

**Cetacean Surveys of Guam and CNMI Waters: May – July, 2012
Including Individual Photo-Identification of Pilot Whales, Spinner Dolphins
and Bottlenose Dolphins (2010-2012)¹**

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Suggested citation:

Hill M.C., A.D. Ligon, M.H. Deakos, A.C. Ü, A.J. Milette-Winfree, and E.M. Oleson. 2013. Cetacean Surveys of Guam and CNMI Waters: May – July, 2012: Including Individual Photo-Identification of Pilot Whales, Spinner Dolphins and Bottlenose Dolphins (2010-2012). Prepared for the U.S. Pacific Fleet Environmental Readiness Office. PIFSC Data Report DR-13-001. 40pp.

¹ PIFSC Data Report DR-13-001
Issued 08 February 2013

Mission

The Pacific Islands Fisheries Science Center's (PIFSC) Cetacean Research Program (CRP) conducted surveys for cetaceans in the waters surrounding Guam and the Commonwealth of the Northern Mariana Islands (CNMI) (Figure 1) in an effort to further develop a record of cetacean occurrence in the region and to gather photos and biopsy samples for population studies. This project was carried out in partnership with the Commander, U.S. Pacific Fleet by a team of four primary personnel (Table 1).

A long-term goal of this research is the evaluation of the population status of each cetacean stock. This includes producing population abundance estimates using mark-recapture techniques. The first step in the process is the creation of species photo-identification catalogs, which began during the summer of 2012.

Methods

Surveys

Small boat surveys were conducted off of Guam between 25-28 May and 26 June – 3 July, 2012 (Tables 2-3, Figure 2). The Guam surveys were conducted aboard four different vessels. The first vessel was an 11-m Sport-fisher with flying bridge and twin-diesel inboard engines (*Ten-II*). The second vessel was an 11.6-m Sport-fisher with flying bridge and twin-diesel inboard engines (*Ten-III*). The third vessel was a 9.4-m Bertram Sport Fisherman with flying bridge and twin diesel inboard engines (*Lucky Strike*). The fourth vessel was a 7.6-m Proline with a 4-stroke outboard engine (*Proline 25*).

Surveys were conducted off of the southernmost islands of the CNMI (Saipan, Tinian, Aguijan, and Rota) 29 May – 24 June, 2012 (Table 4, Figures 3-4). During 29 May – 4 June surveys were based from Rota and conducted aboard a 12.2 m Ocean Alexander Sport-fisher with flying bridge and twin-diesel inboard engines (*Sr. Dung*) in the waters surrounding Rota (Figure 3). During 6 -25 June, surveys were based from Saipan and conducted aboard a 12.2 m sport-fisher with flying bridge and twin-diesel inboard engines (*Sea Hunter*) in the waters surrounding Saipan, Tinian, and Aguijan (Figure 4).

Survey effort was designed to cover representative habitat within the study area and did not conform to systematic (e.g. line-transect) design. Vessel tracks were spread out from day to day to ensure broad survey coverage over a wide range of depths and were also dictated by weather and sea conditions. The survey vessels traveled at a speed of 8-12 knots, depending on the size of the vessel and sea conditions. Between four and six observers scanned for marine mammals with unaided eye or occasional use of 10x binoculars, collectively searching 360-degrees around the vessel. The research team (Tables 1-2) was accompanied by one to two additional volunteer observers. The vessels were operated by locally experienced captains, with knowledge of cetacean sighting locations. In CNMI, both sets of captains allowed the research team to operate the vessel during search effort and when approaching cetaceans for photo-identification and biopsy. On occasion, individuals from Saipan local field offices of the

Pacific Islands Regional Office, CNMI Department of Fish and Wildlife, and CNMI Coastal Resource Management joined the observer team.

All cetacean groups encountered were approached for species confirmation, group size estimates, photo-identification, biopsy sampling (for assessment of genetic population structure), and acoustic recording when possible. Digital SLR cameras with telephoto zoom lenses were used for taking photographs. Photographic efforts were focused on dorsal fin images (for individual identification purposes) and images of the body and head (for assessments of health and scarring). Additional data collected during each sighting included the location, behavior, estimate of calf numbers (young of the year and neonates) (when possible), Beaufort sea state, and swell height. Environmental data (e.g., Beaufort sea state, swell height) and effort status were recorded regularly as conditions changed. Global Positioning System (GPS) readings of the vessel's track were automatically recorded once per minute. Sightings of sea turtles were recorded and species identification was noted when possible.

Although not requested by the Navy, PIFSC conducted biopsy sampling during the project in order to support their goals of evaluating stock structure. Biopsy sampling was conducted using a Barnett RX-150 crossbow and Ceta-Dart bolts with sterilized, stainless steel biopsy tips (25 mm long x 8 mm diameter). Tissue samples were preserved in a cooler on ice while on the boat. Samples were split in half longitudinally at the end of each field day (with each subsample stored in a different vial) and transferred to a standard refrigerator freezer until the end of the project. Samples were transported, in a cooler with dry ice, on board a commercial airline to Honolulu, HI, USA. One vial of each sample is stored in an -80°C freezer at the Pacific Islands Fisheries Science Center (Honolulu, HI, USA), and the other was submitted (via PIFSC) to the Southwest Fisheries Science Center (SWFSC, La Jolla, CA, USA) for tissue archiving. Samples are archived until adequate numbers are available to assess stock structure or until funding is provided to address other specific questions. Biopsy samples were collected under MMPA permit 15240 issued to PIFSC and CNMI-DFW permit, license no. 02444-12.

Bathymetry Data and ArcGIS

Bathymetric datasets used in displaying and analyzing the depth profiles of our survey effort and sightings were obtained from two different sources. First, the Pacific Islands Benthic Habitat Mapping Center (PIBHMC)² has available high-resolution multibeam color-shaded bathymetry datasets for nearshore waters. For this report, 5 m grids were used for waters inside the 400 m isobath surrounding Guam, Rota, Saipan, Tinian, Aguijan and Marpi Reef. Sixty meter resolution grids were used for portions of the waters out to the 3,500 m isobath surrounding Guam; the 2,700 m isobath surrounding Saipan, Tinian, and Aguijan; and the 1,900 m isobath surrounding Rota. In addition, a 114 m resolution synthesis grid of multibeam

² School of Ocean and Earth Science and Technology (University of Hawaii at Manoa)
http://www.soest.hawaii.edu/pibhmc/pibhmc_cnmi.htm

datasets of primarily offshore locations to depths of 10,650 m was used³ (Weiss *et al.* 2007). The second source of bathymetric data was the SRTM30_plus (“Smith and Sandwell”) dataset⁴ (Smith and Sandwell 1997, Becker *et al.* 2009). The dataset uses satellite altimetry and ship depth soundings and covers 0 to 360 in longitude and -90 to 90 in latitude. A portion of this data was used for this report, to fill in the gaps that the other datasets did not cover, which is a 560 m resolution grid that contains the entire CNMI Exclusive Economic Zone (EEZ).

All bathymetry datasets were processed using ArcCatalog 10.0 (ESRI, Redlands, CA). The ASCII files were first converted into raster grids, projected in the WGS 1984 UTM Zone 55N coordinate system and imported into ArcMap 10.0 (ESRI, Redlands, CA). Vessel GPS tracks and sighting locations were also projected in the WGS 1984 UTM Zone 55N coordinate system and then overlaid onto the bathymetric datasets. Depths of sighting locations were determined by using the Spatial Analyst Extraction tool within the ArcToolbox to extract the depth values from each relevant bathymetric raster dataset. If the high-resolution PIBHMC multibeam data were not available for a particular sighting location, then the depth value was obtained from synthesis data set or the Smith and Sandwell (STRM30) dataset. To analyze the amount of search effort by depth, on-effort times were calculated for depth bins from 0 to 3,100 m in 100 m intervals. As with the sighting locations, depths were extracted from the appropriate bathymetric raster datasets for the points (each representing 1 minute) within the on-effort tracklines.

Photo-Identification

Photo analysis began in June 2012 to create species-specific individual photo-identification catalogs. Photos taken by PIFSC in 2010-2012 and those taken by HDR (Navy contractor) in 2011-2012 (HDR 2011, 2012) are being included in the photo analysis. Photos within each sighting were sorted by first removing any that did not have a cetacean and those images that were deemed “unmatchable” (too out of focus to distinguish the edge of the dorsal fin or identifiable marks on the body). Initial matches of individuals were made within each sighting by one photo-identification analyst and were then checked by another. Marks along the leading and trailing edges of the dorsal fins were used as the primary identifiers. Marks or scars on the body, dorsal fin surface, and peduncle; and coloration patterns on the body and dorsal fin were used as secondary identifiers. Each individual fin in each photo was rated for quality based on 4 categories (focus/clarity, contrast/lighting, angle, extent visible) and was assigned an overall quality rating (1 = high, 2 = moderate, 3 = poor). Distinctiveness ratings were assigned to each individual based on the number, size, and shape of the features located on the leading and trailing edges of the dorsal fin (D-1 = high, D-2 = moderate, D-3 = low, D-4 = clean fin and no marks on the peduncle within 12 inches of the dorsal fin)⁵. After the completion of matching and rating within sightings, identified individuals were compared

³ Multibeam datasets from Hawaii MR-1 (COOK06MV & COOK07MV), HS-DS2 (EW0202 & EW0203), SEABEAM (NOAA Vents Program), and EM300 (NOAA OE Ring of Fire 2003 & 2004).

⁴ David T. Sandwell, Walter H. F. Smith, and Joseph J. Becker. Copyright 2008. The Regents of the University of California. All Rights Reserved. http://topex.ucsd.edu/WWW_html/srtm30_plus.html

⁵ Ratings of both quality and distinctiveness were based on methods described in Appendix II of Rosel *et al.* 2011.

between sightings. Only those fins with a distinctiveness of D-1 or D-2 and a quality rating of Q-1 or Q-2 were initially entered into to the catalog.

Results

Guam Surveys

Between 25-28 May and 26 June – 3 July, 11 surveys were completed within the waters surrounding Guam (< 45 km from shore). A total of 1,323 km were covered during 91 on-effort hours of survey (Table 3, Figure 2a). Most of the surveys (7 out of 11) originated from the Hagåtña Boat Basin on the west shore and four surveys originated from Agat Marina on the southwest coast of Guam. The surveys were largely confined to the western portions of the island. Both the sea conditions and the harbor locations (Hagåtña and Agat) of the survey vessels played a role in this outcome. Winds predominated from the east and east-southeast with gusts of 13-24 mph (Table 9) reducing the effort off the east side of the island. The average daily survey Beaufort sea state ranged from 1.3 to 4.3 (Table 3). More than half (58%, 764 km) of the total on-effort trackline distance was surveyed in Beaufort 0-3 conditions, while the remaining 42% (558 km) was surveyed in Beaufort 4 - 5 conditions (Figures 6-7). More than three quarters (84%, 1,108 km) of the total on-effort trackline distance was surveyed in swell heights of 0-4 ft (Figures 9-10). One field day (28 June) was canceled due to inclement weather (*i.e.*, high winds and rain). Most of the survey effort (72%) was conducted inside of the 1000 m isobath and nearly 32% of the survey effort was conducted in water depths of 800-2,200 m (Figure 5). Five offshore underwater formations were surveyed (Rota Bank, Tracey Seamount, 11-Mile Reef, Galvez Banks, and Baby Bank) (Figure 2a).

There were 17 cetacean sightings (Tables 5-6, Figure 2a) during the 11 surveys off of Guam. The overall sighting rate was 1.28 sightings/100 km of effort. The species included bottlenose dolphins (*Tursiops truncatus*), spinner dolphins (*Stenella longirostris*), pantropical spotted dolphins (*Stenella attenuata*), and short-finned pilot whales (*Globicephala macrorhynchus*). An unidentified small whale was seen in the distance during a bottlenose dolphin encounter at Rota Bank and its location was estimated (Table 6, Figure 2a). The bottlenose and spinner dolphin groups at Rota Bank were each approximately 500 m from the same species sighting locations of 2011. Spinner dolphins were the most frequently encountered species with 7 sightings (41%). Except for a bottlenose dolphin sighting off of Orote Pt.⁶, all sightings within 1km of shore along the west side of Guam were of spinner dolphins (Table 6) and occurred in water depths less than 130 m (Table 6, Figure 2a). All other sightings off the west and northwest sides of the island were at least 4.5 km from shore and were in depths less than 800 m (Table 6). These were predominated by pantropical spotted dolphins (n=5). A single short-finned pilot whale sighting occurred 7 km off Ritidian Pt. One individual within the group was recognized immediately, as an individual seen by PIFSC in 2011 off Rota, because of its severely mutilated dorsal fin (Figure 15). During the Guam surveys, a

⁶ This was an interesting sighting because the dolphins were “bow” riding a submarine that was departing from Apra Harbor.

total of 6,264 photos were collected from fifteen of the seventeen cetacean groups encountered (Tables 5-6).

A total of 12 turtle sightings were recorded during all Guam surveys (Table 8, Figure 2b). Most of the sightings were of unidentified hard-shell turtles. Three were identified as green sea turtles (*Chelonia mydas*). No hawksbill turtles (*Eretmochelys imbricata*) were confirmed. All turtle sightings were outside of harbors and (except for 1) within depths less than 100 m (Figure 2b).

CNMI Surveys

Between 29 May and 24 June, a total of 20 cetacean surveys were conducted in the waters surrounding Saipan, Tinian, Aguijan, and Rota. The surveys covered 2,169 km of trackline during 137 on-effort hours (Table 4, Figures 3a, 4a). The survey effort was separated into two regions in order to maximize the time spent around each island. Six surveys (29 May – 4 June) covered the waters surrounding Rota and originated from the Rota West Harbor (Figure 3a). A total of 510 km were surveyed during nearly 30 on-effort hours. Four of the 6 surveys were circumnavigations of the island at varied distances from the shoreline. The predominant winds were out of the east and southeast during the survey period (Table 10). The wind and swell conditions prevented the team from surveying beyond a maximum of 13.5 km from shore. More than half (51%) of the survey effort was in Beaufort 5-6 conditions, and nearly a third (32%) of the effort was in Beaufort 4 conditions. Fifty-eight percent (294 km) of the on-effort trackline was surveyed in swell heights of 4-6 ft (Figure 11). Most (81%) of the survey effort off Rota was in water depths of 0-1000 m (Figure 3a,5). A third (33%) of the survey effort was spent in water depths of 0-200 m. Just over a third (35%) of the survey effort was spent in water depths of 800-2200 m.

