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Cetacean Monitoring in the Mariana Islands Range Complex, August-September 2018

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Mission

The Pacific Islands Fisheries Science Center's (PIFSC) Cetacean Research Program (CRP) has been conducting visual surveys for cetaceans in the waters surrounding Guam and the Commonwealth of the Northern Mariana Islands (CNMI) as part of an ongoing effort to develop a record of cetacean occurrence in the region. Visual surveys have been conducted aboard small boats (7.6–12.2 m) since 2010 off the southernmost islands of the Mariana Archipelago (Saipan, Tinian, Aguijan, Rota, and Guam). These surveys include the collection of photographs for individual identification, tissue samples for genetic analysis of population structure, and the deployment of satellite tags for assessment of individual movements throughout the broader region.

Funding for these surveys was provided in partnership between the Navy (U.S. Pacific Fleet Environmental Readiness Division) and PIFSC. Data sets from the small-boat survey efforts are used to evaluate the distribution, stock structure, and movements of cetaceans within the study area. This report includes a summary of the most recent visual surveys that were conducted in the “summer” (August–September) of 2018.

Methods

Field Methods—Visual Surveys

During August–September 2018, non-systematic visual surveys for cetaceans were conducted from small vessels off Saipan, Tinian, Aguijan, and Guam. Surveys off Saipan, Tinian, and Aguijan were conducted using a 12.2-m sport-fisher with flying bridge and twin-diesel inboard engines (*Sea Hunter*) and a 7.9-m Regulator with twin 4-stroke outboard engines (*Regulator*). Surveys off Guam were conducted aboard a 10-m Grady White with twin outboard engines (*No Quarter*) and a 17.7-m Riviera Sport Fisher with flying bridge and twin diesel inboard engines (*Liquid Soul*). Visual survey effort and vessel tracks were spread out from day to day to ensure broad survey coverage over a wide range of depths. Weather and sea conditions dictated the direction and scope of the survey effort. The survey vessels traveled at a speed of 15–26 km/h, depending on the size of the vessel and sea conditions. Four to 6 observers scanned for marine mammals with unaided eyes, collectively searching 360 degrees around the vessel.

All cetacean groups sighted were approached for species confirmation, group size estimates, photo-identification, and biopsy sampling. Satellite tagging operations were planned during encounters with all cetacean species except stenellid dolphins. Photo-identification, biopsy, and satellite tagging protocols were the same as those described by Hill *et al.* (2014, 2015). Occurrences, locations, and sizes of turtles were recorded, but photos and biological samples were not collected.

Data Processing and Analyses

Visual Surveys and Encounters

The depth and distance from shore for each cetacean encounter was measured using the same methods and bathymetry data as those described in Hill *et al.* (2014, 2016).

Satellite Telemetry

The same methods as those described in Hill *et al.* (2014, 2015) were used to process and analyze the satellite tag location data related to depth and distance from shore. The data included in these analyses were derived from satellite tags deployed during the August–September 2018 small-boat effort.

Results

Visual Surveys and Encounters

Small-boat visual surveys were conducted in the waters surrounding Saipan, Tinian, Aguijan, and Guam on 14 days between 24 August–9 September 2018 (Table 1, Figure 1). A total of 1,168 km of trackline was surveyed, most of which was in Beaufort sea states of 2–4 (73%, 856 km) and swell heights of 0–4 ft (71%, 835 km) (Table 1, Figure 2). Approximately 20% (15.4 h) of the total time on effort was spent inside of the 100-m depth contour (Figure 3). More than a third (37%) of the total effort (28.6 h) was spent over water depths 501–1000 m. Effort was lowest and reduced gradually over depths of 1,101–2,300 m.

Twenty cetacean groups were encountered resulting in the collection of 6,437 photos, 33 biopsy samples, and the deployment of 5 satellite tags (Tables 2–3, 5). All cetacean groups were identified to 5 species, including spinner dolphin (*Stenella longirostris*), pantropical spotted dolphin (*S. attenuata*), bottlenose dolphin (*Tursiops truncatus*), short-finned pilot whale (*Globicephala macrorhynchus*), and sperm whale (*Physeter macrocephalus*).

Spinner dolphins were the most frequently encountered species ($n = 9$) (Tables 2, 5; Figure 1a–b). All encounters were in depths <100 m and were within 3.5 km from shore (Table 5). Group sizes ranged 4–100 individuals. A total of 2,261 photos were collected for photo-identification, and 6 biopsy samples were collected for genetic analysis.

Pantropical spotted dolphins were encountered 7 times (Tables 2, 5; Figure 1a–b). Four encounters were in the 3-Islands area of Saipan, Tinian, and Aguijan. Two encounters northwest of Tinian were separated by a week but were less than 400 m apart. There were 3 encounters off Guam. The median depth of all pantropical spotted dolphin encounter locations was 1,211 m (347–1,427 m), and the median distance from shore was 9.3 km (2.1–10.6 km). Group sizes ranged 8–95 individuals. A total of 656 photos and 7 biopsy samples were collected.

Bottlenose dolphins were encountered twice in the 3-Islands area during the small-boat surveys (Tables 2, 5; Figure 1a). One group was encountered on Marpi Reef, and the other was encountered off the west side of Tinian. The depths of the encounter locations were 64 m and 459 m, and the distances from shore were 16.8 km and 2.6 km, respectively. Group sizes were 5 and 12 individuals, respectively. A total of 294 photos were collected for photo-identification, and 2 biopsy samples were collected for genetic analysis.

Short-finned pilot whales were encountered twice in the 3-Islands area during the small-boat surveys (Tables 2, 5; Figure 1a). One group was encountered off Marpi Reef and the other was encountered off the west side of Tinian. The depths of the encounter locations were 920 m and 698 m, and the distances from shore were 21.0 km and 4.9 km, respectively. Group sizes

were 35 and 19 individuals. A total 2,568 photos were collected for photo-identification, and 15 biopsy samples were collected for genetic analysis. Five satellite tags were deployed to investigate individual movements and spatial use (Table 3, Figure 4).

