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SEA TURTLE TAGGING IN THE MARIANA ISLANDS TRAINING AND TESTING (MITT) STUDY AREA
PROGRAMMATIC REPORT

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List of Acronyms

AAFB – Anderson Air force Base	**KM** – Kilometer
BO – Biological Opinion	**MIRCMP** – Mariana Islands Range Complex Monitoring Plan
C – Celsius	**M** – Meter
CLS – Collection and Location by Satellite	**MITT** – Mariana Islands Training and Testing
CM – Centimeter	**MMPA** – Marine Mammal Protection Act
CNMI – Commonwealth of the Northern Mariana Islands	**MTBAP** – Marine Turtle Biology and Assessment Program
DAWR – Division of Aquatic and Wildlife Resources	**NIST** – National Institute for Standards and Technology
DLNR – Department of Lands and Natural Resources	**NMFS** – National Marine Fisheries Service
DNA – Deoxyribonucleic Acid	**NOAA** – National Oceanic and Atmospheric Administration
EOD – Explosive Ordnance Disposal	**PIFSC** – Pacific Islands Fisheries Science Center
ESA – Endangered Species Act	**PIT** – Passive Integrated Transponder
FY – Fiscal Year	**PSD** – Protected Species Division
GIS – Geographic Information Systems	**SCL** – Straight Carapace Length
GPS – Global Positioning System	**SD** – Standard Deviation
ICMP – Integrated Comprehensive Monitoring Program	**USFWS** – United States Fish and Wildlife Service
ID - Identification	
KIWB – Kernel Interpolation with Barriers	

ABSTRACT

Understanding the spatio-temporal movements of animals is an integral component of wildlife conservation and management. Marine turtles are species of conservation concern and satellite telemetry is a primary research tool used to study their movements**,** providing high accuracy location data in near "real time," thus facilitating rapid identification of movements and key habitats. Although it has been recognized that both green (*Chelonia mydas*) and hawksbill (*Eretmochelys imbricata*) turtles inhabit the waters around Guam and the Commonwealth of the Northern Mariana Islands (collectively referred to as the Mariana Archipelago), their distribution and habitat use in the region remains unclear. In 2013, under an inter-agency agreement between the United States Navy and the National Oceanic and Atmospheric Administration (NOAA), NOAA began conducting in-water surveys to record and quantify observations of marine turtles around the Mariana Archipelago. When observed, attempts were made to hand-capture turtles and equip them with satellite tags in an effort to better understand their spatial ecology. Between 2013 and 2019 (the project is still underway), researchers encountered a total of 517 turtles, 111 of which were captured and equipped with satellite tags, including 97 green turtles and 14 hawksbill turtles. Movements and habitat use were highly neritic for the overwhelming majority of turtles, with home range estimates revealing limited movements for both species. Ninety−four (89.5%) of the tracked turtles remained within a 1−3 km^2 area for the entire life of their tag (average tag retention time = 191 days), demonstrating limited movements and high foraging site fidelity. Notwithstanding this perspective, there were three more vagile movement patterns observed, including shifts in intra-island foraging areas (n = 7), transitions between inter-island foraging areas (n = 2), and a long-range migration departure out the Mariana Archipelago (n = 1). Dive patterns suggest that both green and hawksbill turtles spend most of their time in waters shallower than 25 meters. However, it is possible that habitat partitioning may exist between the two species, with hawksbill turtles spending more time in deeper waters than green turtles, using average depths of 15.3 meters and 10.5 meters, respectively. Spatial analysis of satellite tags has demonstrated limited direct overlap of turtles with Navy detonation sites (i.e., Agat Bay Mine Neutralization Site, Piti Point Mine Neutralization Site, and Outer Apra Harbor Underwater Detonation Site). However, turtles are spending significant amounts of time in and moving through areas within 1−2 km of these sites and additional analyses are needed to better evaluate potential overlap. The research detailed in this report provides important insights into the movement ecology of green and hawksbill turtles around the Mariana Archipelago and represents the most rigorous individual satellite tracking study on these species in the world.

BACKGROUND

The United States Navy developed monitoring questions for the Mariana Islands Training and Testing (MITT) study area under the Mariana Islands Range Complex Monitoring Plan (MIRCMP), including questions specifically related to marine mammals and sea turtles as required under the Marine Mammal Protection Act (MMPA) of 1972 and the Endangered Species Act (ESA) of 1973. The MITT study area monitoring questions outline the scope of monitoring the Navy will undertake to understand marine mammal and sea turtle distribution and, ultimately, impacts from Navy training and testing. The monitoring and analyses outlined in this annual report support the ESA Biological Opinion (BO) received by the Navy with respect to the MITT study area in 2015. The overall objective of the MIRCMP is to collect field data that will enable the Navy and the National Oceanic and Atmospheric Administration's (NOAA) National Marine Fisheries Service (NMFS) to better understand the distribution and habitat use of sea turtles in Guam and the Commonwealth of the Northern Mariana Islands (CNMI) (collectively referred to as the Mariana Archipelago). Data generated via implementation of the MIRCMP will be integrated into the Navy-wide Integrated Comprehensive Monitoring Program (ICMP). Of the five species of sea turtles associated with the MITT study area, this annual report provides data on the habitat and movements of two species; the green (*Chelonia mydas*) and hawksbill (*Eretmochelys* imbricata) turtle. Individuals of both species were

tagged and satellite-tracked in the nearshore waters of Saipan, Tinian, and Guam by staff from NOAA's Pacific Islands Fisheries Science Center's Marine Turtle Biology and Assessment Program (PIFSC MTBAP). Juvenile and adult life-stages were targeted for tagging and satellite tracking, with juveniles composing the majority of turtles observed, captured and equipped with electronic tags. The other three species of sea turtle present in the North Pacific are not generally associated with neritic (i.e., nearshore) waters and were not observed during monitoring activities.

Between 15 August 2013 and 31 October 2019, PIFSC MTBAP spent a total of 47 field days conducting sea turtle surveys around the Mariana Archipelago. These surveys were undertaken during a total of nine field expeditions to Guam, six expeditions to Saipan and four expeditions to Tinian. During that time researchers have encountered a total of 517 turtles, 357 of which were observed but not captured, 47 of which were captured but not equipped with satellite tags, and 111 of which were equipped with satellite tags. The expeditions have included meetings and collaborative fieldwork with numerous local partners, including representatives from Guam Department of Agriculture Division of Aquatic and Wildlife Resources (DAWR), CNMI Department of Lands and Natural Resources (DLNR), United States Fish and Wildlife Service (USFWS), University of Guam/SeaGrant, Naval Base Guam, and the U.S. Pacific Fleet Environmental Readiness Office.

Guiding questions from the FY13–15 Monitoring Plan

- Are there locations of greater cetacean and/or sea turtle concentration around Guam, Saipan, and Tinian?
- What is the occurrence and habitat use of sea turtles in the MITT study area?
- What is the exposure of cetaceans and sea turtles to explosives and/or sonar in the MITT study area?

Summary of tasks

1. Capture and tag sea turtles in the MITT study area and deploy biotelemetry devices.
2. Process and analyze biotelemetry data and other survey data.
3. Prepare annual reports.

Progress on Field Research

The most recent field research was conducted during September 01–11, 2019. Drs. Alexander Gaos, Summer Martin and Camryn Allen of the PIFSC MTBAP collaborated with local partners to conduct marine turtle surveys and in-water captures of green and hawksbill turtles. Researchers that participated in one or more days included Kim Trust (Deputy Chief for the National Wildlife Refuge System [Pacific Region] with USFWS), Tammy Summers (USFWS Guam National Wildlife Refuge Manager and Marianas Trench Marine National Monument Superintendent), Lisa Szutukowski (Endangered Species Program Manager for DLNR), among others. Captured turtles were weighed, measured, biopsied, tagged (i.e., flipper, passive integrated transponder [PIT], satellite tracking) in an effort to expand our knowledge of the population demographics, population structure, and fine-scale habitat use of turtles in the area. Blood samples were also collected for two studies: (1) hormone analysis to determine population sex ratios, and (2) metabolite analysis to determine nutritional/feeding state. The aforementioned activities were permitted under NMFS ESA10a1A Take permits #17022, 15685, and 21260 and NMFS IACUC SWPI2013-05R. Additionally, in Guam, the Division of Aquatic and Wildlife Resources (Guam DAWR) biologists were provided with hands-on refresher training by PIFSC MTBAP staff. In both Guam and CNMI, local partners continue to engage in this collaborative research effort. Many of these activities are part of a larger collaborative effort with PIFSC MTBAP, Guam DAWR, CNMI DLNR, Naval Base Guam, and the U.S. Pacific Fleet Environmental Readiness Office.

The most recent field expedition consisted of 11 days on Guam and Saipan, including four days of travel, one day of logistics planning, and six days of in-water surveys and turtle captures. For the majority of the year, both Guam and Saipan experience strong easterly trade winds, which create hazardous boating and monitoring conditions, and these conditions have complicated efforts to survey the northern and eastern coasts of these islands. In 2018, MTBAP staff planned the survey trip to coincide with months when easterly trade winds occasionally abate (August and September) and for the first time were able to conduct research in some of these difficult-to-study areas along the eastern coasts of the islands. In 2019, PIFSC MTBAP once again implemented this approach, scheduling our trip for September. The team was fortunate to get an excellent weather window, which permitted surveys along the eastern coast of Saipan (e.g., Forbidden Island, Lao Lao, and Dandan) and the northern coast of Guam (e.g., Ritidian, Anderson Airforce Base [AAFB], Tarague, and Pati Point). Given the unpredictable and often unrelenting nature of the weather around the Marianas, the favorable weather during these visits was fortuitous. Indeed, during the 2019 survey trip the weather conditions were substantially worse both the day prior to the team's arrival and the day after departure from the islands. As attempts to survey turtles in these areas have been limited, the 2019 surveys and satellite tag deployments provided novel opportunities to collect important information in these data deficient areas. Surveying and tagging in multiple locations around the perimeters of Guam, Saipan, and Tinian are important for understanding sea turtle occurrence, distribution, relative abundance, and habitat use throughout the MITT study area. Due to the isolated nature of the areas surveyed in 2019, which typically required transit times of 1–2 hours each way, all captured turtles were processed and satellite tagged onboard research vessels (i.e., boat-based surveys). Turtles with straight carapace length (SCL) > 45 cm and good body condition were equipped with Wildlife Computers SPLASH-297A satellite tags, which have both Fastloc-GPS and Argos location capabilities, as well as temperature and depth sensors. Turtles with SCL between 35–45 cm and good body condition were equipped with Wildlife Computers SPOT-311A satellite tags, which have Argos location capabilities and temperature sensors.

Over the six field days, the team observed a total of 79 turtles; 21 were captured, 16 were outfitted with Wildlife Computers SPLASH satellite transmitters, and one was outfitted with a SPOT-311A satellite transmitter.

PROGRESS ON DATA ANALYSIS

Under Interagency Agreement NMFS-PIC-16-008 through NMFS-PIC-18-008 between NOAA and the Navy, data collection and analyses were ongoing from 2013 through 2019. The PIFSC MTBAP project staff continue to process satellite tracking data as they arrive from Collection and Location by Satellite America (CLS America), which collects and stores the Argos satellite information. These data are being organized and analyzed to understand spatial distribution, depth use, and temperature profiles for habitat used by tagged turtles.

The findings presented in this report, which cover research conducted through October 31st, 2019, provide robust and essential biogeographical context for understanding the abundance, spatial distribution, and habitat use of sea turtles in the MITT study area, as well as preliminary data on the abundance and distribution of other large marine vertebrates in the region. Furthermore, these data and analyses have helped to inform the proposed Critical Habitat for the Endangered Central West Pacific distinct population segment of green turtle (NMFS and USFWS 2015). They have also informed incidental take statements and impact assessments for NOAA Fisheries ESA Section 7 and Biological Opinion needs.

In January 2016, the first manuscript derived from this Navy/NOAA Interagency Agreement was published, "Five Decades of Marine Megafauna Surveys from Micronesia" (Martin et al. 2016). The analysis suggested a substantial but isolated increase in sea turtles over the last five decades in Guam. Specifically, there was an observed island-wide trend

in turtle counts from semimonthly aerial surveys (surveys conducted by Guam DAWR). The mean annual population growth rate of turtles (primarily green sea turtles) was 8.0% (s.d. = 5.7%) since 1963, and 9.3% (s.d. = 3.5%) since 1989.

PIFSC MTBAP staff are currently working on the second major manuscript associated with the program and have set a target publication date for mid to late 2021. The manuscript, tentatively titled, "Reef-dwelling turtles of the Mariana Archipelago: fine-scale habitat use revealed by in-water surveys and GPS telemetry," will provide further analyses of the boat-based surveys and satellite telemetry efforts presented in this study, including in-depth analyses of horizontal, vertical, temporal, and temperature-based habit use. The research will encompass the largest sample size for satellite tracking of juvenile green and hawksbill turtles included in a single study available to date in the scientific literature.

A third manuscript, with a 2022 target date, will focus on producing abundance estimates by integrating the survey data from this study with small boat cetacean surveys (Hill et al. 2016) and presence/absence data collected during underwater towed-diver coral reef surveys (NOAA data). These survey data and analyses document the widespread presence of turtles throughout the Mariana Archipelago, with > 1,700 observations. The synthesis of results from in-water surveys, along with data from the first in-water satellite transmitter deployments in this island chain, will advance our understanding of the distribution, relative abundance, and habitat use patterns of the juvenile-dominated green and hawksbill turtle foraging populations throughout the Mariana Archipelago.

Progress on Data Availability

The supplementary materials list all data available to date. The listed files include (1) all boat survey tracks from the 2013−2019 field seasons throughout the MITT study area, (2) all metadata on turtle observations, captures, and satellite tag deployments in 2013−2019 (date, location, species, numbers of all tags applied, turtle length measurement, etc.), (3) all metadata on cetacean observations for 2016−2019 (date, location, species), (4) time-at-depth histogram data from satellite tags deployed in 2014−2019 (raw data are provided as the proportion of time spent at binned depths for designated periods of time), (5) time-at-temperature histogram data from satellite tags deployed in 2014−2019 (raw data are provided as the proportion of time spent at binned temperatures for designated periods of time), (6) raw Argos location data from Wildlife Computers SPLASH and SPOT Satellite tags deployed in 2013−2019 (with a table for interpretation of Argos derived locations), and (7) raw GPS location data from Wildlife Computers SPLASH Satellite tags (with a table for interpretation of GPS locations) deployed in 2013−2019. The PIFSC MTBAP plans to make the data publicly accessible through the Animal Telemetry Network, which will satisfy Public Access to Research Results (PARR) requirements for both NOAA and Navy.

Methods

In-water surveys and capture

Small boat surveys were conducted in the nearshore and coastal waters of Guam, Saipan, and Tinian (Figure 1). During surveys, the boat team recorded all observations of turtles seen by both the in-water snorkel team and the boat team, along with approximate GPS coordinates. We also recorded information on the species, approximate number of individuals, and GPS locations of any observed cetaceans to support other guiding questions from the FY13−15 monitoring plan. Observed turtles were visually assessed as to the feasibility of capture (e.g., turtle behavior and distance from diver). Turtles of all size classes were targeted for capture, either by hand capture while snorkeling or after diving from a slow-moving boat. Hand captures involved free-diving (2−25 m) to capture turtles resting/foraging in the water column or on the substrate. Captured turtles were immediately brought to the surface, lifted into the boat and processed on deck or after being brought to shore and placed in turtle holding bins. All research was authorized under the following permits:

NMFS ESA10a1A 21260, IACUC Protocol NMFS SWPI 2013-05, and Guam Department of Agriculture Special Permit for Scientific Research SC-MPA-19-004.

All turtles were tagged with two metal (Inconel) self-piercing sea turtle tags or "flipper tags" (Style 681, National Band and Tag Company) using the standard technique described in the Marine Turtle Specialist Group Manual on Research Techniques (Eckert et al. 1999) and with two Passive Integrated Transponder (PIT) tags—small (14 mm length × 2 mm diameter) electromagnetically-coded glass-encased "microchips"—Destron Tx 1406L. All Inconel and PIT tags had unique identification numbers. The Inconel flipper tags were attached to the trailing edge of a fore flipper and the PIT tags were injected subcutaneously into the rear flippers. Skin samples were obtained for DNA and stable isotope analysis (Dutton et al. 1996). Straight carapace length (SCL), curved carapace length (CCL), and turtle mass were measured (when feasible), and turtles of appropriate SCL (see Jones et al. 2013) were outfitted with a satellite tag.

The majority of satellite tags attached to turtles was the SPLASH10-F series Platform Transmitting Terminals (PTT) designed by Wildlife Computers. These are data-archiving tags that transmit via the Argos satellite system. In addition to Argos-derived location data, the tags also upload sensor data that include GPS derived locations, depth, temperature, light level, and wet/dry (based on conductivity). For this study, we used SPLASH10-F tags with a frontal area of approximately 12cm^2; however, there is some size variation in the SPLASH tags due to differences in the battery capacity (and hence battery life) of the different versions, with the smaller tags allowing us to apply them to smaller juvenile turtles (minimum 45 cm SCL). Wildlife Computers SPOT-311A tags were also deployed to track turtles of even younger life-stages (i.e., 35 cm−45 cm SCL). In contrast to the SPLASH tags, SPOT tags are much smaller (frontal area = 4.79 cm^2) and only have the capability of collecting data on Argos locations and water temperature. Captured turtles with SCL < 35 cm or that had poor body condition or physical abnormalities were not outfitted with a satellite tag.

Satellite tag attachment followed the drag recommendations of Jones et al. (2011, 2013) and the attachment methods as described in Jones et al. 2018. In short, the attachment area on the carapace was lightly sanded to remove algae and cleaned with denatured ethanol. A 0.75 cm layer of a two-part epoxy (e.g., Superbond) was used to affix the tag to the carapace, and a second putty-type epoxy (J.B. WaterWeld) was form-molded around the tag to protect it from damage by reef and rock ledges during the course of normal turtle behavior. This tag attachment technique is widely used and works well with reef-dwelling hawksbill and green turtles (Hart et al. 2015). All satellite tags were subsequently covered with a layer of anti-fouling paint (Interlux Ulta Micro Extra or Micron66) to inhibit the attachment of algae and other growth that can cover sensors and interfere with tag operation.

MOVEMENT TRACKS, HOME RANGE ESTIMATES AND DIVE BEHAVIOR

Argos locations, GPS locations, dive depth, dive duration, and temperature data were obtained in raw form over the Argos system and processed to produce data ready to analyze. We created tracks for turtles that undertook migrations using GPS locations for those equipped with SPLASH tags and Argos locations for those equipped with SPOT tags. For calculating migration distances and timing of movements, we used the difference in time and distance of path between (i) the last GPS location point (Argos location point for SPOT tags) of a turtle before it began its long-distance movement out of an area and (ii) the first GPS location point (Argos location point for SPOT tags) associated with its arrival at the new location.

Home range estimates were generated using GPS locations for the SPLASH tags due to the increased accuracy of these location points (over Argos). However, we also generated home range estimates for turtles equipped with SPOT tags using Argos locations, omitting the less precise and invalid Argos location classes 0 and Z, respectively (Argos 2008). Home ranges and the associated 50% (core home range) and 95% (overall home range) density volume contours were generated using kernel interpolation with barriers (KIWB). The KIWB method was selected to calculate home range over

traditional kernel density estimation (KDE) due to the ability of KIWB to account for land barriers, which is particularly relevant for nearshore marine species as topological features can inadvertently be incorporated into traditional KDE analyses (Sprogis et al. 2016). All tracks and density estimates were performed in ArcGIS (ESRI 2012). The data analyses remain preliminary as some of the satellite tags are still transmitting. Final analyses will include the full range of GPS data for additional home range analysis and KIWB estimates.

Further details on the KIWB estimates in ArcGIS are given here. The KIWB tool is available within the "Geostatistical Analyst" toolbox section of ArcGIS. Prior to performing a KIWB estimate on a set of GPS or Argos points, we grouped the data by species and tagging location and filtered out (i) all points that occurred within the first two days (i.e., 24 hours) of tag deployment (to account for potentially non-normal behavior), (ii) all points erroneously appearing on land, and (iii) all points suggesting a swim speed greater than 5 km per hour. We generated a point density surface with a cell size of 10 m as a necessary intermediate step. Then we used the point density surface and an output cell size of 10 m to construct the KIWB estimate. Using the KIWB estimate, we produced 50% and 95% volume contour polygons to describe the core area and overall home range, respectively, for turtles pooled by location. We calculated the area of each volume contour polygon (km^2) to quantify core area and overall home range and allow for qualitative comparisons across sites. The data generated by SPLASH and SPOT tags were analyzed separately due to position accuracy differences between the two models.

