Small-Boat Surveys and Satellite Tagging of Odontocetes on the Pacific Missile Range Facility, Kauaʻi, in August 2023

Field survey report to U.S. Pacific Fleet by HDR, under Federal contract number M62470-20-D-0016, Task Order No. 23F0108.

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Executive Summary

As part of the long-term United States (U.S.) Navy-funded Marine Species Monitoring Program, from 5–13 August 2023, Cascadia Research Collective (CRC) carried out a vessel-based field effort in conjunction with passive acoustic monitoring undertaken by 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). 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 2-12). Eight days of field effort were funded by the Navy, and field efforts were undertaken on seven days, with two days in the middle being lost due to conditions related to Hurricane Dora. Overall, we covered 781 km of trackline over 48 survey hours. On the first day, we coordinated with NOAA *Oscar Elton Sette* to increase the likelihood of being able to work with high-priority species. Survey effort was spread primarily across the southernmost tip of the PMRF (Figure 1). There were 30 encounters with six species of cetaceans (Table 1), including 12 sightings of rough-toothed dolphins (*Steno bredanensis*), six sightings of common bottlenose dolphins (*Tursiops truncatus*), four sightings of short-finned pilot whales (*Globicephala macrorhynchus*), four sightings of pantropical spotted dolphins (*Stenella attenuata*), three sightings of spinner dolphins (*Stenella longirostris*), and one sighting of melon-headed whales (*Peponocephala electra*). The pantropical spotted dolphins were the most unusual species encountered during the field project; in 15 years of CRC field effort off Kauaʻi and Niʻihau since 2003, this species has only been encountered 12 previous times during seven

different years. Seven of the 30 total cetacean sightings (18%) were cued by analysts interpreting acoustic detections from the Navy's hydrophone range, including a short-finned pilot whale sighting, three sightings of rough-toothed dolphins, two sightings of common bottlenose dolphins, and the melon-headed whale sighting. In total, 19,610 photographs were taken of all six encountered cetacean species for individual and species identification. There were 11 tagging attempts, during which one tag was lost, and 10 SPLASH10-F (Fastloc®-Global Positioning System (GPS)) tags were deployed onto four different species, including six short-finned pilot whales, two common bottlenose dolphins, one melon-headed whale, and one pantropical spotted dolphin (Table 2). Location data[1] were received from all 10 tags (Figures 2-11), as well as high-resolution time series and/or dive behavior data (Figure 12). Four tags were deployed prior to the start of Phase A, and all tags overlapped with Phase B of the SCC (Table 2). 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. All individuals remained on or in close proximity to the PMRF for the majority of their tag deployments (Figures 2-11). One biopsy sample was collected from a pantropical spotted dolphin, which will be shared with collaborators at the Southwest Fisheries Science Center and the University of Hawai'i for analysis.

Acknowledgements

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[1] Details on location data processing are available in Baird et al. (2021).

Table 1. Details of sightings of marine mammals during the August 2023 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 sample
Common bottlenose dolphin	07-Aug-23	0900-0948	12	22.15622	159.79400	2,515	0	0
Common bottlenose dolphin	10-Aug-23	1020-1038	18	22.02372	159.84300	1,433	0	0
Common bottlenose dolphin	12-Aug-23	0559-0602	9	21.93048	159.69900	128	0	0
Common bottlenose dolphin	13-Aug-23	0844-0953	21	22.06126	159.85158	3,669	2	0
Common bottlenose dolphin	13-Aug-23	1122-1131	18	21.92804	159.94218	76	0	0
Common bottlenose dolphin	13-Aug-23	1138-1138	3	21.98150	159.90000	0	0	0
Melon-headed whale	12-Aug-23	0930-1156	170	22.08812	159.91100	2,849	1	0
Pantropical spotted dolphin	06-Aug-23	0919-0940	16	21.92804	159.84218	319	1	0
Pantropical spotted dolphin	10-Aug-23	0712-0725	14	22.02556	159.89300	441	0	0
Pantropical spotted dolphin	11-Aug-23	0803-0815	11	21.99840	159.90900	348	0	1 biopsy
Pantropical spotted dolphin	12-Aug-23	0757-0818	14	21.92046	159.83300	372	0	0
Rough-toothed dolphin	05-Aug-23	0655-0655	1	21.98852	159.92000	0	0	0
Rough-toothed dolphin	06-Aug-23	0712-0712	1	21.90120	159.77600	0	0	0
Rough-toothed dolphin	06-Aug-23	0922-0939	3	21.93010	159.84300	42	0	0
Rough-toothed dolphin	10-Aug-23	0702-0702	3	22.00006	159.88000	0	0	0
Rough-toothed dolphin	10-Aug-23	0922-0928	3	22.02936	159.89400	133	0	0
Rough-toothed dolphin	11-Aug-23	0717-0744	11	21.95629	159.86700	608	0	0
Rough-toothed dolphin	12-Aug-23	0805-0818	3	21.91810	159.83900	119	0	0
Rough-toothed dolphin	13-Aug-23	0722-0729	4	22.03770	159.90105	123	0	0
Rough-toothed dolphin	13-Aug-23	0732-0745	9	22.04574	159.90855	302	0	0
Rough-toothed dolphin	13-Aug-23	0749-0751	1	22.05883	159.91969	14	0	0
Rough-toothed dolphin	13-Aug-23	1018-1021	3	22.08967	159.89365	36	0	0
Rough-toothed dolphin	13-Aug-23	1024-1031	3	21.91398	159.81214	330	0	0
Short-finned pilot whale	06-Aug-23	0607-0758	16	21.89180	159.79600	1,240	2	0
Short-finned pilot whale	06-Aug-23	0807-0916	7	21.91543	159.80100	438	1	0
Short-finned pilot whale	10-Aug-23	0751-0915	18	22.07828	159.89900	1,867	1	0
Short-finned pilot whale	12-Aug-23	0629-0710	20	21.89149	159.78407	1,414	2	0
Spinner dolphin	06-Aug-23	1318-1318	40	21.95912	159.72100	0	0	0
Spinner dolphin	10-Aug-23	1140-1140	4	21.95158	159.69200	0	0	0
Spinner dolphin	12-Aug-23	0555-0555	5	21.94562	159.69240	0	0	0

Note: Aug = August; HST = Hawaii Standard Time; ºN = degrees North; ºW = degrees West.

