summary

As part of the long-term United States Navy (Navy)-funded Marine Species Monitoring Program, from 9 to 18 February 2025, Cascadia Research Collective (CRC) carried out a vessel-based field effort in conjunction with passive acoustic monitoring undertaken by Navy scientists on and around the underwater hydrophone ranges of the Pacific Missile Range Facility (PMRF). The effort was timed to start 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. 2025). This field survey report provides a summary of small vessel-based survey methodology (Appendix I), survey effort (Figure 1), encounters (Table 1), and satellite tag deployments (Table 2; Figures 2-12). Eight days of field effort were funded by the Navy, and one day of fieldwork was funded by a grant from the National Oceanic and Atmospheric Administration. Over the nine-day period, we were able to survey eight days, covering 1,117 kilometers of trackline over 66 survey hours. Survey effort was focused on the southernmost part of the PMRF (Figure 1). Survey effort was also conducted on a day of transit from Kaua‘i to O‘ahu at the conclusion of the effort (details not included).

There were 54 encounters with 11 species of cetaceans and one brief sighting of an unidentified delphinid that took place during an encounter with a group of short-finned pilot whales (*Globicephala macrorhynchus*, Table 1). Nineteen of the sightings (35 percent) were cued by analysts (from the Naval Undersea Warfare Center and Naval Information Warfare Center) interpreting acoustic detections from the Navy’s hydrophone range. Encounters included 24 sightings of rough-toothed dolphins (*Steno bredanensis*), 12 sightings of humpback whales (*Megaptera novaeangliae*), six sightings of short-finned pilot whales, three sightings each of Blainville’s beaked whales (*Mesoplodon densirostris*) and spinner dolphins (*Stenella longirostris*), one sighting of common bottlenose dolphins (*Tursiops truncatus*), one sighting of false killer whales (*Pseudorca crassidens*), one sighting of fin whales (*Balaenoptera physalus*), one sighting of a *Kogia* sp., one sighting of melon-headed whales (*Peponocephala electra*), and one sighting of pygmy killer whales (*Feresa attenuata*).

Over the course of the field effort, 26,107 photos were taken for species and individual identification. Samples collected included two eDNA samples (one from a pair of fin whales and one from a group of pygmy killer whales), two fecal samples from short-finned pilot whales during two different encounters, one breath sample from a rough-toothed dolphin, and five biopsy samples from three species (two each from false killer whales and short-finned pilot whales and one from a rough-toothed dolphin; Table 1). Skin sub-samples of biopsy samples have been shared with collaborators at the Southwest Fisheries Science Center for genetic analysis, while the remaining skin and blubber from biopsy samples, as well as fecal samples and the breath sample, have been archived at the University of Hawai‘i Health and Stranding Lab.

Wildlife Computers SPLASH10-F Low Impact Minimally Percutaneous External-electronics Transmitter (LIMPET) satellite tags were programmed to collect dive behavior and Fastloc®-Global Positioning System (GPS) data from the time they were deployed until three and a half days after the end of the SCC. There were 11 tagging attempts, resulting in 10 tag attachments onto four species (Table 2). The one failed tagging attempt, during a Blainville's beaked whale encounter, resulted in tag loss. Tags were successfully deployed onto four short-finned pilot whales (from three different groups), three rough-toothed dolphins, two false killer whales, and one Blainville's beaked whale, and all successfully transmitted location[1] (including high-quality Fastloc®-GPS locations) and behavior data (Table 2; Figures 2-12). Six of the tag deployments overlapped temporally with Phase A of the SCC, and all ten overlapped temporally with Phase B (Table 2). Data from all individuals have been provided to collaborating researchers with the Naval Information Warfare Center Pacific for analyses of received levels of MFAS.

Several of the species that were sighted are not commonly encountered off Kaua‘i and Ni‘ihau. Our encounter with fin whales was only the second sighting of this species off Kaua‘i in 17 years of CRC survey effort and was the first mother-calf pair that CRC has encountered in the Hawaiian Islands. The adult female from this encounter was compared to CRC's Hawai‘i fin whale photo-identification catalog but yielded no matches. Additionally, prior to this effort, CRC had only encountered Blainville's beaked whales off Kaua‘i and Ni‘ihau ten times. The data collected from our three encounters with Blainville's beaked whales over the course of this field project therefore represent a substantial increase in our understanding of this species off those islands. One individual each from the first two encounters with Blainville's beaked whales matched to the long-term photo-identification catalog for this species, and the known individual from the second encounter had been tagged off Kaua‘i in 2021 (MdTag020 in Henderson et al. 2025). However, there were no matches between the three encounters, and no individuals from the third Blainville's beaked whale encounter (that included a successful tag deployment) had been previously sighted. Our sightings of Northwestern Hawaiian Islands (NWHI) false killer whales and pygmy killer whales are also particularly notable, as we have only encountered NWHI false killer whales six times previously, all off Kaua‘i (Kratofil et al. 2023), and have only encountered pygmy killer whales off Kaua‘i and Ni‘ihau four times previously (Baird et al. 2024a, 2024b), with field efforts off the islands in 17 different years. Two of the four individuals from the NWHI false killer whale encounter were matched to the CRC long-term photo-identification catalog for this species and had been seen most recently in June 2012 and February 2020 off Kaua‘i. Five individuals from the pygmy killer whale encounter were also compared to the photo-identification catalog but yielded no matches, supporting previous work indicating that

[1] Details on location data processing are available in Kratofil et al. (2023), including steps taken to generate the continuous time-correlated random walk movement models in Figures 2-11.

pygmy killer whales off Kauaʻi are not part of a resident, island-associated population (Baird et al. 2024a).

Acknowledgements

We thank Nancy DiMarzio, Alexandra Carroll, and Elizabeth Henderson for acoustic support; Adrian Burke, Jessica Chen, Elizabeth Henderson, Lynn Opritoiu, James Powell, Kuʻulei Rita, Jennifer Rothe, and Jamie Thomton for their assistance on the water; Jessica Chen and Cathy Bacon for comments on this report, and Waimea Plantation Cottages for accommodating our crew and research vessel on site. Research was undertaken under NMFS ESA/MMPA Permit No. 26596 and was approved by the CRC Institutional Animal Care and Use Committee.

Literature Cited

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. 2024a. 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

Baird, R.W., A.E. Harnish, R.D. Andrews, J.K. Lerma, M.A. Mohler, J.E. Phipps, and S.D. Mahaffy. 2024b. Small-boat surveys and satellite tagging of cetaceans on the Pacific Missile Range Facility, Kauaʻi, in February 2024. Field survey report to U.S. Pacific Fleet by HDR, under Federal contract number N62470-20-D-0016, Task Order No. 24F0102. May 2024.

Henderson, E.E., M.A. Kratofil, R.W. Baird, C.R. Martin, A.E. Harnish, G. Alongi, S.W. Martin, and B.L. Southall. 2025. Exposure and response of satellite-tagged Blainville's beaked whales to mid-frequency active sonar off Kauaʻi, Hawaiʻi. Movement Ecology 13:29. https://doi.org/10.1186/s40462-025-00550-9

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 - Hawaiʻi region. Frontiers in Marine Sciences 10:1053581. https://doi.org/10.3389/fmars.2023.1053581

Table 1. Details of cetacean encounters during the February 2025 Kaua‘i field effort, sorted by species and date.