Temperature and depth data (SPLASH tags only) were collected every 10 seconds and archived by the corresponding tags; these data were then binned across 6-hour periods and sent via satellite transmissions with the Argos and GPS (if applicable) location data when the turtle surfaced. Bins are user-defined and give insights into different aspects associated with dive behavior, including:

- Temperature: the proportion of dives spent at each temperature bin.
- Depth: the proportion of overall dive time spent within each depth bin.
- Max dive depth: the maximum depth bin reached for each dive.
- Dive duration: the time duration bin of each dive.

The temperature, depth, maximum dive depth, and dive duration bins were programmed as follows:

Temperature:		19, 21, 23, 24, 25, 26, 27, 28, 29, 30, 31, 33, 35, >35 (in degrees Celsius)
Depth:		0, 2, 5, 10, 15, 20, 25, 30, 40, 50, 60, 70, 100, >100 (in meters)
Max Dive Depth:		4, 6, 8, 10, 14, 18, 24, 30, 40, 60, 80, >80 (in meters)
Dive Duration	(2013−2017):	1, 2, 3, 4, 5, 10, 15, 20, 25, 30, 40, 50, 60, >60 (in minutes)
	(2018−2019):	1, 5, 10, 20, 30, 40, 50, 60, 75, 90, 105, 120, 150, >150 (in minutes)

Between 2013 and 2017, we recorded dive durations that lasted longer than the maximum bin (see previous reports), so starting in 2018, we adjusted the dive duration to include bins above 60 minutes. The total time a turtle was in a depth, temperature, or duration bin was averaged, and the data were represented in a histogram providing an average of averages of the life of a tag (transmission days) and across turtles. Several tags deployed at the start of the project (green turtles n = 4, hawksbill turtles n = 2) had variable depth bin programs and these data were included when feasible. The data were separated by species and we also evaluated potential differences between diurnal and nocturnal time periods.

SAMPLE ARCHIVING AND ANALYSIS

Tissue samples collected for DNA, stable isotope analysis (SIA), and health assessment were sent to analytical laboratory collaborators within NOAA and the National Institute for Standards and Technology (NIST):

Genetic and Stable Isotope analyses NOAA, NMFS, Southwest Fisheries Science Center
8901 La Jolla Shores Drive
La Jolla, CA 92037

Biological and Environmental Monitoring and Archival of Sea Turtle Tissues
National Institute of Standards and Technology
Hollings Marine Laboratory
331 Fort Johnson Road
Charleston, SC 29412

Results and Discussion

In-water surveys and turtle observation, capture and processing

The following is a synopsis of surveys, captures, and analyses between 2013 and 2019. The survey tracks, satellite tags deployed, and additional turtles observed or captured (i.e., not equipped with satellite tags) by location for the field seasons are shown in Figure 1. A total of 47 days of boat-based snorkel survey effort were conducted; 24 days in Guam, 15 days in Saipan, and 8 days in Tinian (Table 1, Appendix Tables A2-A7).

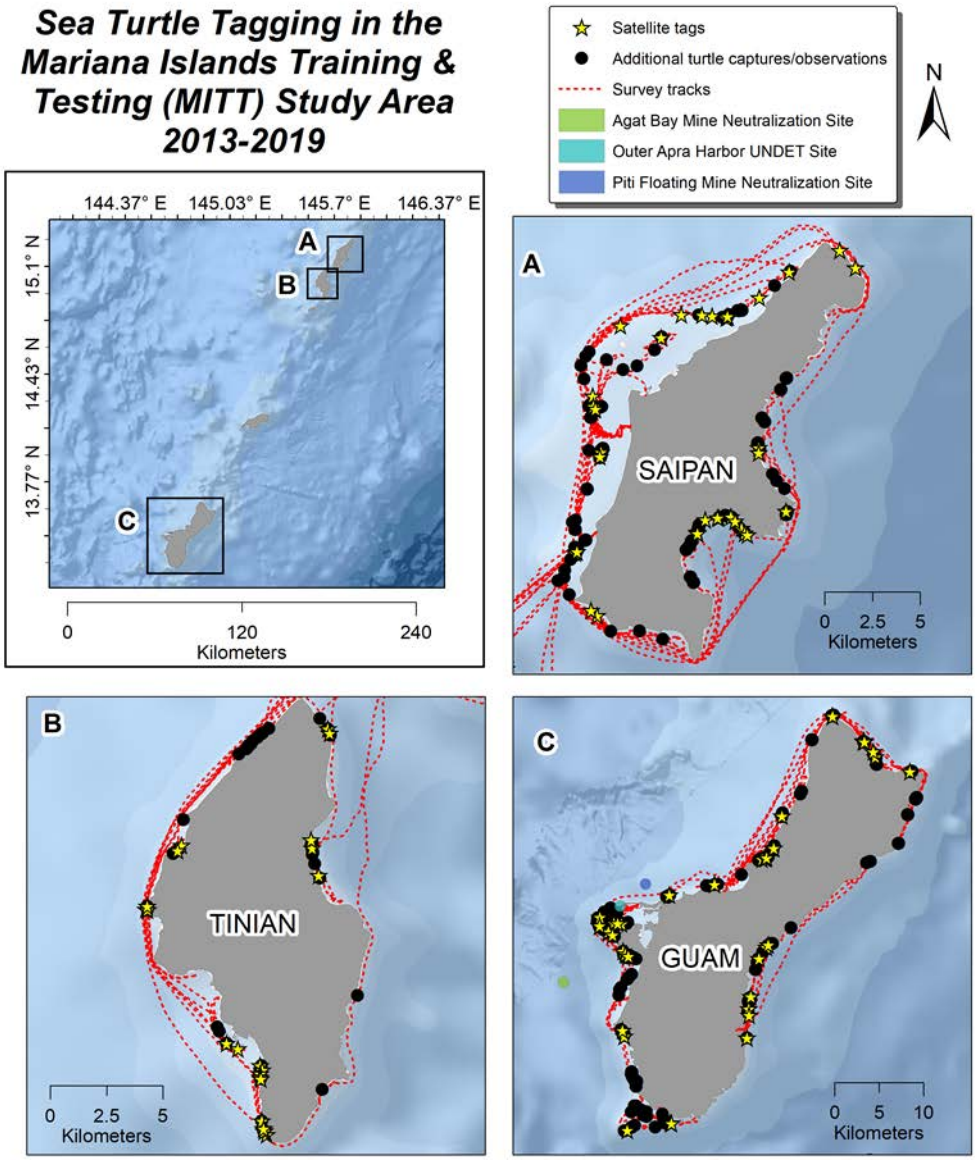

Figure 1. Marine turtle surveys, satellite tag deployment locations, and turtle observations/captures in the MITT study area. Red lines on each map are small-boat GPS tracks from sea turtle surveys conducted in the nearshore waters of Saipan, Tinian, and Guam in 2013–2019. Yellow stars indicate locations of satellite tag deployments on green and hawksbill turtles captured during surveys. Black circles indicate locations where additional turtles were observed/captured.

Table 1. Summary of boat-based snorkel surveys and turtle captures from 2013–2019. Data columns from left to right include: survey dates, site locations, turtle observations (number of individuals), captures, satellite tag deployments, and cetacean observations (number of individuals). CM = green turtle (*Chelonia mydas*); EI = hawksbill turtle (*Eretmochelys imbricata*); UN = unknown turtle species (either green or hawksbill turtle). Cetacean observations were of spinner dolphins (*Stenella longirostris*) or unknown species.

		Observations only				Captures (no sat tags)			Captures (sat tags)			Cetaceans
Survey Date	Location (focal areas)	CM	EI	UN	Total	CM	EI	Total	CM	EI	Total	CET
8/15/13	Guam (Cocos Lagoon)	1	-	5	6	-	-	-	-	-	-	-
8/16/13	Guam (Cocos Lagoon)	-	-	3	3	-	-	-	-	-	-	-
8/18/13	Saipan (Balisa)	-	-	-	-	-	-	-	1	1	2	-
8/19/13	Saipan (Balisa)	-	-	-	-	-	-	-	2	-	2	-
8/20/13	Tinian (Fleming Point)	-	-	-	-	-	-	-	-	1	1	-
8/21/13	Saipan (Balisa)	-	-	-	-	-	-	-	1	-	1	-
	2013 Subtotals	1	-	8	9	-	-	-	4	2	6	-
7/15/14	Guam (Cocos Lagoon + Apra Harbor)	8	-	-	8	-	-	-	-	-	-	-
7/16/14	Guam (Apra Harbor + Dadi Beach)	5	-	-	5	2	-	2	4	-	4	-
7/17/14	Guam (Apra Harbor + Dadi Beach)	8	-	-	8	1	1	2	3	-	3	-
7/18/14	Guam (Apra Harbor)	-	-	-	-	2	-	2	1	-	1	-
7/21/14	Tinian (Fleming Point + Dumpcoke)	-	-	-	-	4	-	4	1	2	3	-
7/22/14	Saipan (Spotlight + Cowtown)	-	-	-	-	-	-	-	2	-	2	-
	2014 Subtotals	21	-	-	21	9	1	10	11	2	13	-
11/12/15	Tinian (Red Wall)	4	-	2	6	2	-	2	6	-	6	-
11/13/15	Saipan (Lao Lao Bay)	1	-	8	9	1	-	1	5	-	5	-
11/14/15	Saipan (Chalan Kanoa Reef)	-	-	4	4	1	-	1	2	-	2	-
11/17/15	Guam (Agat Bay + Dadi Beach)	1	-	4	5	-	1	1	1	-	1	-
11/18/15	Guam (Agat Bay + Dadi Beach)	1	-	9	10	-	-	-	2	-	2	-
	2015 Subtotals	7	-	27	34	4	1	5	16	-	16	-
5/12/16	Guam (Apra Harbor + Orote Point)	11	-	4	15	6	-	6	1	1	2	-
5/13/16	Guam (Orote Point)	12	1	11	24	-	-	-	2	-	2	-
5/15/16	Tinian (Dangkolo + Chulu)	1	-	8	9	1	-	1	2	1	3	-
5/16/16	Tinian (Babui Beach + LamLam + Tohgong)	5	1	4	10	5	3	8	2	-	2	-
5/17/16	Tinian (Chulu + Babui Beach)	4	-	-	4	1	1	2	-	-	-	-
10/26/16	Tinian (circumnavigate + Tachungnya Bay)	8	1	1	10	1	-	1	4	1	5	12
10/27/16	Saipan (Chalan Kanoa + Coral Ocean Point)	4	2	-	6	2	-	2	2	1	3	-
10/28/16	Tinian (Tinian Harbor + Dumpcoke Cove)	7	-	1	8		-	-	3	1	4	-
10/29/16	Saipan (Tanapag Lagoon + Balisa)	5	-	2	7	2	-	2	1	-	1	27
11/1/16	Guam (Bile Bay + Sella Bay)	27	2	1	30	-	-	-	3	-	3	30
11/2/16	Guam (Piti Bomb Holes)	4	-	-	4	-	-	-	-	-	-	-
	2016 Subtotals	88	7	32	127	18	4	22	20	5	25	69
5/22/17	Guam (Piti Bomb Holes)	1	-	-	1	-	-	-	1	-	1	-
5/23/17	Guam (Orote Point)	-	-	-	-	-	-	-	-	1	1	-
10/17/17	Guam (Tanguisson/Tumon)	17	2	3	22	-	-	-	4	-	4	-
10/18/17	Guam (Tumon Bay)	15	-	-	15	3	-	3	4	-	4	-
10/19/17	Guam (Hagatna)	6	-	-	6	-	-	-	1	-	1	-
10/25/17	Saipan (Pau Pau Beach)	7	-	1	8	-	-	-	2	1	3	2
10/26/17	Saipan (Wing Beach)	4	1	-	5	2	-	2	4	-	4	-
10/27/17	Saipan (Managaha/Tanapag)	8	-	-	8	-	-	-	2	1	3	-
	2017 Subtotals	58	3	4	65	5	-	5	18	3	21	2
8/5/18	Saipan (Puntan Gloria)	5	2	-	7	-	-	-	2	-	2	50
8/7/18	Guam (Talofofo Bay + Yona)	8	-	-	8	-	-	-	4	-	4	-
8/8/18	Guam (Pago Bay)	11	-	1	12	-	-	-	3	-	3	-
8/9/18	Guam (Achang Reef + Cocos Island)	11	-	1	12	3	-	3	4	-	4	40
8/10/18	Guam (Mangilao)	1	3	-	4	-	-	-	-	-	-	-
	2018 Subtotals	36	5	2	43	3	-	3	13	-	13	90
9/3/19	Saipan (Forbidden Island)	4	1	1	6	-	-	-	4	-	4	-
9/4/19	Saipan(Dan Dan)	7	1	2	10	-	-	-	1	1	2	-
9/5/19	Saipan (Hidden Beach/Fishing Basin)	22	1	1	24	3	-	3	2	-	2	3
9/7/19	Guam (Jinapsan/Pati Pt./Lafac)	5	-	1	6	-	-	-	1	-	1	-
9/8/19	Guam (Jinapsan/Pati Pt./Yigo)	4	1	1	6	1	-	1	2	-	2	3
9/9/19	Guam (Tarague/Ritidian)	5	-	1	6	-	-	-	5	1	6	20
	2019 Subtotals	47	4	7	58	4	-	4	15	2	17	26
	2013-2019 Totals	258	19	80	357	43	6	49	97	14	111	187

Summary for Turtles	
Survey days:	*47*
Encounters:	*517*
Captures:	*160*
Satellite tags:	*111*

A total of 517 turtles were encountered during the 2013–2019 surveys (Table 1). Of those encounters, 357 turtles were observed but not captured (94 Saipan, 47 Tinian, 216 Guam), 49 turtles were captured but not outfitted with a satellite tag (11 Saipan, 18 Tinian, 20 Guam) due to small size, inadequate body condition (e.g., emaciation or a missing limb), or study design (e.g., geographic distribution of satellite tags across sites), and 111 turtles were captured and

outfitted with satellite tags (38 Saipan, 24 Tinian, 49 Guam) (Table 1). Of the 111 turtles outfitted with satellite tags, 100 were equipped with SPLASH tags and 11 were equipped with SPOT tags.

A total of five turtles were tagged and recaptured during the project timeframe, including two green turtles and three hawksbills (Table 2). Two of the hawksbills were captured on a total of three occasions. The longest period between original capture and most recent capture was 1,037 days. Two additional green turtles that were tagged by a previous in-water project (Summers et al. 2017) were also recaptured in Saipan in 2013 (60 cm and 63 cm). Of the 357 non-capture observations, 258 (72.3%) were identified as green turtles, 19 (5.3%) as hawksbill turtles, and 80 (22.4%) as "unknown" species (but either green or hawksbill turtles) (Table 1). Of the 49 turtles captured but released without a SPLASH or SPOT tag, 43 (87.8%) were green turtles and 6 (12.2%) were hawksbill turtles (Table 1). For the 111 satellite tags, 97 (87.4%) were deployed on green turtles and 14 (12.6%) on hawksbill turtles (Tables 3 to 5). Four of the tags on green turtles and two on hawksbills failed within two weeks of deployment and these tags were not included in our analyses. Table 1 provides a breakdown of observations, captures, and satellite tags by species and location for each year.

Table 2. Summary of five turtles tagged and recaptured during monitoring efforts between 2013 and 2019, including species, island, capture/recapture location, days between captures, SCL (cm) and SCL growth between captures, Weight (kg) and Weight increase between captures.

Species	Island	Capture / recapture location	Capture / recapture date	Days between recaptures	SCL	SCL growth (cm)	Weight (kg)	Weight increase (kg)
Green	GUAM	Dadi Beach	16-Jul-14	1037	54.3	6.9	20.3	10.3
	GUAM	Dadi Beach	18-May-17		61.2		30.6	
Hawksbill	GUAM	Dadi Beach	17-Jul-14	307	42.3	4.6	7.6	8.1
	GUAM	Apra Harbor	20-May-15		46.9		15.7	
Hawksbill	GUAM	Apra Harbor	19-May-15	729	68.2	2.9	32.5	3.9
	GUAM	Apra Harbor	11-May-16		68.2		34.4	
	GUAM	Apra Harbor	17-May-17		71.1		36.4	
Green	GUAM	Apra Harbor	11-May-16	376	60.3	2.9	26.4	6.6
	GUAM	Piti Bomb Holes	22-May-17		63.2		33	
Hawksbill	GUAM	Orote Point	12-May-16	1119	52.9	4.4	14.6	10.0
	GUAM	Orote Point	23-May-17		55.7		19.2	
	GUAM	Orote Point	05-Jun-19		60.1		24.6	

Details on dates, locations, and species of all satellite tag deployments, turtle captures, and turtle observations are provided in Tables 3 to 5, Appendix Tables A1−A6, and as supplementary files. In 2016−2019, cetacean observations were also recorded during surveys and transit periods; sightings details are provided in Appendix Table A7. For all captured and tagged turtles, measurements and satellite tag identification numbers (i.e., Argos ID) are also provided in Tables 3 to 5 and Appendix Tables A1−A6. Captured green turtles ranged in SCL from 36.9 cm to 85.6 cm (mean = 53.8, sd = 9.5 cm, n = 197) and in mass from 6.4 kg to 76.2 kg (mean = 22.0, sd = 12.5 kg, n = 178). Captured hawksbills ranged in SCL from 34.4 cm to 72.6 cm (mean = 51.6, sd = 11.5 cm, n = 33) and in mass from 3.6 kg to 48.9 kg (mean = 18.2, sd = 11.9 kg, n=31). Five large captured green turtles were determined to be male based on tail length and one was determined to be female. All other captured turtles were sub-adults for which sex could not be determined using visual observation and morphometric techniques.

Table 3. Saipan: summary of 2013–2019 satellite tags by species and tag type, including foraging habitat location, tag deployment date, Argos ID number, turtle size (SCL), last Argos signal, tag life as transmission days, tag status (on October 31st, 2019), 50% (i.e., core home range) and 95% (overall home range) volume contours (km²) and mean tag life (days). Yellow highlights tags that were still transmitting data ("active").

SAIPAN Satellite Tag Deployments											
Figure	Species - Tag model	Deploy Location	Deploy Date	Argos ID	SCL (cm)	Last Signal Argos	Tag Life (Argos days)	Tag Status 12/18/18	Core use area (sq. km) 50% KIWB contour	Core use area (sq. km) 95% KIWB contour	Mean Tag Life (Argos days)
Fig. 2	Green turtles - SPLASH	Wing Arch	10/26/17	171252	54.3	NA	NA	tag failed	0.09	0.91	219
		Pau Pau Beach	10/26/17	171245	59.5	1/7/18	73	inactive			
		Pau Pau Beach	10/26/17	171253	49.2	10/28/18	367	inactive			
		Aqua Reef	10/25/17	171250	55.7	5/3/18	190	inactive			
		Tanapag Lagoon	10/29/16	166347	47	6/30/17	244	inactive			
		Outer Managaha	10/27/17	171254	46.3	1/5/18	70	inactive	0.49	3.74	165
		Balisa	8/18/13	85491	60.9	10/15/13	59	inactive			
		Balisa	8/19/13	85495	66.1	1/19/14	154	inactive			
		Balisa	8/19/13	85494	60.4	5/3/14	257	inactive			
		Balisa	8/21/13	85492	62.5	9/17/14	392	inactive			
		Fishing Basin	9/5/19	178567	55.4	10/31/19	56	active			
		Fishing Basin	9/5/19	178568	67.4	NA	NA	tag failed			
		Chalan Kanoa	11/14/15	152585	50.2	4/18/16	157	inactive	0.11	0.59	169
		Chalan Kanoa	11/14/15	152575	67.1	2/1/16	79	inactive			
		Chalan Kanoa	10/27/16	166343	64.3	7/25/17	271	inactive			
		Coral Ocean Point	10/27/16	166346	44	3/7/17	132	inactive	0.03	0.07	132
		Lao Lao Bay	11/13/15	152576	55.6	3/28/16	137	inactive	0.23	1.40	68
		Lao Lao Bay	11/13/15	152572	63.5	12/29/15	46	inactive			
		Lao Lao Bay	11/13/15	152571	56.7	1/13/16	62	inactive			
		Lao Lao Bay	11/13/15	152579	65	1/18/16	67	inactive			
		Lao Lao Bay	11/13/15	152581	53.6	12/21/15	38	inactive			
		Dan Dan	9/4/19	178566	65.5	10/31/19	57	active			
		Spotlight	7/22/14	131995	61.7	7/11/16	721	inactive	0.26	1.70	451
		Cow Town	7/22/14	138958	63.9	1/19/15	181	inactive			
		Tank Beach	8/5/18	171235	54.9	10/5/18	61	inactive	0.19	1.17	68
		Tank Beach*	8/5/18	171255	47.1	1/6/19	154	inactive			
		Forbidden Island	9/3/19	176781	50.3	9/24/19	21	inactive			
		Forbidden Island	9/3/19	178562	63.3	10/31/19	58	active			
		Forbidden Island	9/3/19	178563	50	10/31/19	58	active			
		Forbidden Island	9/3/19	178564	62.9	10/31/19	58	active			
Fig. 3	Hawksbill turtles - SPLASH	Aqua Reef	10/25/17	171251	50.3	12/19/18	420	inactive	0.02	0.19	420
		Balisa	8/18/13	85496	66.6	2/8/17	1270	inactive	0.24	1.97	1270
		Dan Dan	9/4/19	178565	72.6	10/31/19	57	active	0.01	0.02	57
Fig. 8	Green turtles - SPOT	Pau Pau Beach	10/26/17	171257	37.6	3/28/18	153	inactive	8.54	153.03	181
		Aqua Reef	10/25/17	171256	43.3	4/21/18	178	inactive			
		Outer Managaha	10/27/17	171259	42.1	5/27/18	212	inactive			
Fig. 9	Hawksbill turtles - SPOT	Pau Pau Beach	10/27/17	171258	42.4	11/16/17	20	Tag failed	NA	NA	20
		Coral Ocean Point	10/27/16	166354	40	2/12/17	108	inactive	2.05	9.12	108

* Did not exhibit strict foraging site fidelity

The size distributions of green and hawksbill turtles captured in this study are typical for turtles throughout the Mariana Archipelago. From an analysis of 642 in-water captures from 2006 to 2014, Summers et al. (2017) suggest that turtles recruit to the nearshore waters of the Mariana Islands around 34–36 cm SCL and depart to adult foraging and nesting grounds around 78–81 cm SCL, remaining in the nearshore waters for an estimated 17 years (13–28 years: 95% confidence interval) between recruitment and maturity. All but six turtles captured in this study appeared to be juveniles and sub-adults residing in developmental foraging grounds. Our research suggests limited movement and high foraging site fidelity during juvenile development.