There was a single encounter with sperm whales off the west side of Guam during the small-boat surveys (Tables 2, 5; Figure 1b). The encounter location was 10.0 km from shore and had a water depth of 2,051 m. The group consisted of 13 individuals, including 3 mom-calf pairs. A total of 656 photos were collected for photo-identification, and 3 biopsy samples were collected for genetic analysis.

A total of 19 sea turtles were observed during the 2018 summer small-boat surveys; 10 were identified as green sea turtles (Table 4). The rest were not identified to species. Sea turtle sighting data were provided to the PIFSC MTBAP (Marine Turtle Biology and Assessment Program).

Satellite Telemetry

During August 2018, satellite tags were deployed on 5 adult short-finned pilot whales (Table 3, Figure 4); all of which are in the PIFSC CRP photo-identification catalog. Two location-only SPOT6 (tag ID 141710 (photo catalog ID MIGm-073) and 172235 (MIGm-058)) and 1 location–depth SPLASH (141726 (MIGm-066)) satellite tags were deployed during an encounter off Marpi Reef on 26 August. The tag durations ranged from 8.9 d to 127.8 d¹ during which the whales appeared to travel together and primarily moved within the 3-Islands area but made excursions north to Anatahan and south to Rota and Guam. During a short-finned pilot whale encounter off Tinian on 28 August, with a group different than that encountered on 26 August, 1 SPOT6 (tag ID 141711 (MIGm-026)) and 1 SPLASH (169422 (MIGm-022)) satellite tag were deployed. The tags had similar durations of 15.2 d and 14.6 d, respectively, during which the whales primarily stayed off Aguijan and the southern end of Tinian but also went south to Rota and offshore approximately 70 km to the west. On 5 September, the tagged whales from the different encounters briefly crossed paths during which tag IDs 172235 (MIGm-058) and 169422 (MIGm-022) were in close proximity to each other (within 200 m).

¹ Data through December 31, 2018 (UTC). Tags 141710 and 172235 transmitted into the first week of January but the location data are not available for this report.

Discussion

The 2018 summer small-boat surveys off Saipan, Tinian, Aguijan, and Guam represent a continuation of the collaborative effort between the PIFSC's CRP and the U.S. Navy towards a better understanding of the occurrence and distribution of cetaceans in waters off the southernmost islands of the Mariana Archipelago.

The NMFS (PIFSC) is responsible for the assessment of marine mammal stocks in the Exclusive Economic Zone (EEZ) waters of Guam and the CNMI. The U.S. Navy conducts marine species monitoring within the Mariana Islands Training and Testing study area in accordance with Letters of Authorization and Biological Opinions issued under the Marine Mammal Protection Act (MMPA) and the Endangered Species Act (ESA). The scope of Navy funded monitoring in the study area can vary based on annual adaptive management discussions with NMFS' Office of Protected Resources.

For this report, we discuss preliminary results from the 2018 cetacean surveys in an effort toward answering questions currently presented within the U.S. Navy's monitoring plan below.

- 1. What species of marine mammals occur in the nearshore (within small-boat survey range) and offshore areas of the MITT study area?**
- 2. What is the habitat use of cetaceans in the nearshore and offshore areas of the MITT study area?**

During the summer 2018 small-boat visual surveys, 5 species were encountered (spinner dolphins, pantropical spotted dolphins, bottlenose dolphins, short-finned pilot whales, and sperm whales) of the 14 previously seen during PIFSC summer nearshore surveys. The overall encounter rate (1.8 encounters/100 km effort; Table 5) during the summer 2018 surveys was slightly higher than the total observed across all previous surveys between 2010 and February 2018 (1.5 encounters/100 km effort; Hill *et al.* in review).

Spatial use (depth and distance from shore) and encounter rates reveal varying patterns for the species occurring around Saipan, Tinian, Aguijan, and Guam. Patterns of spatial use by the 5 species encountered during the 2018 summer visual surveys were similar to those described in previous years by Hill *et al.* (in review).

Spinner dolphins continue to be the most frequently encountered species (0.8 encounters/100 km effort) and were found close to shore (≤ 3.5 km) and in waters of < 100 m depth. They were encountered off the west side of Saipan, the east side of Tinian, and the west side of Guam. Off Tinian, spinner dolphins have only been encountered on the east side during

PIFSC small-boat surveys despite a more extensive effort off the west side of the island (Hill *et al.* in review).

Pantropical spotted dolphins were the second most frequently sighted species (0.6 encounters/100 km effort) during the August–September surveys, which Hill *et al.* (in review) also found for the summary of all previous small-boat surveys conducted by PIFSC. During the summer 2018 surveys, there were 4 encounters of pantropical spotted dolphins within the 3-Islands area, more than during any prior survey effort in the area. There had been single encounters in 2011, 2012, 2013, and 2016 (Hill *et al.* in review). The summer 2018 pantropical spotted dolphin encounter locations within the 3-Islands area were all closer to shore than those in previous years except for that in 2011, which was approximately 6 km from shore.

Bottlenose dolphins were the third most frequently sighted species across all previous surveys (Hill *et al.* in review). During the summer 2018 small-boat surveys, the encounter rate (0.17 encounters/100 km effort) was consistent with previous surveys. The dolphins were encountered in similar locations on Marpi Reef and off the west side of Tinian where they had been seen in previous years. The depths and distances from shore were also similar.