Fourteen surveys originated from the Smiling Cove Marina on the west shore of Saipan and covered the waters surrounding Saipan, Tinian, and Aguijan (Figure 4a). During these surveys 1,659 km were covered in 107.5 on-effort hours. East and southeast winds continued to predominate and were lighter than off Rota for the first half of the survey period, picking up again on 16 June (Table 10). Most of the survey effort was off of the west sides of the islands (Figure 4a). Just under half (48%, 782 km) of the on-effort trackline was surveyed in Beaufort 0-3 conditions (Figure 8). Most (71%, 1,177 km) of the on-effort trackline was surveyed in swell heights of 0-4 ft. (Figure 11). Most (80%) of the on-effort trackline was in 0-1000 m (Figure 5). More than a third (38%) of the trackline was inside of the 200m isobath. Approximately 23% (25 hr) of the on-effort trackline was over depths of 800-2200 m (Figure 5). Five offshore reefs were surveyed (Marpi, 300, 6-Mile, Coke, and an unnamed reef just north of Esmeralda Bank) (Figure 4a).

During the 20 surveys within the CNMI waters (< 60 km from shore) there were 22 on-effort sightings of cetaceans (Tables 5, 7; Figures 3a, 4a). Most of the sightings (16, 72%) occurred in the waters surrounding Saipan, Tinian, and Aguijan. The overall sighting rate was 1.01 sightings/100 km of effort. The sighting rate for Rota was 1.18 sightings/100 km of effort. The sighting rate for Saipan, Tinian, and Aguijan was 0.96 sightings/100 km of effort.

The species encountered in the waters surrounding Rota included bottlenose dolphins, spinner dolphins, pantropical spotted dolphins, and unidentified Mesoplodon whales (Tables 5, 7; Figure 3a). All of these species except for the spinner dolphins were encountered for the first time off of Rota. All but one of the sightings off of Rota were off the north side of the island (Figure 3a). The one sighting off the east-southeast tip of the island was a group of spinner dolphins and was the only encounter with spinner dolphins during the Rota surveys despite significant nearshore survey effort. The most frequently sighted species off Rota was the pantropical spotted dolphin (n=3). The groups were 2.7-8.1 km from shore and in water depths of 773-1,195 m (Table 7). During the unidentified Mesoplodon whale encounter 2-3 animals were seen approximately 5 km off the southwest tip of the island in 1,032 m deep water. Photographs were obtained but no biopsy sample could be collected, due to high winds (Beaufort 5) and moderate swell (4-6 feet). The whales disappeared quickly and were not resighted. Initially, the observer team thought that they were Blainville's beaked whales. After further analysis of the photos and consultation with other experts the species identification could not be agreed upon. A total of 1,221 photos were collected during the sightings off of Rota (Table 5).

The species encountered in the waters surrounding Saipan, Tinian, and Aguijan included bottlenose dolphins, spinner dolphins, pantropical spotted dolphins, short-finned pilot whales, and an unidentified Ziphiid whale (Tables 5, 7; Figure 4a). Spinner dolphins were the most frequently encountered species with 10 sightings (45%). With the exception of the two sightings at Marpi Reef, all spinner dolphin locations were within 3km of shore. All spinner dolphin sightings were in waters depths less than 135 m (Table 7). All cetacean sightings were in depths less than 1,400 m except for a single sighting of spotted dolphins in 3,012 m deep water offshore of Saipan near Malakis Reef (Table 7, Figure 4a). On 10 June, 2012 an unidentified beaked whale was spotted in the distance before it dove. The survey vessel went to the estimated location (~12 km off the north tip of Tinian; 1,352 m depth) and the observer team scanned the area for 1.5 hours, but the whale was not resighted. A total of 4,034 photos were collected during the study period off of Saipan, Tinian, and Aguijan (Table 5).

A total of 39 turtle sightings were recorded during all CNMI surveys (Table 8, Figure 3b, 4b). Most of the sightings (64%, n = 25) were unidentified turtles. One sighting off of Rota included two green turtles that appeared to be mating (one on top of the other) with a third individual nearby. A single hawksbill turtle was observed off of Saipan (Figure 4b). Most of the sightings occurred off of the west side of Saipan within the channel outside of Smiling Cove Marina (Figure 4b). All sightings were in depths shallower than 100 m (Figure 3b, 4b).

Photo-Identification

To date, photo-identification catalogs for three cetacean species (short-finned pilot whales, spinner dolphins, and bottlenose dolphins) have been created. Photos taken during each of the PIFSC survey years (2010-2012) as well as photos taken by HDR during their winter/spring (February-March) surveys of Guam and Saipan (2011-2012) are being used for the

creation of the catalogs (Oleson and Hill 2010, Ligon *et al.* 2011, HDR 2011, HDR 2012, Hill *et al.* 2012).

A total of 5,636 photos were analyzed from 10 sightings of short-finned pilot whales between 22 February, 2011 and 10 June, 2012. Two of the sightings were made by HDR. Across all locations and years 129 individuals were entered into the catalog. A discovery curve (showing the accumulation of unique individuals into the catalog over time) for the 3 years of survey effort is presented in Figure 12. A summary of the number of encounters and cataloged individuals by location and year is shown in Table 11. A summary of the number of cataloged individual resights between locations is shown in Table 12. During 2 of the pilot whale sightings bottlenose dolphins were present and photographed.

A total of 1,793 photos were analyzed from 9 sightings of bottlenose dolphins between 22 February, 2011 and 29 June, 2012. Two of the sightings were made by HDR. A total of 34 individuals across all locations and years were entered into the catalog. A discovery curve of cataloged individuals for the 3 years of survey effort is presented in Figure 13. A summary of the number of encounters and preliminary number of cataloged individuals by location and year is shown in Table 13. A summary of the number of preliminary cataloged individual resights between locations is shown in Table 14.

A total of 8,047 photos from 29 sightings of spinner dolphins within CNMI (Saipan, Tinian, Aguijan, and Rota) waters between 22 February, 2010 and 16 June, 2012 were analyzed. A total of 89 individuals were cataloged across locations and years. A discovery curve of cataloged individuals for the 3 years of survey effort is presented in Figure 14. A summary of the number of encounters and cataloged individuals by location and year is shown in Table 15. A summary of the number of cataloged individual resights between locations is shown in Table 16.

Discussion

These surveys represent the third collaborative effort of the PIFSC's CRP and the U.S. Navy Pacific Fleet toward a better understanding of the occurrence and distribution of cetaceans in waters off of Guam and the southernmost islands of CNMI (Saipan, Tinian, Aguijan, and Rota). The U.S. National Marine Fisheries Service (NMFS) and the PIFSC are responsible for the assessment of marine mammal stocks in the Exclusive Economic Zone (EEZ) waters of Guam and CNMI. The U.S. Navy is mandated by the Marine Mammal Protection Act (MMPA) of 1972 and the Endangered Species Act (ESA) of 1973 to monitor cetacean and turtle presence within the Mariana Island Range Complex (MIRC). The first collaborative effort was carried out in February-March, 2010 and included 10 survey days off Guam and 6 off Saipan and Tinian (Oleson and Hill 2010, Ligon *et al.* 2011). The second collaborative effort was conducted in August-September, 2011 and included 9 survey days off Guam, 6 survey days off Rota, and 15 survey days in the waters surrounding Saipan, Tinian, and Aguijan (Hill *et al.* 2012). As with the previous survey years, the 2012 surveys were non-random, non-systematic and designed to

maximize effort over a broad range of depths within the constraints of daily weather patterns and vessel harbor locations.

Guam Surveys

The surveys off Guam were largely confined to the western portions of the island. Both the sea conditions and the harbor locations (Hagåtña and Agat) of the survey vessels played a role in this outcome. An effort was made to survey along the southwest side of the island (south of Orote Pt., Apra Harbor), which was somewhat limited in 2011 because of the wind and swell conditions (Hill *et al.* 2012). Additional effort was made to survey further offshore and the amount of survey effort in deeper waters increased from the previous year. In 2011, the deepest depths surveyed were 2000-2200 m over a very brief period (0.5% of the effort). In 2012, 7.5% of the survey effort was in depths of 2000-3000 m. As in 2010 and 2011, the majority of the survey effort in 2012 was in depths of 1000 m or less (85%, 84% and 72% respectively) and 22% of the 2012 effort was within the 200 m depth contour. All of the 2012 sightings off of Guam occurred in depths less than 800 m. All but one sighting during the 2010 and 2011 surveys were in depths less than 1000 m (Ligon *et al.* 2011, Hill *et al.* 2012). In 2010, pantropical spotted dolphins were encountered in 1,864 m deep waters (Ligon *et al.* 2011).

Beaked whales are a species of particular interest for both the Navy and NMFS. From studies in the main Hawaiian Islands, the two most commonly sighted beaked whale species there are Blainville's (*Mesoplodon densirostris*) and Cuvier's beaked whales (*Ziphius cavirostris*), though encounter rates are low (Baird *et al.* 2003, 2006; McSweeney *et al.* 2007). Baird *et al.* (2006) found that Blainville's beaked whales sightings occur in a median water depth of 922 m while Cuvier's beaked whales occur in deeper waters with a median depth of 2,079 m. Two unidentified beaked whale sightings were in water depths of 3,373 and 4,224 m (Baird *et al.* 2006). During the 2012 Guam surveys, nearly 32% of the effort was spent in water depths of 800-2,200 m, while no beaked whales were encountered. No beaked whales were encountered in 2010 or 2011.

CNMI Surveys

As in 2011, the survey effort within the CNMI was separated into two regions in order to maximize the time spent around each island. The surveys around Rota included circumnavigations at varied distances while most of the effort off of Saipan, Tinian, and Aguijan was confined to the western sides of the islands. Survey tracklines went farther offshore of Saipan, Tinian, and Aguijan than in previous years increasing the amount of effort within deeper waters. In 2010 and 2011, there was no survey effort beyond the 1800 m isobath (Ligon *et al.* 2011, Hill *et al.* 2012). In 2012, 5% (6 hr) of the survey effort was in depths of 1800-3100 m (Figure 5). This additional effort resulted in a sighting of pantropical spotted dolphins in 3,012 m deep water (Table 7). In 2011, the sighting location of deepest depth (1,502 m) in CNMI waters was an unidentified small dolphin (likely pantropical spotted dolphin) (Hill *et al.* 2012). All other sightings were in less than 1000 m depth as was the case for the 2010 sightings off Saipan (Ligon *et al.* 2011, Hill *et al.* 2012). Like the Guam surveys, most (80%) of the on-effort trackline in the waters of CNMI was in 0-1000 m (Figure 5). More than a third (35%) of the trackline was inside of the 200m isobath. This was largely related to the location of the Smiling Cove Marina

on the west side of Saipan where there is a large extent of shallow water through which the survey vessel had to pass in the beginning and end of each survey day (Figure 4). Approximately 23% (25 hr) of the on-effort trackline was over depths of 800-2,200 m, resulting in the only two beaked whale sightings of the 3-year effort in the waters of CNMI (Figure 5).

Photo-Identification

It is clear from the initial photo-identification analysis that individuals of the three cataloged species are moving between islands. Both pilot whales and bottlenose dolphins moved between Guam and CNMI waters and bottlenose dolphins moved between islands within the CNMI waters. Spinner dolphins moved between the islands and Marpi Reef (~18 km north of Saipan) within the CNMI waters. Analysis of photos from spinner dolphin sightings off of Guam and at Rota Bank is underway. When complete, individuals will be compared with those from the CNMI.

With only 2-3 years of photo data, it is unlikely that all of the distinct (D-1 or D-2) individuals have been cataloged for any of the three species in which catalogs have been created so far. Given the range of movements between the lower Mariana Islands, it is possible that individuals are moving farther up the chain of islands and that there is a larger population of individuals contributing to the groups encountered during these surveys. This underscores the importance of conducting surveys throughout the Mariana archipelago.

Pantropical spotted dolphins from all locations, sperm whales off Guam and Saipan, and 1 sighting of melon-headed whales off Saipan (by HDR) still need to be processed for creation of photo-identification catalogs. Molecular analysis of the biopsy samples collected during the three years of surveys will help to interpret and refine the results of the photo-identification analysis for all species.

Acknowledgements

We would like to thank our boat owners, captains and crews: Masao Tenbata, Tim Hanley, Jackey Wang, Francis Fong, John Eads, Tom Sapp, Julie Hartup, Fidel Mendiola Jr., Ramon Castro, Ignacio Lizama, Sam Markos, Ben Sablan, Manny Blas, Elano Blas Valdez, Ben Sablan Jr., Clare Sablan, Oscar Sablan. We would also like to thank all of the volunteers that assisted with the surveys and logistical support for this project. This includes: Eric Cruz (PIFSC-Guam), Valerie Brown (PIRO-Guam), Mark & Lynne Michael (Dive Rota), Mike Tenorio, Russell Benford (CNMI-DFW), Steve McKagan, Dana Okano & Ed DelaCruz (CNMI-PIRO), Becky Skeelee (CNMI-CRM), Karri Fisher (CNMI-PSS), and Erik Norris (PIFSC-Honolulu). Rachel Karasik conducted photo-ID matching of Saipan, Tinian, and Aguijan spinner dolphins as part of the Summer Internship Program at PIFSC. Amanda Bradford assisted in refining photo-identification distinctiveness and quality ratings and oversight of the photo-ID portion of this project.

This research was conducted under NMFS Scientific Research MMPA permit no. 15240 (issued to PIFSC) and CNMI Division of Fish and Wildlife permit, license no. 02444-12 issued to

A. Ligon. Funding was provided by the U.S. Navy Pacific Fleet. Photos contributed by HDR were collected under NMFS Scientific Research MMPA permit no. 14451 (issued to Dr. Joseph Mobley).