Table 3. Tinian: summary of 2013–2019 satellite tags by species and tag type, including foraging habitat location, tag deployment date, Argos ID number, turtle size (SCL), last Argos signal, tag life as transmission days, tag status (on October 31st, 22019), 50% (i.e., core home range) and 95% (overall home range) volume contours (km^2) and mean tag life (days). Yellow highlights tags that were still transmitting data ("active").

TINIAN Satellite Tag Deployments											
Figure	Species - Tag model	Deploy Location	Deploy Date	Argos ID	SCL (cm)	Last Signal Argos	Tag Life (Argos days)	Tag Status 12/18/18	Core use area (sq. km) 50% KIWB contour	Core use area (sq. km) 95% KIWB contour	Mean Tag Life (Argos days)
Fig. 4	Green turtles - SPLASH	Dumpcoke Cove	10/28/16	166341	84.1	2/8/17	104	inactive	0.46	2.24	116
		Fleming Point	7/21/14	138959	54.3	11/26/14	128	inactive			
		Tohgong	5/16/16	152584	54.9	12/16/16	214	inactive	0.79	3.27	147
		Tohgong	5/16/16	142753	56.5	5/31/16	15	tag failed			
		Dangkolo	5/15/16	142747	52.6	11/19/16	188	inactive			
		Chulu	5/15/16	142750	51.6	10/31/16	169	inactive			
		Tinian Harbor	10/28/16	166348	47.6	5/12/17	196	inactive	0.47	3.76	163
		Tinian Harbor	10/28/16	166338	44.4	2/15/17	111	inactive			
		Tachungnya Bay	10/26/16	166339	44.4	3/1/17	126	inactive			
		Tachungnya Bay	10/26/16	166344	52.8	2/17/17	114	inactive			
		Tachungnya Bay	10/26/16	166337	48.2	2/8/17	105	inactive			
		Tachungnya Bay	10/26/16	166345	44	1/4/17	70	inactive			
		Red Wall	11/12/15	152580	56	9/30/16	323	inactive			
		Red Wall	11/12/15	152586	61.1	4/17/16	157	inactive			
		Red Wall	11/12/15	152583	54.2	9/17/16	310	inactive			
		Red Wall	11/12/15	152578	59.5	1/9/16	58	inactive			
		Red Wall	11/12/15	152569	53	7/18/16	249	inactive			
		Red Wall	11/12/15	152574	55.4	3/27/16	136	inactive			
Fig. 5	Hawksbill - SPLASH	Dumpcoke Cove	10/28/16	166342	56.2	2/9/17	104	inactive	0.46	3.16	636
		Fleming Point*	8/20/13	85493	61.7	2/28/16	922	inactive			
		Fleming Point*	7/21/14	138963	72.3	4/27/16	647	inactive			
		Fleming Point	7/21/14	131989	58.1	12/8/16	872	inactive			
		Dangkolo	5/15/16	142755	62.8	12/28/17	592	inactive	0.28	1.24	592
Fig. 9	Hawksbill turtle - SPOT	Tachungnya Bay	10/26/16	166355	40	8/17/17	295	inactive	2.27	32.83	295

* Did not exhibit strict foraging site fidelity

Table 5. Guam: summary of 2013–2019 satellite tags by species and tag type, including foraging habitat location, tag deployment date, Argos ID number, turtle size (SCL), last Argos signal, tag life as transmission days, tag status (on October 31ST, 2019), 50% (i.e., core home range) and 95% (overall home range) volume contours (km²) and mean tag life (days). Yellow highlights tags that were still transmitting data ("active").

GUAM Satellite Tag Deployments											
Figure	Species - Tag model	Deploy Location	Deploy Date	Argos ID	SCL (cm)	Last Signal Argos	Tag Life (Argos days)	Tag Status 12/18/18	Core use area (sq. km) 50% KIWB contour	Core use area (sq. km) 95% KIWB contour	Mean Tag Life (Argos days)
Fig. 6	Green turtles - SPLASH	Tanguisson	10/17/17	171249	48.2	7/11/18	267	inactive	0.37	2.10	200
		Tumon Bay	10/17/17	171248	48.8	9/1/18	319	inactive			
		Tumon Bay	10/17/17	171247	62.7	10/12/18	360	inactive			
		Tumon Bay	10/17/17	171246	53.6	6/28/18	254	inactive			
		Tumon Bay	10/18/17	171240	66.6	12/7/17	50	inactive			
		Tumon Bay	10/18/17	171241	73.2	4/1/18	165	inactive			
		Tumon Bay	10/18/17	171242	58.2	2/24/18	129	inactive			
		Tumon Bay	10/18/17	171243	56.4	12/15/17	58	inactive			
		Sewer Island	10/19/17	171244	47.1	NA	NA	tag failed	0.22	1.54	154
		Piti Bomb Holes	5/22/17	166336	56	10/23/17	154	inactive			
		Apra Harbor	7/16/14	131994	49.2	12/26/14	163	inactive	0.08	1.84	197
		Apra Harbor	7/16/14	131991	58.3	3/4/15	231	inactive			
		Apra Harbor	7/17/14	138960	58.6	1/4/15	172	inactive			
		Apra Harbor	7/18/14	138965	59.3	2/23/15	220	inactive			
		Orote Point	5/12/16	131996	60.8	8/24/16	104	inactive	0.04	0.34	204
		Orote Point*	5/13/16	142752	82.3	11/12/16	183	inactive			
		Orote Point	5/13/16	142748	63.8	4/2/17	325	inactive			
		Dadi Beach	7/16/14	131998	64.3	12/18/14	155	inactive	0.23	0.86	128
		Dadi Beach	7/16/14	131990	54.3	1/7/15	175	inactive			
		Dadi Beach	7/17/14	138961	66	9/13/14	58	inactive			
		Dadi Beach	7/17/14	131997	55.2	12/26/14	162	inactive			
		Dadi Beach	11/17/15	152577	65.6	4/30/16	165	inactive			
		Dadi Beach	11/18/15	152582	73.4	1/16/16	59	inactive			
		Dadi Beach	11/18/15	152570	76	3/17/16	121	inactive			
		Sella Bay	11/1/16	166335	49.3	6/15/17	226	inactive	0.14	0.43	226
		Talofofo	8/7/18	171233	44.7	11/29/18	114	inactive	0.03	0.19	110
		Talofofo	8/7/18	171234	55.9	10/26/18	80	inactive			
		Talofofo	8/7/18	176760	69.8	11/9/18	94	inactive			
		Talofofo	8/7/18	176761	53.2	1/5/19	151	inactive			
		Pago Bay	8/8/18	176762	50	11/29/18	113	inactive	0.01	0.19	101
		Pago Bay	8/8/18	176763	44.8	11/8/18	92	inactive			
		Pago Bay	8/8/18	176764	47.9	11/13/18	97	inactive			
		Cocos Island, Achang Reef	8/9/18	176765	64.7	6/1/19	296	inactive	0.14	1.16	294
		Cocos Island, Achang Reef	8/9/18	176766	63.9	5/28/19	292	inactive			
		Pati Point*	9/7/19	178569	67.5	10/31/19	54	active	0.33	2.10	53
		Tarague	9/8/19	178570	64.6	10/31/19	53	active			
		Tarague	9/8/19	178571	59.6	10/31/19	53	active			
		Tarague	9/9/19	178572	44.4	10/31/19	52	active			
		Tarague	9/9/19	178573	84.9	10/31/19	52	active			
		Ritidian Channel	9/9/19	178574	47.6	10/31/19	52	active			
		Ritidian Channel	9/9/19	178576	48.6	10/31/19	52	active			
Fig. 7	Hawksbill turtles - SPLASH	Orote Point	5/12/16	142756	52.9	NA	NA	tag failed	0.10	0.59	208
		Orote Point	5/23/17	166340	55.7	12/17/17	208	inactive			
		Achang Reef*	8/20/13	85493	61.7	2/28/16	922	inactive	0.34	12.57	922
		Ritidian Channel	9/9/19	178575	43	10/31/19	52	active	0.01	0.06	52
Fig. 8	Green turtles - SPOT	Sella Bay	11/1/16	166351	43.7	3/18/17	137	inactive	1.34	26.72	142
		Sella Bay	11/1/16	166353	40.8	3/27/17	146	inactive			
		Cocos Island, Achang Reef	8/9/18	171260	36.9	12/13/18	126	active	4.37	50.89	125
		Cocos Island, Achang Reef	8/9/18	171261	41.4	12/10/18	123	active			
		Tarague*	9/9/19	171263	40.8	10/31/19	52	active	NA	NA	52

* Did not exhibit strict foraging site fidelity

SATELLITE TAG DEPLOYMENT, TAG LONGEVITY, HORIZONTAL MOVEMENTS AND HOME RANGE

The KIWB estimates and volume contours in Figures 2 to 9 elucidate the general habitat use, overall foraging home range (95% volume contour), and core home range (50% volume contour) for the majority of turtles tagged in each location. Of the 111 satellite devices deployed, six were not included in this analysis due to lack of sufficient data, either from immediate failure of the tag, less than two days of data collected from the deployment date, or other complications associated with attaining location positions. Details on the number, species, and carapace lengths of turtles tagged at each site are provided in Tables 3 to 5, along with the longevity (i.e., transmission days), Argos IDs, and current status (e.g., active) of the tags.

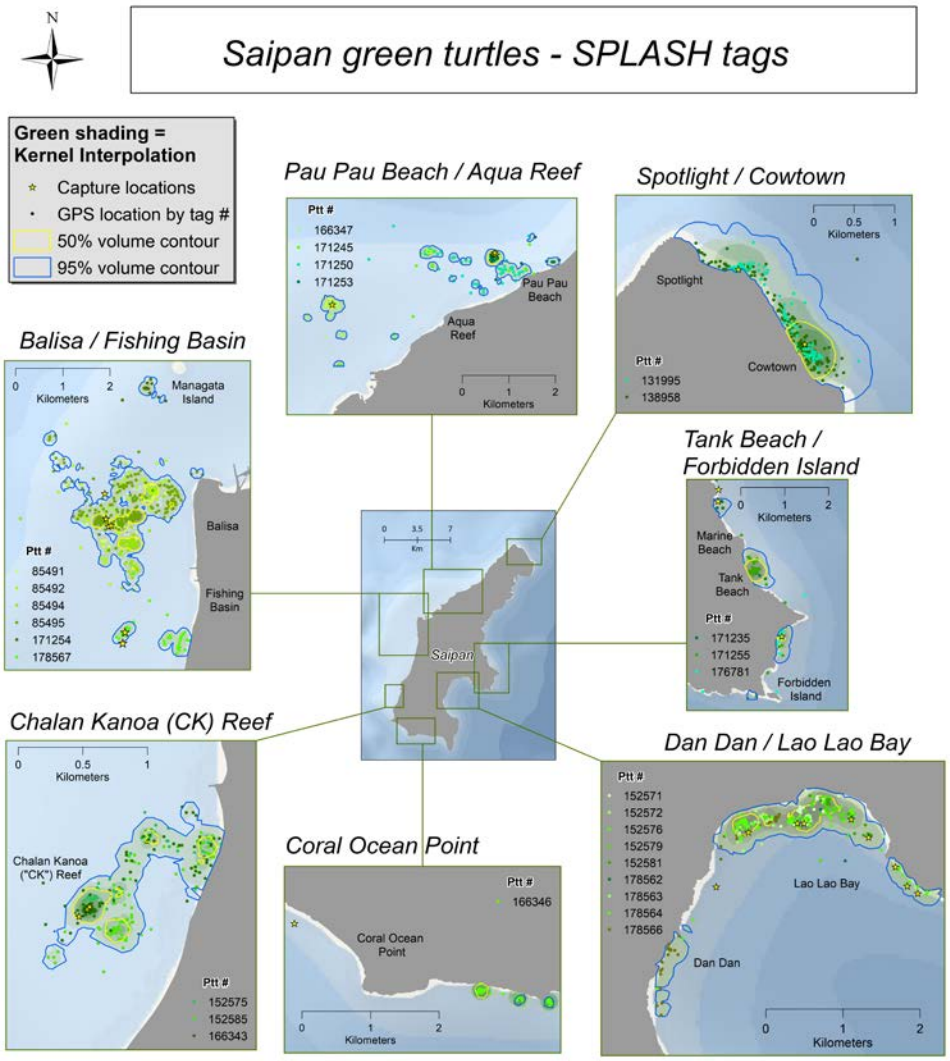

Figure 2. Habitat use maps for green turtles equipped with SPLASH tags in Saipan. GPS location data were analyzed using a Kernel Interpolation with Barriers method. Darker shades of green indicate higher density of GPS location points, with the 50% (core area) and 95% (overall home range) volume contours outlined in yellow and blue, respectively. Table 3 provides additional details on individual tag deployments. Ocean depth contours (isobaths) drawn at every 50 meters are shown for reference.

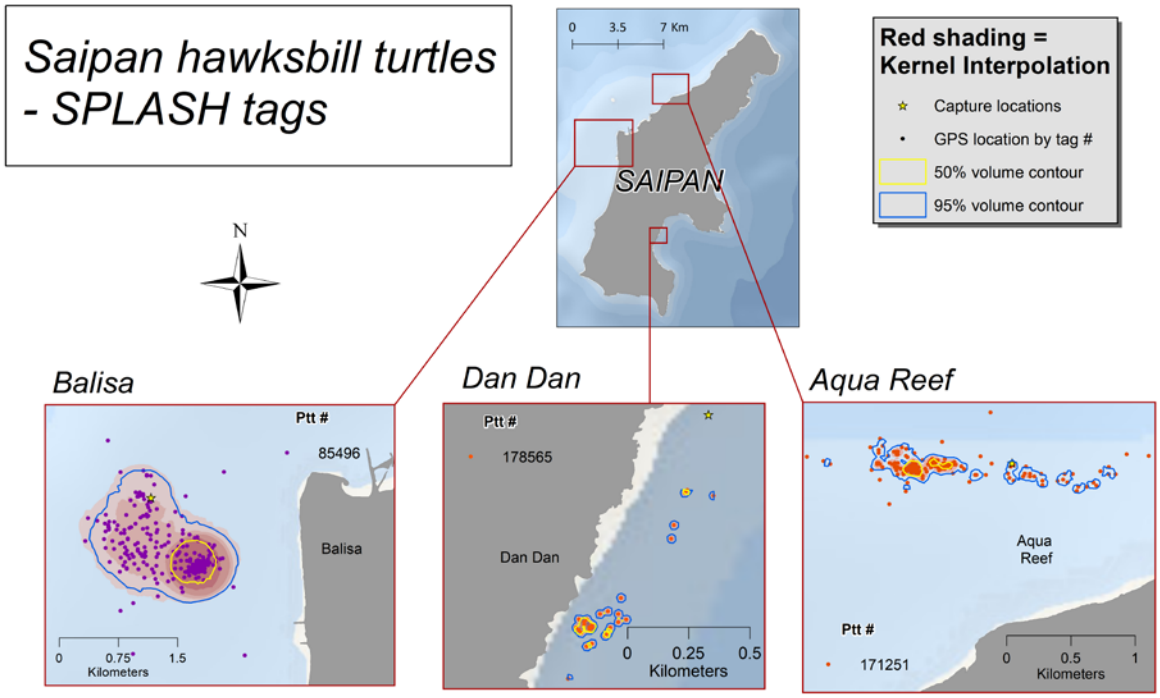

Figure 3. Habitat use maps for hawksbill turtles equipped with SPLASH tags in Saipan. GPS location data were analyzed using a Kernel Interpolation with Barriers method. Darker shades of red indicate higher density of GPS location points, with the 50% (core area) and 95% (overall home range) volume contours outlined in yellow and blue, respectively. Table 3 provides additional details on individual tag deployments. Ocean depth contours (isobaths) drawn at every 50 meters are shown for reference.

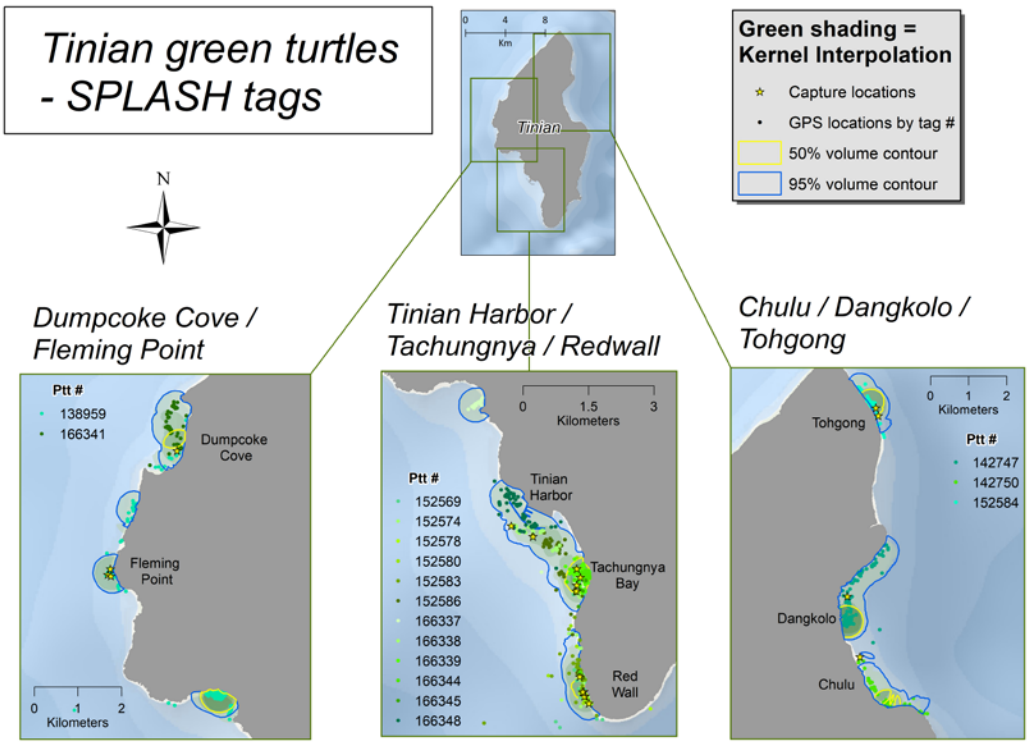

Figure 4. Habitat use maps for green turtles equipped with SPLASH tags in Tinian. GPS location data were analyzed using a Kernel Interpolation with Barriers method. Darker shades of green indicate higher density of GPS location points, with the 50% (core area) and 95% (overall home range) volume contours outlined in yellow and blue, respectively. Table 4 provides additional details on individual tag deployments. Ocean depth contours (isobaths) drawn at every 50 meters are shown for reference.