Species	Date	Start-end time (HST)	Group size (best)	Start latitude (°N)	Start longitude (°W)	# photos	# tags	# & type of samples
Blainville’s beaked whale	09-Feb-25	1319-1345	6	22.18687	-159.89889	1826	0	0
Blainville’s beaked whale	10-Feb-25	0938-0945	6	22.16087	-159.94820	852	0	0
Blainville’s beaked whale	15-Feb-25	0820-0856	4	22.15388	-159.88579	630	1	0
Common bottlenose dolphin	17-Feb-25	0805-0810	2	21.94519	-159.69338	77	0	0
False killer whale	17-Feb-25	0931-1008	3	22.11763	-159.85177	702	2	2 biopsies
Fin whale	10-Feb-25	0810-0917	2	22.03123	-159.93200	1050	0	1 eDNA
Humpback whale	09-Feb-25	1137-1144	1	22.28748	-159.78511	48	0	0
Humpback whale*	09-Feb-25	1424-1529	1	22.16998	-159.89367	39	0	0
Humpback whale	10-Feb-25	0753-0753	1	21.97272	-159.90586	32	0	0
Humpback whale	11-Feb-25	1029-1029	1	22.18206	-159.8676	0	0	0
Humpback whale*	11-Feb-25	1233-1247	2	22.1524	-160.0244	20	0	0
Humpback whale	12-Feb-25	1405-1405	2	22.06946	-159.92779	25	0	0
Humpback whale	13-Feb-25	0905-0908	2	22.02863	-159.79942	62	0	0
Humpback whale	13-Feb-25	0913-0929	6	22.01028	-159.80759	246	0	0
Humpback whale	13-Feb-25	1025-1043	3	21.91423	-159.66603	82	0	0
Humpback whale	14-Feb-25	1023-1030	3	21.83072	-159.48796	101	0	0
Humpback whale*	15-Feb-25	1056-1106	2	22.17748	-159.90545	92	0	0
Humpback whale	17-Feb-25	1425-1425	NR	21.99815	-160.03188	73	0	0
Kogia sp.	10-Feb-25	1123-1123	1	22.28491	-159.92965	0	0	0
Melon-headed whale*	09-Feb-25	1424-1529	170	22.16998	-159.89367	1385	0	0
Pygmy killer whale	12-Feb-25	1131-1157	5	22.16306	-159.88399	1076	0	1 eDNA
Rough-toothed dolphin	09-Feb-25	1144-1149	3	22.28355	-159.78354	330	0	0
Rough-toothed dolphin	09-Feb-25	1237-1247	7	22.27277	-159.88743	291	0	0
Rough-toothed dolphin	09-Feb-25	1313-1318	6	22.18989	-159.89814	179	0	0
Rough-toothed dolphin*	09-Feb-25	1424-1524	40	22.16998	-159.89367	1385	1	0
Rough-toothed dolphin	11-Feb-25	0902-0910	3	22.11535	-159.94541	87	0	0
Rough-toothed dolphin	11-Feb-25	0913-0917	2	22.10878	-159.93784	53	0	0

Species	Date	Start-end time (HST)	Group size (best)	Start latitude (°N)	Start longitude (°W)	# photos	# tags	# & type of samples
Rough-toothed dolphin	11-Feb-25	1000-1112	26	22.20148	-159.86875	2466	1	1 biopsy
Rough-toothed dolphin	11-Feb-25	1119-1119	6	22.16258	-159.88608	0	0	0
Rough-toothed dolphin	11-Feb-25	1231-1231	1	22.15797	-160.02291	19	0	0
Rough-toothed dolphin*	11-Feb-25	1233-1247	4	22.15240	-160.02440	709	1	0
Rough-toothed dolphin	12-Feb-25	0816-0820	1	22.03527	-159.94987	10	0	0
Rough-toothed dolphin	12-Feb-25	0826-0831	3	22.04920	-159.95600	260	0	0
Rough-toothed dolphin	12-Feb-25	0835-0835	1	22.06634	-159.96143	0	0	0
Rough-toothed dolphin	12-Feb-25	0844-0844	1	22.10248	-159.95848	0	0	0
Rough-toothed dolphin*	15-Feb-25	1051-1106	4	22.17843	-159.90991	144	0	0
Rough-toothed dolphin	15-Feb-25	1146-1146	1	22.15807	-159.89969	0	0	0
Rough-toothed dolphin	15-Feb-25	1235-1301	5	22.13703	-159.90615	189	0	1 breath
Rough-toothed dolphin	17-Feb-25	1054-1054	1	22.16693	-159.82962	30	0	0
Rough-toothed dolphin	17-Feb-25	1106-1111	NR	22.18033	-159.84420	38	0	0
Rough-toothed dolphin	17-Feb-25	1132-1132	1	22.19666	-159.82986	16	0	0
Rough-toothed dolphin	17-Feb-25	1138-1138	1	22.18749	-159.84180	0	0	0
Rough-toothed dolphin	17-Feb-25	1149-1153	5	22.16862	-159.87920	155	0	0
Rough-toothed dolphin	17-Feb-25	1220-1225	2	22.12801	-159.90162	85	0	0
Rough-toothed dolphin	17-Feb-25	1320-1327	12	22.08444	-160.10536	56	0	0
Short-finned pilot whale	09-Feb-25	0851-1115	44	22.22422	-159.85192	3214	1	1 fecal
Short-finned pilot whale	10-Feb-25	1214-1258	17	22.30587	-159.86717	1219	2	0
Short-finned pilot whale	11-Feb-25	1000-1002	12	22.20148	-159.86875	55	0	0
Short-finned pilot whale	11-Feb-25	1121-1150	24	22.15874	-159.89098	727	0	1 fecal; 1 biopsy
Short-finned pilot whale	12-Feb-25	1211-1237	15	22.13301	-159.86758	487	0	0
Short-finned pilot whale	15-Feb-25	1108-1223	12	22.16916	-159.89380	2691	1	1 biopsy
Spinner dolphin	14-Feb-25	0645-0646	20	21.93771	-159.68679	0	0	0
Spinner dolphin	17-Feb-25	0756-0802	65	21.94878	-159.69063	799	0	0
Spinner dolphin	17-Feb-25	1414-1414	NR	22.01452	-160.08805	0	0	0
Unidentified dolphin	10-Feb-25	1224-1258	3	22.30587	-159.86717	20	0	0

*Mixed-species encounter. HST = Hawaii Standard Time; NR = Not recorded; °N = degrees North; °W = degrees West.

Table 2. Details of satellite tag deployments during the February 2025 Kauaʻi field effort, sorted by species and date.

