Small-boat Surveys and Satellite Tagging of Odontocetes on the Pacific Missile Range Facility, Kaua‘i, in August 2022

Field survey report to U.S. Pacific Fleet by HDR, under Federal contract number N62470-20-D0016, Task Order No. N62742-21-F0107.

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February 13, 2023

Suggested citation: Baird, R.W., C.J. Cornforth, J.K. Lerma, J.F. Shaff, A.E. Harnish, A. Vanderzee, and M.A. Kratofil. 2023. Small-boat Surveys and Satellite Tagging of Odontocetes on the Pacific Missile Range Facility, Kaua‘i, in August 2022. Field survey report to U.S. Pacific Fleet by HDR, under Federal contract number N62470-20-D0016, Task Order No. N62742-21-F0107. February 2023.

Executive Summary

As part of the long-term United States (U.S.) Navy-funded Marine Species Monitoring Program, from 16–24 August 2022, 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 Phase B 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 (see Henderson et al. 2021). This interim field survey report provides a summary of 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 an additional day was funded by the Pacific Islands Fisheries Science Center. Over the nine days, the research vessel covered 1,238 km of trackline over 63 survey hours. Survey effort was broadly spread across the southern one-third of and to the south of PMRF (Figure 1). There were 26 encounters with seven species of cetaceans (Table 1). A group of approximately 100 striped dolphins (*Stenella coeruleoalba*) was encountered, only the second time this species has been seen off Kaua‘i in the 14 years of CRC field effort off Kaua‘i and Ni‘ihau since 2003. Two groups of Blainville’s beaked whales (*Mesoplodon densirostris*) were encountered, representing the eighth and ninth times that this species has been encountered off Kaua‘i during CRC field work. In addition, there were two sightings of melon-headed whales (*Peponocephala electra*), three sightings each of short-finned pilot whales (*Globicephala macrorhynchus*) and common bottlenose dolphins (*Tursiops truncatus*), seven sightings of rough-toothed dolphins (*Steno bredanensis*), and eight sightings of spinner dolphins (*Stenella longirostris*). Ten of the sightings (38%) were cued by analysts interpreting acoustic detections from the Navy’s hydrophone range, including one of the Blainville’s beaked whale sightings and the striped

dolphin sighting. In total, 33,071 photographs were taken of all seven encountered cetacean species for individual and species identification. There were 11 tagging attempts. One tag was lost, and 10 tags were deployed on five different species: eight depth-transmitting SPLASH10-F (Fastloc®-Global Positioning System (GPS)) tags and two depth-transmitting SPLASH10 tags (Table 2). Location data[1] were received from all 10 tags (Figures 2-12), and dive data from nine of the 10. Six tags were deployed during Phase A of the SCC (Table 2). Two of those tags stopped transmitting before the start of Phase B of the SCC, but four additional tags were deployed prior to Phase B (Table 2). Thus, data from eight of the tagged individuals overlapped temporally with Phase B of the SCC (Table 2). Data from all individuals have been provided to collaborating researchers with NIWCPAC for analyses of received levels of MFAS, and are being examined for potential behavioral changes associated with MFAS exposure. Some of the tagged individuals remained on or close to PMRF during the duration of the tag deployments (e.g., see Figures 2, 3, and 8). Additionally, one fecal sample (from a short-finned pilot whale) and two eDNA samples (from Blainville's beaked whales) were collected. The fecal sample has been archived with the University of Hawai'i Health and Stranding Lab for future prey DNA and hormone chemistry analyses, and the eDNA samples have been contributed to a larger beaked whale genetics project coordinated through the University of Auckland and funded by the Office of Naval Research.

Acknowledgements

We thank Nancy Dimarzio and Elizabeth Henderson for acoustic monitoring and support in locating groups. We thank Mark Mohler and Jana Phipps for assistance in the field, Myles Togioka and Jamie Thomton for logistics support, and Waimea Plantation Cottages for accommodating our crew and research vessel on site. Research was undertaken under NMFS ESA/MMPA Permit No. 20605 and was approved by the CRC Institutional Animal Care and Use Committee.

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[1] Details on tag filtering procedures are available in Baird et al. (2021)

Table 1. Details of sightings of marine mammals during the August 2022 Kaua'i 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 (ºN)	Start longitude (ºW)	# photos*	# tags deployed	# & type of samples
Blainville's beaked whale	17-Aug-22	1030-1032	2	22.08236	159.8548	446	0	0
Blainville's beaked whale	17-Aug-22	1313-1426	8	22.1897	159.94117	2289	1	2 eDNA
Bottlenose dolphin	20-Aug-22	0647-0652	11	21.98643	159.79479	439	0	0
Bottlenose dolphin	21-Aug-22	1011-1118	40	22.00346	159.85485	3673	1	0
Bottlenose dolphin	23-Aug-22	1138-1203	15	22.11635	159.83878	887	0	0
Melon-headed whale	18-Aug-22	0744-0916	275	22.10965	159.93645	4834	2	0
Melon-headed whale	24-Aug-22	0845-1042	220	22.14666	159.9685	2736	2	0
Rough-toothed dolphin	16-Aug-22	0644-0647	12	21.90781	159.7629	225	0	0
Rough-toothed dolphin	18-Aug-22	1108-1126	7	22.16387	159.86166	585	0	0
Rough-toothed dolphin	18-Aug-22	1256-1301	2	22.06013	159.87843	101	0	0
Rough-toothed dolphin	19-Aug-22	1111-1131	13	22.0611	159.98561	1271	0	0
Rough-toothed dolphin	23-Aug-22	0914-0919	2	21.96817	159.86086	23	0	0
Rough-toothed dolphin	23-Aug-22	0929-0944	8	22.13375	159.90984	325	0	0
Rough-toothed dolphin	24-Aug-22	0924-1042	7	22.15246	159.95329	404	1	0
Short-finned pilot whale	17-Aug-22	0732-0755	12	22.02259	159.90634	805	1	0
Short-finned pilot whale	17-Aug-22	0923-1032	22	22.06348	159.88948	1765	2	1 fecal
Short-finned pilot whale	19-Aug-22	1059-1131	24	22.06211	159.98223	993	0	0
Spinner dolphin	16-Aug-22	0619-0619	25	21.9465	159.6936	0	0	0
Spinner dolphin	18-Aug-22	0614-0614	8	21.94578	159.69586	0	0	0
Spinner dolphin	19-Aug-22	1004-1023	13	22.12957	159.75416	783	0	0
Spinner dolphin	20-Aug-22	1059-1119	175	22.11036	159.7448	1691	0	0
Spinner dolphin	20-Aug-22	1154-1159	6	22.00734	159.78718	159	0	0
Spinner dolphin	21-Aug-22	0848-0908	9	22.1259	159.73656	771	0	0
Spinner dolphin	22-Aug-22	1022-1037	38	21.9437	159.68816	730	0	0
Spinner dolphin	23-Aug-22	1345-1350	14	21.97503	159.7603	409	0	0
Striped dolphin	18-Aug-22	1035-1042	100	22.20762	159.96246	1073	0	0