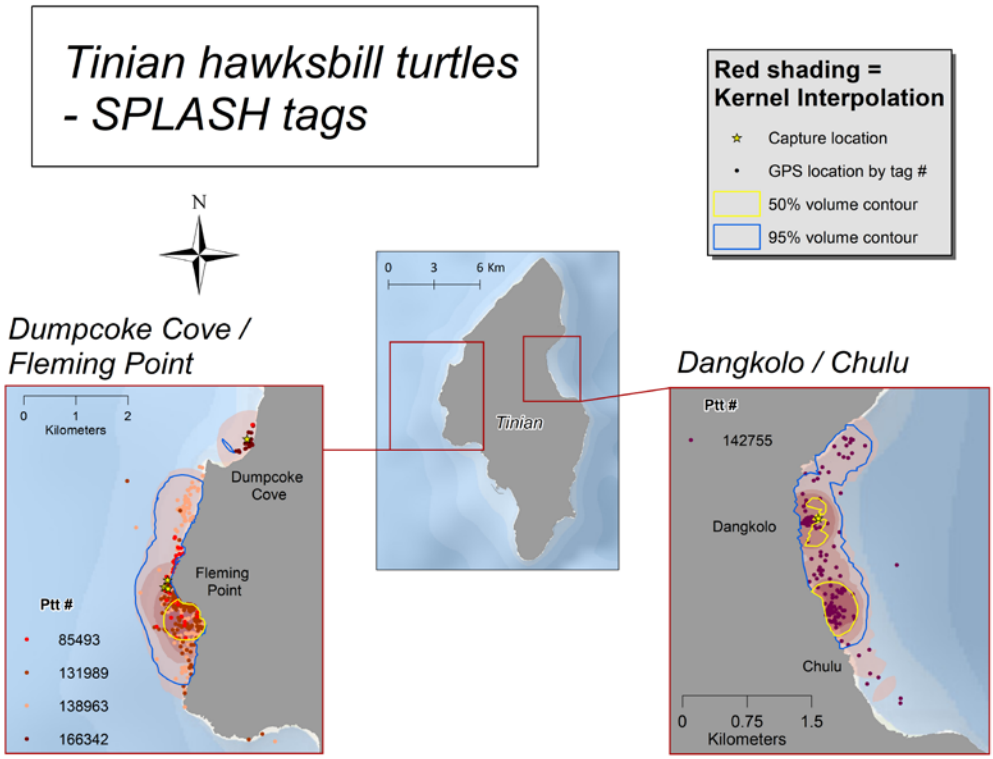

Figure 5. Habitat use maps for hawksbill turtles equipped with SPLASH tags in Tinian. GPS location data were analyzed using a Kernel Interpolation with Barriers method. Darker shades of red indicate higher density of GPS location points, with the 50% (core area) and 95% (overall home range) volume contours outlined in yellow and blue, respectively. Table 4 provides additional details on individual tag deployments. Ocean depth contours (isobaths) drawn at every 50 meters are shown for reference.

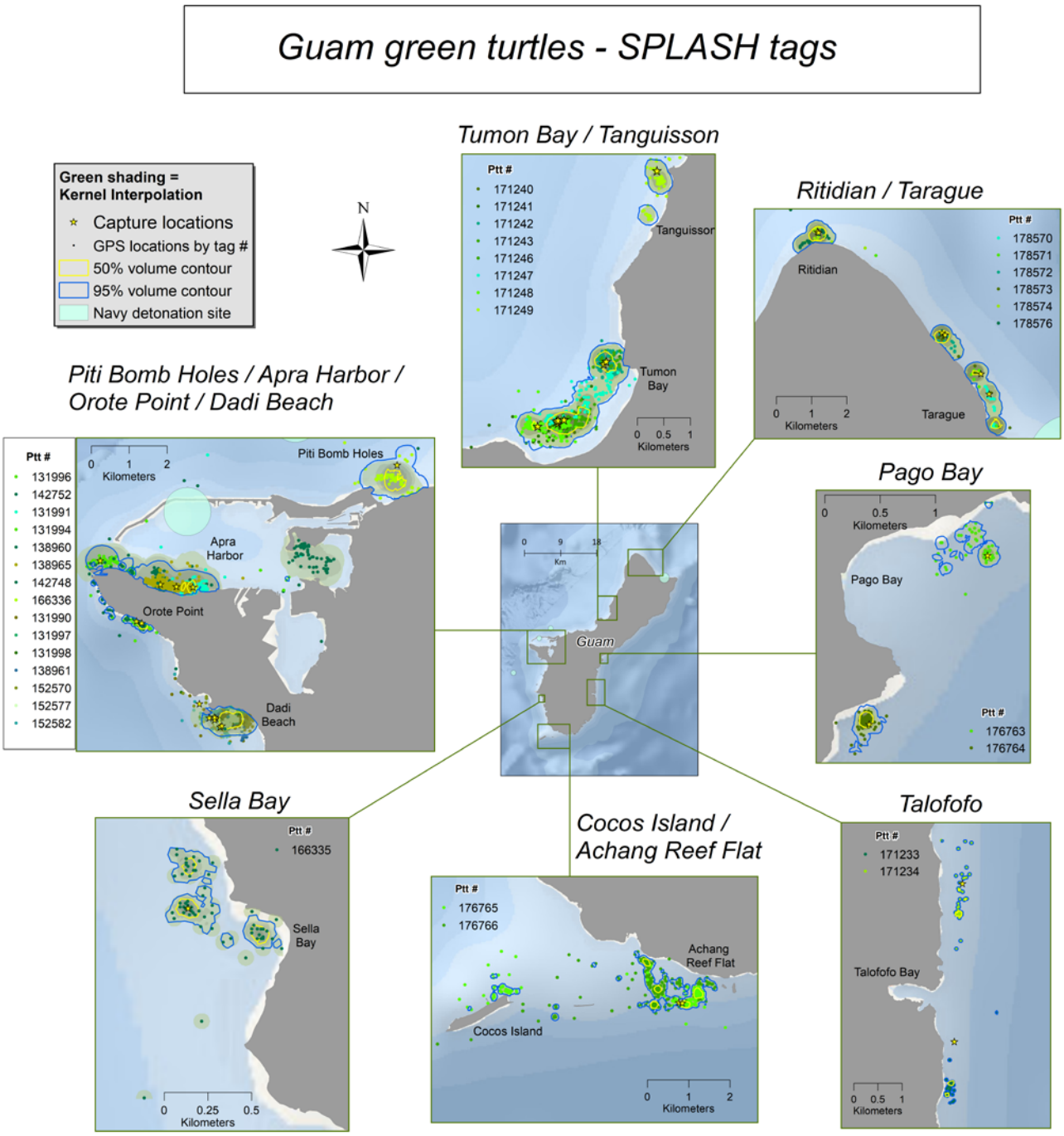

Figure 6. Habitat use maps for green turtles equipped with SPLASH tags in Guam. GPS location data were analyzed using a Kernel Interpolation with Barriers method. Darker shades of green indicate higher density of GPS location points, with the 50% (core area) and 95% (overall home range) volume contours outlined in yellow and blue, respectively. Table 5 provides additional details on individual tag deployments. Ocean depth contours (isobaths) drawn at every 50 meters are shown for reference.

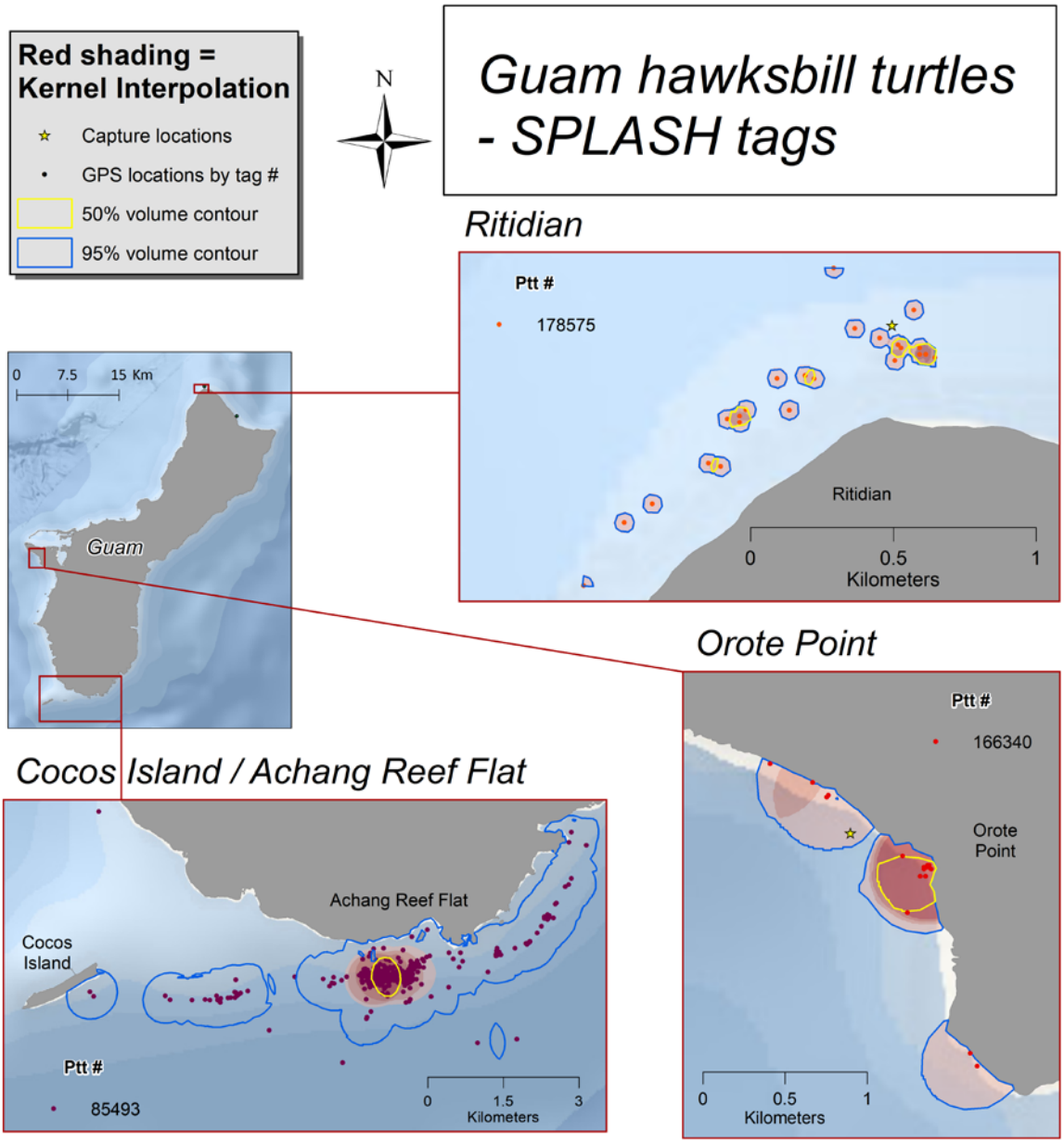

Figure 7. Habitat use maps for hawksbill turtles equipped with SPLASH tags in Guam. GPS location data were analyzed using a Kernel Interpolation with Barriers method. Darker shades of red indicate higher density of GPS location points, with the 50% (core area) and 95% (overall home range) volume contours outlined in yellow and blue, respectively. Table 5 provides additional details on individual tag deployments. Ocean depth contours (isobaths) drawn at every 50 meters are shown for reference.

Tag longevity, calculated from 111 tags that were no longer transmitting a signal as of 31 October 2019, was similar across islands. For green turtles, tags transmitted data for an average of 154 days on Saipan (sd = 142, n = 33 tags), 154 days on Tinian (sd = 82.1, n = 18 tags), and 146 days on Guam (sd = 85.5, n = 46 tags). For hawksbill turtles, tag life was 375 days on Saipan (sd = 524.9, n = 5 tags), 572 days on Tinian (sd = 320.6, n = 6 tags), and 394 days on Guam (sd = 464.0, n = 3 tags). For the three islands combined, tags lasted an average of 150 days (sd = 105.9, n = 97 tags) on green turtles and 464 days (sd = 408.6, n = 15) on hawksbill turtles. Maximum tag life was 721 days for green turtles (Argos ID 131995 tagged on the northern shore of Saipan at Spotlight; Table 3 and Figure 2) and 1,270 days for hawksbill turtles (Argos ID 85496 tagged on the west coast of Saipan at Balisa; Table 3 and Figure 3). Hawksbill turtle shells are thicker and more keratinized than green turtle shells, which tend to be thinner and oilier; this difference likely contributes to the longer tag retention times observed on hawksbill turtles. Fifteen tags were still active and transmitting data on 31 October 2019, all of which were deployed in 2019 (Table 3 and Table 5). KIWB estimates revealed limited movements for the overwhelming majority of both green and hawksbill turtles in Saipan, Tinian, and Guam (Figures 3, 4, 5, 6, 7, 8, 9 and Tables 3, 4, 5). Of the 105 turtles for which we were able to analyze tag data, 94 (89.5%) remained within a 1−3 km^2 area for the entire life of the tag, demonstrating limited movements and high foraging site fidelity.

For SPLASH tags, the core home range area (50% KIWB volume contour) was geographically concentrated for both green turtles (mean = 0.24 km^2, sd = 0.2 km^2, range = 0.01–0.79 km^2) and hawksbill turtles (mean = 0.18 km^2, sd = 0.17 km^2, range = 0.01–0.46 km^2) across all islands and sites. Overall home ranges (95% KIWB volume contour) were also similar for the two species, with green turtles using an average area of 1.48 km^2 (sd = 1.13 km^2, range = 0.07−3.76 km^2) and hawksbill turtles using an average area of 2.48 km^2 (sd = 4.22 km^2, range = 0.02−12.57 km^2). For green turtles, there were some subtle inter-island differences in core area, with turtles in Saipan (mean = 0.22 km^2; sd = 0.2 km^2; range = 0.03−0.49 km^2) and Guam (mean = 0.16 km^2, sd = 0.13 km^2, range = 0.01−0.37 km^2) using potentially smaller core areas than those in Tinian (mean = 0.57 km^2, sd = 0.19 km^2, range = 0.46−1.79 km^2). Overall home range (95% KIWB volume contour) of green turtles was also smaller on Saipan (mean = 1.45 km^2, sd = 1.3 km^2, range = 0.07−3.74 km^2) and Guam (mean = 1.08 km^2, sd = 0.78 km^2, range = 0.19−2.1 km^2), compared to on Tinian (mean = 3.09 km^2, sd = 0.78 km^2, range = 2.24−3.76 km^2).

Similarly, hawksbill turtles equipped with SPLASH tags in Saipan (mean = 0.09 km^2, sd = 0.13 km^2, range = 0.01−0.24 km^2) and Guam (mean = 0.15 km^2; sd = 0.17 km^2; range = 0.01−0.34 km^2) used core areas that were potentially smaller than those used in Tinian (mean = 0.37 km^2, sd = 0.13 km^2, range = 0.28−0.46 km^2). However, the overall home range of hawksbill turtles was smaller on Saipan (mean = 0.73 km^2, sd = 1.08 km^2, range = 0.02−1.97 km^2) and Tinian (mean = 2.20 km^2, sd = 1.36 km^2, range = 1.24−3.16 km^2), compared to Guam (mean = 4.41 km^2, sd = 7.07 km^2, range = 0.06−12.57 km^2). These geographic comparisons will be tested statistically in the final analysis of these data. Additionally, we recognize that the home ranges and core use areas reported here are potentially influenced by our groupings of tags and the geographical span of deployment locations within a group. We are currently working through these issues using a more robust analysis which models each turtle's movement path and calculates its individual habitat use statistics prior to calculating group statistics for a given deployment location. That analysis will be introduced in future reports and publications.

Not surprisingly, both core and overall home ranges were much larger for green and hawksbill turtles equipped with SPOT tags compared to those equipped with SPLASH tags (Figure 8 and Figure 9, Tables 3, 4, 5) due to decreased location accuracy of Argos versus GPS locations. The average core and overall home range areas for green turtles equipped with SPOT tags was 4.75 km^2 (sd =3.62 km^2, range = 1.34–8.54 km^2) and 76.88 km^2 (sd = 67.05 km^2, range = 26.72–153.03 km^2), respectively. The core and overall home range for hawksbill turtles equipped with SPOT tags was 2.16 km^2 (sd = 0.16 km^2, range = 2.05–2.27 km^2) and 20.98 km^2 (sd = 16.77 km^2, range = 9.12–32.83 km^2), respectively. Despite the decreased

accuracy of home ranges calculated from SPOT tags, these tag models are extremely useful to identify the general residency areas and important habitats of younger life-stage turtles.

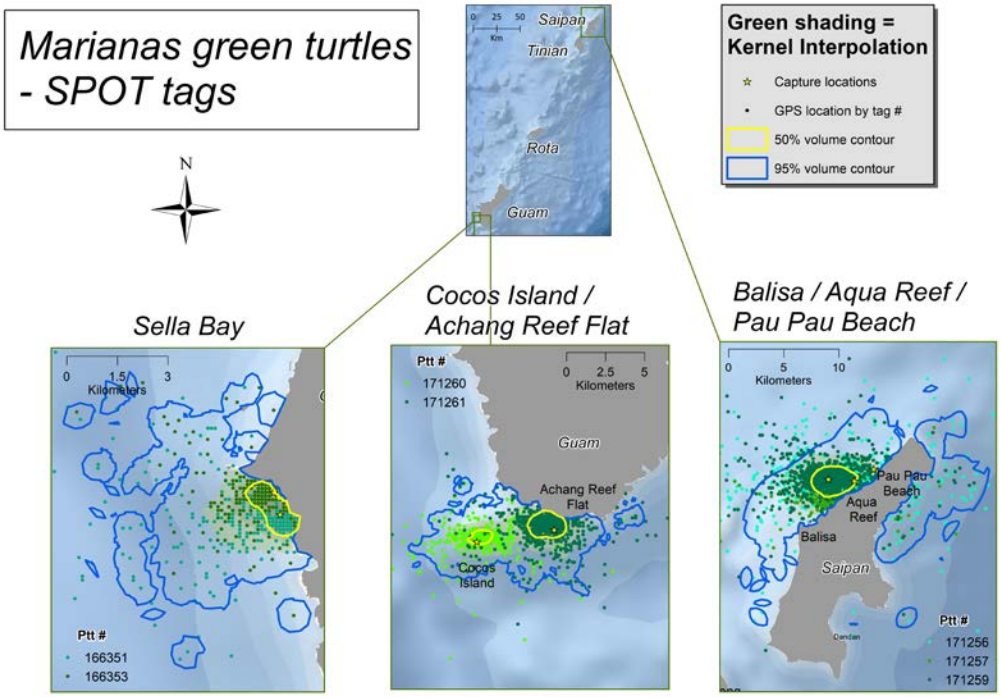

Figure 8. Habitat use maps for green turtles equipped with SPOT tags in Saipan and Guam. Argos location data were analyzed using a Kernel Interpolation with Barriers method. Darker shades of green indicate higher density of Argos location points, with the 50% (core area) and 95% (overall home range) volume contours outlined in yellow and blue, respectively. Table 3 and Table 5 provide additional details on individual tag deployments.

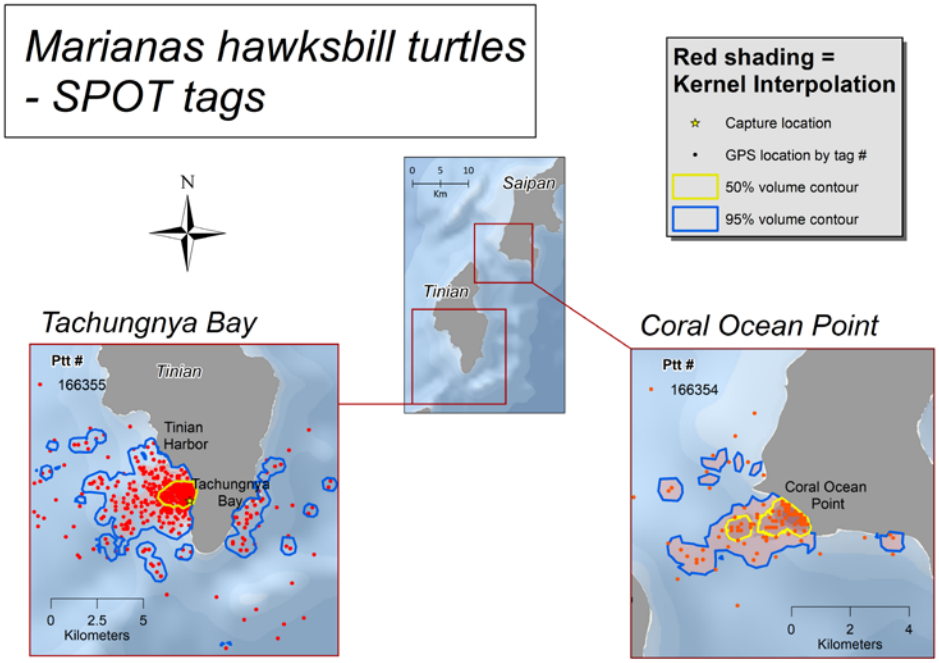

Figure 9. Habitat use maps for hawksbill turtles equipped with SPOT tags in Saipan and Tinian. Argos location data were analyzed using a Kernel Interpolation with Barriers method. Darker shades of red indicate higher density of Argos location points, with the 50% (core area) and 95% (overall home range) volume contours outlined in yellow and blue, respectively. Table 3 and Table 4 provide additional details on individual tag deployments. Ocean depth contours (isobaths) drawn at every 50 meters are shown for reference.