Table 2. Details of satellite tag deployments during the August 2023 Kauaʻi field effort, sorted by species and date. All tags were SPLASH10-F tags.

Species	**Date**	**Type of dive data**	**Tag ID**	**# days location data**	**Comments**
Common bottlenose dolphin	13-Aug-23	5 min time series and behavior logs	TtTag042	14.5	Overlap with Phase B
Common bottlenose dolphin	13-Aug-23	5 min time series	TtTag043	9.9	Overlap with Phase B
Melon-headed whale	12-Aug-23	5 min time series	PeTag037	6.0	Overlap with Phase B
Pantropical spotted dolphin	06-Aug-23	2.5 min time series	SaTag012	12.1	Overlap with Phase A and B
Short-finned pilot whale	06-Aug-23	5 min time series	GmTag241	58.9	Overlap with Phase A and B
Short-finned pilot whale	06-Aug-23	5 min time series and behavior logs	GmTag242	18.5	Overlap with Phase A and B
Short-finned pilot whale	06-Aug-23	5 min time series and behavior logs	GmTag243	32.6	Overlap with Phase A and B
Short-finned pilot whale	10-Aug-23	5 min time series	GmTag244	20.1	Overlap with Phase A and B
Short-finned pilot whale	12-Aug-23	5 min time series	GmTag245	7.2	Overlap with Phase B
Short-finned pilot whale	12-Aug-23	5 min time series and behavior logs	GmTag246	27.0	Overlap with Phase B

Note: For Tag ID, species are indicated by two-letter codes (Gm = *Globicephala macrorhynchus*, Pe = *Peponocephala electra*; Sa = *Stenella attenuata*, Tt = *Tursiops truncatus*). Aug = August; min = minute.

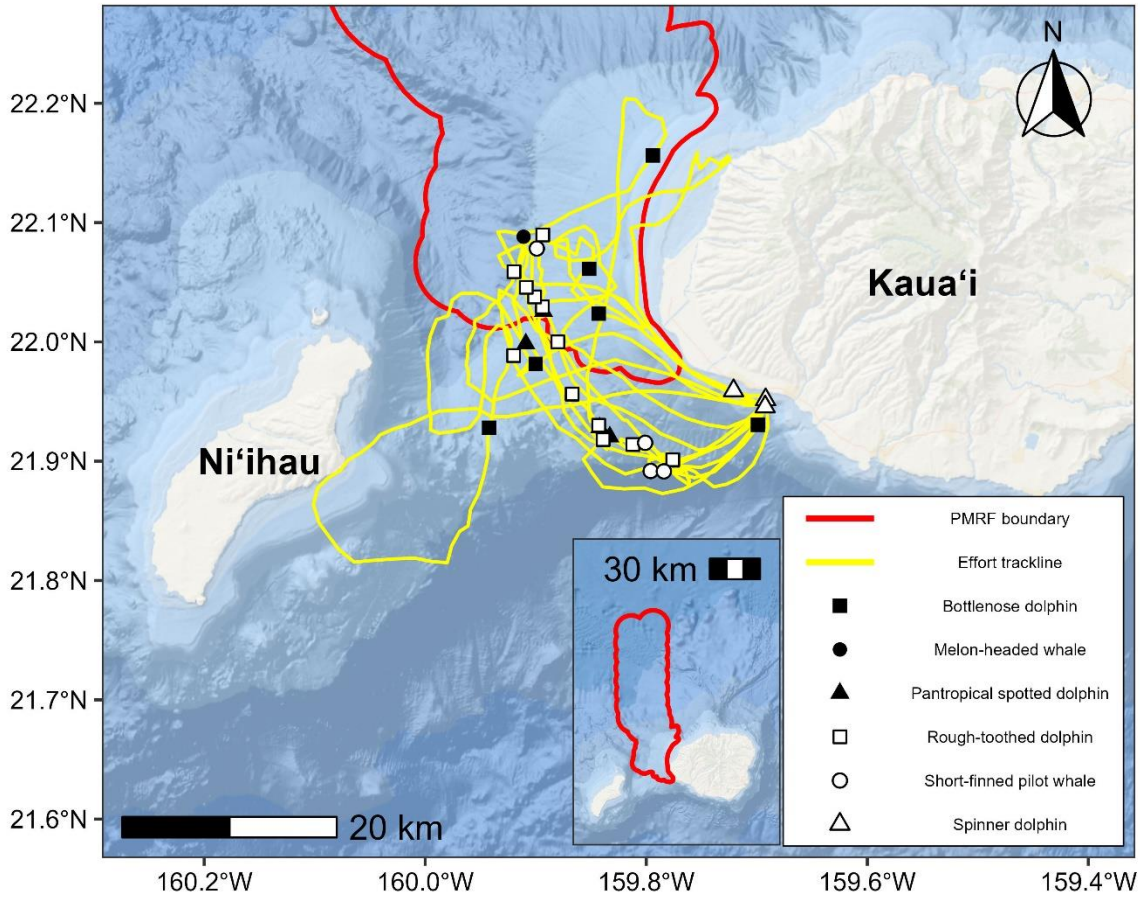

Figure 1. Search effort and odontocete sightings over seven days from 5 to 13 August 2023.