Species	Date deployed (HST)	Tag ID	# days location data	# days behavior log data	Temporal overlap with Submarine Command Course
Blainville's beaked whale	15-Feb-25	MdTag024	6.45	4.48	Phase B overlap
False killer whale	17-Feb-25	PcTag096	12.37	3.82	Phase B overlap
False killer whale	17-Feb-25	PcTag097	25.58	7.07	Phase B overlap
Rough-toothed dolphin	09-Feb-25	SbTag026	8.33	4.05	Phase A & B overlap
Rough-toothed dolphin	11-Feb-25	SbTag027	6.53	3.62	Phase A & B overlap
Rough-toothed dolphin	11-Feb-25	SbTag028	14.40	11.92	Phase A & B overlap
Short-finned pilot whale	09-Feb-25	GmTag259	25.10	12.37	Phase A & B overlap
Short-finned pilot whale	10-Feb-25	GmTag260	22.02	14.26	Phase A & B overlap
Short-finned pilot whale	10-Feb-25	GmTag261	20.00	14.07	Phase A & B overlap
Short-finned pilot whale	15-Feb-25	GmTag262	22.50	9.14	Phase B overlap

Note: For Tag Identification (ID), species are indicated by two-letter codes (Gm = *Globicephala macrorhynchus*, Md = *Mesoplodon densirostris*, Pc = *Pseudorca crassidens*, Sb = *Steno bredanensis*). HST = Hawaii Standard Time

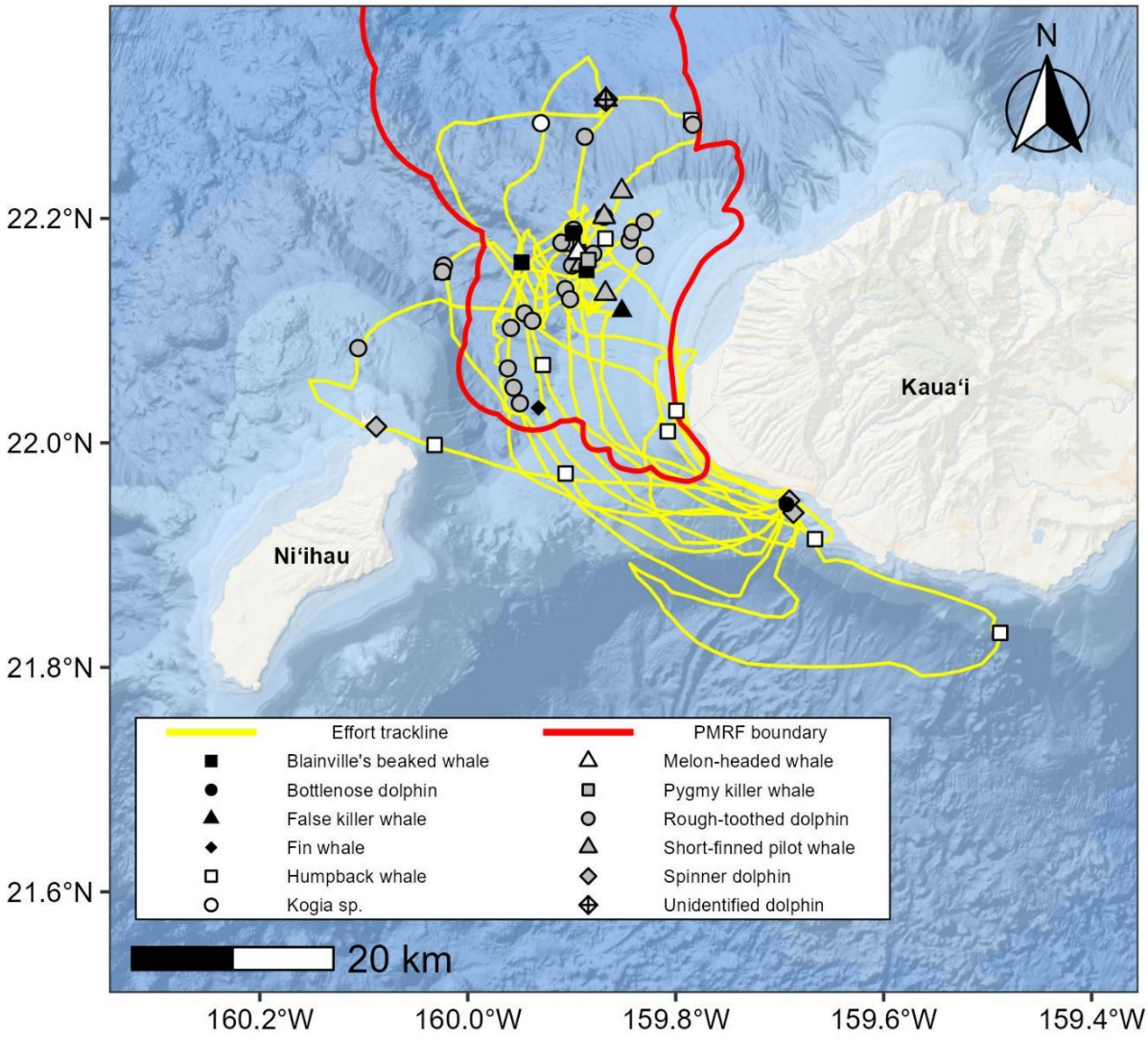

Figure 1. Search effort and sightings over eight days from 9 to 17 February 2025. One additional day of survey effort, not shown here, was conducted on 18 February during transit from Kaua‘i to O‘ahu.

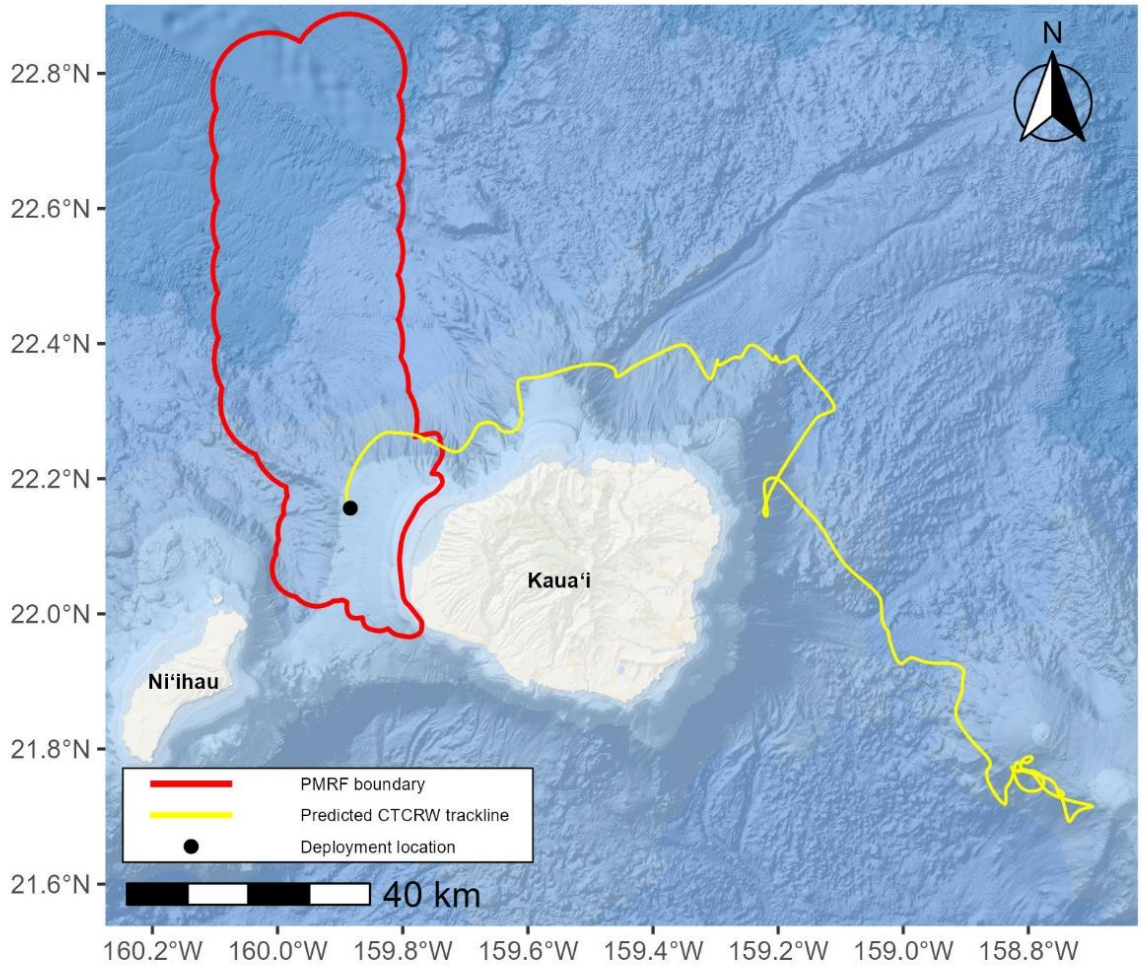

Figure 2. Predicted continuous time-correlated random walk model trackline, rerouted around land using a 300 m isobath buffer for a Blainville's beaked whale (MdTag024) over a 7-day period from 15 to 21 February 2025.