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Tables

Table 1: Personnel, roles and organizations.

| Name | Role | Organization |
|-----------------|--|---|
| Marie Hill | Chief Scientist/Marine Mammal Observer | Joint Institute for Marine and Atmospheric Research |
| Allan Ligon | Survey Leader/Marine Mammal Observer | Contractor |
| Mark Deakos | Marine Mammal Observer | Contractor |
| Adam Ü | Marine Mammal Observer | Contractor |
| Erin Oleson* | Marine Mammal Observer | Pacific Islands Fisheries Science Center |
| Rachel Karasik* | Marine Mammal Observer/intern | Pacific Islands Fisheries Science Center |

*Participated in surveys off Saipan, Tinian, in Aguijan (see Table 2).

Table 2: Mission schedule, locations, and personnel.

| Dates | Location | Personnel |
|-------------------|-----------------------|---|
| 25 – 28 May | Guam | Deakos, Hill, Ligon, Ü |
| 29 May – 04 June | Rota | Deakos, Hill, Ligon, Ü |
| 07 – 24 June | Saipan-Tinian-Aguijan | Deakos, Hill, Karasik*, Ligon, Oleson*, Ü |
| 26 June – 03 July | Guam | Deakos, Hill, Ligon, Ü |

*Participated in surveys 17-22 June.

Table 3: Guam surveys summary. Times are local (GMT +10)

| Date (2012) | Vessel | Harbor | Survey Description | Begin On-Effort Time | End On-Effort Time | Total On-Effort Time | On-Effort Distance (km) | Average Beaufort | Maximum Swell Height (ft) |
|---------------|---------------------|--------------------|---|----------------------|--------------------|----------------------|-------------------------|------------------|---------------------------|
| 5/25 | <i>Ten II</i> | Hagåtña Boat Basin | Hagåtña to NW & around north side | 7:00 | 16:13 | 09:12 | 122 | 3.2 | 6 |
| 5/26 | <i>Ten II</i> | Hagåtña Boat Basin | Hagåtña to Rota Bank | 6:12 | 16:08 | 09:10 | 114 | 2.7 | 4 |
| 5/27 | <i>Ten II</i> | Hagåtña Boat Basin | Hagåtña to 11 mile reef | 6:14 | 14:13 | 07:59 | 121 | 2.7 | 4 |
| 5/28 | <i>Ten III</i> | Agat Marina | Agat to south of Cocos Is. | 6:16 | 10:18 | 04:02 | 83 | 1.3 | 2 |
| 6/26 | <i>Lucky Strike</i> | Hagåtña Boat Basin | Hagåtña to Rota Bank | 6:13 | 16:17 | 09:42 | 121 | 2.6 | 4 |
| 6/27 | <i>Lucky Strike</i> | Hagåtña Boat Basin | Hagåtña to Tracey Seamount | 6:26 | 14:14 | 07:48 | 106 | 3.9 | 6 |
| 6/29 | <i>Lucky Strike</i> | Hagåtña Boat Basin | Hagåtña to Guam west | 6:09 | 15:22 | 09:13 | 124 | 3.4 | 5 |
| 6/30 | <i>Ten III</i> | Agat Marina | Agat Bay to Guam east | 6:24 | 16:29 | 10:04 | 167 | 3.0 | 6 |
| 7/1 | <i>Ten III</i> | Agat Marina | Agat to Galvez and Baby Banks | 6:18 | 14:51 | 08:32 | 139 | 4.3 | 6 |
| 7/2 | <i>Proline 25</i> | Agat Marina | Guam west-Agat S to Cocos- N to Double Reef | 6:29 | 17:14 | 09:51 | 158 | 2.8 | 4 |
| 7/3 | <i>Lucky Strike</i> | Hagåtña Boat Basin | Hagåtña - NW Guam - Ledge Buoy | 6:07 | 11:17 | 05:10 | 66 | 3.9 | 4 |
| Total: | | | | | | 90:49 | 1323 | | |

Table 4: CNMI surveys summary. Times are local (GMT +10)

| Date (2012) | Vessel | Harbor | Survey Description | Begin On-Effort Time | End On-Effort Time | Total On-Effort Time | On-Effort Distance (km) | Average Beaufort | Maximum Swell Height (ft) |
|-------------|-------------------|---------------------|--|----------------------|--------------------|----------------------|-------------------------|------------------|---------------------------|
| 5/29 | <i>Sr. Dung</i> | Rota West | Rota counterclockwise circumnavigation at 2-4km; then clockwise along north shore to ENE pt. & back at 2.5km | 6:27 | 13:43 | 07:16 | 119 | 4.3 | 6 |
| 5/30 | <i>Sr. Dung</i> | Rota West | Rota west & northwest out to 7km | 6:13 | 11:26 | 05:00 | 74 | 4.6 | 6 |
| 6/1 | <i>Sr. Dung</i> | Rota West | Rota west-southwest out to 13.5km | 6:12 | 9:22 | 03:10 | 65 | 4.5 | 6 |
| 6/2 | <i>Sr. Dung</i> | Rota West | Rota clockwise circumnavigation- north offshore out to 13km to south nearshore | 6:10 | 10:41 | 04:30 | 83 | 3.7 | 6 |
| 6/3 | <i>Sr. Dung</i> | Rota West | Rota counterclockwise circumnavigation- close to north shore out to 3-6km off south shore | 7:12 | 11:53 | 04:41 | 81 | 4.8 | 6 |
| 6/4 | <i>Sr. Dung</i> | Rota West | Rota counterclockwise circumnavigation- close around entire shore then out to 5km off northwest shore | 6:06 | 11:12 | 05:06 | 88 | 4.2 | 6 |
| 6/7 | <i>Sea Hunter</i> | Smiling Cove Marina | Saipan west out to Malakis and 300 Reefs | 6:11 | 15:38 | 09:27 | 162 | 3.4 | 6 |
| 6/8 | <i>Sea Hunter</i> | Smiling Cove Marina | Saipan west -Tinian/Aguijan east to south of Naftan Rock | 6:06 | 18:46 | 12:13 | 158 | 1.6 | 4 |
| 6/9 | <i>Sea Hunter</i> | Smiling Cove Marina | Saipan west up to Marpi Reef | 8:41 | 15:05 | 06:23 | 98 | 2.0 | 6 |
| 6/10 | <i>Sea Hunter</i> | Smiling Cove Marina | Tinian west-toward Esmeralda Bank | 6:08 | 17:46 | 11:38 | 158 | 2.1 | 6 |
| 6/11 | <i>Sea Hunter</i> | Smiling Cove Marina | Saipan circumnavigation clockwise- close on west side; out to 6km on east | 6:05 | 13:13 | 07:08 | 108 | 2.2 | 6 |
| 6/13 | <i>Sea Hunter</i> | Smiling Cove Marina | Saipan and Tinian west to fads (II,HH & GG) and Coke Reef | 8:05 | 13:48 | 05:42 | 95 | 3.9 | 4 |
| 6/14 | <i>Sea Hunter</i> | Smiling Cove Marina | Tinian and Aguijan west along shore & offshore 6km | 6:10 | 14:47 | 07:52 | 134 | 3.7 | 6 |
| 6/15 | <i>Sea Hunter</i> | Smiling Cove Marina | Saipan west out to 300 Reef | 6:04 | 14:45 | 08:41 | 148 | 3.9 | 6 |

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| Date (2012) | Vessel | Harbor | Survey Description | Begin On-Effort Time | End On-Effort Time | Total On-Effort Time | On-Effort Distance (km) | Average Beaufort | Maximum Swell Height (ft) |
|--------------------|-------------------|---------------------|---|-----------------------------|---------------------------|-----------------------------|--------------------------------|-------------------------|----------------------------------|
| 6/16 | <i>Sea Hunter</i> | Smiling Cove Marina | Saipan clockwise circumnavigation along shore | 8:05 | 15:34 | 07:29 | 101 | 4.3 | 6 |
| 6/17 | <i>Sea Hunter</i> | Smiling Cove Marina | Tinian northeast to Saipan west- 300 Reef | 8:13 | 16:26 | 06:31 | 106 | 4.4 | 6 |
| 6/19 | <i>Sea Hunter</i> | Smiling Cove Marina | Saipan west to 300 Reef south to west of Tinian north tip | 8:42 | 14:21 | 05:18 | 85 | 4.5 | 6 |
| 6/20 | <i>Sea Hunter</i> | Smiling Cove Marina | Off Tinian west side out to Coke Reef | 6:04 | 12:48 | 06:44 | 110 | 4.0 | 4 |
| 6/22 | <i>Sea Hunter</i> | Smiling Cove Marina | Saipan-Tinian east to Tinian-Saipan west | 7:34 | 13:39 | 05:34 | 89 | 4.1 | 7 |
| 6/24 | <i>Sea Hunter</i> | Smiling Cove Marina | Saipan northwest to Marpi Reef | 6:14 | 13:03 | 06:49 | 105 | 3.7 | 6 |
| Total: | | | | | | 137:19 | 2169 | | |

Table 5: Summary of on-effort cetacean sightings and number of photos collected by region, island/submerged reef, and species.

| | No. | |
|-----------------------------|------------------|-------------------|
| | Sightings | No. Photos |
| Guam | | |
| Bottlenose dolphin | 1 | 285 |
| Pantropical spotted dolphin | 5 | 1,455 |
| Short-finned pilot whale | 1 | 676 |
| Spinner dolphin | 7 | 3,518 |
| Rota Bank | | |
| Bottlenose dolphin | 1 | 141 |
| Spinner dolphin | 1 | 189 |
| Unid. small whale | 1 | 0 |
| Guam Total | 17 | 6,264 |
| Saipan | | |
| Pantropical spotted dolphin | 1 | 213 |
| Spinner dolphin | 6 | 1,658 |
| Saipan/Tinian | | |
| Unid. Ziphiid whale | 1 | 0 |
| Aguijan | | |
| Bottlenose dolphin | 1 | 116 |
| Short-finned pilot whale | 2 | 734 |
| Spinner dolphin | 2 | 126 |
| Esmeralda Bank | | |
| Short-finned pilot whale | 1 | 373 |
| Marpi Reef | | |
| Spinner dolphin | 2 | 814 |
| Rota | | |
| Bottlenose dolphin | 1 | 340 |
| Pantropical spotted dolphin | 3 | 814 |
| Spinner dolphin | 1 | 30 |
| Unid. Mesoplodon | 1 | 37 |
| CNMI Total | 22 | 5,255 |
| Marianas Total | 39 | 11,519 |

Table 6: Guam cetacean sightings details.

| Date (2012) | Sighting No. | Species-Common | Species-Scientific | Time (GMT +10) | Location | Latitude (°N) | Longitude (°E) | Depth (m) | Bathymetry Source | Distance from Shore (km) | Beaufort | Swell Height (ft) | Group Size | No. Calves* | Behavior | No. Photos | Acoustic Recording |
|-------------|--------------|-----------------------------|-----------------------------------|----------------|-----------|---------------|----------------|-----------|-------------------|--------------------------|----------|-------------------|------------|-------------|---|------------|--------------------|
| 5/25 | 1 | Spinner dolphin | <i>Stenella longirostris</i> | 12:55 | Guam | 13.6085 | 144.9086 | 31 | S&S | 0.33 | 1 | 0-2 | 18 | 1 | mill, rest, leap/spin, boat approach, bow ride, evasive | 374 | No |
| 5/26 | 2 | Pantropical spotted dolphin | <i>Stenella attenuata</i> | 7:45 | Guam | 13.6667 | 144.8088 | 505 | PIBHMC Guam 60m | 5.05 | 3 | 2-4 | 35 | 0 | mill, feed, boat approach, bow ride, leap/spin | 148 | No |
| 5/26 | 3 | Short-finned pilot whale | <i>Globicephala macrorhynchus</i> | 8:19 | Guam | 13.7076 | 144.8246 | 469 | PIBHMC Guam 60m | 6.98 | 3 | 2-4 | 30 | 1 | slow travel, boat approach, spy hop, dive, evasive, log | 676 | Yes |
| 5/26 | 4 | Pantropical spotted dolphin | <i>Stenella attenuata</i> | 11:07 | Guam | 13.7654 | 144.8582 | 523 | S&S | 12.29 | 3 | 2-4 | 22 | 0 | boat approach, bow ride, leap/spin, mod trav | 113 | No |
| 6/26 | 25 | Pantropical spotted dolphin | <i>Stenella attenuata</i> | 7:03 | Guam | 13.5955 | 144.7627 | 784 | PIBHMC Guam 60m | 6.90 | 2 | 2-4 | 55 | 0 | leap, boat approach, bow ride, mill | 599 | Yes |
| 6/26 | 26 | Pantropical spotted dolphin | <i>Stenella attenuata</i> | 9:25 | Guam | 13.6928 | 144.8144 | 517 | PIBHMC Guam 60m | 6.35 | 3 | 2-4 | 24 | 0 | leap, boat approach, bow ride, mod trav, evasive | 130 | No |
| 6/26 | 27 | Bottlenose dolphin | <i>Tursiops truncatus</i> | 11:34 | Rota Bank | 13.7958 | 144.9563 | 126 | S&S | 18.49 | 2 | 2-4 | 5 | 0 | mill, rest, evasive | 141 | No |
| 6/26 | 28 | Spinner dolphin | <i>Stenella longirostris</i> | 12:33 | Rota Bank | 13.7950 | 144.9584 | 126 | S&S | 18.53 | 2 | 2-4 | 45 | 0 | rest, boat approach, bow ride | 189 | No |