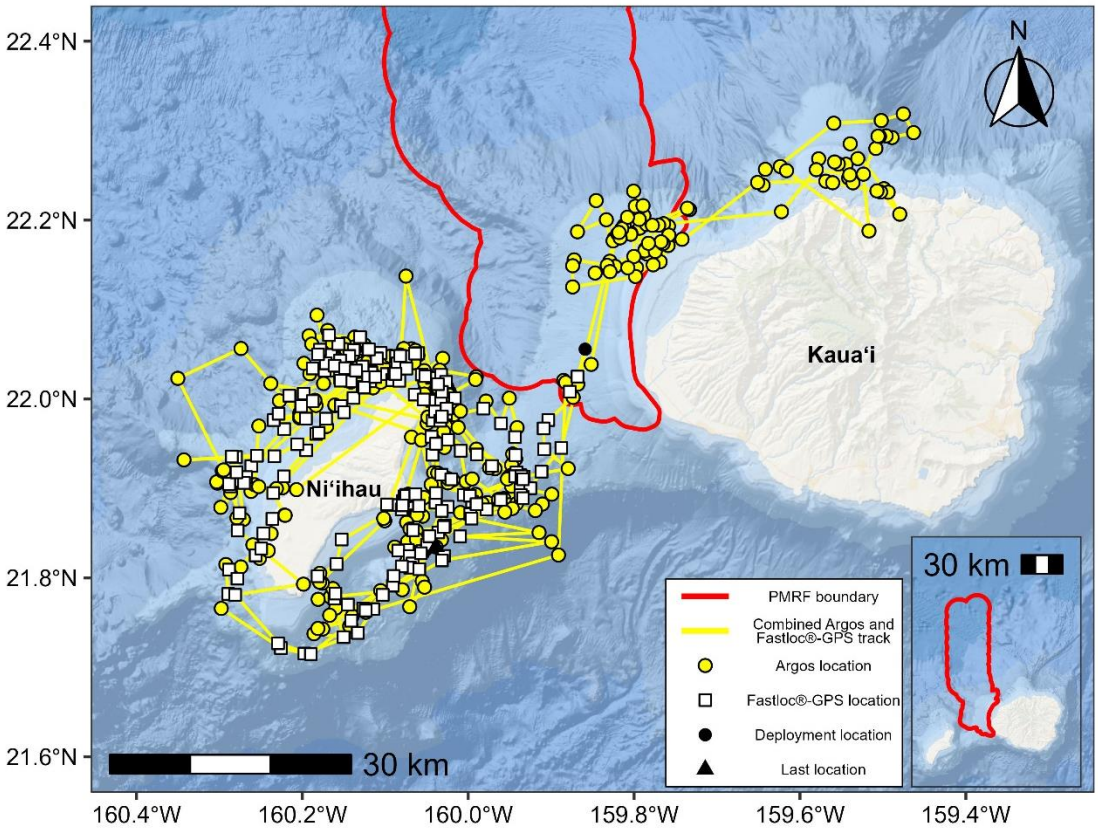

Figure 2. Filtered satellite tag data from a common bottlenose dolphin (TtTag042) over a 14.5-day period from 13 to 28 August 2023. Temporally consecutive locations (regardless of location type) are joined in the combined Argos and Fastloc®-GPS track.

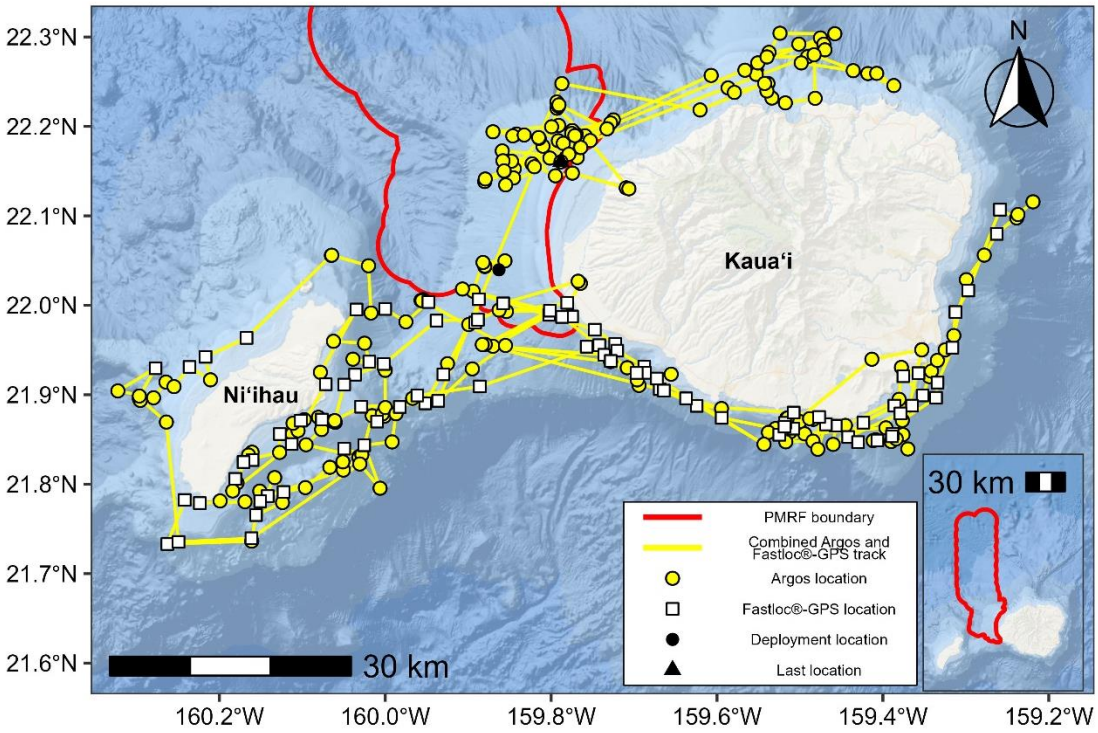

Figure 3. Filtered satellite tag data from a common bottlenose dolphin (TtTag043) over a 9.9-day period from 13 to 23 August 2023. Temporally consecutive locations (regardless of location type) are joined in the combined Argos and Fastloc®-GPS track.