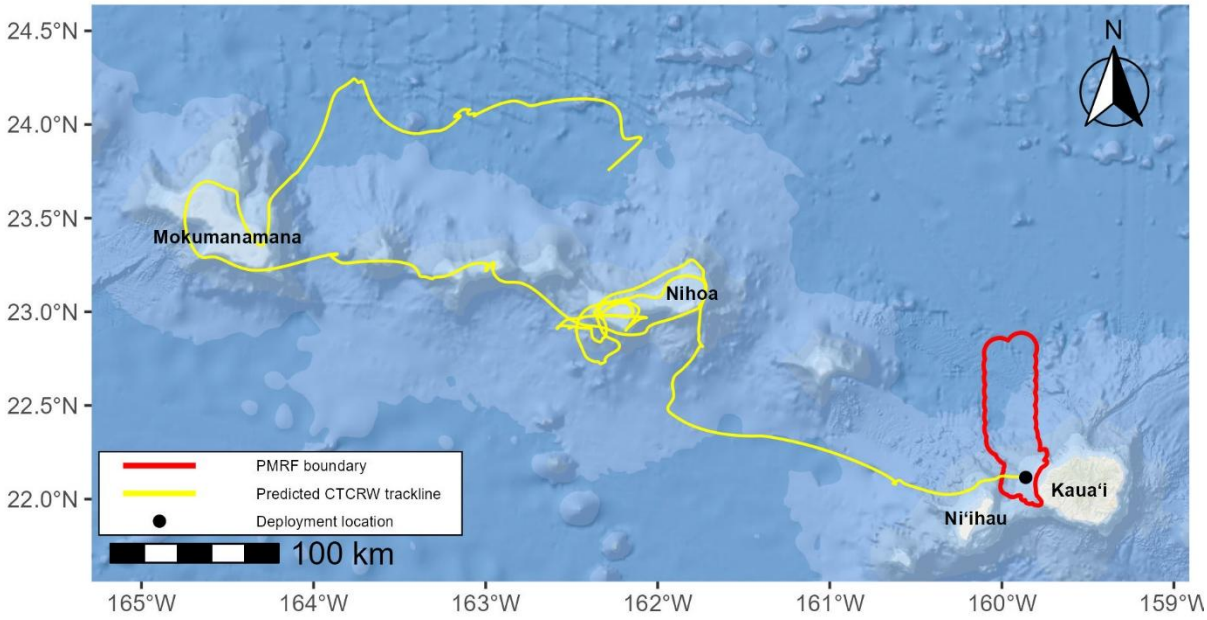

Figure 3. Predicted continuous time-correlated random walk model trackline, rerouted around land using a 50 m land buffer for a false killer whale (PcTag096) over a 13-day period from 17 February to 1 March 2025.

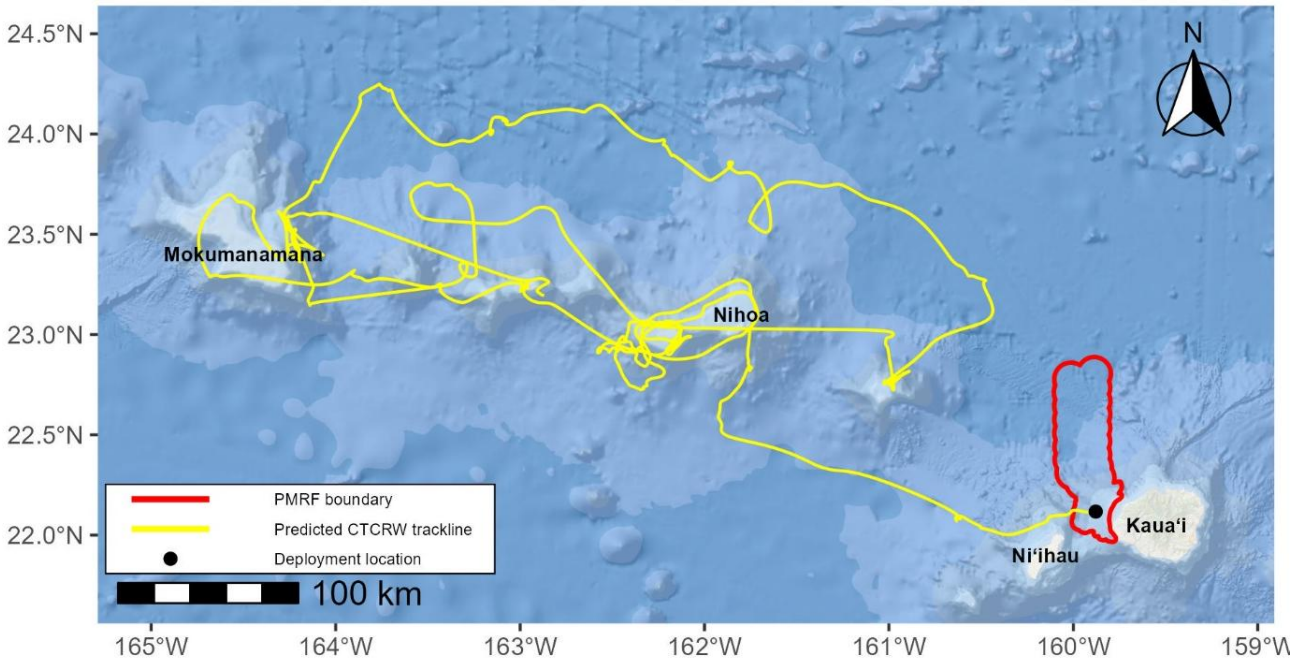

Figure 4. Predicted continuous time-correlated random walk model trackline, rerouted around land using a 50 m land buffer for a false killer whale (PcTag097) over a 26-day period from 17 February to 14 March 2025.