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| Date (2012) | Sighting No. | Species-Common | Species-Scientific | Time (GMT +10) | Location | Latitude (°N) | Longitude (°E) | Depth (m) | Bathymetry Source | Distance from Shore (km) | Beaufort | Swell Height (ft) | Group Size | No. Calves* | Behavior | No. Photos | Acoustic Recording |
|-------------|--------------|-----------------------------|-----------------------|----------------|-----------|---------------|----------------|-----------|-------------------|--------------------------|----------|-------------------|------------|-------------|--|------------|--------------------|
| 6/26 | 29** | Unid. small whale | Unid. small whale | 11:37 | Rota Bank | 13.7976 | 144.9562 | 343 | S&S | 21.31 | 2 | 2-4 | 1 | 0 | slow travel | 0 | No |
| 6/29 | 30 | Bottlenose dolphin | Tursiops truncatus | 9:36 | Guam | 13.4410 | 144.6093 | 559 | PIBHMC Guam 60m | 1.10 | 4 | 2-4 | 7 | 0 | bow ride, boat approach, slow travel | 285 | No |
| 6/29 | 31 | Spinner dolphin | Stenella longirostris | 14:41 | Guam | 13.5140 | 144.7942 | 28 | PIBHMC Guam 5m | 0.88 | 3 | 2-4 | 43 | 0 | rest | 215 | No |
| 6/30 | 32 | Spinner dolphin | Stenella longirostris | 15:38 | Guam | 13.3473 | 144.6346 | 50 | S&S*** | 0.62 | 1 | 0-2 | 8 | 0 | rest, social, tail slap, leap, boat approach | 346 | No |
| 7/2 | 33 | Spinner dolphin | Stenella longirostris | 7:28 | Guam | 13.3277 | 144.6481 | 14 | S&S*** | 0.20 | 1 | 0-2 | 14 | 0 | rest, boat approach, bow ride, leap, social, evasive | 440 | Yes |
| 7/2 | 34 | Spinner dolphin | Stenella longirostris | 9:04 | Guam | 13.2775 | 144.6607 | 17 | S&S*** | 0.28 | 2 | 0-2 | 65 | 1 | rest, leap, spin, boat approach, bow ride, social, evasive | 987 | No |
| 7/2 | 35 | Spinner dolphin | Stenella longirostris | 12:25 | Guam | 13.4779 | 144.7144 | 33 | PIBHMC Guam 5m | 0.46 | 3 | 0-2 | 18 | 0 | rest | 360 | No |
| 7/2 | 36 | Pantropical spotted dolphin | Stenella attenuata | 15:07 | Guam | 13.5927 | 144.7845 | 652 | PIBHMC Guam 60m | 4.77 | 3 | 0-2 | 35 | 1 | mod trav, leap, boat approach, bow ride, porpoise | 465 | No |
| 7/3 | 37 | Spinner dolphin | Stenella longirostris | 6:10 | Guam | 13.4862 | 144.7475 | 52 | PIBHMC Guam 5m | 0.51 | 1 | 0-2 | 22 | 1 | Nose out, rest | 796 | No |

*Calf numbers are a best estimate of the number of young of the year (< 1/2 adult size) and neonates (presence of fetal folds).

**The position of the unidentified whale sighting was estimated. It was seen in the distance during a bottlenose dolphin sighting at Rota Bank.

***Depth value interpolated from the nearest neighbor within the Smith and Sandwell bathymetry raster dataset.

Table 7: CNMI cetacean sightings details.

| Date (2012) | Sighting No. | Species-Common | Species-Scientific | Time (GMT +10) | Location | Latitude (°N) | Longitude (°E) | Depth (m) | Bathymetry Source | Distance from Shore (km) | Beaufort | Swell Height (ft) | Group Size | No. Calves* | Behavior | No. Photos | Acoustic Recording |
|-------------|--------------|-----------------------------|-----------------------|----------------|--------------------------------|---------------|----------------|-----------|-------------------|--------------------------|----------|-------------------|------------|-------------|---|------------|--------------------|
| 5/29 | 5 | Bottlenose dolphin | Tursiops truncatus | 10:23 | Rota | 14.1621 | 145.1491 | 43 | PIBHMC Rota 5m | 0.52 | 3 | 2-4 | 12 | 0 | slow travel, boat approach, bow ride, mill, evasive | 340 | No |
| 5/30 | 6 | Pantropical spotted dolphin | Stenella attenuata | 8:56 | Rota | 14.1655 | 145.0710 | 1195 | PIBHMC Rota 60m | 7.05 | 5 | 4-6 | 70 | 1 | fast travel, boat approach, bow ride, leap/spin, feed, mill | 604 | No |
| 6/2 | 7 | Pantropical spotted dolphin | Stenella attenuata | 6:54 | Rota | 14.2545 | 145.1845 | 870 | PIBHMC Rota 60m | 8.11 | 4 | 2-4 | 12 | 0 | boat approach, bow ride, mod trav | 127 | No |
| 6/3 | 8 | Unid. Mesoplodon | Mesoplodon sp. | 10:49 | Rota | 14.1563 | 145.0866 | 1032 | PIBHMC Rota 60m | 5.09 | 5 | 4-6 | 2 | 0 | slow travel, dive | 37 | No |
| 6/4 | 9 | Spinner dolphin | Stenella longirostris | 7:08 | Rota | 14.1831 | 145.2920 | 133 | S&S | 0.35 | 5 | 4-6 | 33 | 0 | boat approach, bow ride, mill | 30 | No |
| 6/4 | 10 | Pantropical spotted dolphin | Stenella attenuata | 9:27 | Rota | 14.1383 | 145.0999 | 773 | PIBHMC Rota 60m | 2.79 | 4 | 2-4 | 11 | 0 | boat approach, mod trav, bow ride, spy hop | 83 | No |
| 6/7 | 11 | Pantropical spotted dolphin | Stenella attenuata | 9:53 | Saipan-offshore (Malakis Reef) | 15.6227 | 145.4533 | 3012 | PIBHMC Synthesis | 52.81 | 4 | 2-4 | 45 | 0 | evasive, low swim | 213 | No |
| 6/8 | 12 | Spinner dolphin | Stenella longirostris | 6:35 | Saipan | 15.1765 | 145.6872 | 35 | PIBHMC Saipan 5m | 2.53 | 1 | 0-2 | 29 | 1 | slow travel, boat approach, bow ride, evasive | 401 | No |

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| Date (2012) | Sighting No. | Species-Common | Species-Scientific | Time (GMT +10) | Location | Latitude (°N) | Longitude (°E) | Depth (m) | Bathymetry Source | Distance from Shore (km) | Beaufort | Swell Height (ft) | Group Size | No. Calves* | Behavior | No. Photos | Acoustic Recording |
|-------------|--------------|--------------------------|----------------------------|----------------|-------------------------|---------------|----------------|-----------|--------------------|--------------------------|----------|-------------------|------------|-------------|--|------------|--------------------|
| 6/8 | 13 | Spinner dolphin | Stenella longirostris | 10:23 | Aguijan | 14.8525 | 145.5788 | 79 | S&S** | 0.28 | 2 | 2-4 | 12 | 0 | boat approach, bow ride, evasive, dive, low swim | 122 | No |
| 6/8 | 14a | Short-finned pilot whale | Globicephala macrorhynchus | 12:09 | Aguijan | 14.7827 | 145.4912 | 676 | PIBHMC SMAR 60m*** | 8.33 | 2 | 2-4 | 22 | 1 | slow travel, dive, evasive, spy hop | 534 | Yes |
| 6/8 | 14b | Bottlenose dolphin | Tursiops truncatus | 13:08 | Aguijan | 14.7785 | 145.5184 | 734 | PIBHMC SMAR 60m | 7.34 | 1 | 2-4 | 5 | 0 | mod trav, boat approach, bow ride | 116 | No |
| 6/8 | 14c | Short-finned pilot whale | Globicephala macrorhynchus | 14:59 | Aguijan | 14.7960 | 145.5292 | 553 | PIBHMC SMAR 60m | 5.13 | 2 | 2-4 | 19 | 1 | slow travel, evasive, dive | 200 | No |
| 6/9 | 15 | Spinner dolphin | Stenella longirostris | 10:48 | Marpi Reef | 15.4218 | 145.8792 | 68 | PIBHMC Marpi 5m | 16.28 | 2 | 4-6 | 90 | 0 | spin, boat approach, leap, bow ride, social, tail slap, mill | 710 | No |
| 6/10 | 16 | Unid. Ziphiid whale**** | Ziphiid whale | 7:31 | Tinian/Saipan | 15.1349 | 145.5257 | 1352 | PIBHMC Synthesis | 11.80 | 3 | 4-6 | 2 | 0 | log, dive | 0 | No |
| 6/10 | 17 | Short-finned pilot whale | Globicephala macrorhynchus | 11:52 | north of Esmeralda Bank | 14.9935 | 145.2356 | 720 | PIBHMC Synthesis | 36.28 | 1 | 4-6 | 23 | 1 | slow travel, dive, spy hop, mill, evasive | 373 | No |
| 6/11 | 18 | Spinner dolphin | Stenella longirostris | 6:18 | Saipan | 15.2292 | 145.6915 | 8 | PIBHMC Saipan 5m | 2.91 | 1 | 2-4 | 8 | 0 | slow travel, mill, rest | 330 | No |
| 6/11 | 19 | Spinner dolphin | Stenella longirostris | 7:58 | Saipan | 15.2896 | 145.8181 | 105 | PIBHMC Saipan 5m | 0.34 | 3 | 4-6 | 24 | 0 | boat approach, bow ride, spin, leap | 180 | No |
| 6/14 | 20 | Spinner dolphin | Stenella longirostris | 10:12 | Aguijan | 14.8687 | 145.5752 | 103 | S&S | 0.31 | 4 | 2-4 | 12 | 0 | leap, boat approach | 4 | No |

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| Date (2012) | Sighting No. | Species-Common | Species-Scientific | Time (GMT +10) | Location | Latitude (°N) | Longitude (°E) | Depth (m) | Bathymetry Source | Distance from Shore (km) | Beaufort | Swell Height (ft) | Group Size | No. Calves* | Behavior | No. Photos | Acoustic Recording |
|-------------|--------------|-----------------|-----------------------|----------------|------------|---------------|----------------|-----------|-------------------|--------------------------|----------|-------------------|------------|-------------|--|------------|--------------------|
| 6/16 | 21 | Spinner dolphin | Stenella longirostris | 9:35 | Saipan | 15.2730 | 145.8341 | 39 | PIBHMC Saipan 5m | 0.40 | 4 | 4-6 | 60 | 1 | leap, mill, spin, boat approach, bow ride | 676 | No |
| 6/16 | 22 | Spinner dolphin | Stenella longirostris | 12:02 | Saipan | 15.1631 | 145.7994 | 76 | PIBHMC Saipan 5m | 0.42 | 5 | 4-6 | 15 | 0 | surf, boat approach, bow ride, leap | 24 | No |
| 6/16 | 23 | Spinner dolphin | Stenella longirostris | 13:11 | Saipan | 15.1179 | 145.7599 | 75 | PIBHMC Saipan 5m | 0.34 | 5 | 2-4 | 23 | 0 | boat approach, bow ride | 47 | No |
| 6/24 | 24 | Spinner dolphin | Stenella longirostris | 9:33 | Marpi Reef | 15.4210 | 145.8763 | 64 | PIBHMC Marpi 5m | 16.07 | 5 | 4-6 | 20 | 1 | leap, boat approach, bow ride, evasive, low swim | 104 | No |

* Calf numbers are a best estimate of the number of young-of-the-year (< 1/2 adult size) and neonates (presence of fetal folds).

**Depth value interpolated from the nearest neighbor within the Smith and Sandwell bathymetry raster dataset.

*** The bathymetry source SMAR refers to the Southern Marianas 60 m grid and includes the waters surrounding Saipan, Tinian, and Aguijan out to 2,700 m depth in some locations.

****The position of the unidentified Ziphiid whale was estimated based on the observed dive location seen in the distance.

Table 8: Sea turtle sightings in the waters surrounding all island surveyed within the Marianas (25 May – 3 July, 2012). Latitude/longitude values are vessel locations.

| Date (2012) | Time (GMT +10) | Island | Latitude (°N) | Longitude (°E) | Description* |
|-------------|----------------|--------|---------------|----------------|--|
| 5/25 | 12:44 | Guam | 13.6242 | 144.9028 | Turtle-med |
| 5/25 | 15:33 | Guam | 13.5528 | 144.8083 | Turtle-med |
| 5/25 | 15:34 | Guam | 13.5502 | 144.8078 | Turtle-small |
| 5/25 | 15:38 | Guam | 13.5425 | 144.8044 | Turtle-med |
| 5/27 | 13:34 | Guam | 13.5378 | 144.6550 | Green Turtle-small |
| 5/28 | 6:31 | Guam | 13.3974 | 144.6570 | Turtle-med |
| 5/30 | 6:59 | Rota | 14.1138 | 145.1885 | Green Turtles mating ; a third one alongside other two |
| 6/1 | 8:48 | Rota | 14.1293 | 145.1590 | Turtle-med |
| 6/7 | 15:29 | Saipan | 15.2284 | 145.7018 | Turtle-med |
| 6/8 | 18:38 | Saipan | 15.2272 | 145.7052 | Turtle x 2 |
| 6/8 | 18:42 | Saipan | 15.2279 | 145.7160 | Turtle-small |
| 6/9 | 8:51 | Saipan | 15.2277 | 145.6960 | Turtle-small |
| 6/10 | 17:40 | Saipan | 15.2277 | 145.7100 | Hawksbill- small |
| 6/11 | 7:01 | Saipan | 15.2379 | 145.6920 | Green Turtle-med |
| 6/11 | 12:01 | Saipan | 15.1037 | 145.7247 | Turtle-large; fully submerged |
| 6/11 | 12:02 | Saipan | 15.1034 | 145.7229 | Green Turtle-med |
| 6/11 | 12:27 | Saipan | 15.1400 | 145.6873 | Turtle-small |
| 6/11 | 12:47 | Saipan | 15.1894 | 145.7005 | Green Turtle-small |
| 6/11 | 12:58 | Saipan | 15.2086 | 145.6979 | Turtle x2-small and large |
| 6/11 | 13:12 | Saipan | 15.2258 | 145.7212 | Turtle-small |
| 6/13 | 8:10 | Saipan | 15.2275 | 145.7146 | Green Turtle-small |
| 6/14 | 6:25 | Saipan | 15.2259 | 145.7012 | Turtle-small |
| 6/14 | 7:17 | Saipan | 15.2219 | 145.6999 | Green Turtle-small |
| 6/14 | 8:23 | Tinian | 15.0766 | 145.6140 | Green Turtle-med |
| 6/14 | 14:30 | Saipan | 15.2075 | 145.6927 | Turtle-med |
| 6/16 | 8:09 | Saipan | 15.2279 | 145.7143 | Turtle-small |
| 6/16 | 9:26 | Saipan | 15.2856 | 145.8235 | Turtle-med x2 |
| 6/16 | 9:28 | Saipan | 15.2830 | 145.8254 | Turtle-med |
| 6/16 | 11:04 | Saipan | 15.2636 | 145.8319 | Turtle-med |
| 6/16 | 12:57 | Saipan | 15.1434 | 145.7468 | Green Turtle-med |
| 6/16 | 15:23 | Saipan | 15.2241 | 145.6994 | Turtle-small |
| 6/16 | 15:32 | Saipan | 15.2257 | 145.7200 | Green Turtle-med |
| 6/17 | 16:24 | Saipan | 15.2261 | 145.7202 | Green Turtle-small |
| 6/19 | 8:45 | Saipan | 15.2275 | 145.7169 | Turtle-small |
| 6/19 | 8:52 | Saipan | 15.2288 | 145.6997 | Turtle-small |
| 6/19 | 14:04 | Saipan | 15.2258 | 145.6836 | Green Turtle-med |