Note: Aug = August; ºN = degrees North; ºW = degrees West. *In the case of mixed species groups (24 August 2022 melon-headed whale and rough-toothed dolphins; 19 August 2022 short-finned pilot whales and rough-toothed dolphins), the number of photos from the combined encounters (i.e., not sorted by species) is included for both species.

Table 2. Details of satellite tag deployments during the August 2022 Kaua‘i field effort, sorted by species and date.

Species	Date	Tag type	Tag ID	# days location data	Comments
Blainville's beaked whale	17-Aug-22	SPLASH10-F	MdTag022	24.3	Overlap with Phase A and B
Bottlenose dolphin	21-Aug-22	SPLASH10	TtTag041	17	Overlap with Phase B
Melon-headed whale	18-Aug-22	SPLASH10-F	PeTag033	11.1	Overlap with Phase A and B
Melon-headed whale	18-Aug-22	SPLASH10-F	PeTag034	4.1	Only 1 poor-quality GPS location after restrictions, overlap with Phase A
Melon-headed whale	24-Aug-22	SPLASH10-F	PeTag035	18.3	Overlap with Phase B
Melon-headed whale	24-Aug-22	SPLASH10-F	PeTag036	10.4	Overlap with Phase B
Rough-toothed dolphin	24-Aug-22	SPLASH10	SbTag025	7.5	Overlap with Phase B
Short-finned pilot whale	17-Aug-22	SPLASH10-F	GmTag235	17.1	Overlap with Phase A and B
Short-finned pilot whale	17-Aug-22	SPLASH10-F	GmTag236	4.1	Overlap with Phase A
Short-finned pilot whale	17-Aug-22	SPLASH10-F	GmTag237	45.5	Overlap with Phase A and B

Note: For Tag ID, species are indicated by two-letter codes (Gm = *Globicephala macrorhynchus*, Md = *Mesoplodon densirostris*; Pe = *Peponocephala electra;* Sb = *Steno bredanensis*, Tt = *Tursiops truncatus*). Aug = August.

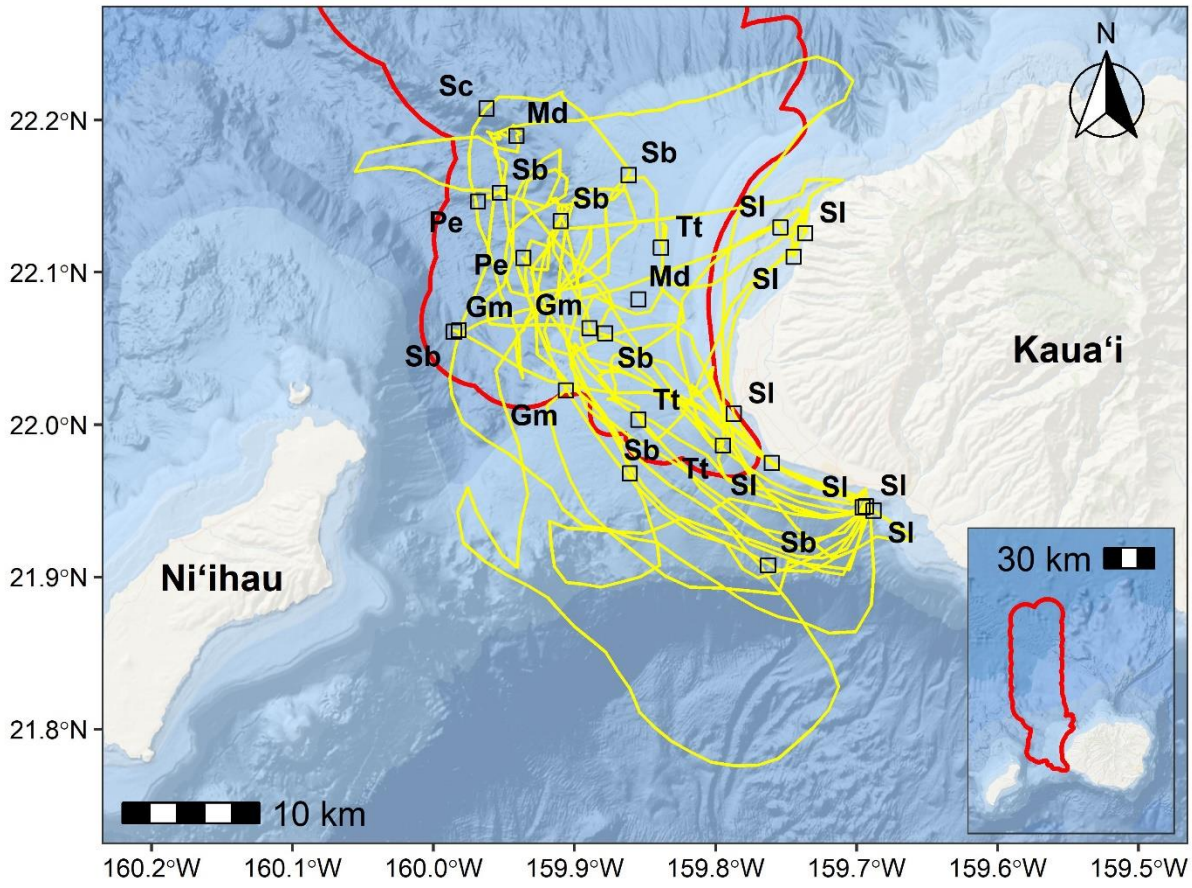

Figure 1. Search effort (yellow lines) and odontocete sightings (open squares) over nine days from 16–24 August 2022. Species are indicated by two-letter codes (Gm = *Globicephala macrorhynchus*; Md = *Mesoplodon densirostris*; Pe = *Peponocephala electra*; Sb = *Steno bredanensis*; Sc = *Stenella coeruleoalba*; Sl = *Stenella longirostris;* Tt = *Tursiops truncatus*). The PMRF outer boundary is indicated in red.