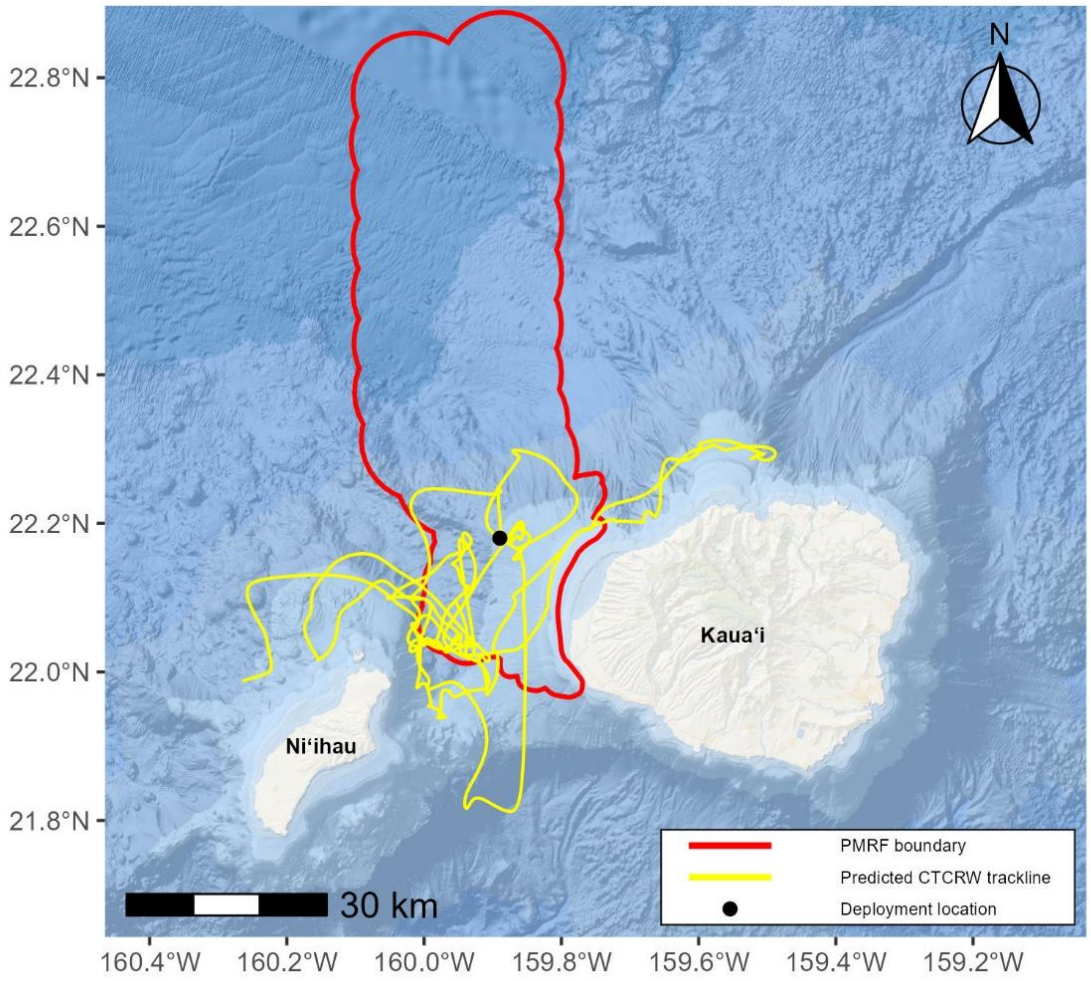

Figure 5. Predicted continuous time-correlated random walk model trackline, rerouted around land using a 200 m isobath buffer for a rough-toothed dolphin (SbTag026) over a 9-day period from 9 to 17 February 2025.

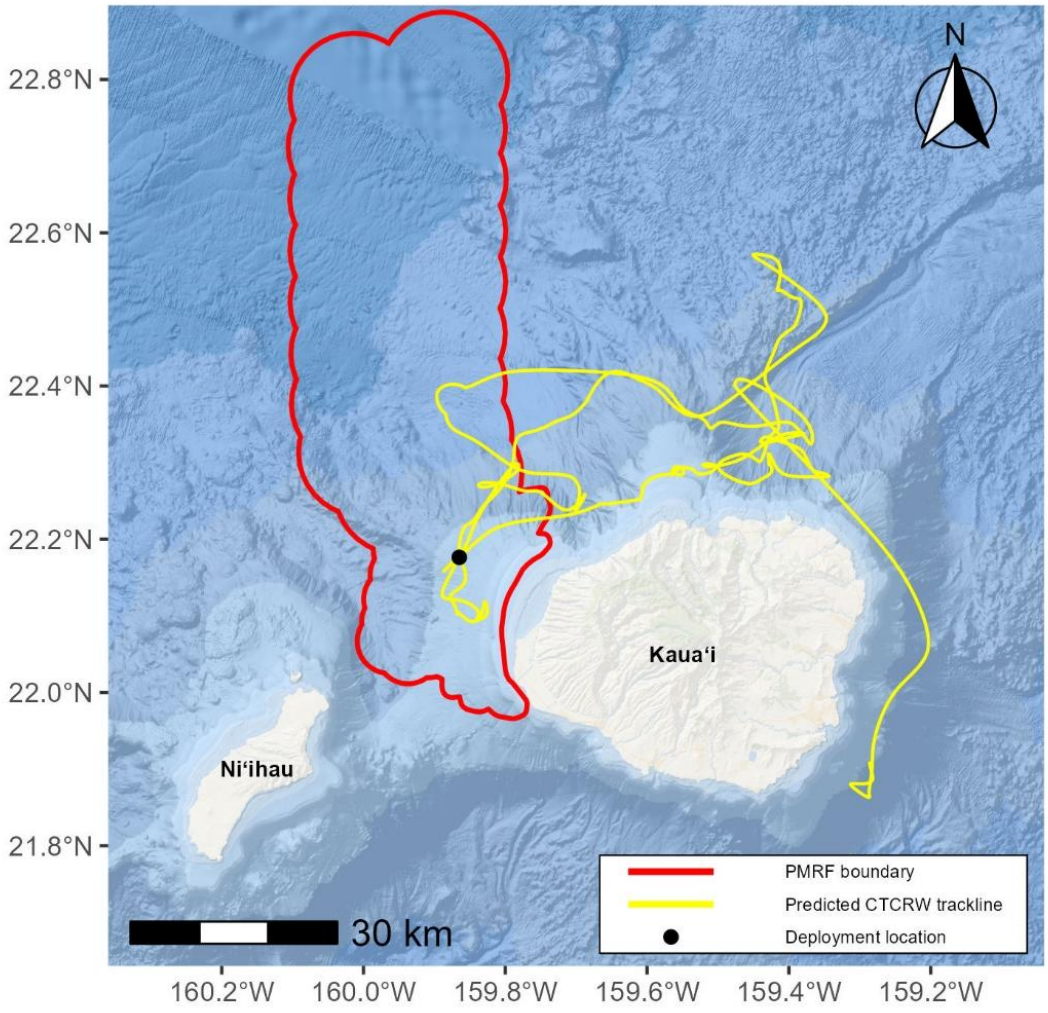

Figure 6. Predicted continuous time-correlated random walk model trackline, rerouted around land using a 200 m isobath buffer for a rough-toothed dolphin (SbTag027) over a 7-day period from 11 to 17 February 2025.