| Date (2012) | Time (GMT +10) | Island | Latitude (°N) | Longitude (°E) | Description* |
|-------------|----------------|--------|---------------|----------------|--------------------|
| 6/19 | 14:10 | Saipan | 15.2273 | 145.6980 | Turtle-small |
| 6/19 | 14:12 | Saipan | 15.2278 | 145.7036 | Turtle-small |
| 6/20 | 6:15 | Saipan | 15.2238 | 145.6981 | Turtle-med |
| 6/20 | 12:33 | Saipan | 15.2103 | 145.6945 | Turtle-small |
| 6/22 | 13:27 | Saipan | 15.2233 | 145.6956 | Turtle-small |
| 6/22 | 13:30 | Saipan | 15.2263 | 145.7014 | Turtle-med |
| 6/22 | 13:31 | Saipan | 15.2268 | 145.7037 | Turtle-med |
| 6/24 | 12:49 | Saipan | 15.2314 | 145.6879 | Green Turtle-small |
| 6/24 | 12:57 | Saipan | 15.2281 | 145.7078 | Green Turtle-med |
| 7/2 | 6:41 | Guam | 13.4099 | 144.6560 | Turtle-small |
| 7/2 | 6:49 | Guam | 13.4093 | 144.6563 | Turtle-small |
| 7/2 | 8:40 | Guam | 13.3266 | 144.6486 | Turtle-small |
| 7/2 | 10:14 | Guam | 13.2659 | 144.6540 | Turtle-med |
| 7/2 | 13:46 | Guam | 13.4847 | 144.7572 | Green Turtle-med |
| 7/2 | 17:12 | Guam | 13.3673 | 144.6432 | Green Turtle-med |

* Green turtle (*Chelonia mydas*), hawksbill turtle (*Eretmochelys imbricata*). Turtles were categorized by carapace size (diameter): small (< 1.5 ft), medium (1.5 – 2.5 ft), large (> 2.5 ft) when possible.

Table 9: Wind speed and direction on Guam during the 2012 cetacean survey study period. Preliminary local climatological data from the National Weather Service (Station: Guam International Airport). Note: Data have not undergone final quality control by the National Climatic Data Center (NCDC).

| Month | Day | Average (24 hr) Speed (mph) | Max Speed (mph) | Direction ° (2 min avg) |
|-------|-----|-----------------------------|-----------------|-------------------------|
| May | 25 | 5.4 | 15 | 220 |
| | 26 | 5.4 | 20 | 110 |
| | 27 | 5.8 | 13 | 110 |
| | 28 | 7.1 | 16 | 70 |
| June | 26 | 5.2 | 14 | 90 |
| | 27 | 7.7 | 16 | 60 |
| | 28 | 10.7 | 24 | 50 |
| | 29 | 8.4 | 16 | 90 |
| | 30 | 5.9 | 18 | 150 |
| July | 1 | 4.9 | 23 | 80 |
| | 2 | 6.6 | 15 | 110 |
| | 3 | 6.6 | 14 | 100 |

Table 10: Wind speed and direction on Saipan during the 2012 cetacean survey study period. Preliminary local climatological data from the National Weather Service (Station: Saipan/Isley). Note: Data have not undergone final quality control by the National Climatic Data Center (NCDC). No data are available from Rota.

| Month | Day | Average (24 hr) Speed (mph) | Max Speed (mph) | Direction ° (2 min avg) |
|-------|-----|--------------------------------------|-----------------------|-------------------------------|
| May | 29 | 8.6 | 15 | 140 |
| | 30 | 6.7 | 16 | 140 |
| | 31 | 7.8 | 14 | 170 |
| June | 1 | 10.3 | 21 | 90 |
| | 2 | 10.7 | 17 | 80 |
| | 3 | 9.3 | 14 | 70 |
| | 4 | 9.9 | 16 | 80 |
| | 5 | 8.3 | 18 | 80 |
| | 6 | 8.1 | 15 | 130 |
| | 7 | 6.8 | 13 | 90 |
| | 8 | 3.9 | 13 | 40 |
| | 9 | 4.2 | 12 | 160 |
| | 10 | 5.8 | 12 | 160 |
| | 11 | 6 | 13 | 60 |
| | 12 | 4.7 | 14 | 90 |
| | 13 | 8.4 | 17 | 40 |
| | 14 | 9.4 | 17 | 90 |
| | 15 | 7.2 | 18 | 150 |
| | 16 | 9.6 | 22 | 40 |
| | 17 | 10.5 | 17 | 80 |
| | 18 | 10.8 | 18 | 80 |
| | 19 | 10.4 | 16 | 60 |
| | 20 | 12.2 | 25 | 50 |
| | 21 | 12.1 | 29 | 70 |
| | 22 | 12.4 | 20 | 110 |
| | 23 | 10.9 | 18 | 110 |
| | 24 | 7.6 | 16 | 80 |

Table 11: Number of pilot whale encounters and cataloged individuals by location and year, including within-year matches.

| Year | Esmeralda Bank | | Saipan | | Tinian | | Aguijan | | Rota | | Guam | |
|------|----------------|---------------------------|----------------|---------------------------|----------------|---------------------------|----------------|---------------------------|----------------|---------------------------|----------------|---------------------------|
| | No. Encounters | No. Cataloged Individuals | No. Encounters | No. Cataloged Individuals | No. Encounters | No. Cataloged Individuals | No. Encounters | No. Cataloged Individuals | No. Encounters | No. Cataloged Individuals | No. Encounters | No. Cataloged Individuals |
| 2010 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | n/a | n/a | 0 | 0 |
| 2011 | 0 | 0 | 1 | 19 | 1 | 30 | 0 | 0 | 1 | 32 | 2* | 23 |
| 2012 | 1 | 9 | 0 | 0 | 0 | 0 | 2 | 25 | 0 | 0 | 2* | 39 |

*One encounter during this year was made by HDR.

Table 12: Number of cataloged pilot whale individuals matched between locations across all years (2010-2012). The numbers on the diagonal represent the number of cataloged individuals seen more than once at that location and in parentheses (the number of cataloged individuals encountered only once at that location).

| | Esmeralda Bank | Saipan | Tinian | Aguijan | Rota | Guam |
|----------------|----------------|--------|--------|---------|--------|-------|
| Esmeralda Bank | 0 (9) | 0 | 0 | 0 | 0 | 0 |
| Saipan | | 0 (11) | 0 | 0 | 0 | 8 |
| Tinian | | | 0 (10) | 0 | 0 | 20 |
| Aguijan | | | | 0 (25) | 0 | 0 |
| Rota | | | | | 0 (13) | 19 |
| Guam | | | | | | 0(15) |

Table 13: Number of bottlenose dolphin encounters and cataloged individuals by location and year, including within-year resights.

| Year | Saipan | | Tinian | | Aguijan | | Rota | | Rota Bank | | Guam | |
|------|----------------|---------------------------|----------------|---------------------------|----------------|---------------------------|----------------|---------------------------|----------------|---------------------------|----------------|---------------------------|
| | No. Encounters | No. Cataloged Individuals | No. Encounters | No. Cataloged Individuals | No. Encounters | No. Cataloged Individuals | No. Encounters | No. Cataloged Individuals | No. Encounters | No. Cataloged Individuals | No. Encounters | No. Cataloged Individuals |
| 2010 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | n/a | n/a | 0 | 0 |
| 2011 | 1 | 7 | 1 | 6 | 0 | 0 | 0 | 0 | 1 | 8 | 1* | 3 |
| 2012 | 1* | 1 | 0 | 0 | 1 | 4 | 1 | 12 | 1 | 6 | 1 | 5 |

*HDR encounters

Table 14: Number of cataloged bottlenose dolphin individuals matched between locations across all years (2010-2012). The numbers on the diagonal represent the number of cataloged individuals seen more than once at that location and in parentheses (the number of cataloged individuals encountered only once at that location).

| | Saipan | Tinian | Aguijan | Rota | Rota Bank | Guam |
|-----------|--------|--------|---------|------|-----------|------|
| Saipan | 0 | 6 | 0 | 4 | 0 | 4 |
| Tinian | | 0 | 0 | 3 | 0 | 2 |
| Aguijan | | | 0(4) | 0 | 0 | 0 |
| Rota | | | | 0(8) | 0 | 3 |
| Rota Bank | | | | | 4(6) | 0 |
| Guam | | | | | | 0(3) |

Table 15: Number of spinner dolphin encounters and cataloged individuals by location and year, including within-year resights. TBD = To Be Determined

| Year | Marpi Reef | | Saipan | | Tinian | | Aguijan | | Rota | | Rota Bank | | Guam | |
|------|----------------|---------------------------|----------------|---------------------------|----------------|---------------------------|----------------|---------------------------|----------------|---------------------------|----------------|---------------------------|----------------|---------------------------|
| | No. Encounters | No. Cataloged Individuals | No. Encounters | No. Cataloged Individuals | No. Encounters | No. Cataloged Individuals | No. Encounters | No. Cataloged Individuals | No. Encounters | No. Cataloged Individuals | No. Encounters | No. Cataloged Individuals | No. Encounters | No. Cataloged Individuals |
| 2010 | 1 | 7 | 3 | 8 | 0 | 0 | 0 | 0 | n/a | n/a | n/a | n/a | 8 | TBD |
| 2011 | 2 | 24 | 4 | 18 | 2 | 2 | 1 | 18 | 7 | 57 | 1 | TBD | 3 | TBD |
| 2012 | 2 | 22 | 6 | 14 | 0 | 0 | 2 | 3 | 1 | 1 | 1 | TBD | 6 | TBD |

Table 16: Number of cataloged spinner dolphin individuals matched between locations across all years (2010-2012). The numbers on the diagonal represent the number of cataloged individuals seen more than once at that location and in parentheses (the number of cataloged individuals encountered only once at that location). TBD = To Be Determined

| | Marpi Reef | Saipan | Tinian | Aguijan | Rota | Rota Bank | Guam |
|------------|------------|--------|--------|---------|-------|-----------|------|
| Marpi Reef | 6(14) | 7 | 0 | 7 | 1 | TBD | TBD |
| Saipan | | 5(14) | 1 | 3 | 0 | TBD | TBD |
| Tinian | | | 0(1) | 0 | 0 | TBD | TBD |
| Aguijan | | | | 0(9) | 1 | TBD | TBD |
| Rota | | | | | 16(4) | TBD | TBD |
| Rota Bank | | | | | | TBD | TBD |
| Guam | | | | | | | TBD |

Figures

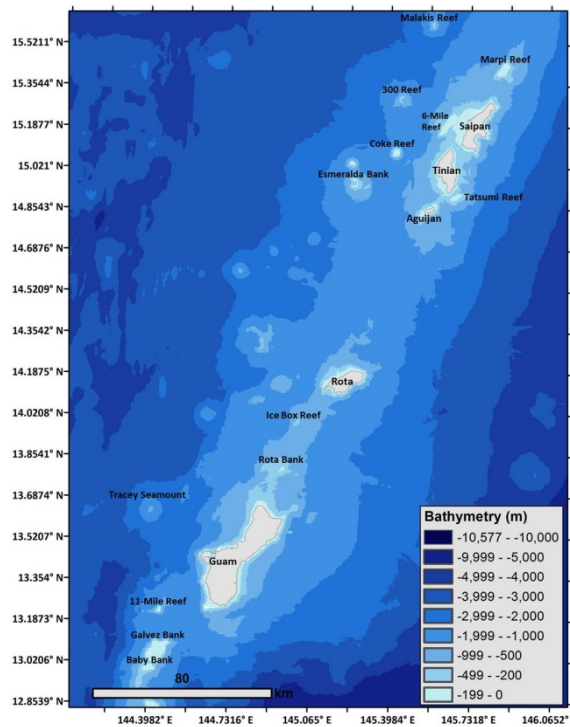
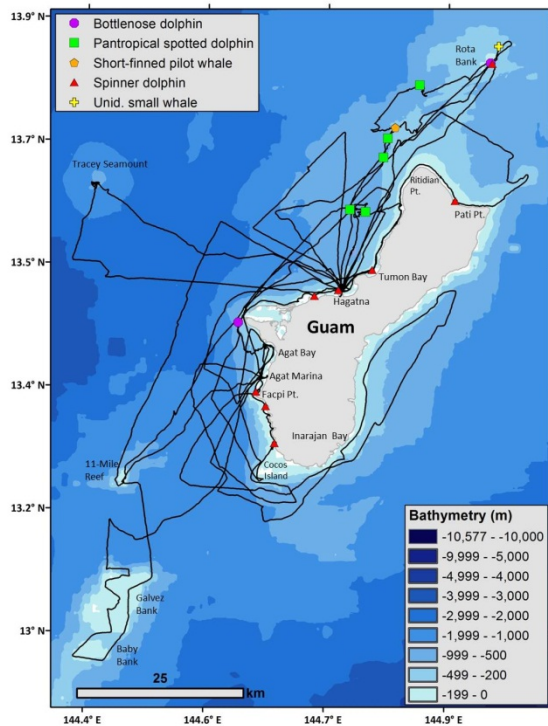


Figure 1: Survey locations of Guam and the Commonwealth of the Northern Mariana Islands displaying bathymetry from all datasets combined in depth bins between 0 and 10,500 m.