Although the overwhelming majority (89.5%) of tagged turtles remained relatively sedentary and within a <1 km^2 core area for the entirety of their tracking period, there were three more vagile movement patterns observed, including shifts in intra-island foraging areas (movement pattern 1), transitions between inter-island foraging areas (movement pattern 2) and a long-range migration departure out of the Mariana Islands (movement pattern 3) (Table 6, Figures 9, 10, 11).

Table 4. Details on 10 turtles tracked between 2013–2019 that exhibited movement behavior other than remaining in a single, 1–3 km^2 area foraging area.

Figure	Movement pattern	Species	SCL (cm)	Argos ID	Deploy Date	Deploy Location	Furthest location travelled	Distance between locations (km)	Tag Life (Argos days)	Tag Status 12/18/18
Fig. 10	1	CM	56.7	152571	11/13/15	Lao Lao Bay, Saipan	Old Man by the Sea, Saipan	8	62	inactive
	1	CM	47.1	171255	8/5/18	Tank Beach, Saipan	Tanguisson, Saipan	13	154	inactive
	1	CM	48.2	166337	10/26/16	Tachungnya Bay, Tinian	Airport Bay, Tinian	5	105	inactive
	1	CM	54.3	138959	7/21/14	Fleming Point, Tinian	Dumpcoke Cove, Tinian	8	128	inactive
	1	CM	63.8	142748	5/13/16	Orote Point, Guam	Tanguisson, Guam	20	325	inactive
	1	CM	67.5	178569	9/7/19	Pati Point, Guam	Talofofo, Guam	37	54	active
	1	CM	82.3	142752	5/13/16	Orote Point, Guam	Pati Point, Guam	39	183	inactive
Fig. 11	2	CM	40.8	171263	9/9/19	Tarague, Guam	Fishing Basin, Saipan	210	52	active
	2	EI	61.7	85493	8/20/13	Fleming Point, Tinian	Achang Reef Flat, Guam	233	922	inactive
Fig. 12	3	EI	72.3	138963	7/21/14	Fleming Point, Tinian	Ant Atoll, Pohnpei, FSM	2,118	647	inactive

Shifts in intra-island foraging areas was the most common movement pattern (Figure 10), exhibited by a total of seven turtles, all of which were green turtles. This included two turtles on Saipan, two on Tinian, and three on Guam. The average straight-line distance travelled between foraging grounds was 19 km (sd = 14.1 km), and ranged from 5 km to 39 km. The largest green turtle (82.3 cm SCL), a male tagged off Orote Point in Guam in May 2016, moved 39 km north to Pati Point before travelling back to Apra Harbor and Orote Point (Argos ID 142752; Figure 9). Given there are known nesting sites near both Pati Point (e.g., along Andersen Air Force Base beaches) and Orote Point (e.g., Spanish Steps in Apra Harbor), this adult male could have been visiting multiple breeding grounds to encounter females or possibly moving between a combination of foraging and breeding sites.

There were two turtles that exhibited movement pattern 2 (Figure 11), including a small (40.8 cm SCL) green turtle (Argos ID 171263) encountered off of the coast of northern Guam. This is one of only four turtles encountered by the program that has had an SCL <41.0 cm; turtles of this size class represent recent recruits to neritic habitats after spending their first years of life in the pelagic habitat (i.e., the "lost years"). It is likely that turtle 171263 had very recently recruited to neritic areas and had still not settled in a fixed foraging habitat, and the 210 km migration north to Saipan represented the turtle's ongoing search for a suitable location to settle. The second turtle that underwent movement pattern 2 was a subadult hawksbill measuring 61.7 cm that was tagged in 2013 on Tinian and traveled 233 km south to the southern coast of Guam, where it remained for over 2 years (Argos ID 85493; Figure 10). It is possible this turtle underwent some sort of ontogenetic habitat shift as it was getting closer to maturity, or that it reached maturity at a smaller size than expected and moved to breed.

Only a single turtle has been recorded departing the Marianas Archipelago (i.e., movement pattern 3), and this was a 72.3 cm adult hawksbill (Argos ID 138963) tagged in 2014 on Tinian that migrated east 2,118 km in 74 days to Ant Atoll, adjacent to Pohnpei, in the Federated States of Micronesia (Figure 11). The turtle remained in the nearshore waters of Ant Atoll for 10 months (Figure 12). This individual was likely making a long-distance breeding migration to a known breeding site; however, it is also possible that it was concluding a breeding season near Tinian and returning to Ant Atoll to forage.

Combined, these movements indicate some diversity in nearshore habitat use and movements around the Marianas Archipelago and beyond. Omitting turtle 171263 due to the likelihood it was a new recruit to neritic habitats, the average size of turtles that undertook one of the three migration patterns was larger (SCL = 61.5 cm, sd = 12.2 cm, range = 47.1–82.3 cm) than the SCL of turtles that used only a single foraging area (SCL = 55.7 cm, sd = 9.7 cm, range = 36.9–84.9 cm). This suggests that movement patterns, residency times, and thus exposure to nearshore threats, likely vary throughout an individual's life, with smaller juvenile turtles potentially spending most of their time in a localized reef area and larger turtles potentially undergoing occasional habitat shifts. Mature turtles may also have intermittent periods of residency as they move between foraging and breeding grounds.

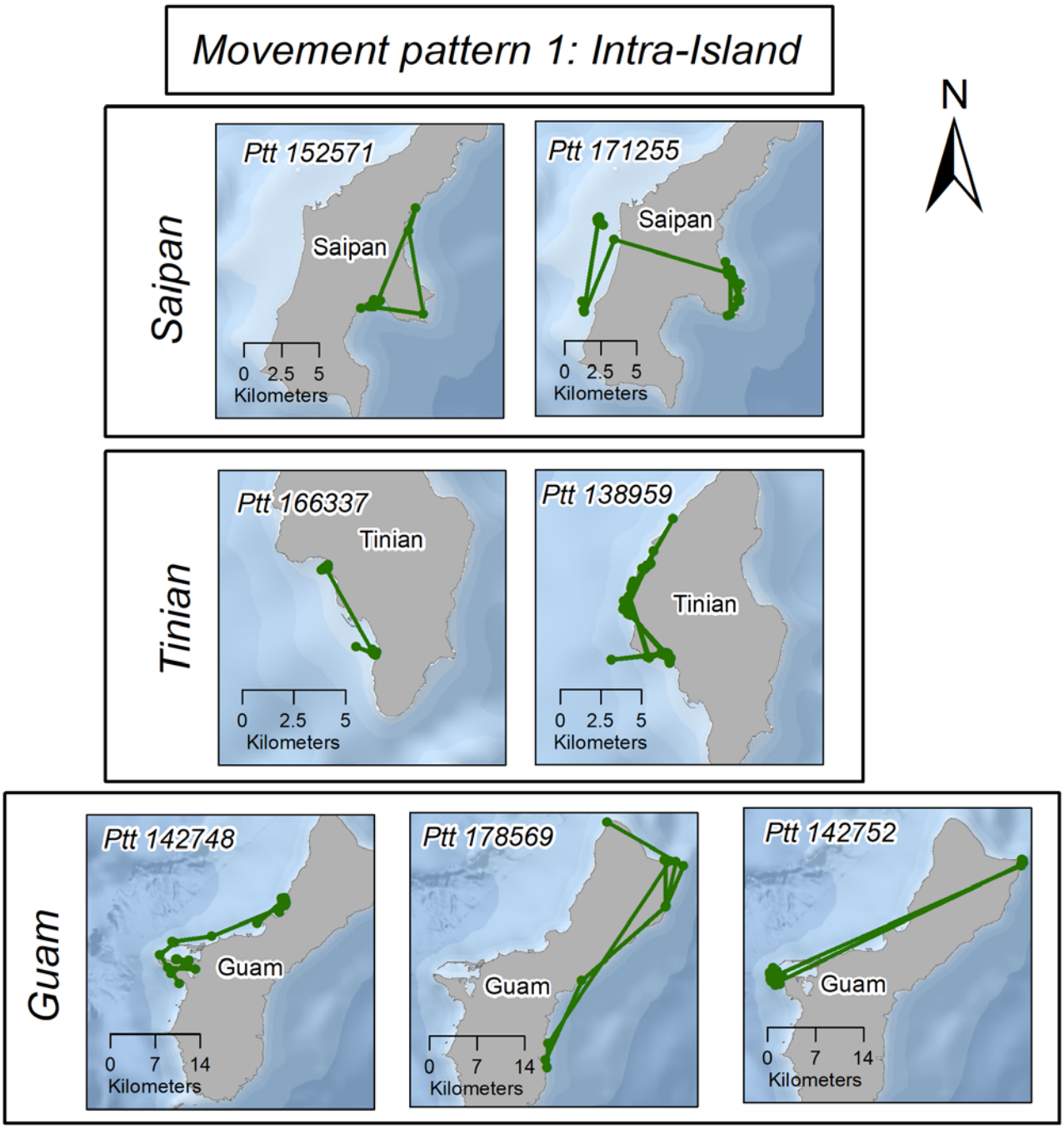

Figure 10. Map depicting the tracks of seven green turtles that undertook intra-island movements (i.e., movement pattern 1) during the course of this project. Ocean depth contours (isobaths) drawn at every 50 meters are shown for reference.

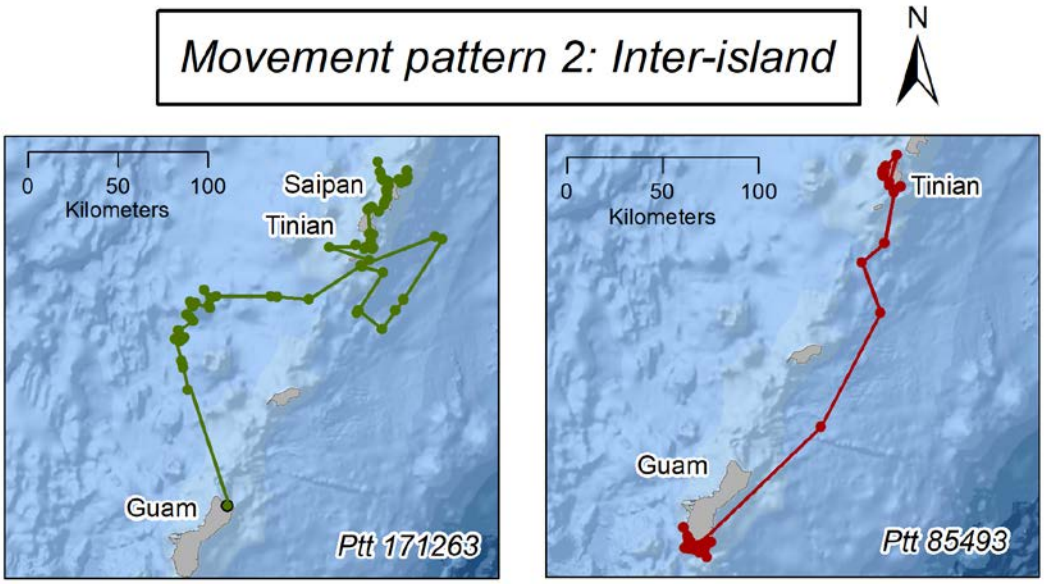

Figure 11. Map depicting the tracks of two turtles (one green and one hawksbill) that have undertaken inter-island movements (i.e., movement pattern 2) during the course of this project. The green turtle (Argos ID 171263) was a recent pelagic recruit and the hawksbill turtle (Argos ID 835493) was a subadult.

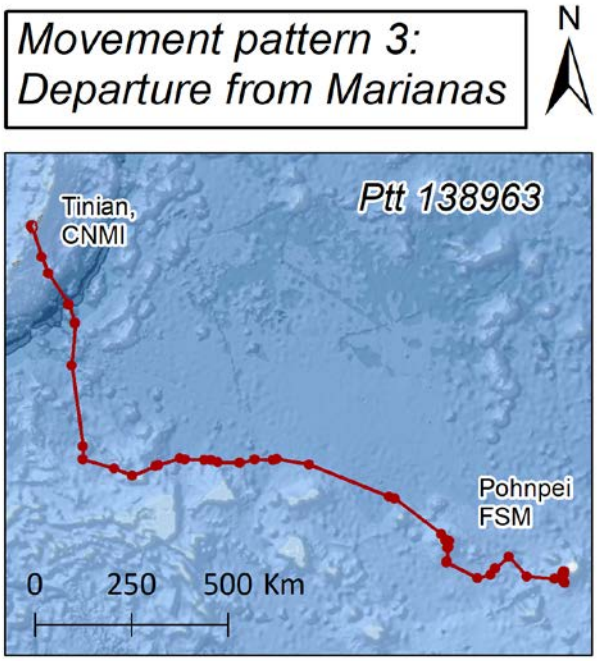

Figure 12. Map depicting the tracks of an adult hawksbill turtle that departed the Marianas Islands (i.e., movement pattern 3) and migrated to Ant Atoll, Pohnpei, FSM, during the course of this project.

DIVE BEHAVIOR AND VERTICAL MOVEMENT

Dive patterns suggest that both green and hawksbill turtles spend most of their time in waters shallower than 25 m (Figures 13 and 14), and it is possible that habitat partitioning may exist between the two species in the Mariana Archipelago. Binned depth data from the tags suggest both species made dives down to 100 m. However, hawksbill turtles spent more time in deeper waters than green turtles, with an average depth of 15.3 m compared to 10.5 m, respectively (Figure 13), and spending 59.0% of their time in waters <10 m in depth, compared to 65.6% for greens. Additionally, the maximum dive depth of hawksbills was substantially deeper than that of green turtles, with averages of 23.1 m compared to 13.3 m, respectively (Figure 13).

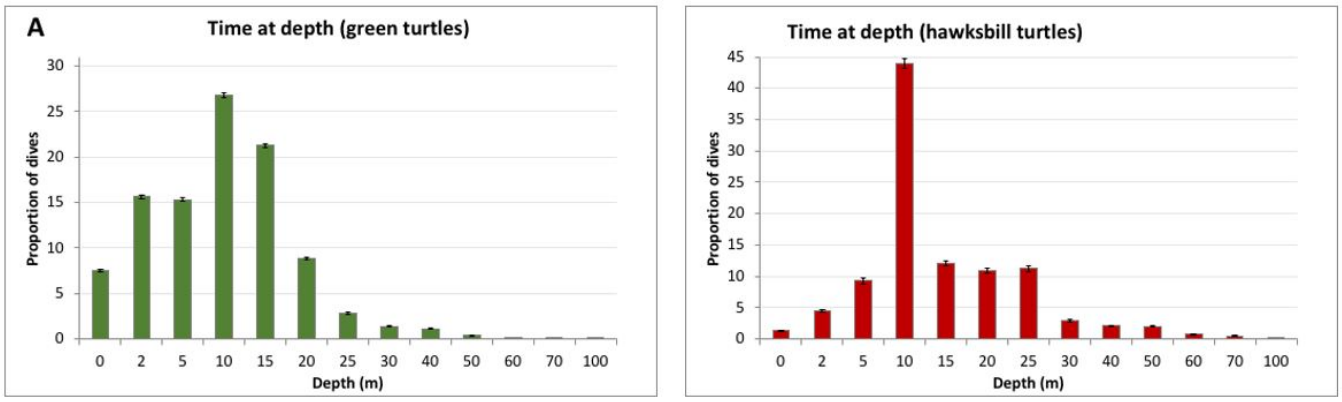

Figure 13. Proportion of time-at-depth profiles for 84 green turtles (A) and 9 hawksbill turtles (B) in the MITT study area in 2014–2019. Green turtles resided between the surface and 25 m depth 98.0% of the time, with an average depth of 10.5 m. Hawksbill turtles spent more time at deeper depths, with 93.1% of the time spent between the surface and 25 m and an average depth of 15.3 m. Histogram bars are time-at-depth averages; error bars represent standard error of the mean.

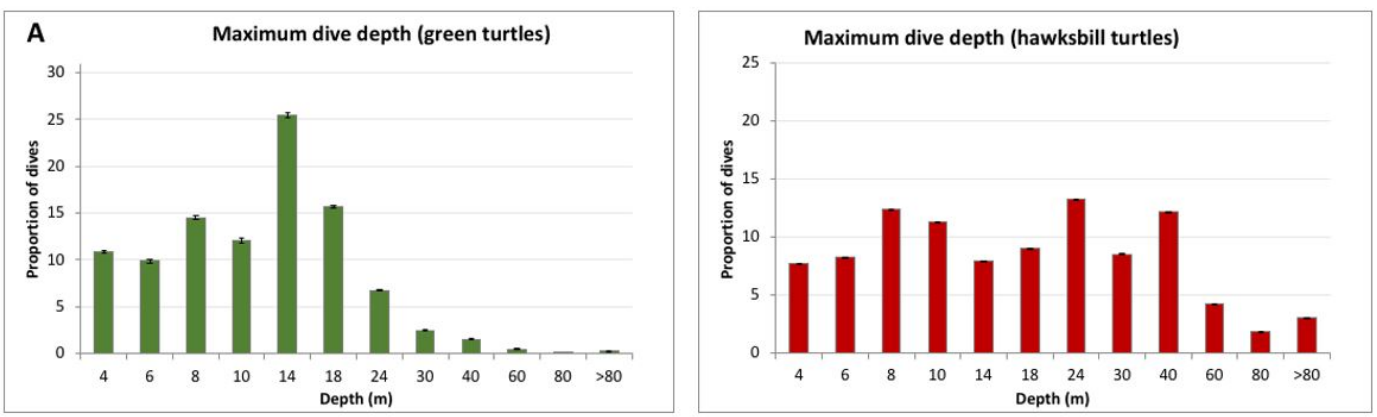

Figure 14. Maximum dive depth profiles for 84 green turtles (A) and 9 hawksbill turtles (B) in the MITT study area in 2014–2019. Green turtles dove to maximum depths of 24 m or less on 95.2% of their dives, with an average maximum depth of 13.3 m. Hawksbill turtles performed deeper dives more frequently, with only 70.0% of their dives occurring in the 0 to 24 m depth range, and an average of 23.1 m maximum dive depth. Histogram bars are max dive depth averages; error bars represent standard error of the mean.

Green and hawksbill turtles primarily use waters with temperatures of 28–31 °C, but hawksbill turtles spent more time in slightly warmer waters, with 41.0% of their time in waters of 30 °C, compared to green turtles that spent 37.5% of their time in waters of 29 °C (Figure 15). In general hawksbill turtles prefer warmer waters than their green turtle counterparts and it is likely that hawksbills are actively seeking out slightly warmer waters during the day (Gaos et al. 2012).

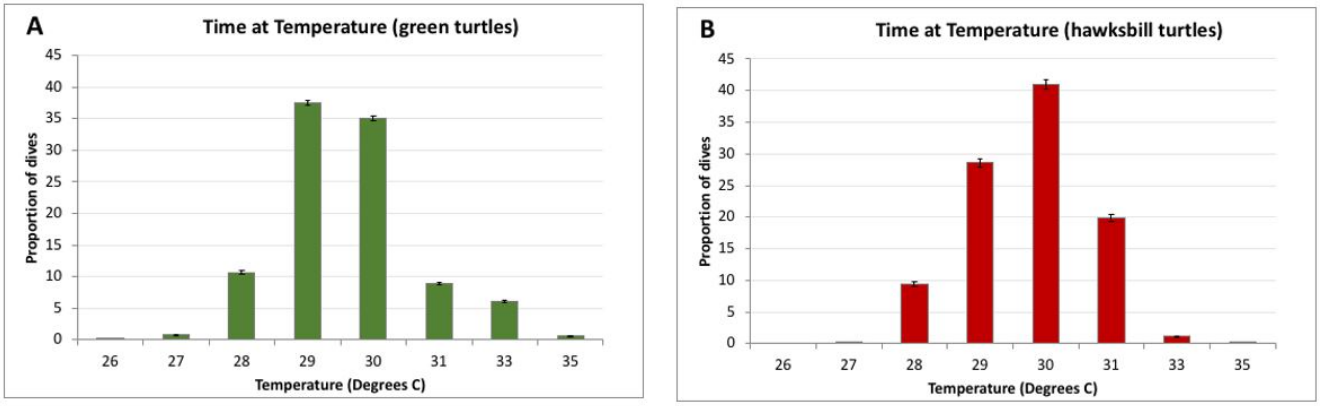

Figure 15. Proportion of time-at-temperature profiles for 84 green turtles (A) and 9 hawksbill turtles (B) in the MITT study area in 2014–2019. Green turtles spent 37.5% of their time in temperatures of 29 °C, with an average temperature of 29.8 °C. Hawksbill turtles spent more time in slightly warmer waters, with 41.0% of their time in temperatures of 30 °C, but had also had an average temperature of 29.8 °C. Histogram bars are time-at-temperature averages; error bars represent standard error of the mean.