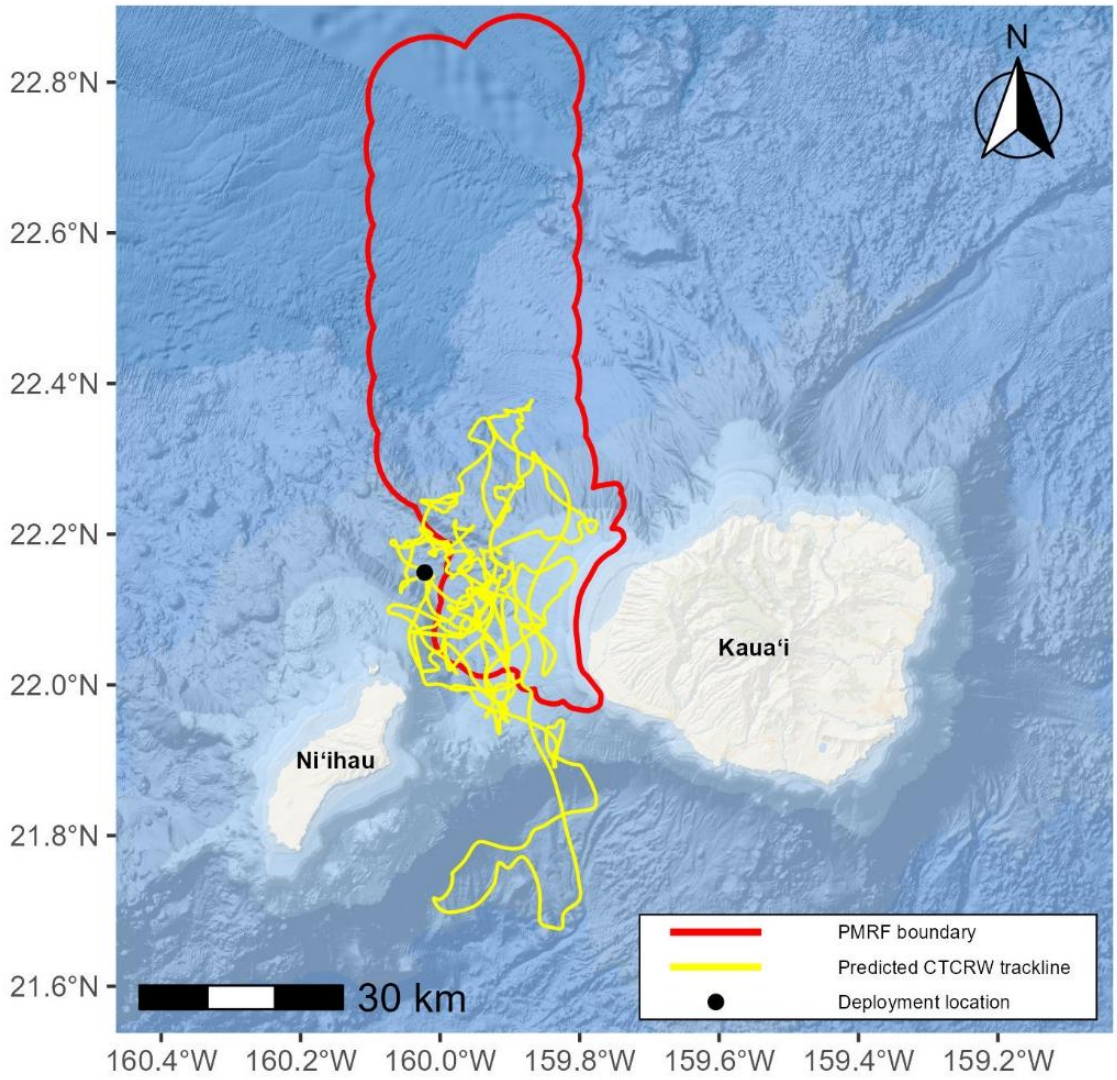

Figure 7. Predicted continuous time-correlated random walk model trackline, rerouted around land using a 200 m isobath buffer for a rough-toothed dolphin (SbTag028) over a 15-day period from 11 to 25 February 2025.

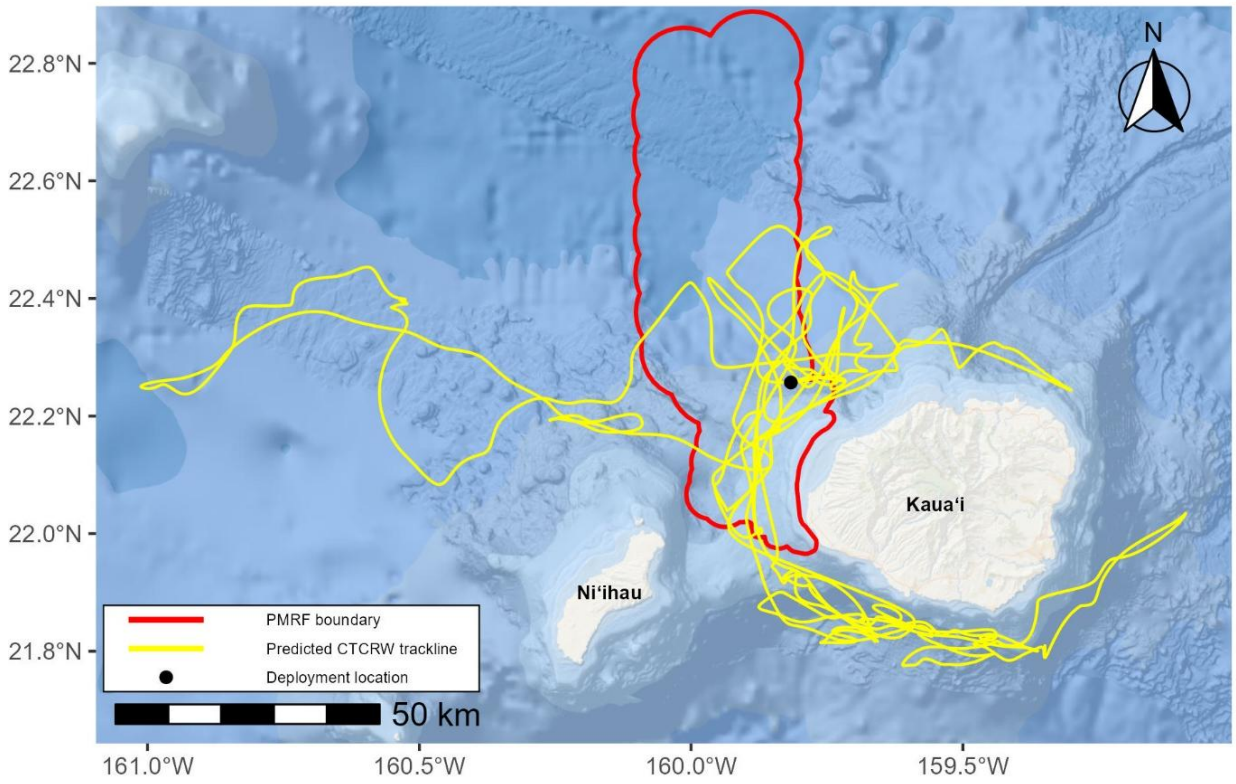

Figure 8. Predicted continuous time-correlated random walk model trackline, rerouted around land using a 300 m isobath buffer for a short-finned pilot whale (GmTag259) over a 26-day period from 9 February to 6 March 2025.