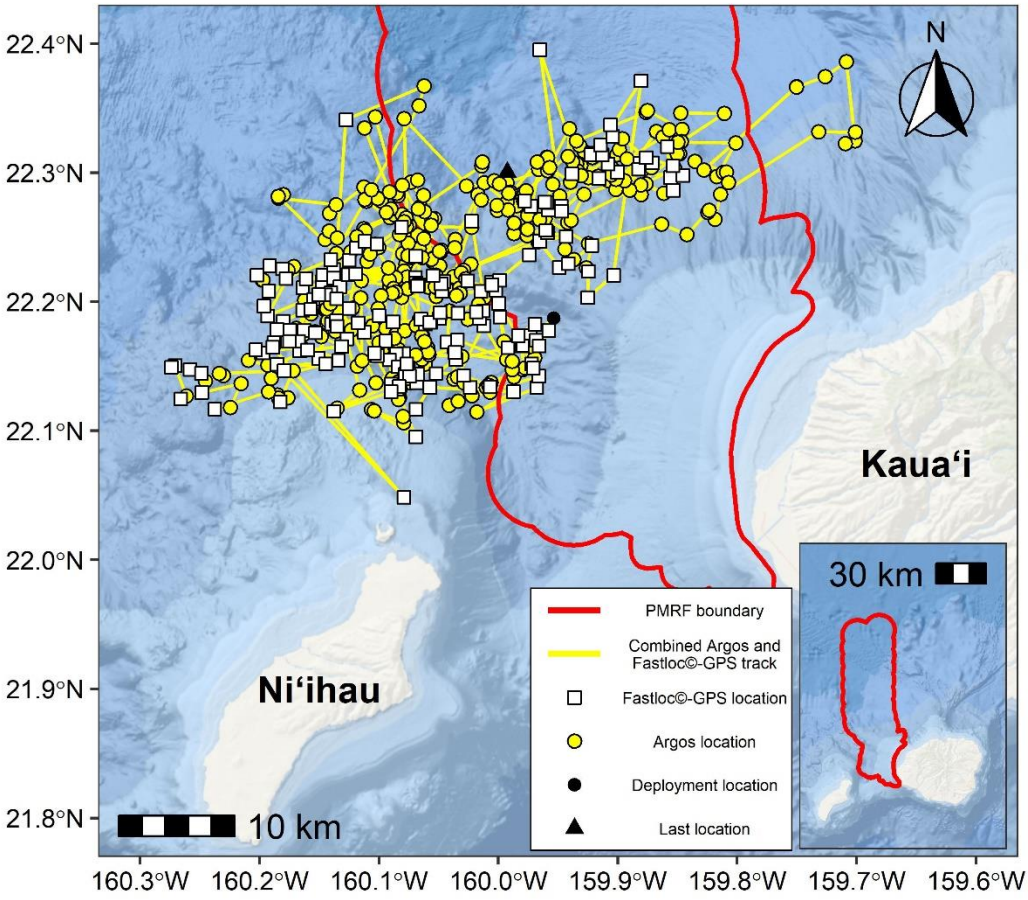

Figure 2. Filtered satellite tag data from a Blainville's beaked whale (MdTag022) over a 24.3-day period from 17 August 2022 to 10 September 2022. Temporally consecutive locations (regardless of location type) are joined in the combined Argos and Fastloc®-GPS track.

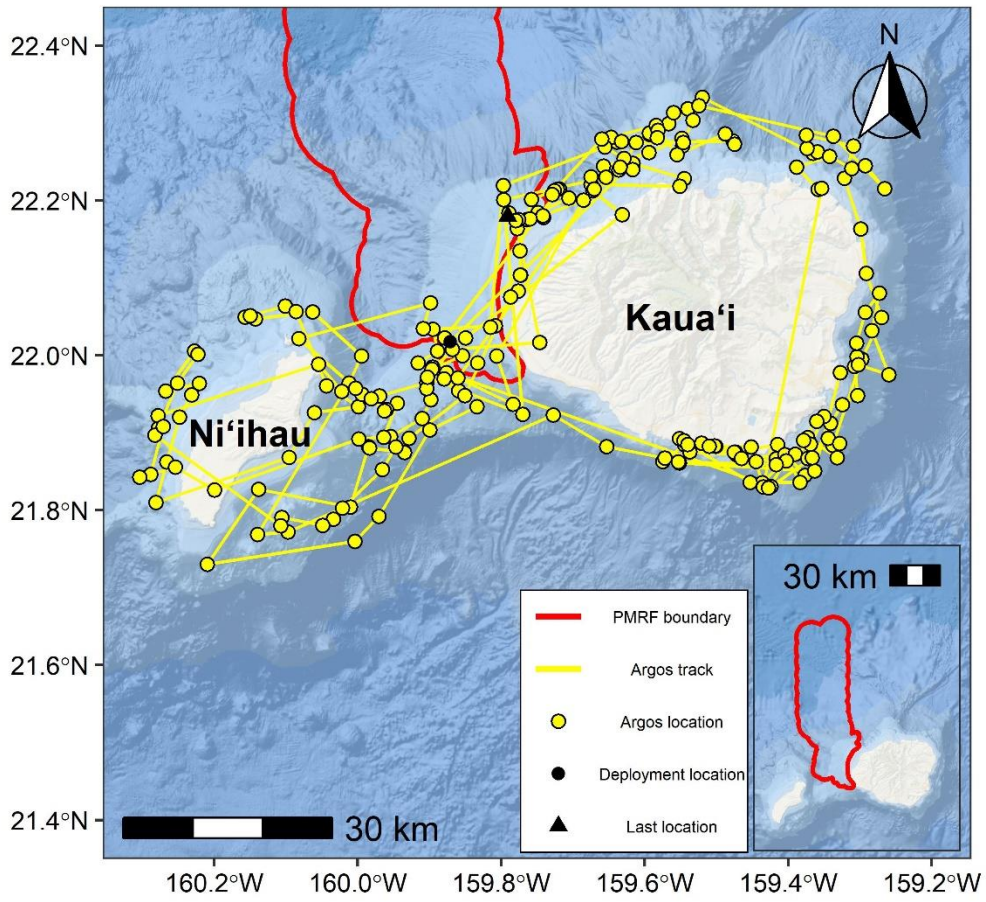

Figure 3. Filtered satellite tag data from a bottlenose dolphin (TtTag041) over a 17.0-day period from 21 August 2022 to 7 September 2022. Temporally consecutive locations are joined in the Argos track.