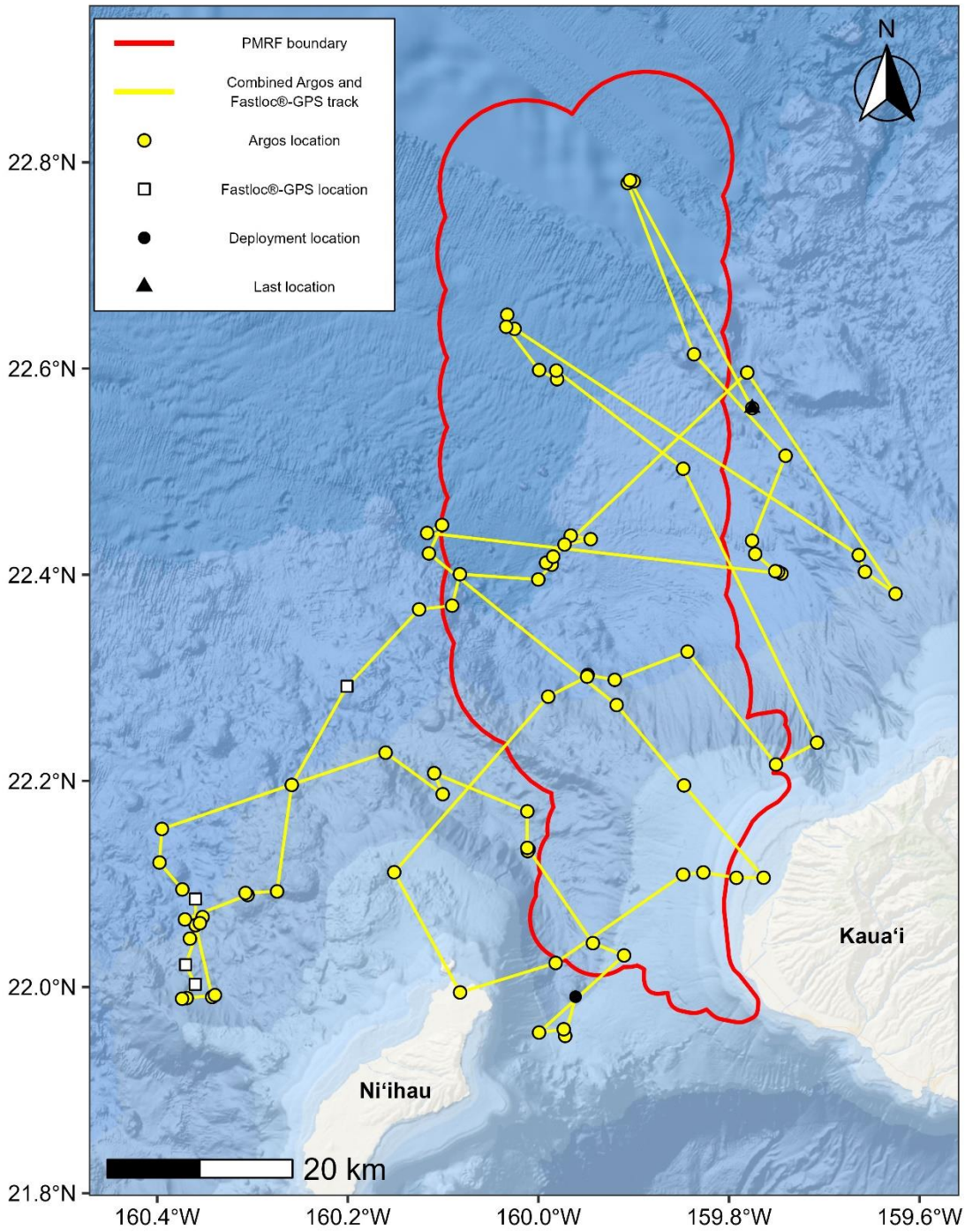

Figure 4. Filtered satellite tag data from a melon-headed whale (PeTag037) over a 6.0-day period from 12 to 18 August 2023. Temporally consecutive locations (regardless of location type) are joined in the combined Argos and Fastloc®-GPS track.

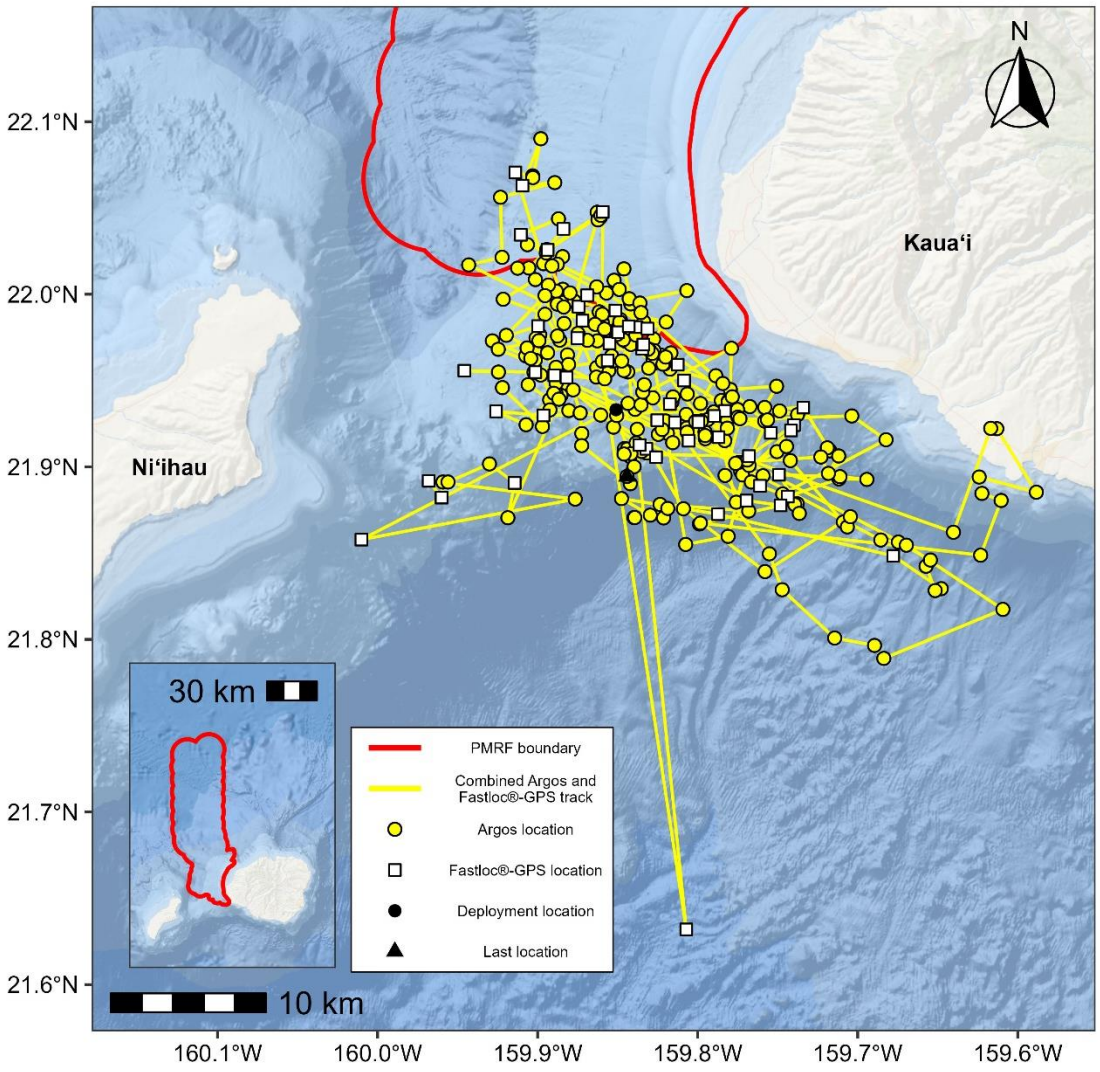

Figure 5. Filtered satellite tag data from a pantropical spotted dolphin (SaTag012) over a 12.1-day period from 6 to 18 August 2023. Temporally consecutive locations (regardless of location type) are joined in the combined Argos and Fastloc®-GPS track.