Short-finned pilot whales were encountered during the August–September 2018 surveys at a higher rate than expected based on previous surveys (0.16 vs. 0.09 encounters/100 km effort) (Hill *et al.* in review). The 28 August 2018 encounter location off west side of Tinian was similar in location, depth, and distance to shore as a September 2011 encounter with short-finned pilot whales. The 26 August 2018 encounter off Marpi Reef was the farthest north that short-finned pilot whales were encountered during all PIFSC small-boat surveys but was not the farthest offshore. In 2012, short-finned pilot whales were encountered 36 km west of Tinian near Esmeralda Bank (Hill *et al.* 2018). All 5 short-finned pilot whales satellite tagged in 2018 are in the PIFSC photo-identification catalog, are part of the main social cluster identified by Hill *et al.* (2018), and were seen previously in multiple years. The 2 individuals tagged off Tinian on 28 August (MIGm-022 and MIGm-026) were encountered together off Tinian in 2011 and off Guam in 2012. MIGm-022 is a male with mitochondrial DNA (mtDNA) haplotype A2 that was first seen off Guam in 2007 during a U.S. Navy shipboard survey (Hill *et al.* 2018). MIGm-026 was not previously sampled and was encountered again off Guam in 2016. A biopsy sample was collected from this individual during the 2018 encounter. The 3 individuals tagged on 26 August 2018 (MIGm-058, MIGm-073, and MIGm-066) were first seen together off Rota in 2011. MIGm-058 is a female with haplotype A2 (Hill *et al.* 2018) that was also seen off Guam in 2012, 2013, and 2016. MIGm-073 has not been previously biopsied, though a sample was collected during the 2018 encounter. This individual was encountered off Rota in 2014 and off Guam in 2016. MIGm-066 is a female with haplotype A2 (Hill *et al.* 2018) who was with MIGm-058 during the 2013 encounter off Guam, with MIGm-073 during the 2014 encounter off Rota, and with

MIGm-026 during the 2016 encounter off Guam. MIGm-066 was also satellite-tagged in 2014 off Rota (tag ID 137727; Hill *et al.* 2018). During the 94.6 d that the tag transmitted, she primarily used the waters off Guam, but moved as far north as FDM and as far south as Galvez Banks (approximately 30 km southwest of Guam). Hill *et al.* (2018) used satellite tag data from individuals tagged off Guam and Rota (including 137727 (MIGm-066)) in 2013, 2014, and 2016 to demonstrate that although their core area was centered around Guam and Rota, they had a home range of 51,849 km² that extended to the north beyond FDM and to the south beyond Guam to Santa Rosa Reef. The 2018 tagged short-finned pilot whales primarily remained within the 3-Islands area, but they also made trips beyond the area south to Rota and Guam and north to FDM and Anatahan (Figure 4). Comparing the spatial use of MIGm-066 between years alongside oceanographic data could be informative for understanding any shift in the habitat use of this individual from 2014 to 2018.

Sperm whales were encountered once off the west side of Guam during the 2018 August–September small-boat surveys. They had been previously encountered twice off Guam’s west side in 2010 and 2016 (Hill *et al.* in review). The 2016 encounter was at a similar depth and distance from shore as the 2018 encounter.

3. What are the abundance and population structures of marine mammals in the MITT study area?

See Hill *et al.* (in review) for a detailed discussion on the status of the data collected for each cetacean species encountered during PIFSC small-boat surveys to evaluate the probability of determining population structure and abundance.

4. What are the seasonal occurrence and movements of baleen whales in the nearshore and offshore areas of the MITT study area?

There were no encounters of baleen whales during the 2018 summer surveys.

5. What is the exposure of cetaceans and sea turtles to explosives and/or sonar in the MITT study area?

Currently, we have no information on the timing of specific explosives training off Guam during the period of our 2018 surveys (Figure 5). Based on the locations of the explosives training areas, we can suggest the possibility that certain species may be affected by explosive activities. During the summer (August–September) surveys, sperm whales and pantropical spotted dolphins were encountered within 3 km of the Agat Bay UNDET site. In addition, the depths of the other locations where pantropical spotted dolphins were encountered are similar to that of the Agat Bay UNDET site (1,750 m).

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Tables

Table 1: Effort summaries for 2018 Marianas summer (August-September) surveys.

Local Date (2018)	Location	Vessel	Survey Description	On Effort Time (h:mm)	On Effort Distance (km)
24-Aug	CNMI-Saipan	Sea Hunter	Saipan west side figure eight	4:20	73.0
25-Aug	CNMI-Saipan/Tinian/Aguijan	Sea Hunter	Tinian east side and Aguijan circumnav. then return along Tinian/Saipan west side	6:55	107.6
26-Aug	CNMI-Saipan/Marpi Reef	Sea Hunter	Marpi Reef - partial survey along 500m contour	9:50	104.2
27-Aug	CNMI-Saipan/Tinian	Sea Hunter	Saipan-Tinian west side loop down 1000m contour and up 500 m contour	5:16	71.0
28-Aug	CNMI-Saipan/Tinian	Regulator	Saipan-Tinian west loop	7:54	113.5
29-Aug	CNMI-Saipan/Marpi Reef	Regulator	Saipan circumnavigation.	2:34	43.9
30-Aug	CNMI-Saipan	Sea Hunter	Saipan west loop	4:00	59.5
2-Sep	CNMI-Saipan/Tinian	Sea Hunter	Saipan-Tinian west loop	5:15	86.5
3-Sep	CNMI-Saipan/Tinian	Sea Hunter	Saipan-Tinian west loop	3:47	53.0
5-Sep	Guam	Liquid Soul	Agat Marina - SW to SE loop (1000m to 500m contours)	6:33	118.9
6-Sep	Guam	Liquid Soul	Agat Marina - NW loop offshore	6:18	110.1
7-Sep	Guam	Liquid Soul	Agat Marina - SW loop offshore	6:49	80.0
8-Sep	Guam	No Quarter	Agat Marina - NW loop	4:07	85.0
9-Sep	Guam	No Quarter	Agat Marina - SW loop	3:51	61.9
				77:36	1,168.0

Table 2: Details of the cetacean encounters during the 2018 Marianas summer (August-September) small-boat surveys. Best estimates for the total group size, calves, and neonates were made by observer consensus in the field. The estimate of calves included neonates. Neonates were determined by observation of visible fetal folds.