Hawksbills tended to have longer dive durations than green turtles, with average dive durations of 47.4 minutes compared to 30.8 minutes, respectively (Figure 16). Time-at-depth, time-at-temperature, maximum dive depth, and dive duration histograms in Figures 13 to 16 provide detailed breakdowns of these habitat and behavioral variables for each species and suggest that hawksbill turtles spend more time at depth and in warmer waters.

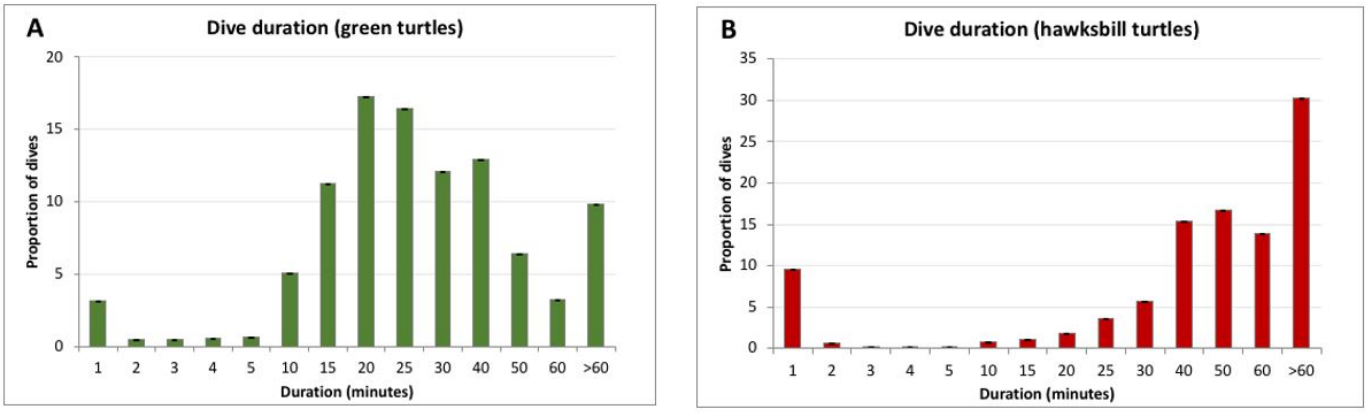

Figure 16. Dive duration profiles for 59 green turtles (A) and 7 hawksbill turtles (B) in the MITT study area in 2014–2017. Green turtles dove for 60 minutes or less on 90.1% of their dives, with an average dive duration of 30.8 minutes. Hawksbill turtles performed longer dives more frequently, with only 69.7% of their dives lasting 60 minutes or less and an average dive duration of 47.4 minutes. Histogram bars are dive duration averages; error bars represent standard error of the mean.

Beginning in 2018, we adjusted our dive duration bins (see Methods) and since that time have been able to get increased resolution on the dive duration of 25 green turtles and 2 hawksbill turtles equipped with SPLASH tags. Results of the new bin settings further supported longer dive durations by hawksbills, with 18.7% of dives lasting more than one hour, compared to 9.0% for green turtles (Figure 17).

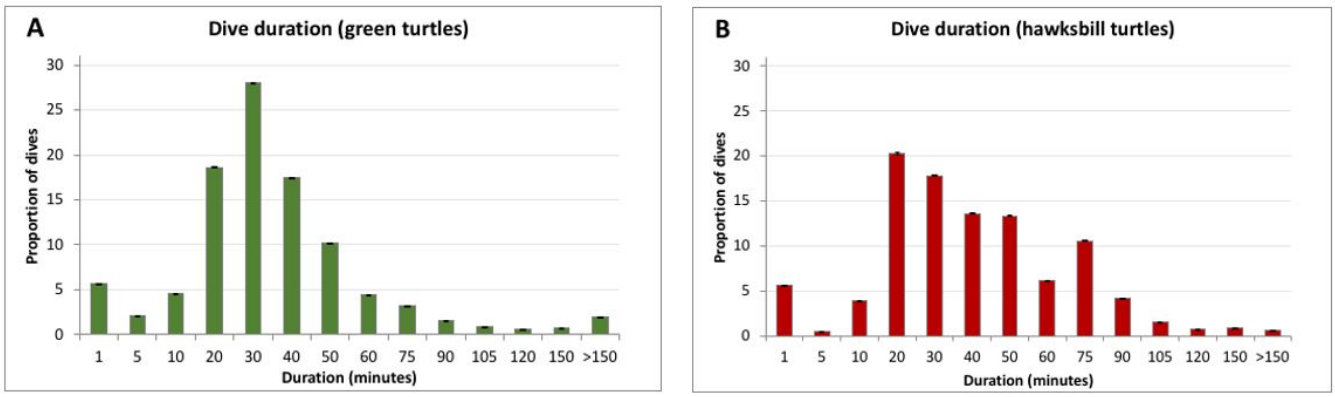

Figure 17. Dive duration profiles with increased time resolution beyond 60 minutes for 25 green turtles (A) and 2 hawksbill turtles (B) in the MITT study area in 2018 and 2019. Green turtle dives lasted more than one hour only 9.0% of the time, compared to 18.7% for hawksbill turtles.

Diel comparisons indicated that green and hawksbill turtles use shallower water depths during nocturnal timeframes (10PM–4AM) compared to diurnal timeframes (10AM–4PM) (Figure 18 A–D). Green turtles spent 77.6% of their time in waters ≤10 m in depth during the night, compared to 48.3% during the day, while hawksbills spent 77.9% compared to 33.3%, respectively. The average depth where green and hawksbill turtles spent the most time during the night was 8.7 m and 12.3 m, respectively, compared to 13.2 m and 21.8 m during the day, respectively. Similarly, 85.1% of the maximum dive depths for green turtles were to depths of ≤14 m during the night compared to 60.5% during the day, while 69.0% of hawksbill dives were to depths of ≤14 m during the night compared 29.7% during the day. The average maximum dive depth at night for green turtles and hawksbill turtles was 11.0 m and 16.6 m, respectively, compared to 15.5 m and 29.5 m during the day, respectively. These findings suggest that green turtles and hawksbills actively forage in deeper waters during the day, then settle in shallower waters to rest during the night, with hawksbills using deeper waters under both diel time periods. Both species spent time in slightly cooler waters during the day compared to night, although the average temperatures between these timeframes were very similar, with 29.8 °C versus 29.6 °C for green turtles, and 29.9 °C and 29.7 °C for hawksbill turtles, respectively (Figure 18 E–F). Green and hawksbill turtles tend to undertake dives of longer duration at night compared to the day. The average dive duration at night for green turtles and hawksbill turtles was 32.2 minutes and 52.4 minutes, respectively, compared to 28.9 minutes and 35.5 minutes during the day, respectively (Figure 18 G–H). The longer dive durations during the night most likely reflect extended resting bouts during nocturnal time periods.

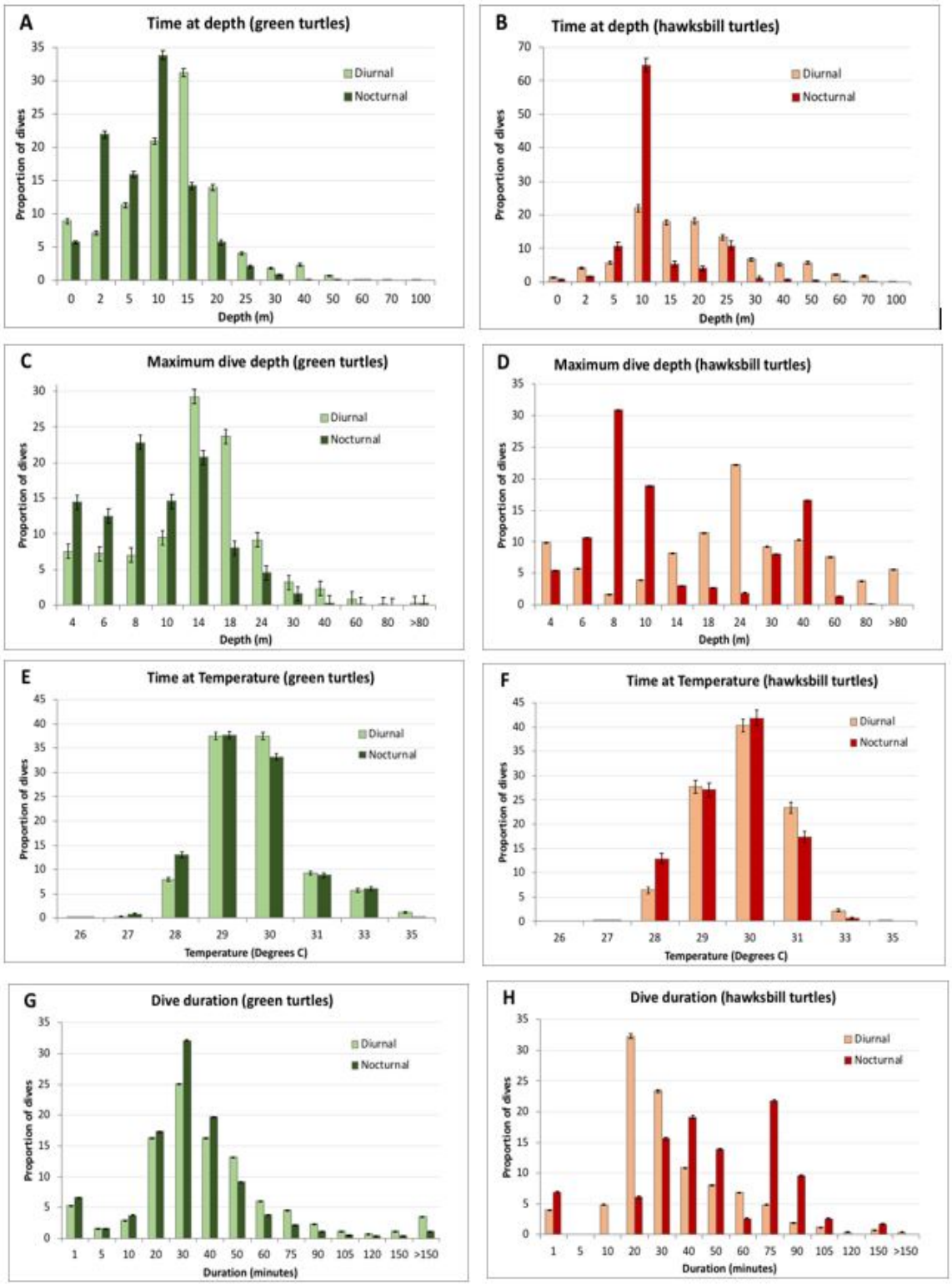

Figure 18. Diurnal (10 am–4 pm) versus Nocturnal (10 pm–4 am) depth profiles for 68 green turtles and 7 hawksbills, including time at depth (A & B), maximum dive depth (C & D), and time at temperature (E & F), as well as dive duration profiles for 25 green turtles and 2 hawksbill turtles (G & H), in the MITT study area in 2014–2019.

PROGRESS TOWARDS SUMMARY OF TASKS

(1) Capture and tag sea turtles in the MITT study area, and deploy biotelemetry devices

From 2013 through 2019, there were 160 turtles captured (with identification tags applied) and 111 satellite tags deployed in the MITT study area.

(2) Process and analyze biotelemetry data and other survey data

Kernel interpolation estimates include all tags to date (2013–2019, tags with sufficient data) and all areas of capture. Analyses revealed high site fidelity and limited movements for most turtles, although other movement patterns were also recorded. Tagging results suggest that movement patterns, residency times, and thus exposure to nearshore threats, likely vary throughout an individual's life. Smaller juvenile turtles potentially settle into nearshore habitats after reaching 35 cm SCL, then spend most of their time in a localized reef area, while larger turtles (> 60 cm SCL) may undergo ontogenetic habitat shifts or have intermittent periods of residency as they move between foraging and breeding grounds. These habitat-use patterns are consistent with previous telemetry studies on reef-dwelling green and hawksbill turtles in other locations, yet possibly reveal habitat niches that are specific to the region.

Fifteen tags were still active at the time of data analysis and PIFSC MTBAP staff will conduct additional in-depth analysis of satellite tagging data as the program advances. See Figures 2 to 9 and Table 2 for kernel interpolation estimates, Figures 10 to 12 for turtle migratory movements, and Figures 13 to 18 for time at depth, maximum dive depth, time at temperature and dive duration histograms.

(3) Prepare annual reports

Completed annually.

PROGRESS TOWARDS GUIDING QUESTIONS FROM THE FY13-15 MONITORING PLAN

(i) Are there locations of greater cetacean and/or sea turtle concentration around Guam, Saipan, and Tinian? Efforts are on-going to answer this question.

Every field season we expand our survey efforts to new areas of the Mariana Archipelago and encounter turtles in most locations around Guam, Saipan, and Tinian. The following areas appear to have high turtle density based on the boat-based snorkel survey observations and captures, as well as analysis of aerial survey data from Guam: (1) in Guam, the waters inside Apra Harbor near San Luis, Gab Gab, out to Spanish Steps including Dadi and Tipalao beaches outside of the harbor, Tumon Bay, Cocos Island, Cocos Lagoon, and Achang Bay (Martin et al. 2016), as well as between Pago Bay and Talofofo Bay. Although hawksbills can be found around the island, they comprised a much greater proportion of the turtles observed and caught in the area of Double Reef in northwest Guam; (2) in Saipan, the area stretching from the Balisa Channel to Managaha Island, as well as Lao Lao Bay and Puntan Gloria along the east side of the island, and (3) virtually the entire west coast of Tinian. These areas are primarily dominated by patch reef communities where the turtles both forage and rest.

(ii) What is the occurrence and/or habitat use of sea turtles in areas that the Navy conducts underwater detonations?

Dozens of turtles have been outfitted with satellite tags inside and just outside of Apra Harbor (including capture sites at Orote Point, Dadi Beach, and Piti Bomb Holes). From the spatial analysis of the GPS locations and movements from these satellite tags shown in Figure 6, we have not seen direct overlap of the turtles and their core use or home range areas with the Agat Bay Mine Neutralization Site, Piti Point Mine Neutralization Site, and Outer Apra Harbor Underwater Detonation Site. However, turtles are spending significant amounts of time in and moving through areas within 1−2 km of these sites, and the lack of overlapping GPS points could be due to the relatively low frequency of GPS locations obtained from these tags (often a maximum of one per day). Analyses and filtering of Argos location classes (see supplemental materials) may provide more data on daily locations.

ACTIVITIES PLANNED FOR 2020

We have a minimum of one in-water survey planned for Guam, Saipan, and Tinian for June through November (weather dependent) of 2020 to survey new areas or those requiring additional monitoring and satellite tag deployment. We will continue our analyses of the satellite data to understand home range, habitat preferences, preferred depths and temperature, as well as movement within and outside the archipelago. These analyses will provide the basis of a manuscript intended for journal submission in 2021. The research to date has largely focused on in-water surveys and expansion to regions/areas throughout the archipelago. Moving into FY21 and beyond, our efforts will build from presence/absence to population status and trends and eventually abundance estimates. To get to trends and abundance, the PIFSC MTBAP will use data derived from the Navy / NOAA Interagency Agreement as well as Guam DAWR, PIFSC Habitat and Living Marine Resources Program, and PIFSC Cetacean Research Program turtle sighting data to gain a more robust understanding of the population distribution and abundance. The MTBAP is also incorporating genetic and hormone assays to get at regional management units and to understand environmental impacts such as climate change. In the coming two years, our research portfolio will include manuscripts (publications and submissions) describing the in-water and nesting populations, modeling for habitat use, and population abundance.

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SUPPLEMENTARY MATERIAL

1. Text file: PACFLEET1_PIFSC_Turtles_Surveys_GPS_BoatTracks_2013-2019.txt
   Includes all boat survey tracks from the 2013-2019 field seasons throughout the MITT study area.
2. Text file: PACFLEET2_PIFSC_Turtles_Obs_Capts_SatTags_2013-2019.txt
   Includes all metadata on turtle observations, captures, and satellite tag deployments in 2013-2019 (date, location, species, numbers of all tags applied, turtle length measurement, etc.).
3. Text file: PACFLEET3_PIFSC_Cetaceans_Obs_2016-2019.txt
   Includes all metadata on cetacean observations for 2016-2019 (date, location, species).
4. Text file: PACFLEET4_PIFSC_Turtles_SatTags_Locations_GPS_2013-2019.txt
   Includes raw GPS location data from Wildlife Computers SPLASH Satellite tags. See table below for interpretation of GPS locations.
5. Text file: PACFLEET5_PIFSC_Turtles_SatTags_Locations_ARGOS_2013-2019.txt
   Includes raw Argos location data from Wildlife Computers SPLASH Satellite tags deployed in 2013-2019. See table below for interpretation of Argos derived locations.
6. Text file: PACFLEET6_PIFSC_Turtles_SPOTSatTags_Locations_ARGOS_2013-2019.txt
   Includes raw Argos location data from Wildlife Computers SPLASH Satellite tags deployed in 2013-2019. See table below for interpretation of Argos derived locations.
7. Text file: PACFLEET7_PIFSC_Turtles_SatTags_TimeAtDepth_2014-2019.txt
   Includes time-at-depth histogram data from satellite tags deployed in 2014-2019. Raw data are provided as the proportion of time spent at binned depths for designated periods of time.
8. Text file: PACFLEET8_PIFSC_Turtles_SatTags_TimeAtTemp_2014-2019.txt
   Includes time-at-temperature histogram data from satellite tags deployed in 2014-2019. Raw data are provided as the proportion of time spent at binned temperatures for designated periods of time.
9. Text file: PACFLEET9_PIFSC_Turtles_SatTags_DiveDepth_2014-2019.txt
   Includes dive depth histogram data from satellite tags deployed in 2014-2019. Raw data are provided as the number of dives reaching the maximum depth within specified bins for designated periods of time.
10. Text file: PACFLEET10_PIFSC_Turtles_SatTags_DiveDuration_2014-2019.txt
    Includes dive duration histogram data from satellite tags deployed in 2014-2019. Raw data are provided as the number of dives reaching the durations within specified bins for designated periods of time.

Argos satellite tag reference table. Provides information describing accuracy of location classes associated with Argos-derived and Fastloc-GPS-derived locations.

Class	Type	Estimated error*		Number of messages received per satellite pass	
		Least Squares	Kalman Filter	Least Squares	Kalman Filter
G	GPS	< 100m		1 message or more	
3	Argos	< 250m		4 messages or more	
2	Argos	250m ≤ ≤ 500m		4 messages or more	
1	Argos	500m ≤ ≤ 1500m		4 messages or more	
0*	Argos	> 1500m		4 messages or more	
A	Argos	No accuracy estimation	Unbounded accuracy estimation	3 messages	
B	Argos	No accuracy estimation	Unbounded accuracy estimation	messages	1 or 2 messages
Z	Argos	Invalid location (available only for Service Plus/Auxiliary Location Processing)			

APPENDIX

Table A1. Summary of 2013–2014 turtle observations, captures, and satellite tag deployments from boat-based snorkel surveys in nearshore waters of Guam, Saipan, and Tinian. Data fields from left to right: Survey date, Island, Site location, Longitude, Latitude, Type of Event (Obs. = observation only, SatTag = capture with satellite tag deployment, Capt. = capture but no satellite tag deployed), Species (CM = green turtle, EI = hawksbill turtle, UN = unknown species, but green or hawksbill turtle), Number of individuals, Attachments (instruments), Argos ID (satellite tags), Straight Carapace Length (cm), Mass (kg), Sex (U = unknown, M = male), Turtle ID (species, date, location, length), Flipper tag ID (left front flipper), Flipper tag ID (right front flipper), PIT tag microchip ID (left hind flipper), PIT tag microchip ID (right hind flipper).