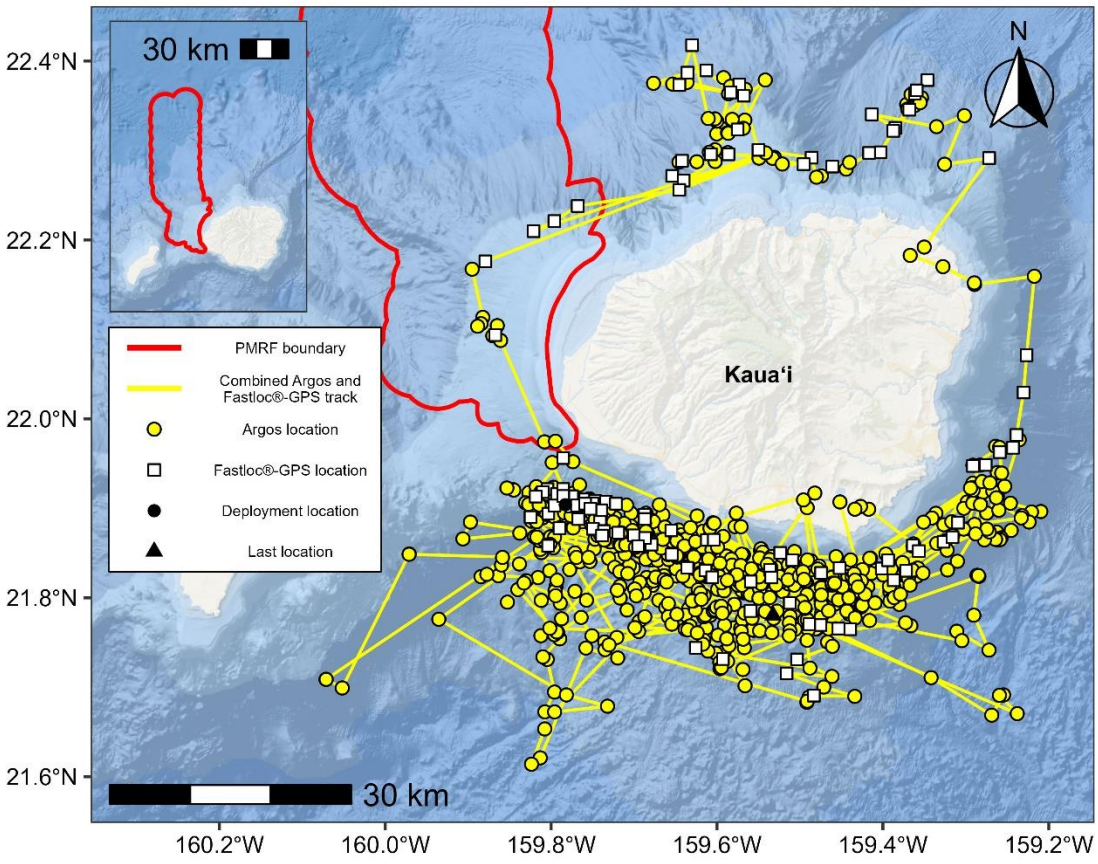

Figure 6. Filtered satellite tag data from a short-finned pilot whale (GmTag241) over a 58.9-day period from 6 August 2023 to 4 October 2023. Temporally consecutive locations (regardless of location type) are joined in the combined Argos and Fastloc®-GPS track.

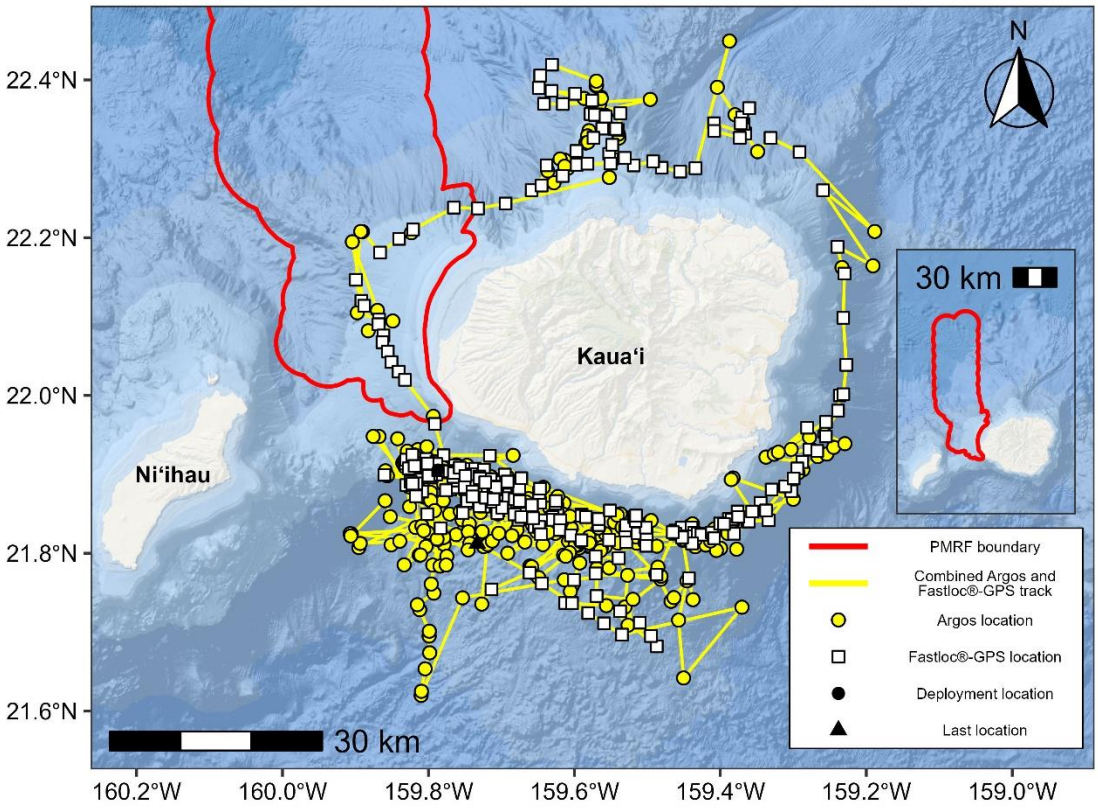

Figure 7. Filtered satellite tag data from a short-finned pilot whale (GmTag242) over an 18.5-day period from 6 to 25 August 2023. Temporally consecutive locations (regardless of location type) are joined in the combined Argos and Fastloc®-GPS track.