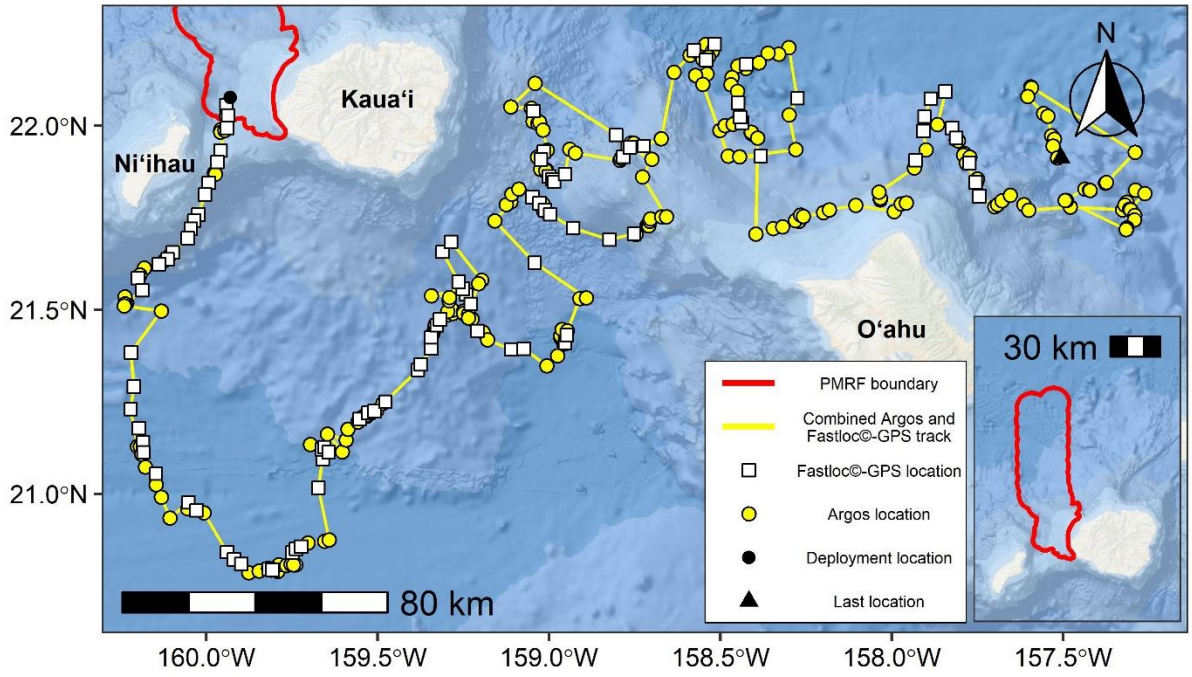

Figure 4. Filtered satellite tag data from a melon-headed whale (PeTag033) over an 11.1-day period from 18 August 2022 to 29 August 2022. Temporally consecutive locations (regardless of location type) are joined in the combined Argos and Fastloc®-GPS track.

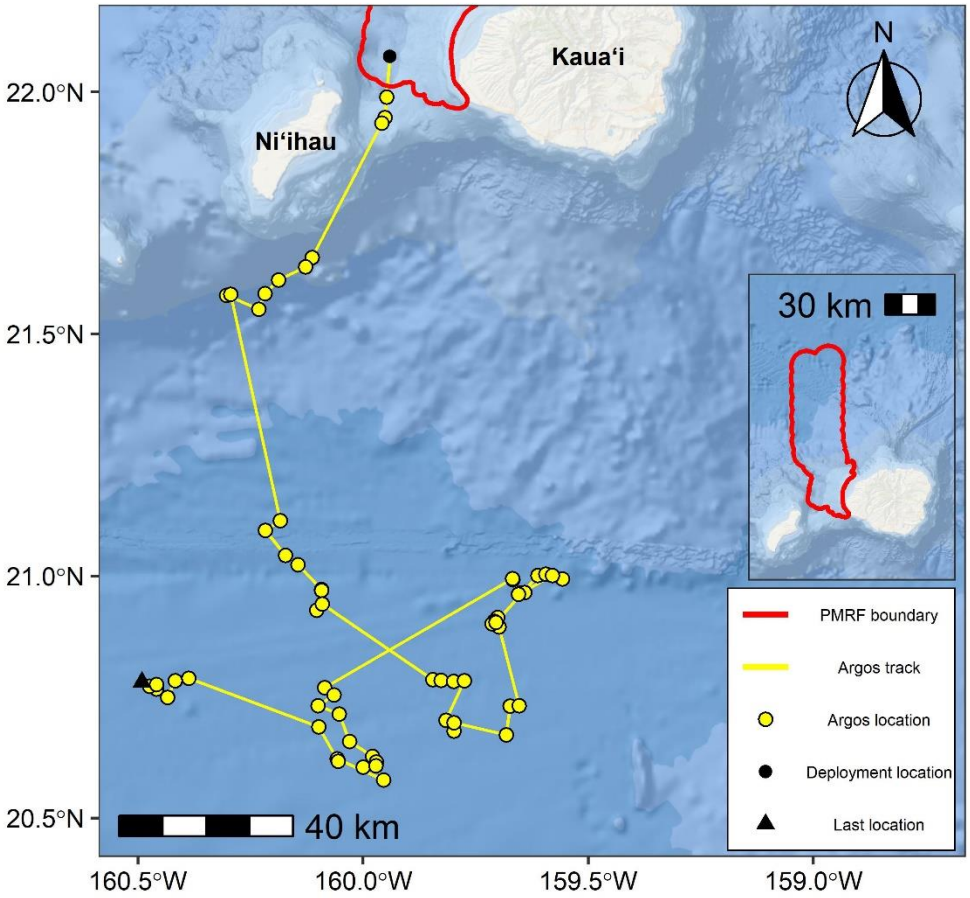

Figure 5. Filtered Argos satellite tag data from a melon-headed whale (PeTag034) over a 4.1-day period from 18 August 2022 to 22 August 2022. Temporally consecutive locations are joined in the Argos track.