Local Date (2018)	Sighting	Common Name	Local Time (UTC +10)	Location	Latitude (N)	Longitude (E)	Depth (m)	Shore Distance (km)	Beaufort	Swell Height (ft)	Total Best	Calves Best	Neonate Best	Behavior	# Photos	# Biopsy Samples	# Tags
25-Aug	1	Spinner dolphin	8:52	Tinian	15.0110	145.6748	63	0.38	4	2-4	50	2	1	boat approach bow ride	407	0	0
26-Aug	2	Spinner dolphin	7:31	Saipan	15.2451	145.6972	46	3.52	3	2-4	52	4	3	travel boat approach bow ride	183	0	0
26-Aug	3	Short-finned pilot whale	9:58	Marpi Reef	15.4707	145.8726	920	21.04	4	2-4	35	2	0	surface active mill	1,575	7	3
26-Aug	4	Bottlenose dolphin	15:23	Marpi Reef	15.4324	145.8651	64	16.77	4	2-4	5	0	0	boat approach bow ride	28	0	0
27-Aug	5	Spinner dolphin	7:55	Saipan	15.2314	145.6983	46	2.38	1	0-2	70	4	2	boat approach bow ride travel	689	0	0
27-Aug	6	Pantropical spotted dolphin	10:11	Tinian	15.1369	145.5443	1211	10.38	2	2-4	40	5	5	boat approach bow ride travel surface active	120	3	0
28-Aug	7	Pantropical spotted dolphin	10:50	Saipan	15.2758	145.6394	811	10.39	4	2-4	8	0	0	surface active boat approach bow ride mill	0	0	0
28-Aug	8	Short-finned pilot whale	12:21	Tinian	15.0828	145.5629	698	4.86	4	2-4	19	0	0	boat approach bow ride mill	993	8	2

Local Date (2018)	Sighting	Common Name	Local Time (UTC +10)	Location	Latitude (N)	Longitude (E)	Depth (m)	Shore Distance (km)	Beaufort	Swell Height (ft)	Total Best	Calves Best	Neonate Best	Behavior	# Photos	# Biopsy Samples	# Tags
28-Aug	9	Pantropical spotted dolphin	15:44	Tinian	15.0526	145.5760	347	2.10	3	2-4	55	2	0	fish chase/feed boat approach bow ride mill travel	45	0	0
28-Aug	10	Bottlenose dolphin	16:02	Tinian	15.0977	145.6069	459	2.61	3	2-4	12	0	0	travel	266	2	0
30-Aug	11	Spinner dolphin	12:39	Saipan	15.2009	145.6945	23	2.20	5	2-4	27	1	0	travel	125	0	0
3-Sep	12	Pantropical spotted dolphin	8:40	Tinian	15.1402	145.5449	1211	10.57	2	4-6	15	0	0	travel surface active	130	4	0
3-Sep	13	Spinner dolphin	10:46	Saipan	15.2128	145.6874	29	3.03	1	4-6	49	2	2	boat approach bow ride surface active social travel	181	0	0
6-Sep	14	Pantropical spotted dolphin	9:38	Guam	13.6477	144.7543	820	9.29	0	2-4	65	1	0	travel boat approach bow ride surface active mill	244	0	0
7-Sep	15a	Sperm whale	8:12	Guam	13.3810	144.5509	2051	10.08	4	2-4	13	3	0	mill	658	3	0
7-Sep	15b	Pantropical spotted dolphin	10:29	Guam	13.3120	144.6074	1427	4.42	3	2-4	54	0	0	boat approach bow ride surface active social mill	10	0	0

Local Date (2018)	Sighting	Common Name	Local Time (UTC +10)	Location	Latitude (N)	Longitude (E)	Depth (m)	Shore Distance (km)	Beaufort	Swell Height (ft)	Total Best	Calves Best	Neonate Best	Behavior	# Photos	# Biopsy Samples	# Tags
8-Sep	16	Spinner dolphin	11:04	Guam	13.3975	144.6571	<100	0.54	3	0-2	32	0	0	travel boat approach bow ride social	68	0	0
9-Sep	17	Pantropical spotted dolphin	7:28	Guam	13.4150	144.5898	1363	4.43	1	2-4	95	3	0	mill	107	0	0
9-Sep	18	Spinner dolphin	8:40	Guam	13.2594	144.6522	<100	1.63	3	0-2	4	1	0	travel	56	1	0
9-Sep	19	Spinner dolphin	9:04	Guam	13.2927	144.6555	<100	0.19	1	0-2	100	4	0	travel boat approach bow ride surface active social	539	5	0
9-Sep	20	Spinner dolphin	10:33	Guam	13.3556	144.6417	<100	0.40	1	0-2	21	0	0	mill	13	0	0
Total															6,437	33	5

Table 3: Short-finned pilot whale satellite tag deployment information and summary of depth and distance to shore for the Douglas ARGOS filtered (DAF) tag locations by tag ID. Information on each individual (photo catalog ID, sex, and mitochondrial DNA haplotype from previous analyses) is included. Biopsy samples were collected from all individuals during tagging but have not been processed.