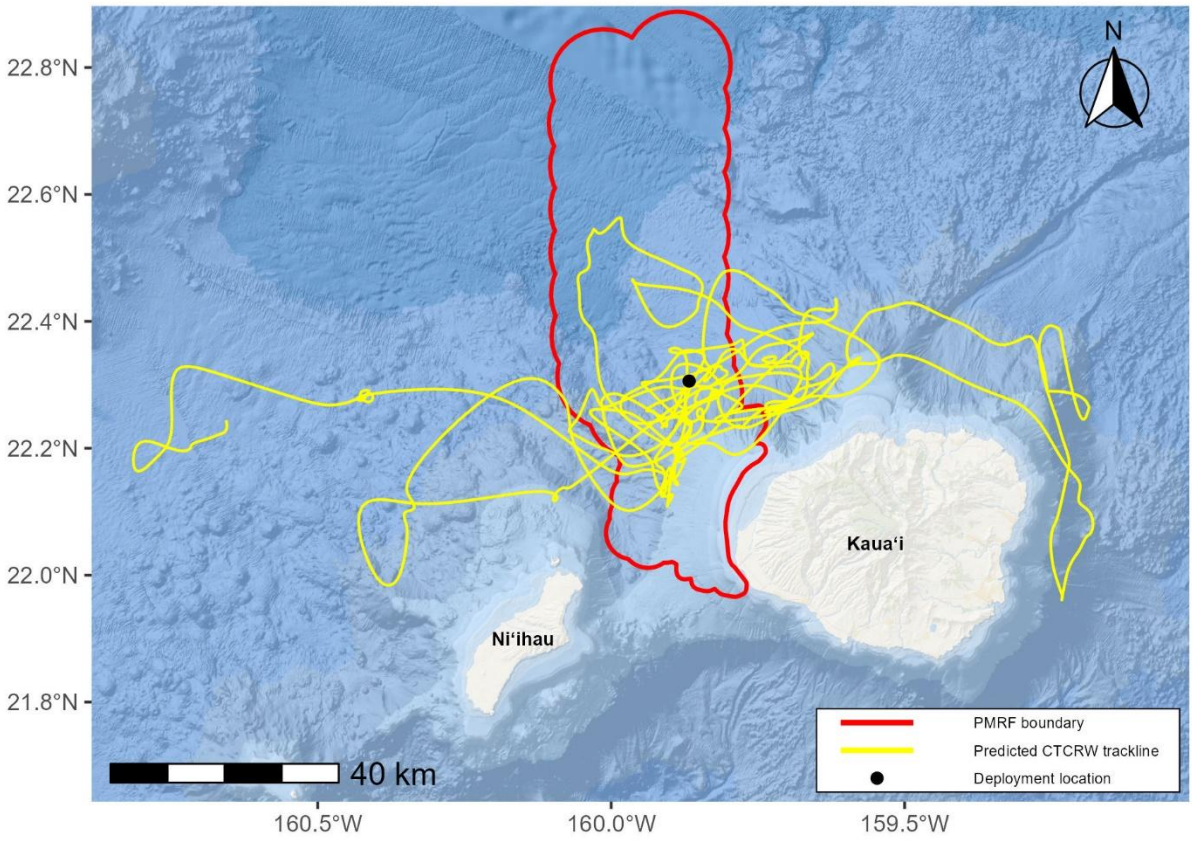

Figure 9. Predicted continuous time-correlated random walk model trackline, rerouted around land using a 300 m isobath buffer for a short-finned pilot whale (GmTag260) over a 23-day period from 10 February to 4 March 2025.

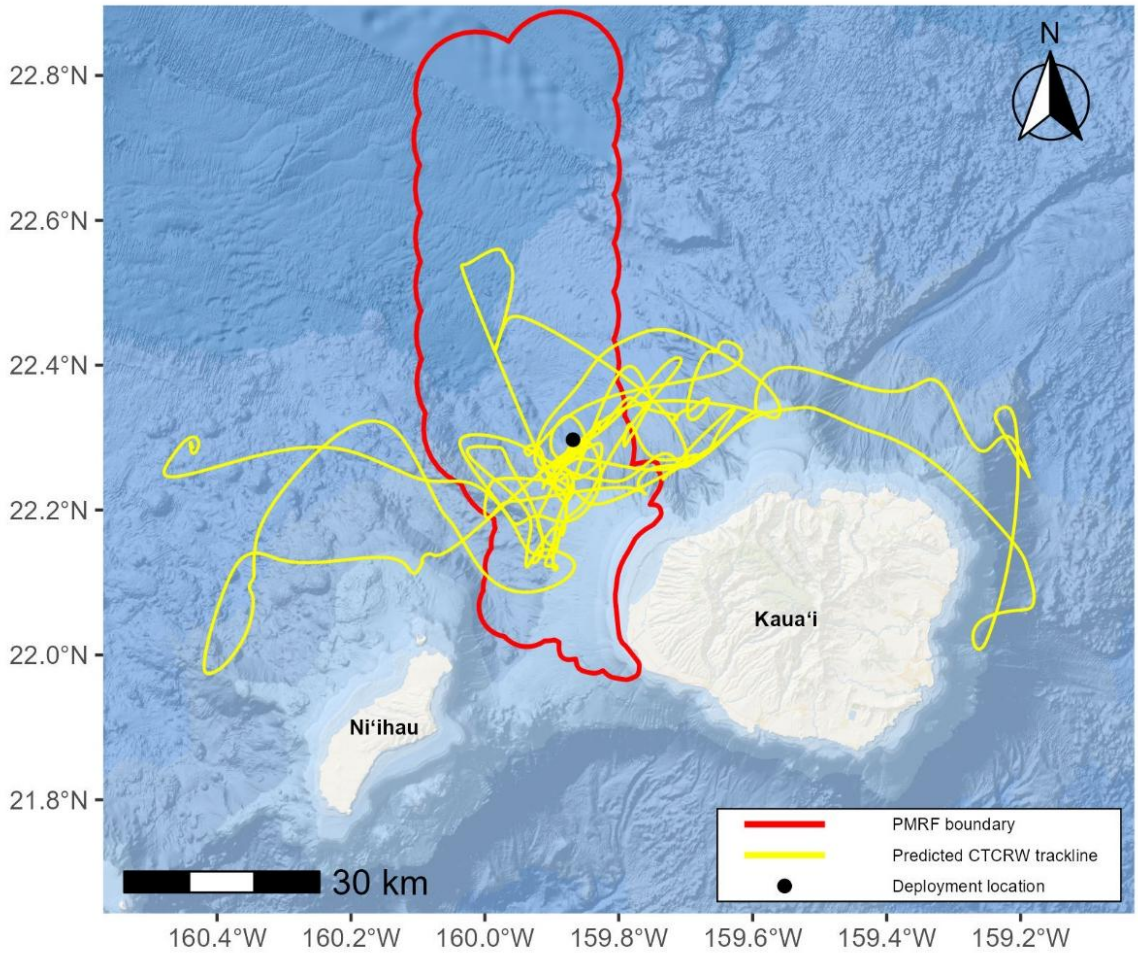

Figure 10. Predicted continuous time-correlated random walk model trackline, rerouted around land using a 300 m isobath buffer for a short-finned pilot whale (GmTag261) over a 20-day period from 10 February to 2 March 2025.