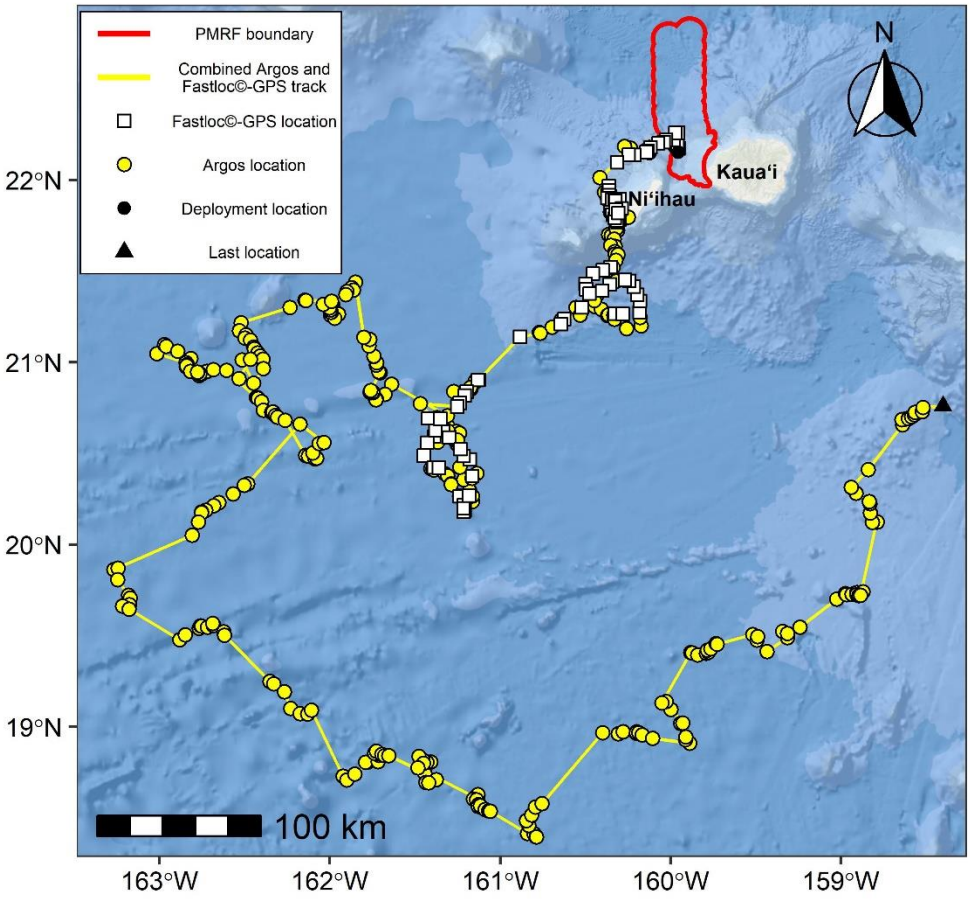

Figure 6. Filtered satellite tag data from a melon-headed whale (PeTag035) over an 18.3-day period from 24 August 2022 to 11 September 2022. Temporally consecutive locations (regardless of location type) are joined in the combined Argos and Fastloc®-GPS track.

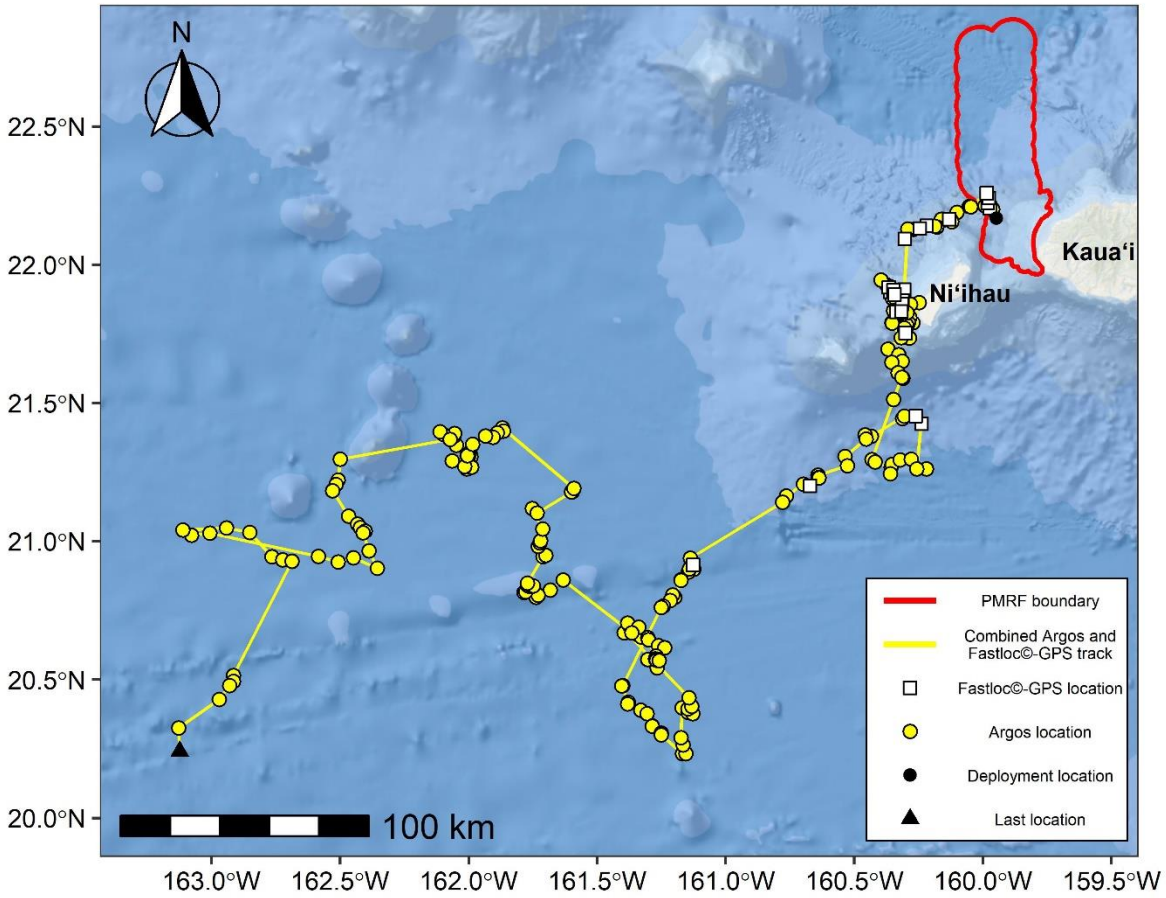

Figure 7. Filtered Argos satellite tag data from a melon-headed whale (PeTag036) over a 10.4-day period from 24 August 2022 to 3 September 2022. Temporally consecutive locations (regardless of location type) are joined in the combined Argos and Fastloc®-GPS track.