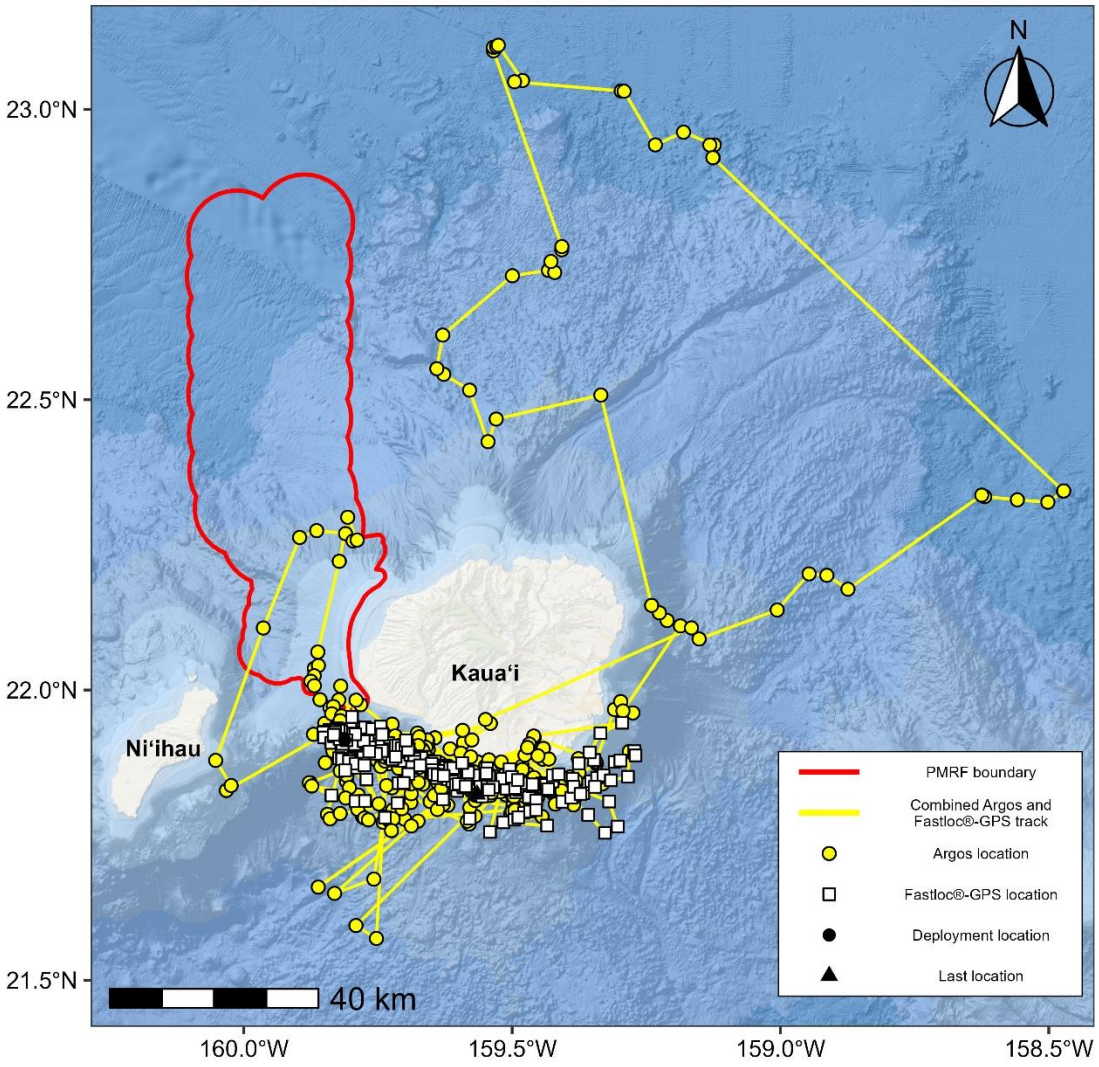

Figure 8. Filtered satellite tag data from a short-finned pilot whale (GmTag243) over a 32.6-day period from 6 August 2023 to 8 September 2023. Temporally consecutive locations (regardless of location type) are joined in the combined Argos and Fastloc®-GPS track.