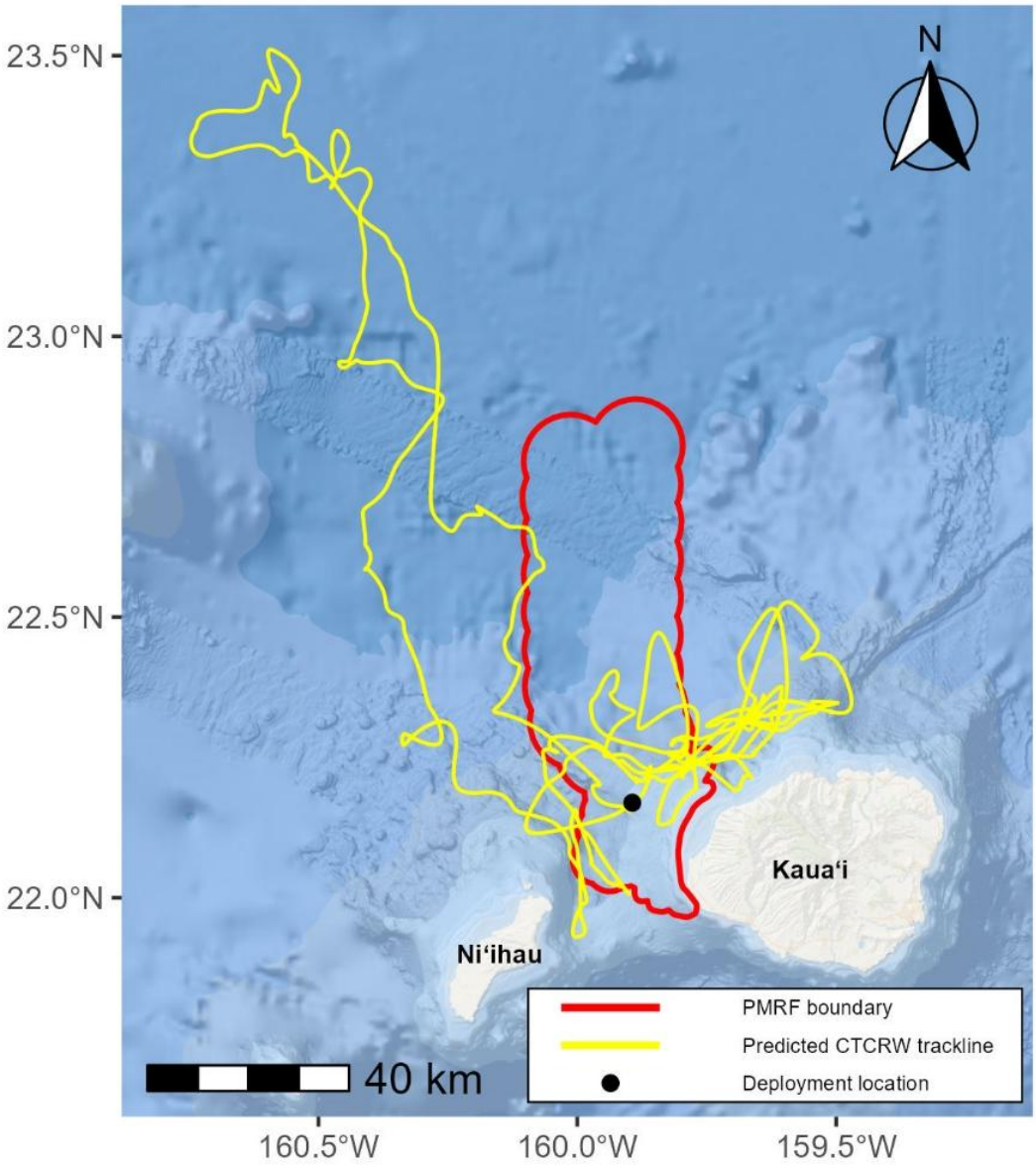

Figure 11. Predicted continuous time-correlated random walk model trackline, rerouted around land using a 300 m isobath buffer for a short-finned pilot whale (GmTag262) over a 23-day period from 15 February to 9 March 2025.

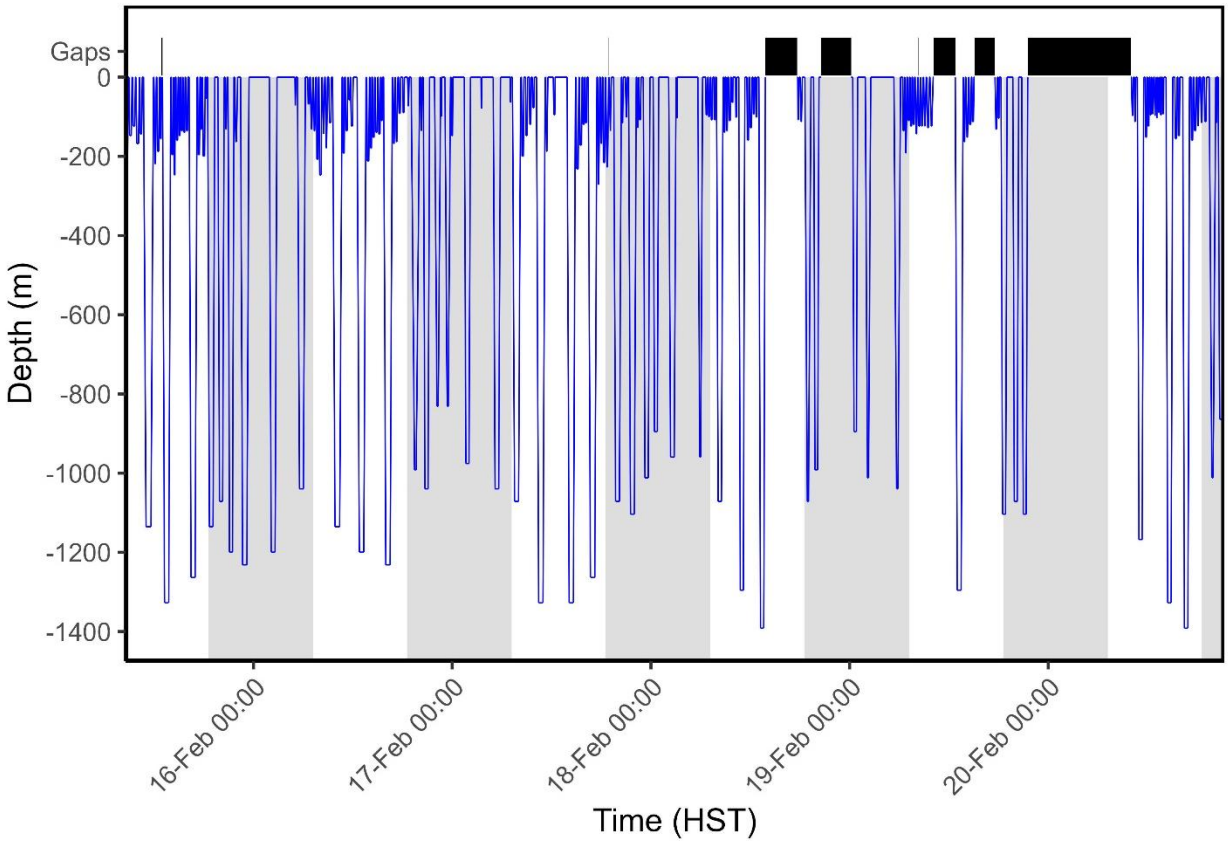

Figure 12. An example of dive behavior data (obtained from a Blainville's beaked whale (MdTag024) over a 6-day period from 15 to 20 February 2025). Nighttime periods are shaded, and gaps in the data are indicated as black boxes above the dive profiles.

Appendix 1. Field Survey Methods

The field project was timed to occur over a 9-day span in February 2025. 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 six to seven observers scanning 360 degrees around the vessel. Vessel locations were recorded on a Global Positioning System unit at 5-minute intervals.

When weather conditions permitted and there were no range access constraints, the primary area of operations was the PMRF instrumented hydrophone range, with a focus on deep-water areas to increase the likelihood of encountering high-priority species (see below). Coordination with acoustic analysts from Marine Mammal Monitoring on Navy Ranges (M3R) and Naval Information Warfare Center Pacific 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 suboptimal 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 Navy analysts monitoring the hydrophone range), and the relative encounter rates. Species encountered infrequently (short-finned pilot whales, pygmy killer whales, false killer whales, Blainville's beaked whales, and fin whales) were given higher priority than frequently encountered species (bottlenose dolphins, rough-toothed dolphins, spinner dolphins, and humpback whales). Extended work with frequently encountered species was typically only undertaken when no other higher priority species were in areas suitable for working or, in the case of rough-toothed dolphins, when the behavior of the dolphins was conducive to tagging.

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 the encounter, group size (minimum, best, and maximum estimates), sighting cue (e.g., acoustic detection from the hydrophone range, 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.