Date	Isl.	Site	Longitude	Latitude	Type	Sp.	No.	Attach.	Argos ID	SCL	Mass	Sex	Turtle ID	L. Flipper	R. Flipper	Left PIT	Right PIT
8/15/13	GU	Cocos Lagoon	144.668	13.249	Observation	CM	1										
8/15/13	GU	Cocos Lagoon	144.659	13.258	Observation	UN	1										
8/15/13	GU	Cocos Lagoon	144.660	13.258	Observation	UN	1										
8/15/13	GU	Cocos Lagoon	144.662	13.256	Observation	UN	1										
8/15/13	GU	Cocos Lagoon	144.665	13.254	Observation	UN	1										
8/15/13	GU	Cocos Lagoon	144.668	13.252	Observation	UN	1										
8/16/13	GU	Cocos Lagoon	144.668	13.250	Observation	UN	1										
8/16/13	GU	Cocos Lagoon	144.657	13.253	Observation	UN	1										
8/16/13	GU	Cocos Lagoon	144.655	13.252	Observation	UN	1										
8/18/13	SA	Balisa	145.699	15.210	Capture-SatTag	CM	1	SPLASH	85491	60.9	32.5	U	CM08182013CN60.9	RI08566	RI08565	982.000149990073	NA
8/18/13	SA	Balisa	145.698	15.217	Capture-SatTag	EI	1	SPLASH	85496	66.6	34.0	U	EI08182013CN66.6	RI08560	RI08561	982.000150012839	NA
8/19/13	SA	Balisa	145.698	15.212	Capture-SatTag	CM	1	SPLASH	85495	66.1	39.1	U	CM08192013CN66.1	RI08563	RI08552	982.000153675029	NA
8/19/13	SA	Balisa	145.698	15.212	Capture-SatTag	CM	1	SPLASH	85494	60.4	30.2	U	CM08192013CN60.4	RI01207	RI01208	982.000153662662	4B107C1747
8/20/13	TI	Fleming Point	145.581	15.016	Capture-SatTag	EI	1	SPLASH	85493	61.7	27.5	U	EI08202013CN61.7	RI08553	RI08558	982.000149986359	NA
8/21/13	SA	Balisa	145.699	15.211	Capture-SatTag	CM	1	SPLASH	85492	62.5	34.6	U	CM08212013CN62.5	RI01351	RI01352	982.000153662001	NA
7/15/14	GU	Apra Harbor	144.650	13.445	Observation	CM	1										
7/15/14	GU	Apra Harbor	144.649	13.444	Observation	CM	1										
7/15/14	GU	Cocos Lagoon	144.671	13.248	Observation	CM	1										
7/15/14	GU	Cocos Lagoon	144.671	13.247	Observation	CM	1										
7/15/14	GU	Cocos Lagoon	144.671	13.252	Observation	CM	1										
7/15/14	GU	Cocos Lagoon	144.658	13.258	Observation	CM	1										
7/15/14	GU	Cocos Lagoon	144.659	13.258	Observation	CM	1										
7/15/14	GU	Cocos Lagoon	144.659	13.255	Observation	CM	1										
7/16/14	GU	San Luis/Gab Gab	144.638	13.444	Capture	CM	1			47.3	13.8	U	CM07162014GM47.3	PI1030	PI1031	982.000167772196	982.000167771931
7/16/14	GU	San Luis/Gab Gab	144.632	13.445	Capture	CM	1			53.5	19.5	U	CM07162014GM53.5	PI1037		982.000167827186	NA
7/16/14	GU	Wharf/Spanish	144.621	13.450	Capture-SatTag	CM	1	SPLASH	131994	49.2	16.1	U	CM07162014GM49.2	PI1035	PI1036	982.000167772276	982.000167799783
7/16/14	GU	Dadi to Tipalao	144.649	13.413	Capture-SatTag	CM	1	SPLASH	131998	64.3	32.0	U	CM07162014GM64.3	PI1034	PI1033	982.000167777159	982.000167771216
7/16/14	GU	Dadi to Tipalao	144.649	13.412	Capture-SatTag	CM	1	SPLASH	131990	54.3	20.3	U	CM07162014GM54.3	PI1051	PI1032	982.000167792000	982.000167850045
7/16/14	GU	San Luis/Gab Gab	144.643	13.444	Capture-SatTag	CM	1	SPLASH	131991	58.3	26.6	U	CM07162014GM58.3	PI1028	PI1029	982.000167824346	982.000167776941
7/16/14	GU	Apra Harbor	144.632	13.445	Observation	CM	1										
7/16/14	GU	Apra Harbor	144.629	13.447	Observation	CM	1										
7/16/14	GU	Apra Harbor	144.619	13.449	Observation	CM	1										
7/16/14	GU	Dadi Beach	144.656	13.409	Observation	CM	1										
7/16/14	GU	Dadi Beach	144.645	13.415	Observation	CM	1										
7/17/14	GU	Dadi to Tipalao	144.653	13.411	Capture	CM	1			50.1	16.9	U	CM07172014GM50.1	PI1078	PI1079	982.000190724529	982.000190219933
7/17/14	GU	Dadi to Tiaplao	144.654	13.410	Capture	EI	1			42.3	7.6	U	EI07172014GM42.3	PI1077	PI1076	982.000190720929	982.000190220237
7/17/14	GU	Dadi to Tipalao	144.645	13.416	Capture-SatTag	CM	1	SPLASH	138961	66.0	40.6	U	CM07172014GM66	PI1086	PI1082	982.000167777401	982.000167769582
7/17/14	GU	Dadi to Tipalao	144.649	13.413	Capture-SatTag	CM	1	SPLASH	131997	55.2	24.5	U	CM07172014GM55.2	PI1085	PI1084	982.000190685832	982.000190657337
7/17/14	GU	Gab Gab	144.635	13.444	Capture-SatTag	CM	1	SPLASH	138960	58.6	26.7	U	CM07172014GM58.6	PI1088	PI1089	982.000167832019	982.000190686081
7/17/14	GU	Dadi Beach	144.651	13.409	Observation	CM	1										
7/17/14	GU	Dadi Beach	144.659	13.408	Observation	CM	1										
7/17/14	GU	Dadi Beach	144.652	13.411	Observation	CM	1										
7/17/14	GU	Dadi Beach	144.648	13.413	Observation	CM	1										
7/17/14	GU	Apra Harbor	144.632	13.459	Observation	CM	1										
7/17/14	GU	Apra Harbor	144.625	13.455	Observation	CM	1										
7/17/14	GU	Apra Harbor	144.642	13.444	Observation	CM	1										
7/17/14	GU	Apra Harbor	144.635	13.445	Observation	CM	1										
7/18/14	GU	Gab Gab/Wharf	144.641	13.445	Capture	CM	1			49.7	14.6	U	CM07182014GM49.7	PI1099	PI1100	982.000167845961	982.000167846072
7/18/14	GU	Gab Gab/Wharf	144.640	13.444	Capture	CM	1			48.8	15.9	U	CM07182014GM48.8	PI1098	PI1097	982.000167777299	982.000167777349
7/18/14	GU	Gab Gab/Wharf	144.639	13.444	Capture-SatTag	CM	1	SPLASH	138965	59.3	24.5	U	CM07182014GM59.3	PI1095	PI1096	982.000190220432	982.000190550517
7/21/14	TI	Dumpcoke	145.596	15.052	Capture	CM	1			49.1	17.3	U	CM07212014CN49.1	RI11221	RI11220	982.000190546954	
7/21/14	TI	Fleming Point	145.582	15.016	Capture	CM	1			46.6	13.0	U	CM07212014CN46.6	RI11219	RI11216	982.000167843811	
7/21/14	TI	Fleming Point	145.582	15.017	Capture	CM	1			47.8	14.6	U	CM07212014CN47.8	RI11211	RI11210	989.001000126187	
7/21/14	TI	Dumpcoke Cove	145.592	15.039	Capture	CM	1			37.2	6.6	U	CM07212014CN37.2	RI11209	RI11208	989.001000126213	
7/21/14	TI	Fleming Point	145.582	15.016	Capture-SatTag	CM	1	SPLASH	138959	54.3	20.5	U	CM07212014CN54.3	RI11215	RI11214	NA	982.000167831575
7/21/14	TI	Fleming Point	145.582	15.016	Capture-SatTag	EI	1	SPLASH	138963	72.3	48.9	U	EI07212014CN72.3	RI11218	RI11217	NA	982.000167825272
7/21/14	TI	Fleming Point	145.582	15.017	Capture-SatTag	EI	1	SPLASH	131989	58.1	21.3	U	EI07212014CN58.1	RI11213	RI11212	982.000167836199	NA
7/22/14	SA	Cow Town	145.826	15.278	Capture-SatTag	CM	1	SPLASH	138958	63.9	36.0	U	CM07222014CN63.9	RI11207	RI11206	989.001000126236	
7/22/14	SA	Spotlight	145.818	15.287	Capture-SatTag	CM	1	SPLASH	131995	61.7	30.4	U	CM07222014CN61.7	RI11205	RI11204	989.001000126251	

Table A2. Summary of 2015 turtle observations, captures, and satellite tag deployments from boat-based snorkel surveys in Guam, Saipan, and Tinian. Data fields as in Table A1.

Date	Isl.	Site	Longitude	Latitude	Type	Sp.	No.	Attach.	Argos ID	SCL	Mass	Sex	Turtle ID	L. Flipper	R. Flipper	Left PIT	Right PIT
11/12/15	TI	Red Wall	145.631	14.927	Capture	CM	1			44.0	10.6	U	CM11122015CN44	none	RI12041	982.000167837266	
11/12/15	TI	Red Wall	145.630	14.931	Capture	CM	1			46.4	14.5	U	CM11122015CN46.4	RI12026	RI12036	982.000167827644	
11/12/15	TI	Red Wall	145.631	14.928	Capture-SatTag	CM	1	SPLASH	152583	54.2	19.4	U	CM11122015CN54.2	RI12045	RI12046	982.000167837893	
11/12/15	TI	Red Wall	145.631	14.927	Capture-SatTag	CM	1	SPLASH	152578	59.5	28.0	U	CM11122015CN59.5	RI12044	RI12043	982.000167841620	
11/12/15	TI	Red Wall	145.632	14.926	Capture-SatTag	CM	1	SPLASH	152580	56.0	25.2	U	CM11122015CN56	RI12034	RI12031	982.000167818272	
11/12/15	TI	Red Wall	145.631	14.927	Capture-SatTag	CM	1	SPLASH	152569	53.0	19.5	U	CM11122015CN53	RI12035	RI12033	982.000167847472	
11/12/15	TI	Red Wall	145.630	14.928	Capture-SatTag	CM	1	SPLASH	152574	55.4	20.6	U	CM11122015CN55.4	RI12040	RI12039	982.000190685201	
11/12/15	TI	Red Wall	145.630	14.931	Capture-SatTag	CM	1	SPLASH	152586	61.1	29.8	U	CM11122015CN61.1	RI12038	RI12037	982.000167831390	
11/12/15	TI	Red Wall	145.631	14.927	Observation	CM	1										
11/12/15	TI	Red Wall	145.631	14.927	Observation	CM	1										
11/12/15	TI	Red Wall	145.631	14.927	Observation	CM	1										
11/12/15	TI	Red Wall	145.631	14.927	Observation	CM	1										
11/12/15	TI	Red Wall	145.631	14.928	Observation	UN	1										
11/12/15	TI	Red Wall	145.631	14.927	Observation	UN	1										
11/13/15	SA	Lao Lao Bay	145.766	15.160	Capture	CM	1			46.7	13.1	U	CM11132015CN46.7	RI12029	RI12027	982.000190215353	
11/13/15	SA	Lao Lao Bay	145.768	15.158	Capture-SatTag	CM	1	SPLASH	152581	53.6	20.9	U	CM11132015CN53.6	RI12032	RI12028	982.000190550407	
11/13/15	SA	Lao Lao Bay	145.766	15.160	Capture-SatTag	CM	1	SPLASH	152579	65.0	39.7	U	CM11132015CN65	RI12030	RI11876	982.000190221835	
11/13/15	SA	Lao Lao Bay	145.760	15.159	Capture-SatTag	CM	1	SPLASH	152576	55.6	22.1	U	CM11132015CN55.6	RI11878	RI11879	982.000167825279	
11/13/15	SA	Lao Lao Bay	145.759	15.159	Capture-SatTag	CM	1	SPLASH	152571	56.7	26.3	U	CM11132015CN56.7	RI11880	RI11881	982.000167841944	
11/13/15	SA	Lao Lao Bay	145.753	15.158	Capture-SatTag	CM	1	SPLASH	152572	63.5	38.2	U	CM11132015CN63.5	RI11877	RI11882	982.000167830770	
11/13/15	SA	Lao Lao Bay	145.766	15.160	Observation	CM	1										
11/13/15	SA	Lao Lao Bay	145.765	15.160	Observation	UN	1										
11/13/15	SA	Lao Lao Bay	145.764	15.160	Observation	UN	1										
11/13/15	SA	Lao Lao Bay	145.764	15.160	Observation	UN	1										
11/13/15	SA	Lao Lao Bay	145.764	15.160	Observation	UN	1										
11/13/15	SA	Lao Lao Bay	145.764	15.160	Observation	UN	1										
11/13/15	SA	Lao Lao Bay	145.763	15.160	Observation	UN	1										
11/13/15	SA	Lao Lao Bay	145.760	15.159	Observation	UN	1										
11/13/15	SA	Lao Lao Bay	145.760	15.159	Observation	UN	1										
11/14/15	SA	Chalan Kanoa	145.690	15.142	Capture	CM	1			44.4	11.2	U	CM11142015CN44.4	RI11895	RI11891	363810876	
11/14/15	SA	Chalan Kanoa	145.691	15.143	Capture-SatTag	CM	1	SPLASH	152575	67.1	47.5	U	CM11142015CN67.1	RI11885	RI11892	none	363834195
11/14/15	SA	Chalan Kanoa	145.690	15.142	Capture-SatTag	CM	1	SPLASH	152585	50.2	16.6	U	CM11142015CN50.2	RI11887	RI11884	363805919	
11/14/15	SA	Chalan Kanoa	145.690	15.158	Observation	UN	1										
11/14/15	SA	Chalan Kanoa	145.690	15.158	Observation	UN	1										
11/14/15	SA	Chalan Kanoa	145.688	15.157	Observation	UN	1										
11/14/15	SA	Chalan Kanoa	145.691	15.144	Observation	UN	1										
11/17/15	GU	Agat Bay	144.643	13.378	Capture	EI	1			44.5	9.4	U	EI011172015GM44.5	PI1574	PI1575	363805702	
11/17/15	GU	Dadi Beach	144.648	13.413	Capture-SatTag	CM	1	SPLASH	152577	65.6	37.8	U	CM011172015GM65.6	PI1573	PI1572	363794111	
11/17/15	GU	Agat Bay	144.650	13.387	Observation	CM	1										
11/17/15	GU	Agat Bay	144.654	13.392	Observation	UN	1										
11/17/15	GU	Agat Bay	144.651	13.389	Observation	UN	1										
11/17/15	GU	Agat Bay	144.651	13.389	Observation	UN	1										
11/17/15	GU	Agat Bay	144.642	13.376	Observation	UN	1										
11/18/15	GU	Dadi Beach	144.651	13.411	Capture-SatTag	CM	1	SPLASH	152570	76.0	59.2	U	CM011182015GM76	PI1571	PI1570	363834759	
11/18/15	GU	Dadi Beach	144.650	13.410	Capture-SatTag	CM	1	SPLASH	152582	73.4	52.9	U	CM11182015GM73.4	PI1569	PI1568	363794120	
11/18/15	GU	Agat Bay	144.642	13.371	Observation	CM	1										
11/18/15	GU	Dadi Beach	144.650	13.411	Observation	UN	1										
11/18/15	GU	Dadi Beach	144.650	13.411	Observation	UN	1										
11/18/15	GU	Dadi Beach	144.650	13.411	Observation	UN	1										
11/18/15	GU	Dadi Beach	144.648	13.411	Observation	UN	1										
11/18/15	GU	Dadi Beach	144.646	13.413	Observation	UN	1										
11/18/15	GU	Dadi Beach	144.655	13.409	Observation	UN	1										
11/18/15	GU	Dadi Beach	144.651	13.409	Observation	UN	1										
11/18/15	GU	Dadi Beach	144.651	13.409	Observation	UN	1										
11/18/15	GU	Dadi Beach	144.646	13.411	Observation	UN	1										

Table A3. Summary of 2016 turtle observations, captures, and satellite tag deployments from boat-based snorkel surveys in Guam, Saipan, and Tinian. Data fields as in Table A1.