Tag ID	Tag Type	Photo-ID Catalog ID	Sex	Haplotype	Deployment Location	Deployment Local Date-Time (UTC +10)	Sighting	Latitude (N)	Longitude (E)	Duration (d)	No. DAF Locations	Median Depth (m) (min-max)	Median Shore Distance (km) (min-max)
141710	SPOT6	MIGm-073	-	-	Marpi Reef	08/26/2018 10:09	03	15.4705	145.87784	127.4*	861	1,006 (16-3,135)	14.5 (0.1-59.0)
141726	SPLASH10	MIGm-066	Female	A2	Marpi Reef	08/26/2018 11:39	03	15.4821	145.90559	8.9	131	922 (59-2,882)	16.5 (0.02-40.4)
172235	SPOT6	MIGm-058	Female	A2	Marpi Reef	08/26/2018 14:21	03	15.5214	145.93185	127.8*	731	925 (47-3,630)	13.3 (0.2-69.9)
141711	SPOT5	MIGm-026	-	-	Tinian	08/28/2018 12:45	08	15.0743	145.55768	15.2	143	1,211 (429-3022)	14.6 (2.1-70.8)
169422	SPLASH10	MIGm-022	Male	A2	Tinian	08/28/2018 13:50	08	15.0423	145.56094	14.6	199	1,251 (239-2,906)	16.6 (0.2-68.7)
Total											2,065	1,006 (47-3,630)	14.5 (0.02-70.8)

*Data through 31 December 2018 UTC. 141710 last transmission 1 January 2019; 172235 last transmission 10 January 2019. January location data unavailable for this report.

Table 4: Turtle sightings during the 2018 Marianas summer (August–September) small-boat cetacean surveys.

Local Date (2018)	Local Time (GMT +10)	Location	Latitude (N)	Longitude (E)	Description
24-Aug	9:26	Saipan	15.2557	145.7619	Turtle-large (>2.5 ft)
24-Aug	9:33	Saipan	15.2595	145.7466	Green Turtle-small (<1.5 ft)
24-Aug	12:10	Saipan	15.2090	145.6939	Turtle-large (>2.5 ft)
25-Aug	7:28	Saipan	15.2094	145.6953	Green Turtle-small (<1.5 ft)
25-Aug	7:28	Saipan	15.2070	145.6951	Turtle-small (<1.5 ft)
25-Aug	8:28	Saipan	15.0560	145.6610	Turtle-large (>2.5 ft)
25-Aug	14:07	Saipan	15.2073	145.6939	Turtle-large (>2.5 ft)
25-Aug	14:08	Saipan	15.2096	145.6955	Green Turtle-med (1.5-2.5 ft)
25-Aug	14:09	Saipan	15.2112	145.6961	Turtle-med (1.5-2.5 ft)
27-Aug	8:42	Saipan	15.2283	145.6864	Green Turtle-large (>2.5 ft)
28-Aug	17:09	Saipan	15.2263	145.7064	Turtle-med (1.5-2.5 ft)
29-Aug	12:14	Saipan	15.1561	145.6903	Green Turtle-large (>2.5 ft)
29-Aug	12:14	Saipan	15.1574	145.6906	Green Turtle-med (1.5-2.5 ft)
29-Aug	12:15	Saipan	15.1586	145.6909	Green Turtle-med (1.5-2.5 ft)
29-Aug	12:17	Saipan	15.1633	145.6918	Turtle-med (1.5-2.5 ft)
29-Aug	12:24	Saipan	15.1786	145.6949	Green Turtle-large (>2.5 ft)
29-Aug	12:35	Saipan	15.2022	145.6997	Green Turtle-med (1.5-2.5 ft)
30-Aug	12:58	Saipan	15.2084	145.6944	Green Turtle-large (>2.5 ft)
9-Sep	10:39	Guam	13.3556	144.6417	Turtle-med (1.5-2.5 ft)

Table 5: Cetacean species encounter summary for 2018 Marianas summer (August–September) small-boat cetacean surveys (1,168 km survey distance) including encounter rate (No. encounters/100 km effort), range of best group size estimates determined by observer consensus in the field, median (range) of encounter location depth (m) and distance from shore (km), total number of photos and biopsy samples collected and satellite tags deployed.

Species	No. Species Encounters	Encounters/100km Effort	Best Group Size Estimate (min-max)	Median Depth (m) (min-max)	Median Shore Distance (km) (min-max)	No. Photos	No. Biopsy Samples	No. Tags
Spinner dolphin	9	0.77	4-100	46 (23-63)	1.6 (0.2-3.5)	2,261	6	0
Pantropical spotted dolphin	7	0.60	8-95	1,211 (347-1427)	9.3 (2.1-10.6)	656	7	0
Bottlenose dolphin	2	0.17	5-12	262 (64-459)	9.7 (2.6-16.8)	294	2	0
Short-finned pilot whale	2	0.17	19-35	809 (698-920)	12.9 (4.8-21.0)	2,568	15	5
Sperm whale	1	0.09	13	1,211	10.6	658	3	0
Total	21	1.80				6,437	33	5