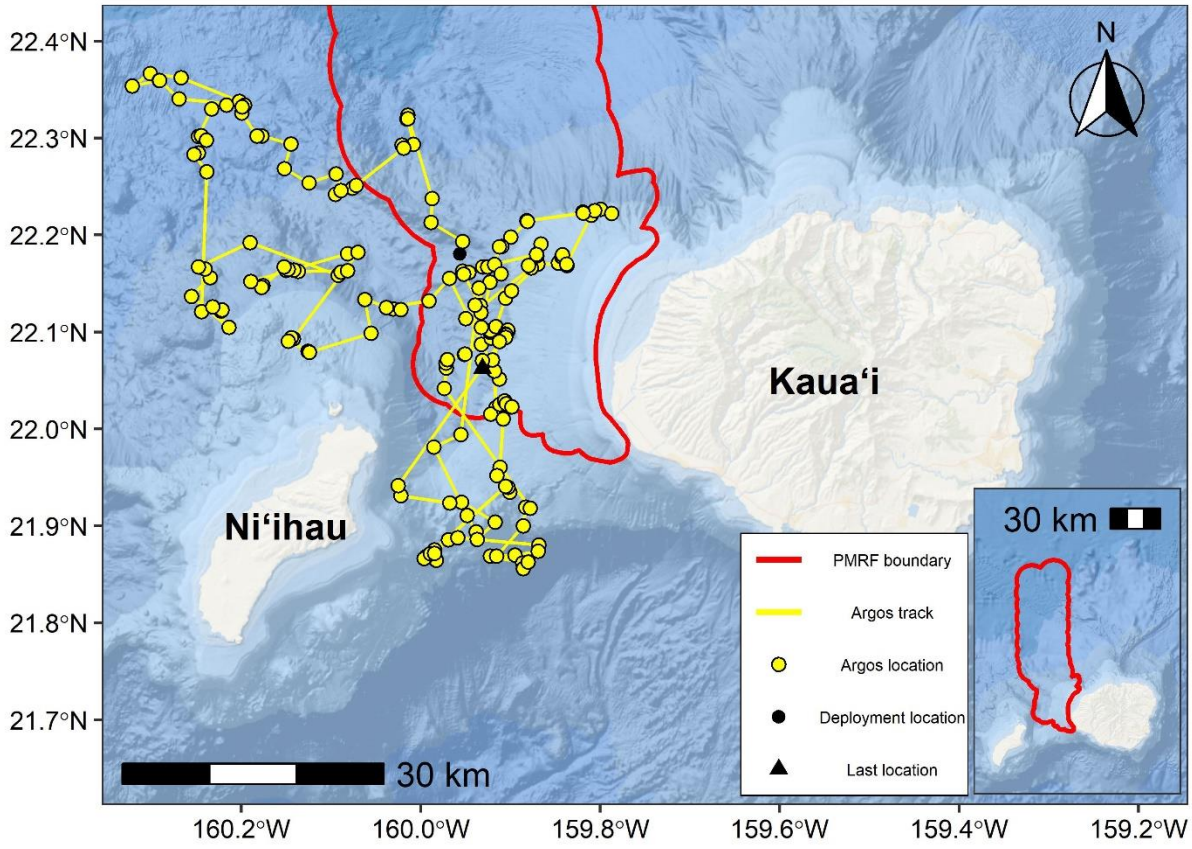

Figure 8. Filtered satellite tag data from a rough-toothed dolphin (SbTag025) over a 7.5-day period from 24 August 2022 to 31 August 2022. Temporally consecutive locations are joined in the Argos track.