A.



B.

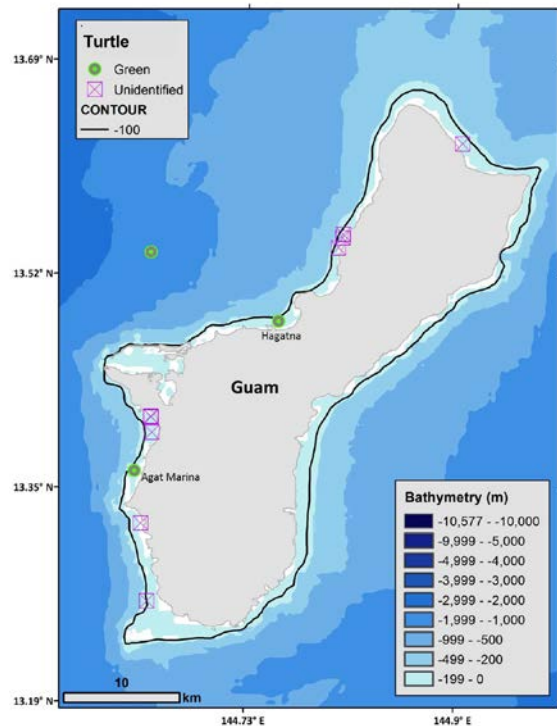


Figure 2: (A) Guam survey tracklines (black lines) and cetacean sightings and (B) Guam sea turtle sighting locations (25-28 May; 26 June – 3 July, 2012) relevant to the 100 m isobath (black line).

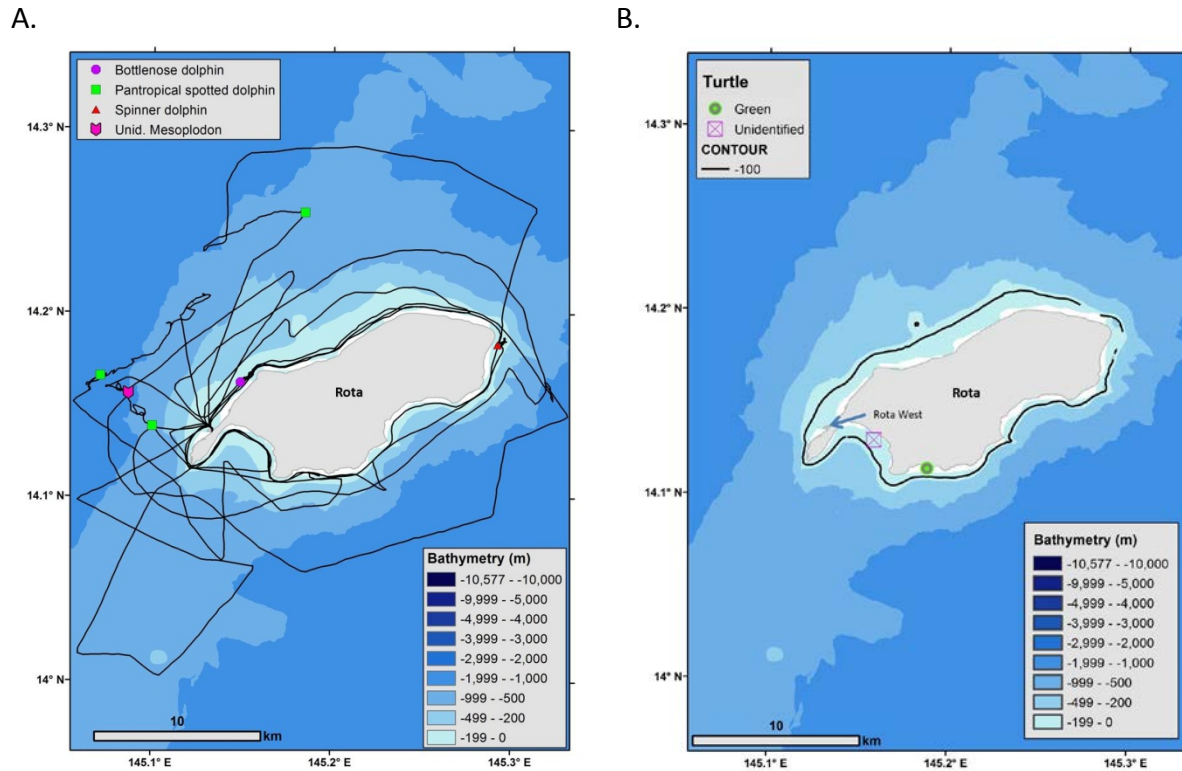


Figure 3: (A) Rota survey tracklines (black lines) and cetacean sightings and (B) Rota sea turtle sighting locations (29 May – 4 June, 2012) relevant to the 100 m isobath (black line).

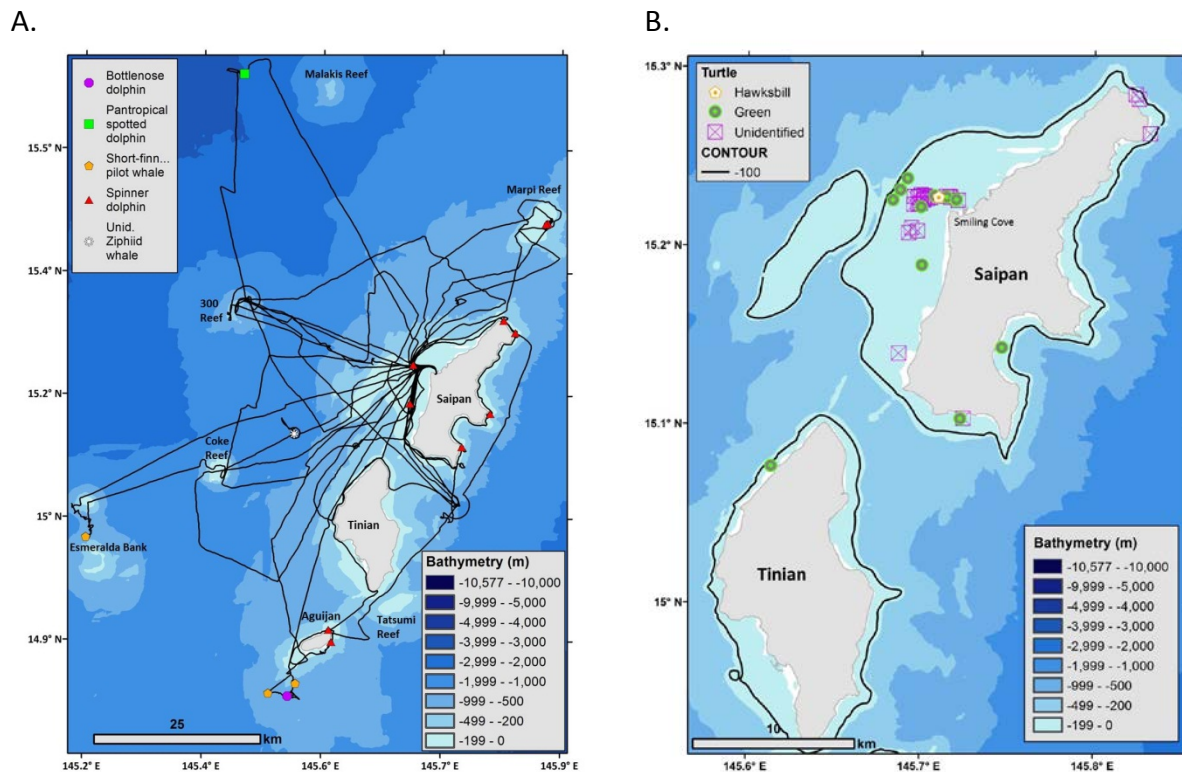


Figure 4: (A) Survey tracklines (black lines) and cetacean sightings around Saipan, Tinian, and Aguijan and (B) sea turtle sighting locations around Saipan and Tinian (7-24 June, 2012) relevant to the 100 m isobath (black line).

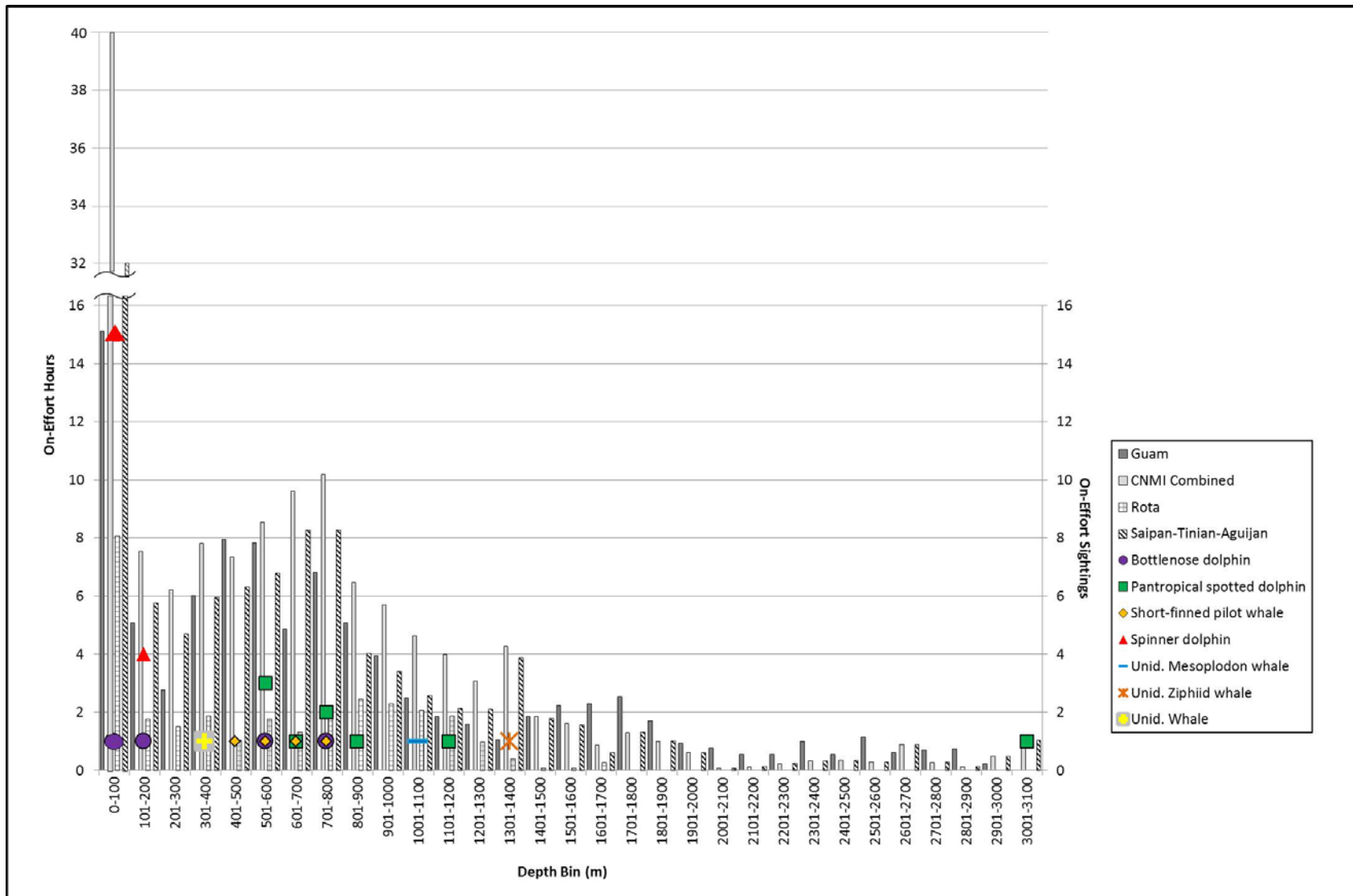


Figure 5: Distribution of the 2012 sightings and search effort across depth profiles divided into 100 m interval depth bins. Guam total on-effort hours = 90.82. CNMI total on-effort hours = 137.32. Rota total on-effort hours = 29.75. Saipan-Tinian-Aguijan total on-effort hours = 107.57.