Figures

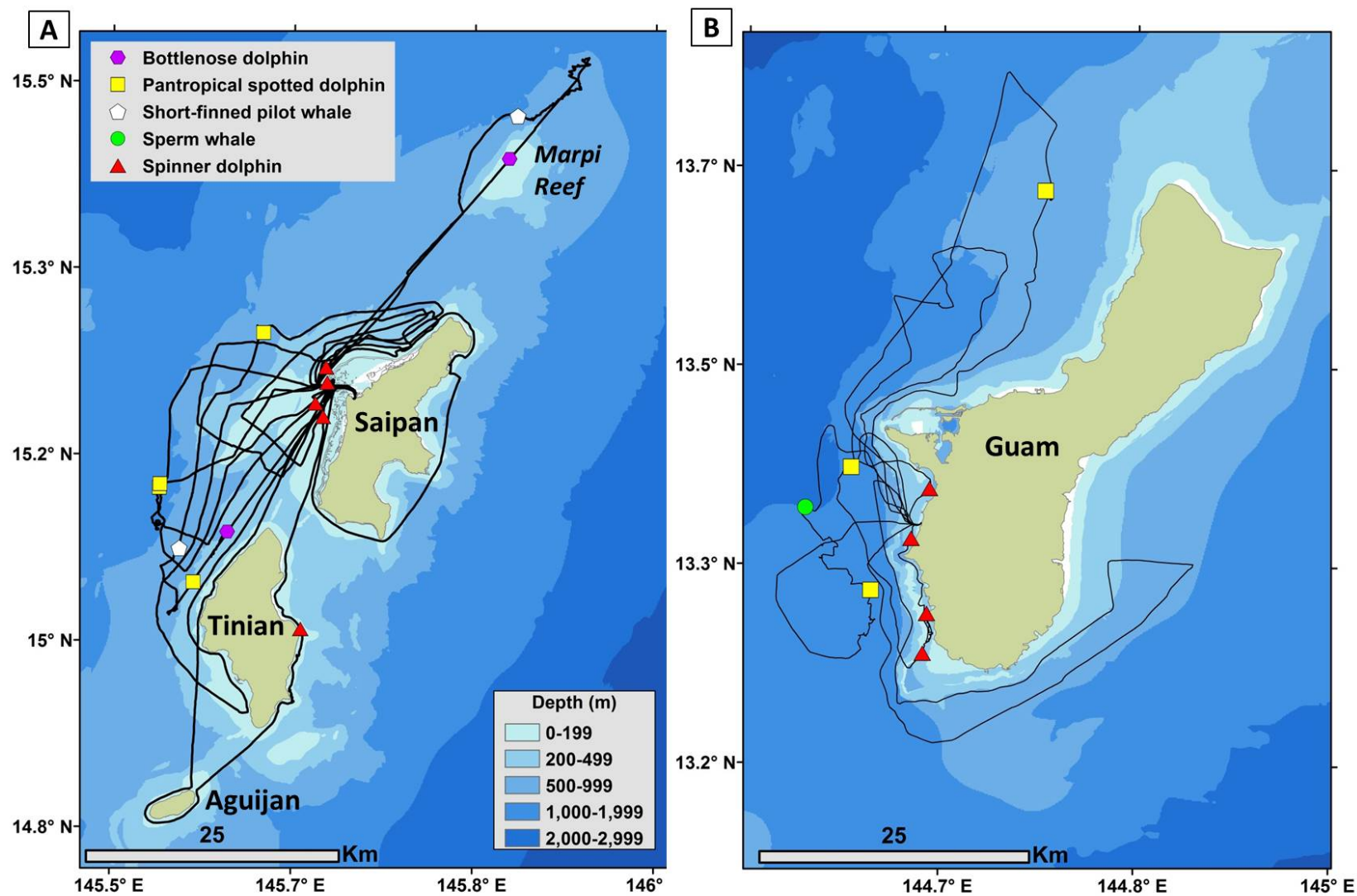


Figure 1: Tracklines and cetacean encounter locations during the 2018 Marianas summer (August–September) small-boat surveys. Panel A: The 3-Islands area of Saipan, Tinian, and Aguijan (24 August–3 September). Panel B: Guam (5–9 September).

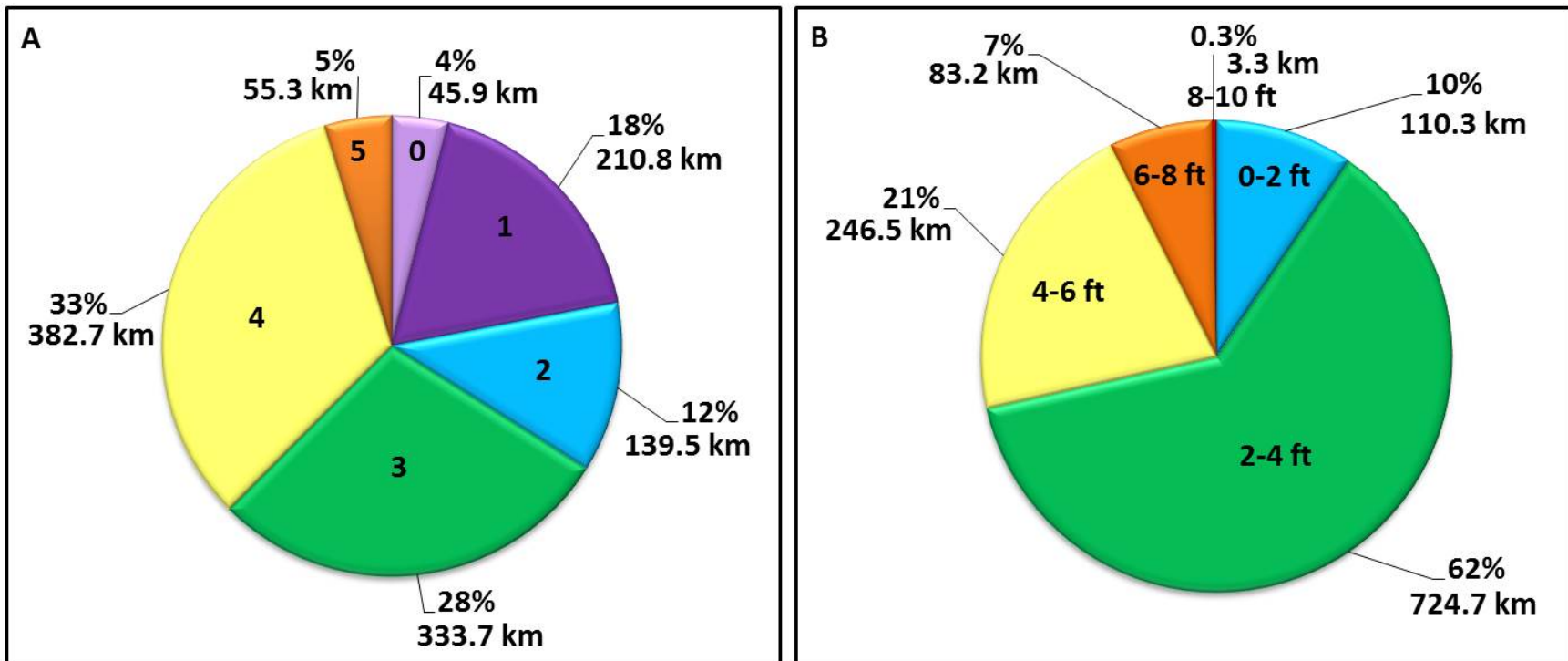


Figure 2: Effort by (A) Beaufort sea state and (B) swell height (ft) during the 2018 Marianas summer (August–September) small-boat cetacean surveys.