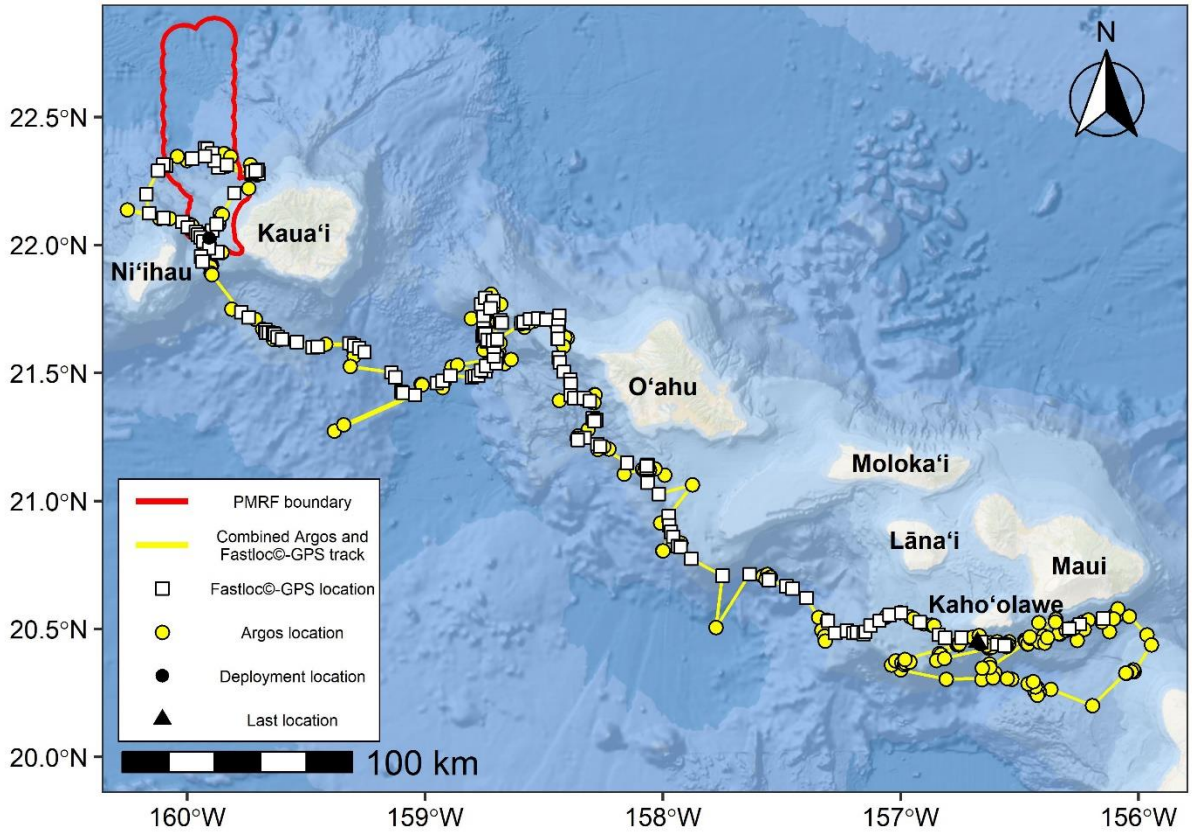

Figure 9. Filtered satellite tag data from a short-finned pilot whale (GmTag235) over a 17.1-day period from 17 August 2022 to 3 September 2022. Temporally consecutive locations (regardless of location type) are joined in the combined Argos and Fastloc®-GPS track.

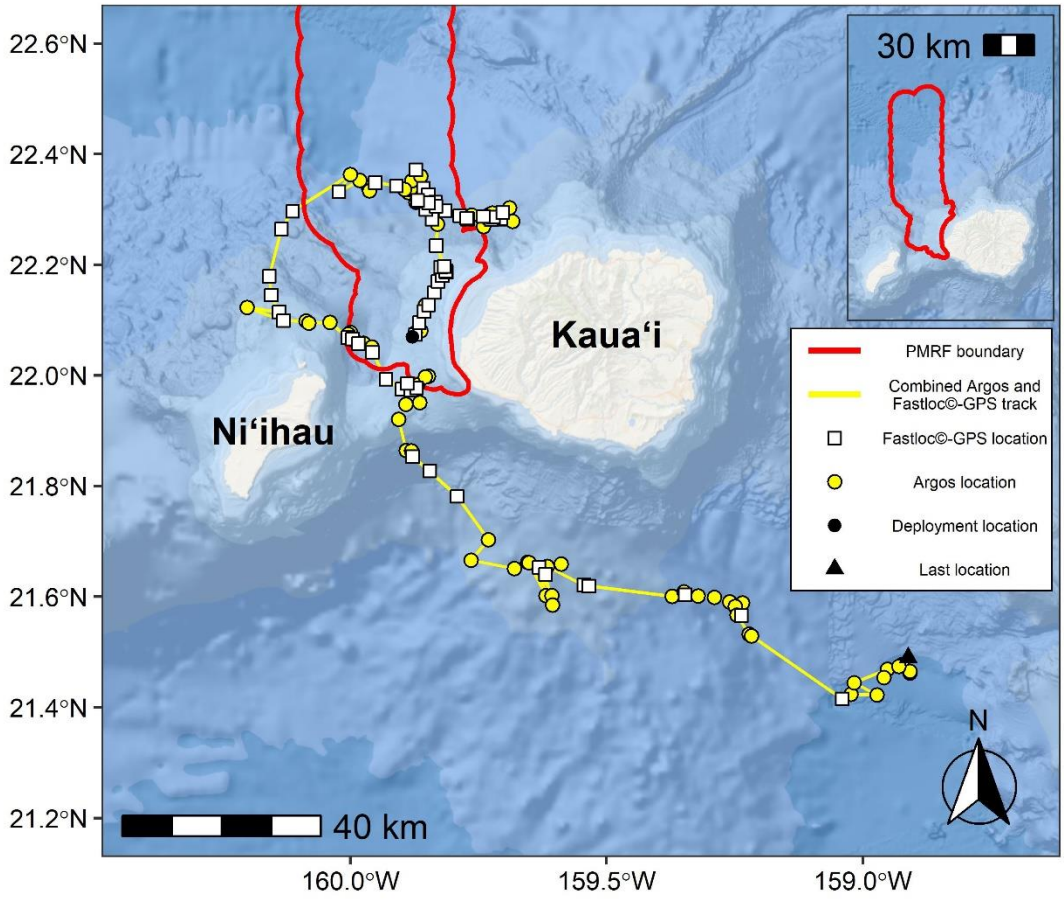

Figure 10. Filtered satellite tag data from a short-finned pilot whale (GmTag236) over a 4.1-day period from 17 August 2022 to 21 August 2022. Temporally consecutive locations (regardless of location type) are joined in the combined Argos and Fastloc®-GPS track.