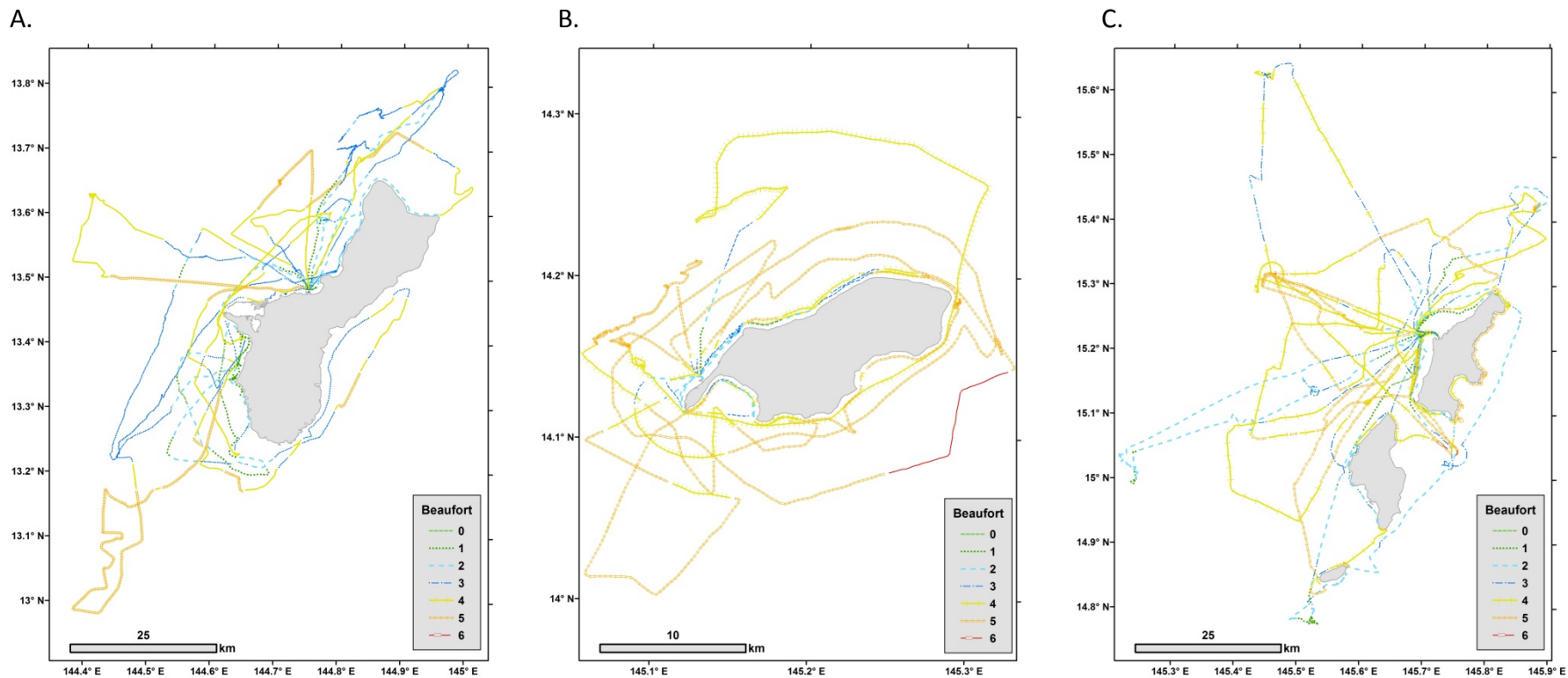
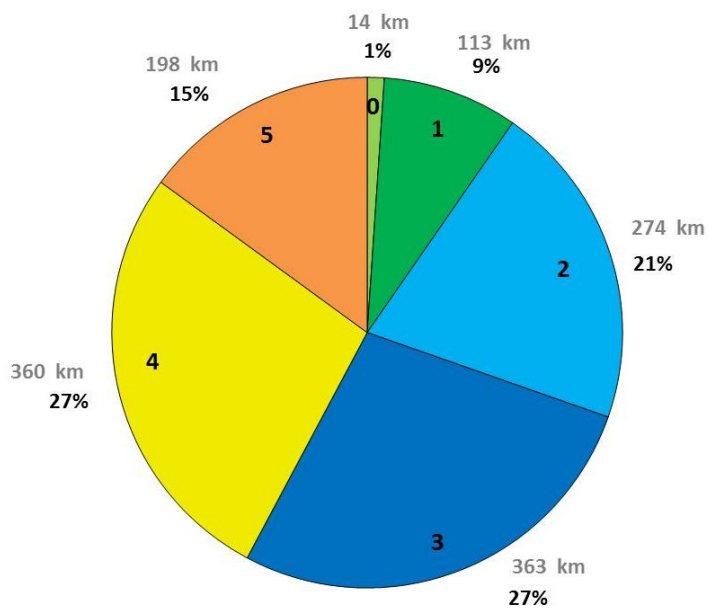


Figure 6: On-effort tracklines by Beaufort sea state in the waters surrounding (A) Guam; (B) Rota; and (C) Saipan, Tinian, and Aguijan.

A.



B.

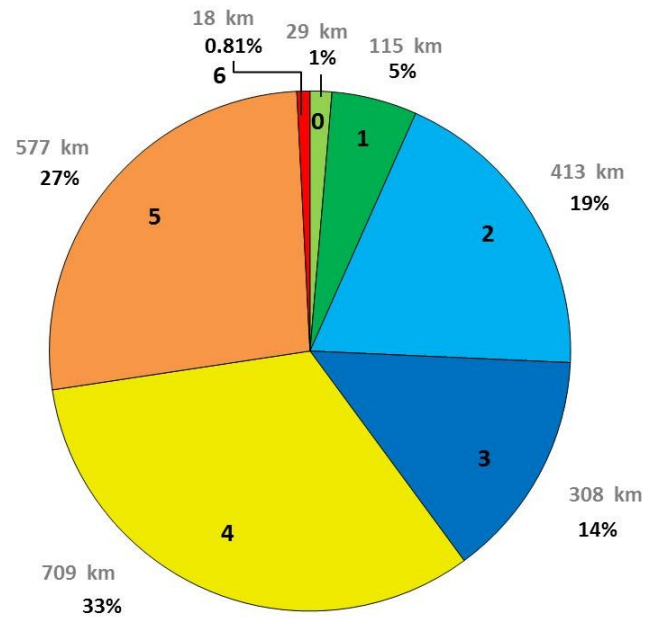
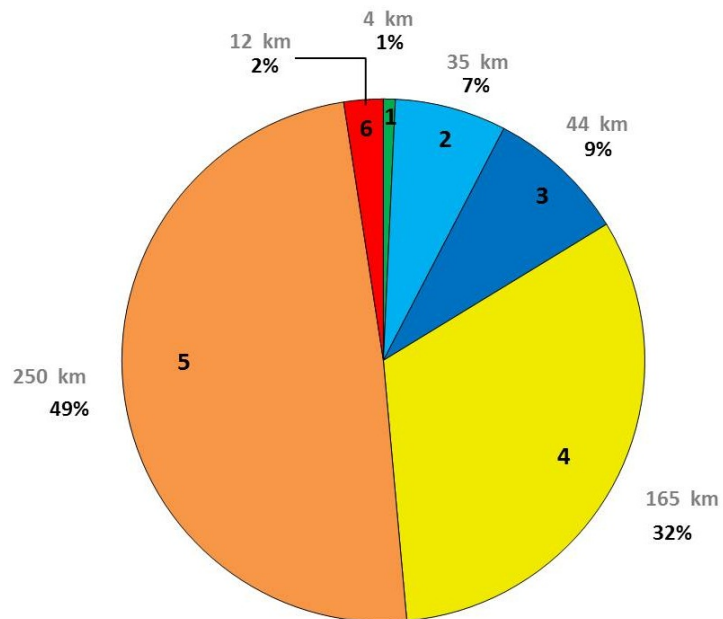


Figure 7: Beaufort sea state as a percentage of the total on-effort trackline distance off (A) Guam (1,324 km) and (B) Saipan, Tinian, Aguijan, and Rota (2,169km).

A.



B.

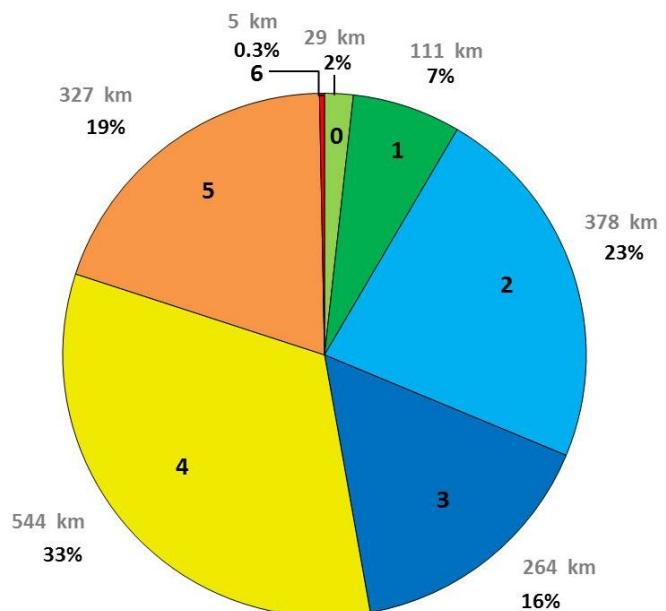


Figure 8: Beaufort sea state as a percentage of the total on-effort trackline distance off (A) Rota (510 km) and (B) Saipan, Tinian, and Aguijan (1,659km).

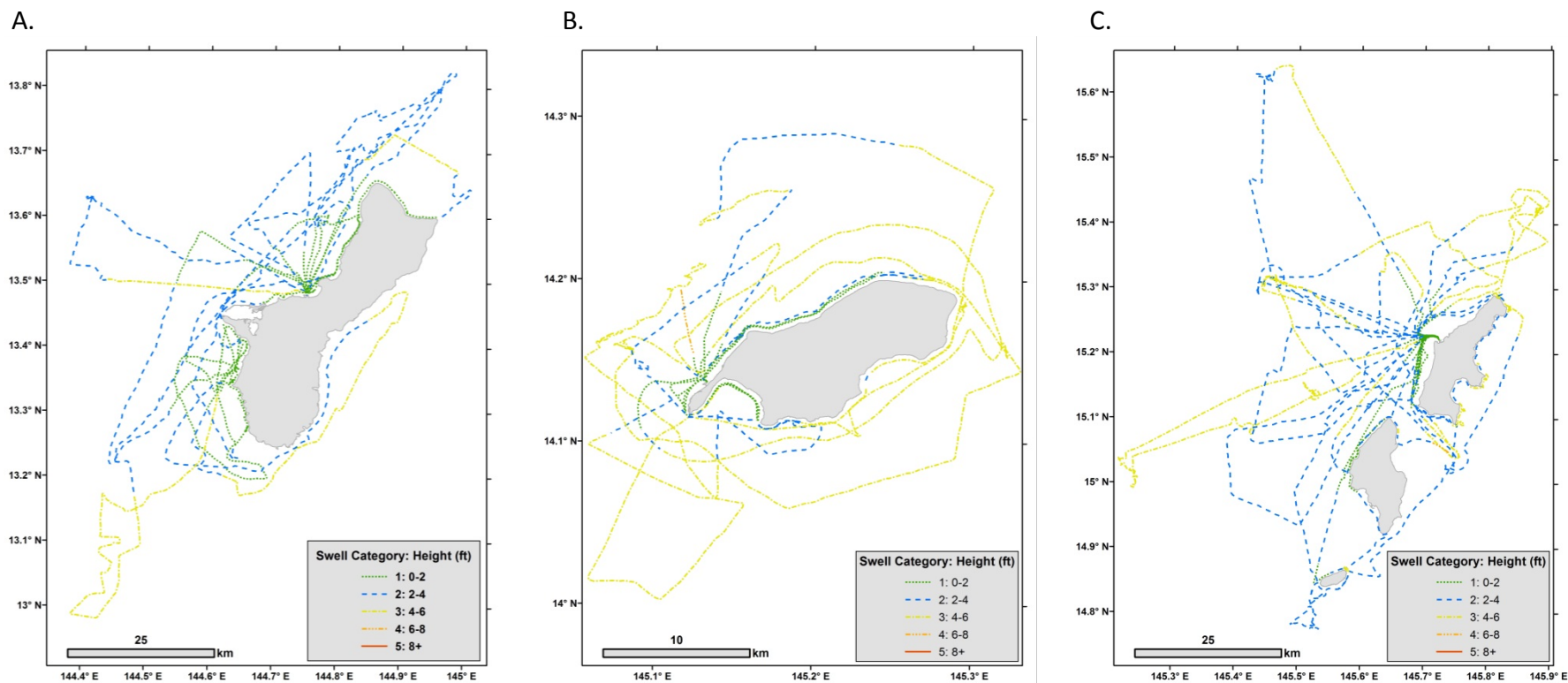
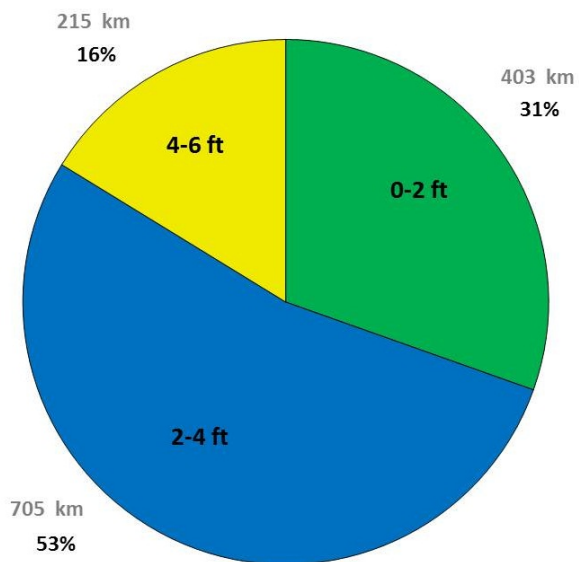


Figure 9: On-effort survey tracklines by swell height in the waters surrounding (A) Guam; (B) Rota; and (C) Saipan, Tinian, and Aguijan.

A.



B.

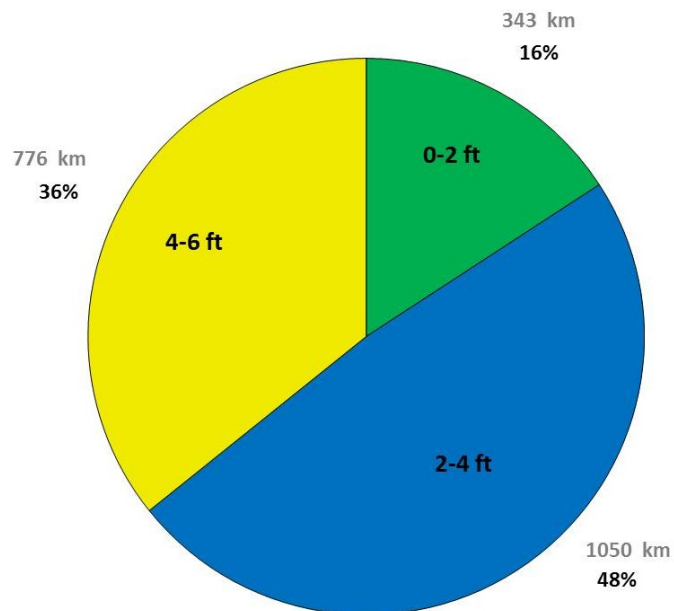
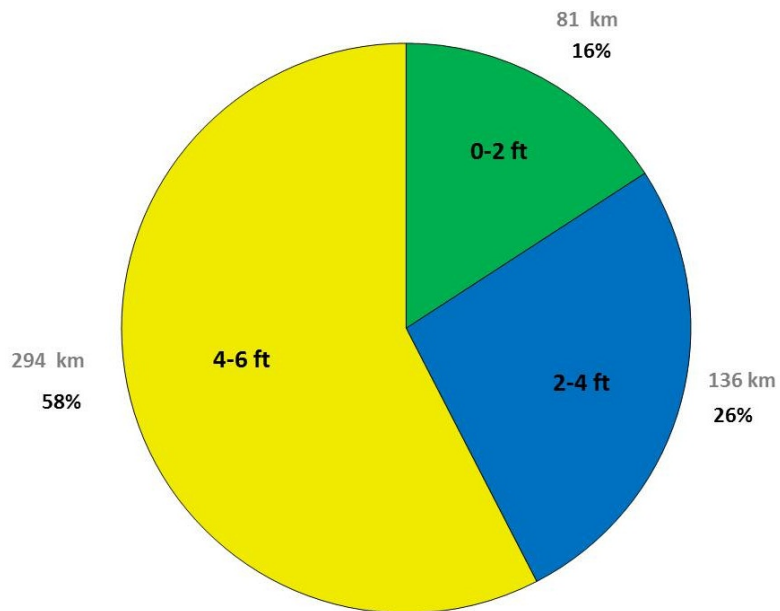


Figure 10: Swell height as a percentage of the total on-effort trackline distance off (A) Guam (1,324 km) and (B) Saipan, Tinian, Aguijan, and Rota (2,169 km).