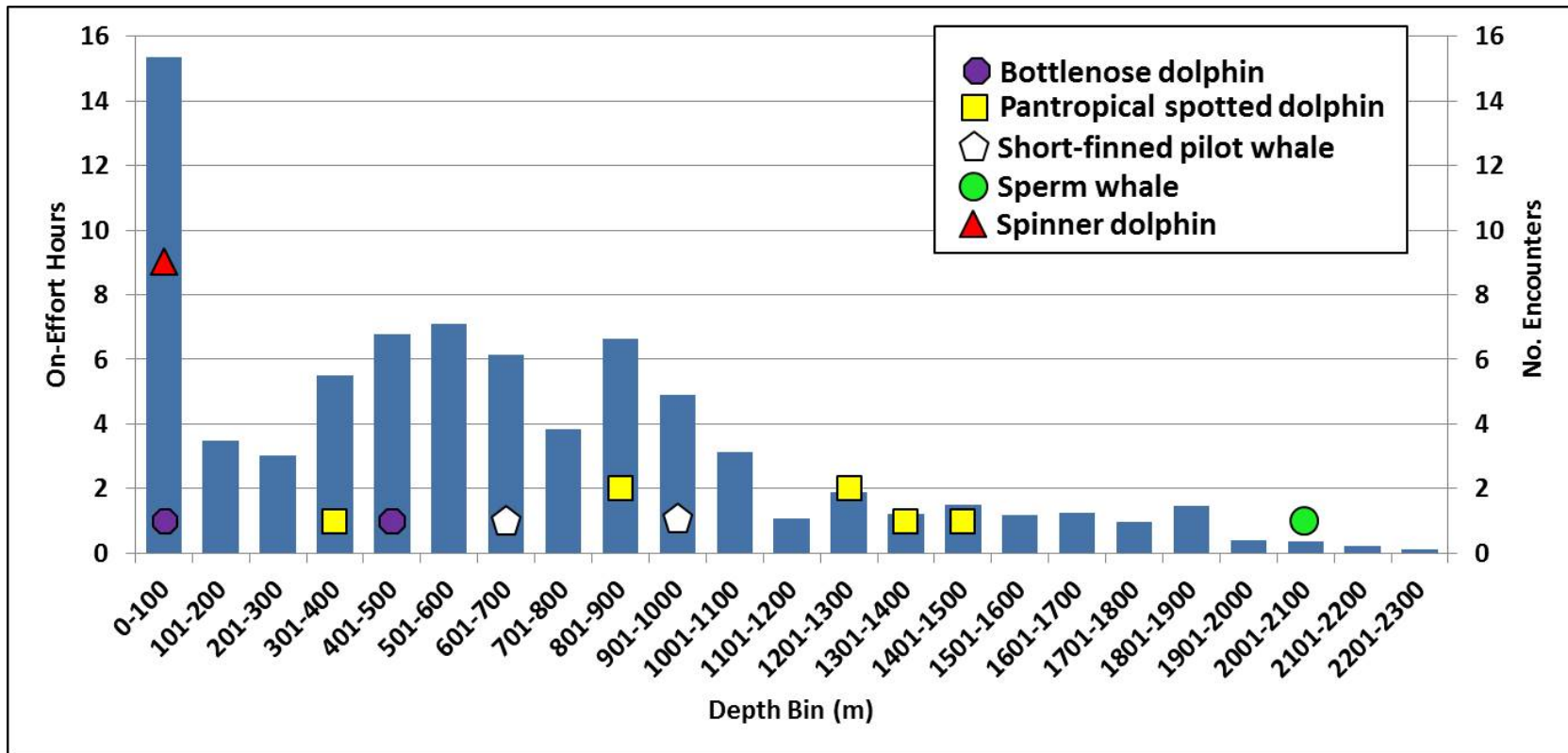


Figure 3: Effort (h) and encounters by depth (m) during the 2018 Marianas summer (August–September) small-boat cetacean surveys.