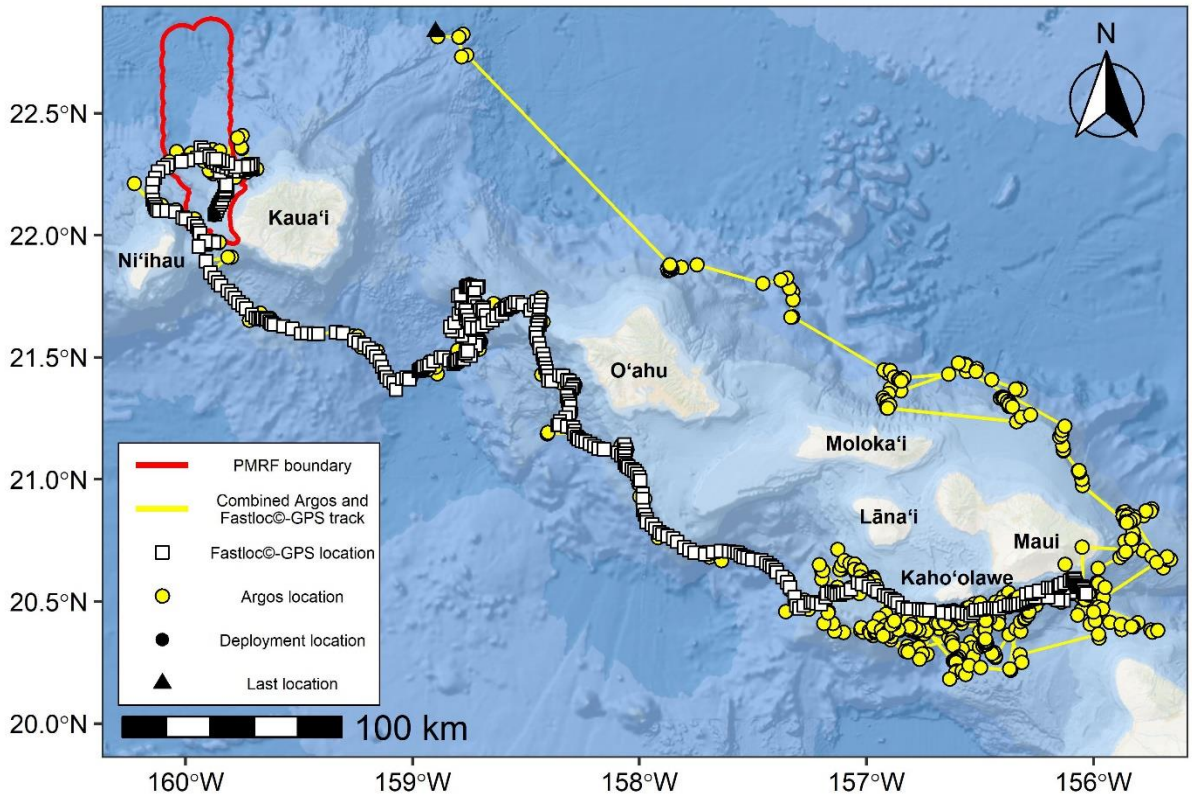

Figure 11. Filtered satellite tag data from a short-finned pilot whale (GmTag237) over a 45.5 day period from 17 August 2022 to 1 October 2022. Temporally consecutive locations (regardless of location type) are joined in the combined Argos and Fastloc®-GPS track.

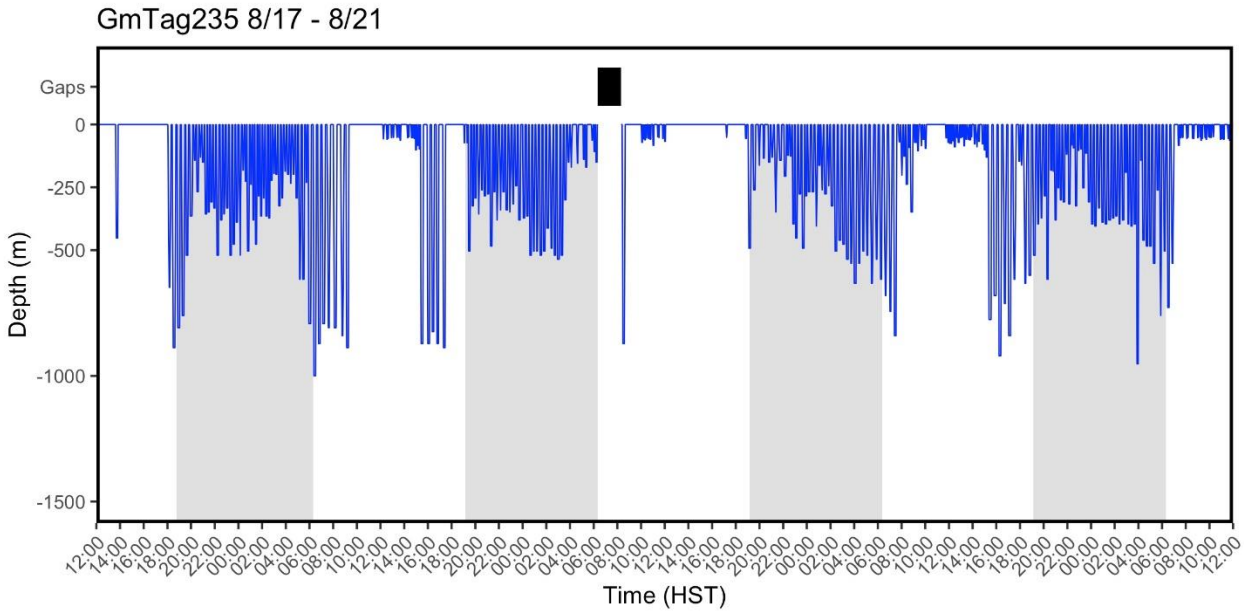

Figure 12. An example of behavior data obtained from a short-finned pilot whale (GmTag235) over a 4-day period, from 1200 hrs HST on 17 August 2022 to 1200 hrs HST on 21 August 2022. Night time periods are shaded. For any dives shallower than 50 m, a line at the 0 m depth is shown. Gaps in the data are indicated by 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 Phase B of a Submarine Command Course (SCC) scheduled to occur in August 2022. Field operations began the day before Phase A of the SCC started. Eight days of funding were provided by the U.S. Navy (Navy), and an additional day was funded by a grant from the Pacific Islands Fisheries Science Center. The vessel used was a 24-foot (7.3 m) 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 the Marine Mammal Monitoring on U.S. Navy Ranges (M3R) and NIWCPAC analysts was undertaken for all days when weather conditions allowed access to the range or areas near the range. When positions from the 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 NMFS MMPA/ESA Scientific Research Permit No. 20605. 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, false killer whales, 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 (e.g., false killer whales, short-finned pilot whales, melon-headed whales, and Blainville's beaked whales), if conditions were suitable, we attempted to deploy at least one satellite tag per group. Tags for these species were depth transmitting SPLASH10F (Fastloc®-GPS) tags. Bottlenose dolphins and rough-toothed dolphins were considered low priority species by the Navy, and thus only SPLASH10s (provided by a non-Navy grant) were used. 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. Species targeted for biopsy samples were those where samples could be used to assess stock identity (e.g., false killer whale, see Martien et al. 2014), or when behavior of the group and conditions facilitated sample collection. In encounters where tagging was going to be undertaken, biopsy sampling was only undertaken after the cessation of tagging operations. Biopsy samples were sub-sampled for a number of ongoing studies through the Southwest Fisheries Science Center and the University of Hawai‘i.

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