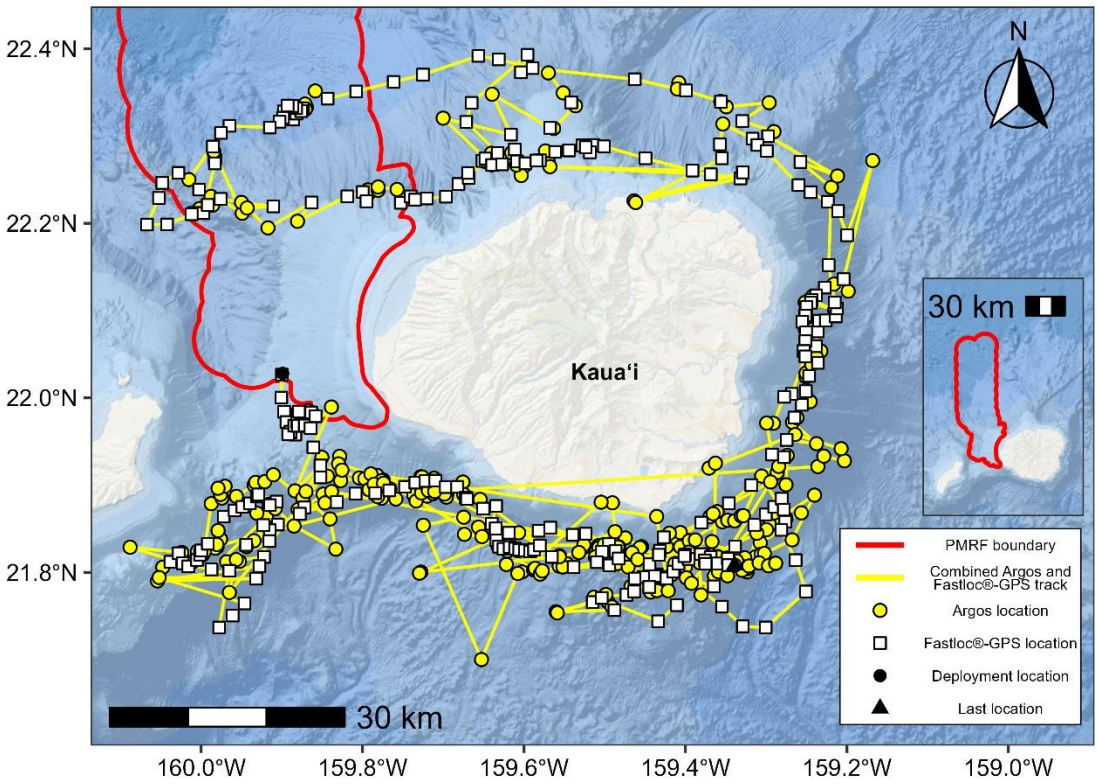

Figure 9. Filtered satellite tag data from a short-finned pilot whale (GmTag244) over a 20.1-day period from 10 to 30 August 2023. Temporally consecutive locations (regardless of location type) are joined in the combined Argos and Fastloc®-GPS track.

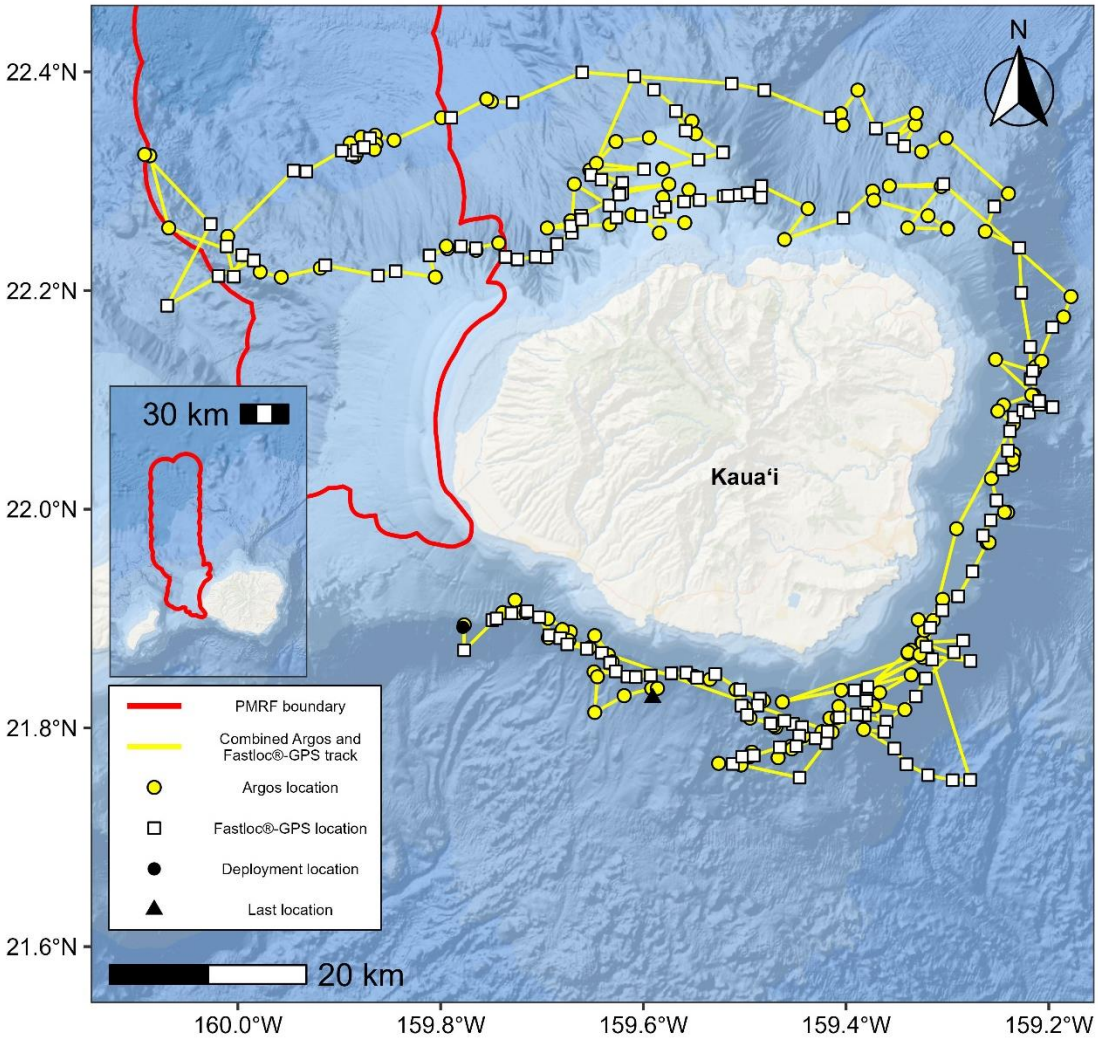

Figure 10. Filtered satellite tag data from a short-finned pilot whale (GmTag245) over a 7.2-day period from 12 to 19 August 2023. Temporally consecutive locations (regardless of location type) are joined in the combined Argos and Fastloc®-GPS track.