A.



B.

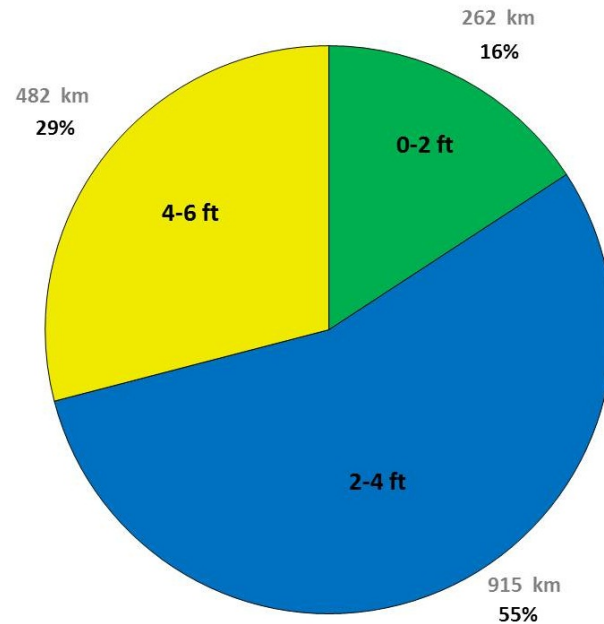


Figure 11: Swell height as a percentage of the total on-effort trackline distance off (A) Rota (510 km) and (B) Saipan, Tinian, and Aguijan (1,659 km).

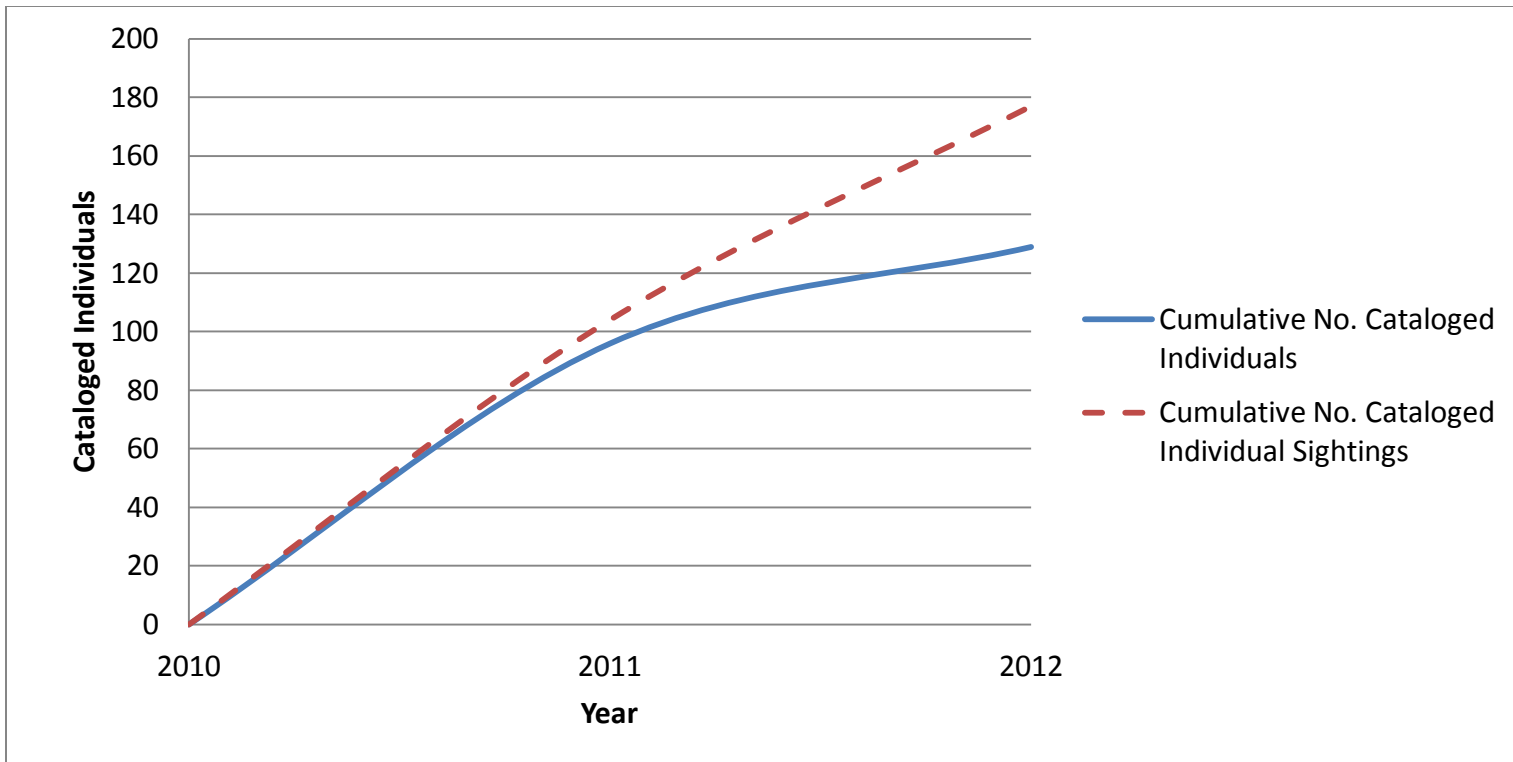


Figure 12: Discovery curve for cataloged pilot whales in the Marianas and the cumulative number of sightings of those individuals during the study period (2010-2012).

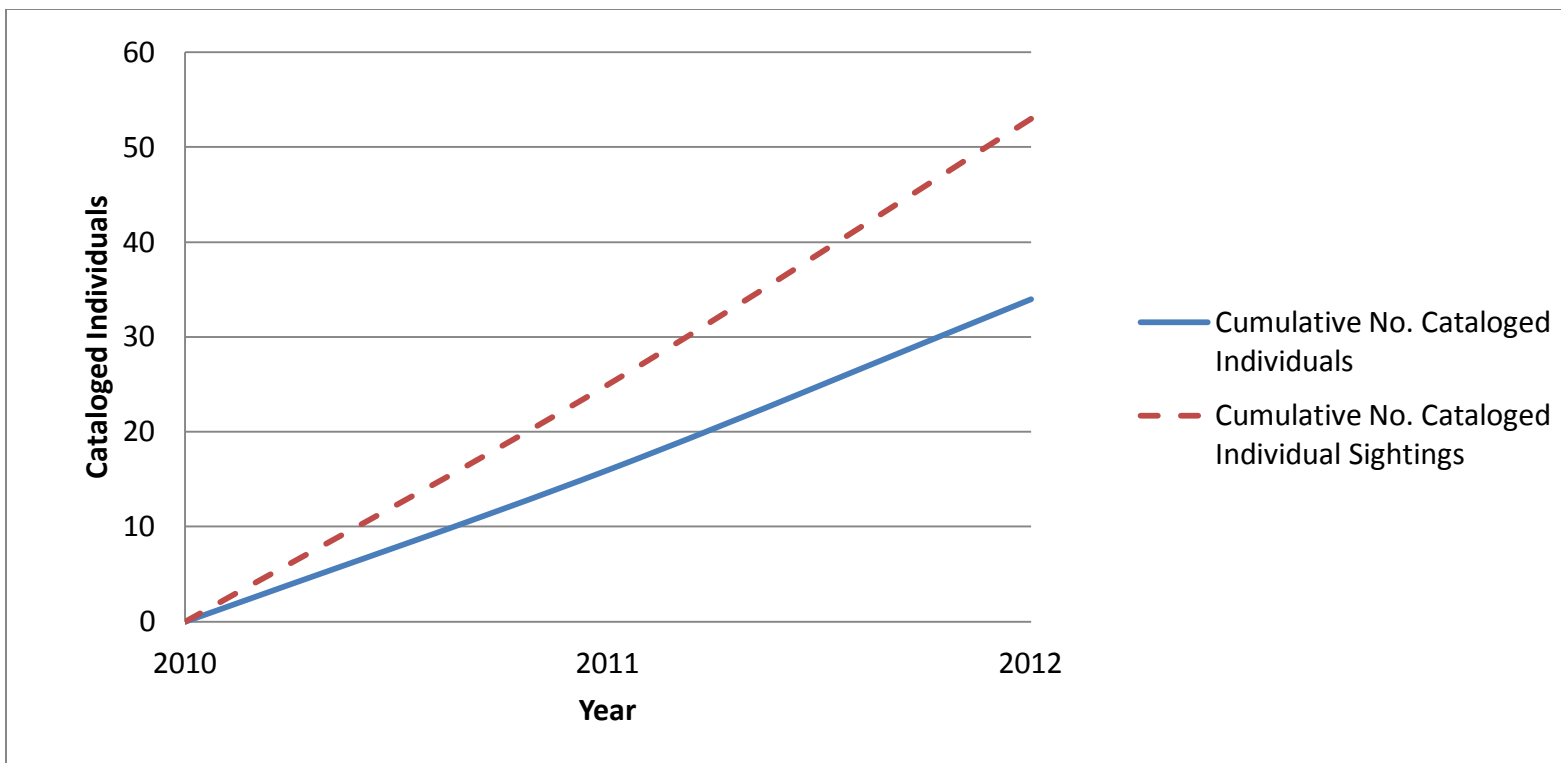


Figure 13: Discovery curve for cataloged bottlenose dolphins in the Marianas and the cumulative number of sightings of those individuals during the study period (2010-2012).

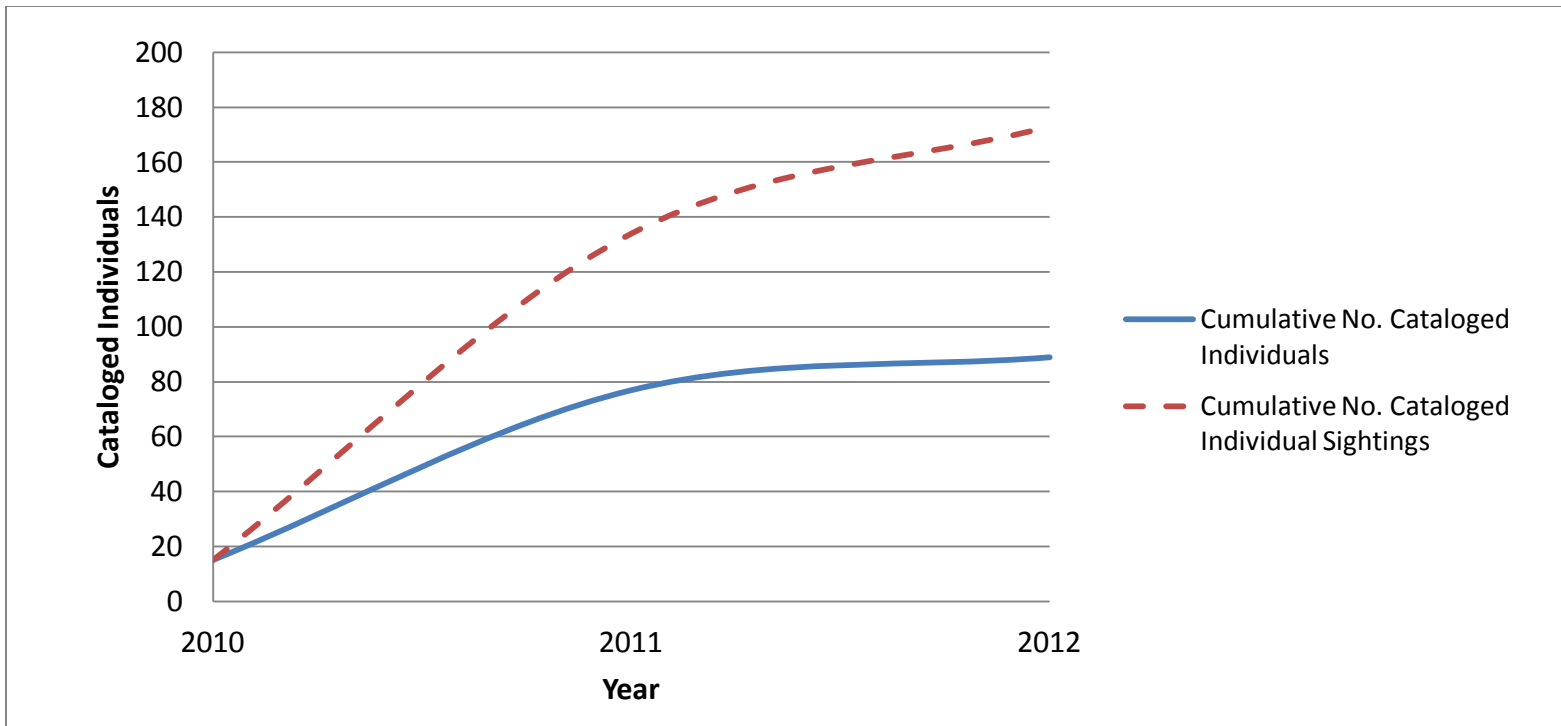


Figure 14: Discovery curve for cataloged spinner dolphins in CNMI and the cumulative number of sightings of those individuals during the study period (2010-2012).

A.



B.



Figure 15: Pilot whale (MIGm-000057) photographed (A) off of Rota in 2011 and (B) off of Guam in 2012.