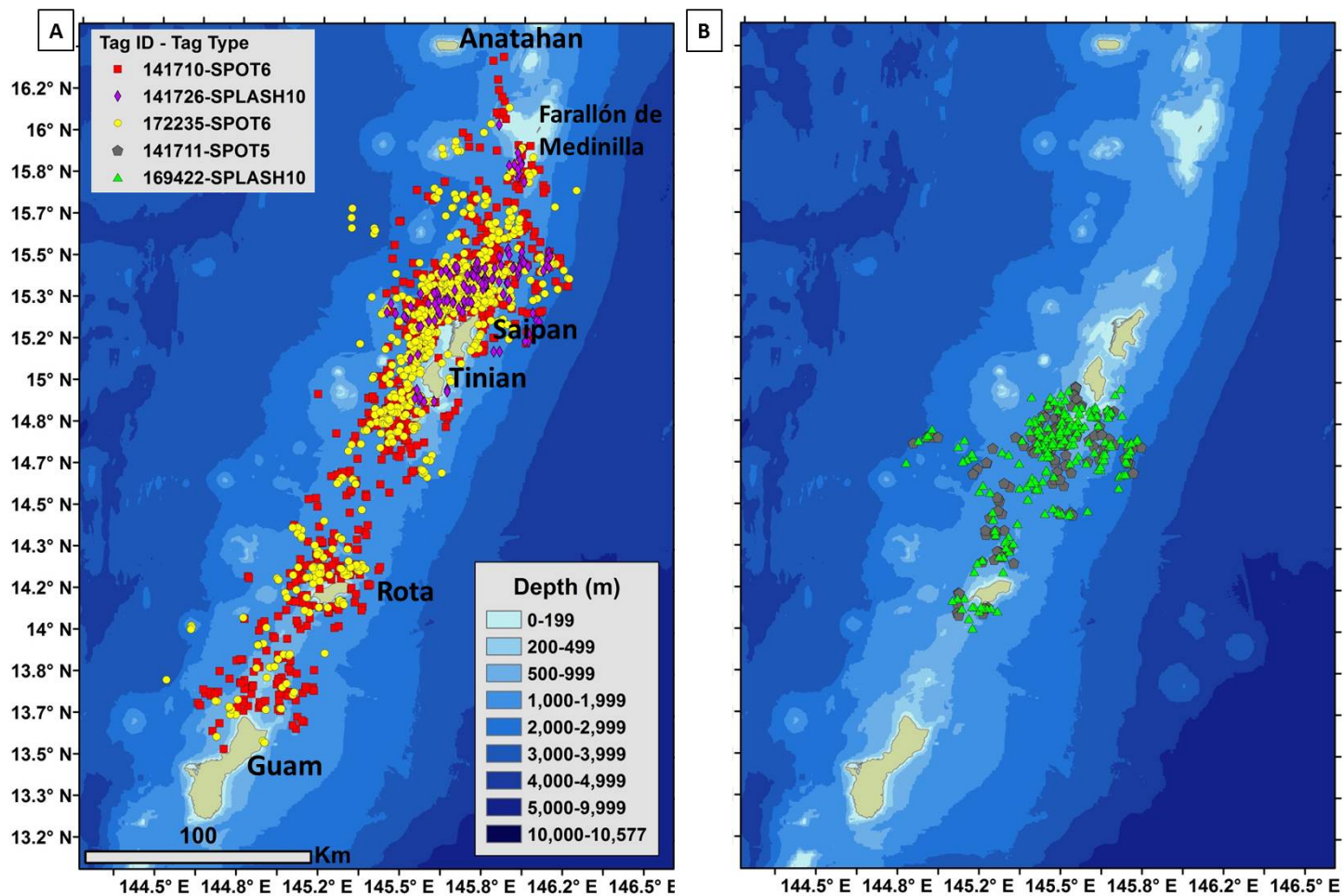


Figure 4: Douglas Argos Filtered locations for satellite tags deployed on short-finned pilot whales during small-boat cetacean surveys. Panel A – off Marpi Reef (26 August) and Panel B –off Tinian (28 August). Duration of the tags ranged 8.9–127.8 d (See Table 3).

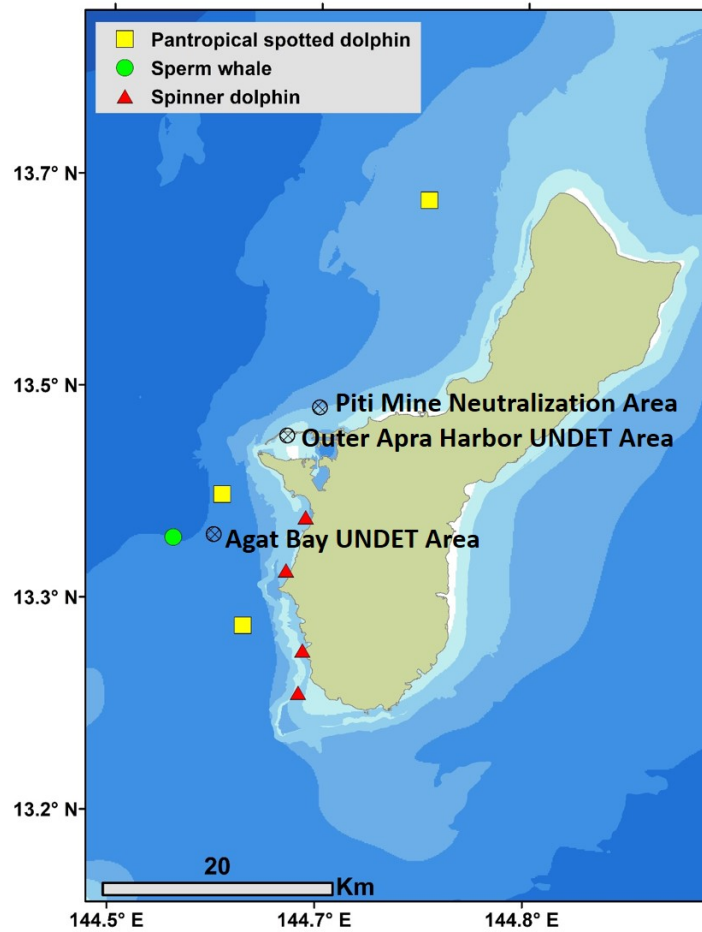


Figure 5: U.S. Navy underwater explosive operation sites off Guam (hashed circles) and the cetacean encounter locations off Guam during the 2018 summer (August–September) small-boat surveys. Circles represent the 640 m exclusion zones. Piti Mine Neutralization Area = 750 m depth, 1.9 km shore distance; Outer Apra Harbor UNDET Area = 38 m depth, 0.3 km shore distance; Agat Bay UNDET Area = 1,750 m depth, 6.7 km shore distance.