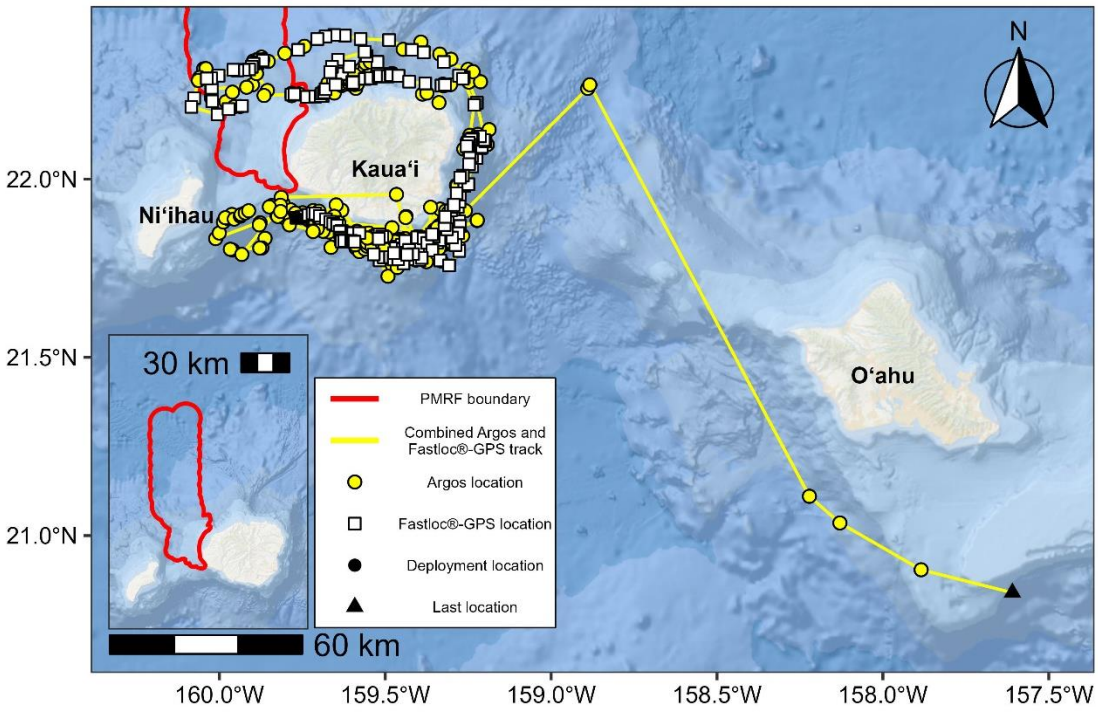

Figure 11. Filtered satellite tag data from a short-finned pilot whale (GmTag246) over a 27.0-day period from 12 August 2023 to 8 September 2023. Temporally consecutive locations (regardless of location type) are joined in the combined Argos and Fastloc®-GPS track.

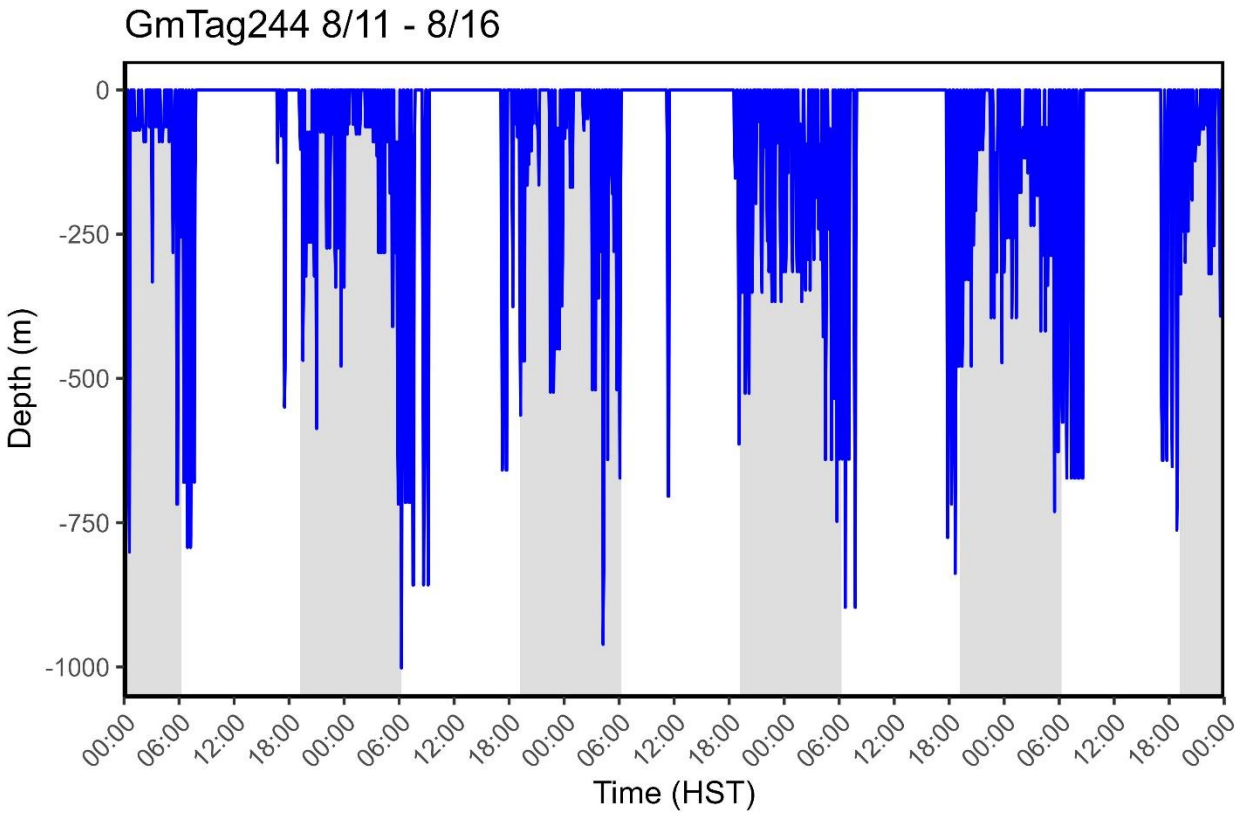

Figure 12. An example of time series dive behavior data obtained from a short-finned pilot whale (GmTag244) at 5-minute intervals over a 5-day period from 00:00 hrs HST on 11 August 2023 to 00:00 hrs HST on 16 August 2023. Nighttime periods are shaded. For any intervals shallower than 50 m, a line at the 0 m depth is shown.

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 August 2023. Two days of field work were lost due to poor weather conditions related to the nearby Hurricane Dora, but the vessel conducted seven days of dedicated survey effort during this time. Field operations began three days before Phase A of the SCC started, with all field days funded by the United States (U.S.) Navy (Navy). 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 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) analysts was undertaken for all days when weather conditions allowed access to the range or areas near the range. When positions from M3R 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 M3R 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 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 (melon-headed whales, pantropical spotted dolphins, and short-finned pilot whales) were given higher priority than frequently encountered species (bottlenose dolphins, rough-toothed dolphins, and spinner dolphins). 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 bowriding, and information necessary for permit requirements.

For infrequently encountered species, if conditions were suitable, we attempted to deploy at least one satellite tag per group. Tags used for these species were depth-transmitting SPLASH10F (Fastloc®-GPS) tags. 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.