Date	Isl.	Site	Longitude	Latitude	Type	Sp.	No.	Attach.	Argos ID	SCL	Mass	Sex	Turtle ID	L. Flipper	R. Flipper	Left PIT	Right PIT
5/12/16	GU	Dump/Orote	144.635	13.433	Capture	CM	1			46.2	13.2	U	CM05122016GM46.2	PI1580	PI1581	982.000190725951	982.000190547778
5/12/16	GU	Dump/Orote	144.628	13.436	Capture	CM	1			48.0	14.0	U	CM05122016GM48	PI1585	PI1584	982.000190550798	982.000190550362
5/12/16	GU	Gab Gab	144.642	13.444	Capture	CM	1			47.8	13.2	U	CM05122016GM47.8	PI1587	PI1586	982.000167837687	982.000190551030
5/12/16	GU	Gab Gab	144.633	13.445	Capture	CM	1			42.7	8.6	U	CM05122016GM42.7	PI1591	PI1590	982.000190550197	982.000190546384
5/12/16	GU	Gab Gab	144.633	13.445	Capture	CM	1			56.9	27.2	U	CM05122016GM56.9	PI1588	PI1589	982.000190553692	982.000190686463
5/12/16	GU	Gab Gab	144.632	13.445	Capture	CM	1			38.4	7.2	U	CM05122016GM38.4	PI1592	PI1563	982.000190686178	982.000190642806
5/12/16	GU	Dump/Orote	144.631	13.435	Capture-SatTag	CM	1	SPLASH	131996	60.8	28.8	U	CM05122016GM60.8	PI1582	PI1583	982.000167837911	982.000190214992
5/12/16	GU	Orote Point	144.621	13.441	Capture-SatTag	EI	1	SPLASH	142756	52.9	14.6	U	EI05122016GM52.9	none	PI1579	982.000167835281	982.000167815470
5/12/16	GU	Orote Point	144.621	13.441	Observation	CM	2										
5/12/16	GU	Orote Point	144.619	13.444	Observation	CM	7										
5/12/16	GU	Dump/Orote	144.631	13.435	Observation	CM	1										
5/12/16	GU	Dump/Orote	144.628	13.435	Observation	CM	1										
5/12/16	GU	Dump/Orote	144.636	13.431	Observation	UN	1										
5/12/16	GU	Dump/Orote	144.630	13.435	Observation	UN	1										
5/12/16	GU	Gab Gab	144.643	13.444	Observation	UN	1										
5/12/16	GU	Gab Gab	144.635	13.445	Observation	UN	1										
5/13/16	GU	Dump/Orote	144.630	13.435	Capture-SatTag	CM	1	SPLASH	142752	82.3	75.0	M	CM05132016GM82.3	PI1593	PI1594	982.000167847438	982.000190550507
5/13/16	GU	Dump/Orote	144.620	13.441	Capture-SatTag	CM	1	SPLASH	142748	63.8	29.0	U	CM05132016GM63.8	PI1596	PI1595	982.000406138283	982.000406135443
5/13/16	GU	Dump/Orote	144.636	13.430	Observation	CM	1										
5/13/16	GU	Dump/Orote	144.630	13.435	Observation	CM	1										
5/13/16	GU	Dump/Orote	144.630	13.435	Observation	CM	2										
5/13/16	GU	Orote Point	144.618	13.445	Observation	CM	3										
5/13/16	GU	Dump/Orote	144.639	13.454	Observation	CM	1										
5/13/16	GU	Dump/Orote	144.636	13.431	Observation	CM	1										
5/13/16	GU	Dump/Orote	144.636	13.431	Observation	CM	1										
5/13/16	GU	Dump/Orote	144.621	13.440	Observation	CM	2										
5/13/16	GU	Orote Point	144.618	13.445	Observation	EI	1										
5/13/16	GU	Orote Point	144.621	13.440	Observation	UN	1										
5/13/16	GU	Orote Point	144.620	13.441	Observation	UN	1										
5/13/16	GU	Dump/Orote	144.624	13.437	Observation	UN	1										
5/13/16	GU	Dump/Orote	144.621	13.440	Observation	UN	1										
5/13/16	GU	Dump/Orote	144.621	13.440	Observation	UN	3										
5/13/16	GU	Dump/Orote	144.621	13.440	Observation	UN	1										
5/13/16	GU	Dump/Orote	144.621	13.441	Observation	UN	1										
5/13/16	GU	Dump/Orote	144.621	13.440	Observation	UN	1										
5/13/16	GU	Dump/Orote	144.620	13.441	Observation	UN	1										
5/15/16	TI	Chulu	145.650	15.038	Capture	CM	1			48.6	14.2	U	CM05152016CN48.6	RI15006	RI15005	982.000406092730	
5/15/16	TI	Chulu	145.652	15.030	Capture-SatTag	CM	1	SPLASH	142750	51.6	22.0	U	CM05152016CN51.6	RI15019	RI15020	982.000406092295	
5/15/16	TI	Dangkolo	145.649	15.044	Capture-SatTag	CM	1	SPLASH	142747	52.6	18.6	U	CM05152016CN52.6	none	RI15017	982.000406092569	
5/15/16	TI	Dangkolo	145.650	15.041	Capture-SatTag	EI	1	SPLASH	142755	62.8	31.1	U	EI05152016CN62.8	RI15008	RI15007	982.000406092592	
5/15/16	TI	Dangkolo	145.649	15.042	Observation	CM	1										
5/15/16	TI	Chulu	145.651	15.035	Observation	UN	2										
5/15/16	TI	Chulu	145.653	15.029	Observation	UN	1										
5/15/16	TI	Chulu	145.650	15.039	Observation	UN	2										
5/15/16	TI	Chulu	145.650	15.040	Observation	UN	1										
5/15/16	TI	Chulu	145.650	15.043	Observation	UN	1										
5/15/16	TI	Dangkolo	145.649	15.042	Observation	UN	1										
5/16/16	TI	Tohgong	145.653	15.093	Capture	CM	1			50.3	18.5	U	CM05162016CN50.3	RI15009	RI15010	982.000406092685	
5/16/16	TI	Babui	145.622	15.081	Capture	CM	1			48.1	14.5	U	CM05162016CN48.1	RI15016	RI15015	982.000406092417	
5/16/16	TI	Babui/LamLam	145.623	15.082	Capture	CM	1			51.0	16.4	U	CM05162016CN51	PI1565	PI1559	982.000406137787	
5/16/16	TI	Babui/LamLam	145.629	15.087	Capture	CM	1			45.9	13.4	U	CM05162016CN45.9	PI1552	PI1554	982.000406092394	
5/16/16	TI	Babui/LamLam	145.632	15.089	Capture	CM	1			44.0	10.9	U	CM05162016CN44	PI1553	PI1564	982.000406092191	
5/16/16	TI	Babui/LamLam	145.623	15.082	Capture	EI	1			46.7	12.9	U	EI05162016CN46.7	PI1501	PI1502	982.000406137779	
5/16/16	TI	Babui/LamLam	145.624	15.083	Capture	EI	1			34.4	4.4	U	EI05162016CN34.4	PI1558	PI1561	982.000406092624	
5/16/16	TI	Babui/LamLam	145.629	15.087	Capture	EI	1			42.3	8.7	U	EI05162016CN42.3	PI1555	PI1560	982.000406138075	
5/16/16	TI	Tohgong	145.656	15.089	Capture-SatTag	CM	1	SPLASH	152584	54.9	24.3	U	CM05162016CN54.9	RI15011	RI15012	982.000406092812	
5/16/16	TI	Tohgong	145.657	15.087	Capture-SatTag	CM	1	SPLASH	142753	56.5	26.5	U	CM05162016CN56.5	RI15014	RI15013	982.000406137831	
5/16/16	TI	Tohgong	145.688	15.139	Observation	CM	3										
5/16/16	TI	Babui/LamLam	145.628	15.087	Observation	CM	1										
5/16/16	TI	Babui/LamLam	145.629	15.087	Observation	CM	1										
5/16/16	TI	Tohgong	145.682	15.129	Observation	EI	1										
5/16/16	TI	Tohgong	145.656	15.089	Observation	UN	1										
5/16/16	TI	Tohgong	145.657	15.087	Observation	UN	1										
5/16/16	TI	Babui/LamLam	145.623	15.082	Observation	UN	1										
5/16/16	TI	Babui	145.627	15.085	Observation	UN	1										
5/17/16	TI	Chulu/Babui	145.625	15.084	Capture	CM	1			40.1	7.9	U	CM05172016CN40.1	PI1504	PI1505	982.000406133981	
5/17/16	TI	Chulu/Babui	145.619	15.079	Capture	EI	1			37.2	5.2	U	EI05172016CN37.2	PI1503	PI1567	982.000406133987	
5/17/16	TI	Chulu/Babui	145.624	15.083	Observation	CM	1										
5/17/16	TI	Chulu/Babui	145.623	15.081	Observation	CM	1										
5/17/16	TI	Chulu/Babui	145.625	15.084	Observation	CM	2										
10/26/16	TI	Tachungnya Bay	145.629	14.948	Capture	CM	1			40.1	8.6	U	CM10262016CN40.1	RI15266	RI15267	982.000363798452	
10/26/16	TI	Tachungnya Bay	145.629	14.954	Capture-SatTag	CM	1	SPLASH	166339	44.4	11.5	U	CM10262016CN44.4	RI15278	RI15279	982.000363805390	

Table A3 (continued). Summary of 2016 turtle observations, captures, and satellite tag deployments from boat-based snorkel surveys in Guam, Saipan, and Tinian. Data fields as in Table A1.

Date	Isl.	Site	Longitude	Latitude	Type	Sp.	No.	Attach.	Argos ID	SCL	Mass	Sex	Turtle ID	L. Flipper	R. Flipper	Left PIT	Right PIT
10/26/16	TI	Tachungnya Bay	145.630	14.952	Capture-SatTag	CM	1	SPLASH	166344	52.8	19.1	U	CM10262016CN52.8	RI15275	RI15274	982.000363834373	
10/26/16	TI	Tachungnya Bay	145.629	14.950	Capture-SatTag	CM	1	SPLASH	166337	48.2	14.6	U	CM10262016CN48.2	RI15270	RI15271	982.000363805655	
10/26/16	TI	Tachungnya Bay	145.629	14.949	Capture-SatTag	CM	1	SPLASH	166345	44.0	10.6	U	CM10262016CN44	RI15268	RI15269	982.000363835417	
10/26/16	TI	Tachungnya Bay	145.629	14.948	Capture	EI	1	SPOT	166355	40.0	6.6	U	EI10262016CN40	RI15272	RI15273	982.000363834980	
10/26/16	TI	circumnavigate	145.690	15.141	Observation	CM	2										
10/26/16	TI	circumnavigate	145.685	15.134	Observation	CM	2										
10/26/16	TI	circumnavigate	145.669	14.982	Observation	CM	1										
10/26/16	TI	Tachogna Bay	145.629	14.954	Observation	CM	1										
10/26/16	TI	Tachogna Bay	145.629	14.953	Observation	CM	1										
10/26/16	TI	Tachogna Bay	145.629	14.950	Observation	CM	1										
10/26/16	TI	Tachogna Bay	145.629	14.952	Observation	EI	1										
10/26/16	TI	Banzai	145.655	14.944	Observation	UN	1										
10/27/16	SA	Chalan Kanoa	145.691	15.144	Capture	CM	1			59.9	27.4	U	CM10272016CN59.9	RI15251	RI15252	982.000363797151	
10/27/16	SA	Chalan Kanoa	145.690	15.142	Capture	CM	1			57.0	23.4	U	CM10272016CN57	RI15253	RI15254	982.000363810157	
10/27/16	SA	Chalan Kanoa	145.691	15.143	Capture-SatTag	CM	1	SPLASH	166343	64.3	31.6	U	CM10272016CN64.3	RI15265	RI15264	982.000363810884	
10/27/16	SA	Coral Ocean Point	145.698	15.115	Capture-SatTag	CM	1	SPLASH	166346	44.0	11.2	U	CM10272016CN44	RI15261	RI15260	982.000363797040	
10/27/16	SA	Coral Ocean Point	145.701	15.113	Capture	EI	1	SPOT	166354	40.0	7.0	U	EI10272016CN40	RI15263	RI15262	982.000363835085	
10/27/16	SA	CK reef	145.690	15.145	Observation	CM	1										
10/27/16	SA	CK reef	145.691	15.144	Observation	CM	1										
10/27/16	SA	transit	145.687	15.122	Observation	CM	1										
10/27/16	SA	transit	145.708	15.105	Observation	CM	1										
10/27/16	SA	Obyan Beach	145.733	15.102	Observation	EI	1										
10/27/16	SA	Obyan Beach	145.722	15.105	Observation	EI	1										
10/28/16	TI	TI Harbor	145.620	14.960	Capture-SatTag	CM	1	SPLASH	166348	47.6	12.0	U	CM10282016CN47.6	RI15255	RI15256	982.000363835278	
10/28/16	TI	TI Harbor	145.615	14.962	Capture-SatTag	CM	1	SPLASH	166338	44.4	11.8	U	CM10282016CN44.4	RI15257	RI15258	982.000363835472	
10/28/16	TI	Dumpcoke Cove	145.594	15.040	Capture-SatTag	CM	1	SPLASH	166341	84.1	76.2	M	CM10282016CN84.1	RI15225	RI15259	982.000363798612	
10/28/16	TI	Dumpcoke Cove	145.596	15.042	Capture-SatTag	EI	1	SPLASH	166342	56.2	21.3	U	EI10282016CN56.2	RI15224	RI15223	982.000363835630	
10/28/16	SA	transit to TI	145.694	15.148	Observation	CM	1										
10/28/16	TI	TI Harbor	145.615	14.962	Observation	CM	3										
10/28/16	TI	TI Harbor	145.612	14.967	Observation	CM	2										
10/28/16	TI	TI Harbor	145.611	14.969	Observation	CM	1										
10/28/16	TI	Dumpcoke Cove	145.595	15.040	Observation	UN	1										
10/29/16	SA	Balisa	145.702	15.211	Capture	CM	1			53.7	21.6	U	CM10292016CN53.7	RI15220	RI15219	982.000363794612	
10/29/16	SA	Balisa	145.701	15.212	Capture	CM	1			55.6	25.1	U	CM10292016CN55.6	RI15217	RI15218	982.000363812343	
10/29/16	SA	Tanapag Lagoon	145.731	15.245	Capture-SatTag	CM	1	SPLASH	166347	47.0	12.2	U	CM10292016CN47	RI15222	RI15221	982.000363835363	
10/29/16	SA	transit/Managaha	145.720	15.231	Observation	CM	1										
10/29/16	SA	Tanapag Lagoon	145.732	15.245	Observation	CM	1										
10/29/16	SA	Tanapag Lagoon	145.731	15.245	Observation	CM	1										
10/29/16	SA	Tanapag Lagoon	145.713	15.229	Observation	CM	1										
10/29/16	SA	Balisa	145.696	15.191	Observation	CM	1										
10/29/16	SA	transit/Managaha	145.728	15.239	Observation	UN	1										
10/29/16	SA	Balisa	145.703	15.212	Observation	UN	1										
11/1/16	GU	Sella Bay	144.647	13.329	Capture-SatTag	CM	1	SPLASH	166335	49.3	14.4	U	CM11012016GM49.3	PI1506	PI1525	982.000363835197	
11/1/16	GU	Sella Bay	144.647	13.329	Capture	CM	1	SPOT	166351	43.7	11.8	U	CM11012016GM43.7	PI1508	PI1507	982.000363812713	
11/1/16	GU	Sella Bay	144.645	13.335	Capture	CM	1	SPOT	166353	40.8	8.2	U	CM11012016GM40.8	PI1510	PI1509	982.000363834810	
11/1/16	GU	Bile Bay	144.660	13.278	Observation	CM	1										
11/1/16	GU	Bile Bay	144.661	13.283	Observation	CM	1										
11/1/16	GU	Bile Bay	144.658	13.285	Observation	CM	1										
11/1/16	GU	Bile Bay	144.657	13.287	Observation	CM	1										
11/1/16	GU	Bile Bay	144.655	13.290	Observation	CM	2										
11/1/16	GU	Bile Bay	144.655	13.290	Observation	CM	1										
11/1/16	GU	Bile Bay	144.655	13.291	Observation	CM	1										
11/1/16	GU	Bile Bay	144.656	13.291	Observation	CM	3										
11/1/16	GU	Bile Bay	144.656	13.292	Observation	CM	1										
11/1/16	GU	Bile Bay	144.655	13.293	Observation	CM	1										
11/1/16	GU	transit/Sella Bay	144.647	13.330	Observation	CM	1										
11/1/16	GU	transit/Sella Bay	144.647	13.330	Observation	CM	1										
11/1/16	GU	transit/Sella Bay	144.647	13.330	Observation	CM	1										
11/1/16	GU	Sella Bay	144.647	13.332	Observation	CM	1										
11/1/16	GU	Sella Bay	144.646	13.333	Observation	CM	1										
11/1/16	GU	Sella Bay	144.646	13.333	Observation	CM	2										
11/1/16	GU	Sella Bay	144.645	13.334	Observation	CM	1										
11/1/16	GU	Sella Bay	144.645	13.334	Observation	CM	1										
11/1/16	GU	Sella Bay	144.645	13.335	Observation	CM	3										
11/1/16	GU	Sella Bay	144.644	13.335	Observation	CM	1										
11/1/16	GU	Sella Bay	144.644	13.336	Observation	CM	1										
11/1/16	GU	Bile Bay	144.660	13.278	Observation	EI	1										
11/1/16	GU	Bile Bay	144.657	13.287	Observation	EI	1										
11/1/16	GU	Bile Bay	144.661	13.283	Observation	UN	1										
11/2/16	GU	Piti Bomb Holes	144.690	13.471	Observation	CM	1										
11/2/16	GU	Piti Bomb Holes	144.690	13.472	Observation	CM	1										
11/2/16	GU	Piti Bomb Holes	144.691	13.471	Observation	CM	1										
11/2/16	GU	Piti Bomb Holes	144.743	13.485	Observation	CM	1										

Table A4. Summary of 2017 turtle observations, captures, and satellite tag deployments from boat-based snorkel surveys in Guam, Saipan, and Tinian. Data fields as in Table A1.

Date	Isl.	Site	Longitude	Latitude	Type	Sp.	No.	Attach.	Argos ID	SCL	Mass	Sex	Turtle ID	L. Flipper	R. Flipper	Left PIT	Right PIT
5/22/17	GU	Piti Bomb Holes	144.693	13.473	Capture-SatTag	CM	1	SPLASH	166336	56.0	22.6	U	0402169998	PI4546	PI4547	982.000402169998	982.000402169358
5/22/17	GU	Piti Bomb Holes	144.693	13.473	Observation	CM	1										
5/23/17	GU	Dump	144.634	13.432	Capture-SatTag	EI	1	SPLASH	166340	55.7	19.2	U	0167835281	PI4453	PI1579	982.000167835281	982.000167815470
10/17/17	GU	Tanguisson	144.809	13.555	Capture-SatTag	CM	1	SPLASH	171249	48.2	14.8	U	0402166755	PI4801	PI4802	982.000402166755	982.000402166794
10/17/17	GU	Tumon Hilton	144.789	13.511	Capture-SatTag	CM	1	SPLASH	171248	48.8	13.4	U	0402167077	PI4804	PI4803	982.000402167077	982.000402163319
10/17/17	GU	Tumon Hilton	144.792	13.511	Capture-SatTag	CM	1	SPLASH	171247	62.7	32.7	U	0364287768	PI4807	PI4808	982.000364287768	982.000364287508
10/17/17	GU	Tumon Hilton	144.792	13.512	Capture-SatTag	CM	1	SPLASH	171246	53.6	18.1	U	0402166489	PI4806	PI4805	982.000402166489	982.000402163424
10/17/17	GU	Tanguisson Beach	144.809	13.554	Observation	CM	1										
10/17/17	GU	Tanguisson Beach	144.809	13.556	Observation	CM	1										
10/17/17	GU	Tanguisson Beach	144.810	13.558	Observation	CM	1										
10/17/17	GU	Haputo Beach	144.828	13.577	Observation	CM	1										
10/17/17	GU	Tanguisson Beach	144.809	13.556	Observation	CM	1										
10/17/17	GU	Tumon Bay	144.785	13.509	Observation	CM	4										
10/17/17	GU	Tumon Bay	144.786	13.510	Observation	CM	1										
10/17/17	GU	Tumon Bay	144.787	13.510	Observation	CM	1										
10/17/17	GU	Tumon Bay	144.787	13.510	Observation	CM	1										
10/17/17	GU	Tumon Bay	144.790	13.511	Observation	CM	1										
10/17/17	GU	Tumon Bay	144.791	13.511	Observation	CM	1										
10/17/17	GU	Tumon Bay	144.792	13.511	Observation	CM	2										
10/17/17	GU	Tumon Bay	144.786	13.510	Observation	CM	1										
10/17/17	GU	Haputo Beach	144.829	13.580	Observation	EI	1										
10/17/17	GU	Tumon Bay	144.785	13.509	Observation	EI	1										
10/17/17	GU	Tanguisson Beach	144.810	13.557	Observation	UN	1										
10/17/17	GU	Tumon Bay	144.786	13.510	Observation	UN	1										
10/17/17	GU	Tumon Bay	144.786	13.510	Observation	UN	1										
10/18/17	GU	Tumon (north)	144.795	13.512	Capture	CM	1			49.3	16.4	U	0364283766	PI4818	PI4813	982.000364283766	982.000364287102
10/18/17	GU	Tumon (north)	144.796	13.513	Capture	CM	1			54.0	19.5	U	0364287113	PI4815	PI4816	982.000364287113	982.000364291543
10/18/17	GU	Tumon (north)	144.800	13.520	Capture	CM	1			45.8	11.5	U	0364290092	PI4817	PI4818	982.000364290092	982.000364287444
10/18/17	GU	Tumon (central)	144.792	13.512	Capture-SatTag	CM	1	SPLASH	171240	66.6	38.4	U	0364286882	PI4809	PI4810	982.000364286882	982.000364285156
10/18/17	GU	Tumon (north)	144.793	13.512	Capture-SatTag	CM	1	SPLASH	171241	73.2	48.9	U	0364287735	PI4811	PI4812	982.000364287735	982.000364345328
10/18/17	GU	Tumon (north)	144.800	13.522	Capture-SatTag	CM	1	SPLASH	171242	58.2	26.4	U	0364285556	PI4819	PI4820	982.000364285556	982.000364284980
10/18/17	GU	Tumon (north)	144.801	13.522	Capture-SatTag	CM	1	SPLASH	171243	56.4	24.3	U	0364287500	PI4821	PI4822	982.000364287500	982.000364282890
10/18/17	GU	Tumon Bay	144.791	13.513	Observation	CM	1										
10/18/17	GU	Tumon Bay	144.791	13.512	Observation	CM	1										
10/18/17	GU	Tumon Bay	144.792	13.512	Observation	CM	2										
10/18/17	GU	Tumon Bay	144.794	13.512	Observation	CM	1										
10/18/17	GU	Tumon Bay	144.795	13.513	Observation	CM	1										
10/18/17	GU	Tumon Bay	144.799	13.520	Observation	CM	1										
10/18/17	GU	Tumon Bay	144.800	13.520	Observation	CM	1										
10/18/17	GU	Tumon Bay	144.800	13.520	Observation	CM	2										
10/18/17	GU	Tumon Bay	144.800	13.521	Observation	CM	1										
10/18/17	GU	Tumon Bay	144.800	13.522	Observation	CM	1										
10/18/17	GU	Tumon Bay	144.801	13.524	Observation	CM	3										
10/19/17	GU	Sewer Island	144.740	13.484	Capture-SatTag	CM	1	SPLASH	171244	47.1	13.7	U	0364288919	PI4823	PI4824	982.000364288919	982.000364283283
10/19/17	GU	Alupang	144.768	13.494	Observation	CM	1										
10/19/17	GU	Tumon Bay	144.791	13.511	Observation	CM	1										
10/19/17	GU	Tumon Bay	144.792	13.512	Observation	CM	1										
10/19/17	GU	Adelupe	144.731	13.483	Observation	CM	1										
10/19/17	GU	Adelupe	144.732	13.483	Observation	CM	1										
10/19/17	GU	Sewer Island	144.739	13.484	Observation	CM	1										
10/25/17	SA	Aqua Reef	145.763	15.255	Capture-SatTag	CM	1	SPLASH	171250	55.7	22.6	U	0167838510	PI4825	PI4826	982.000167838510	982.000190642571
10/25/17	SA	Aqua Reef	145.763	15.254	Capture	CM	1	SPOT	171256	43.3	9.6	U	0364285390	PI4827	PI4828	982.000364285390	982.000364285415
10/25/17	SA	transit / Sugar Dock	145.697	15.207	Observation	CM	1										
10/25/17	SA	Garapan	145.696	15.212	Observation	CM	2										
10/25/17	SA	Pau Pau Beach	145.769	15.258	Observation	CM	1										
10/25/17	SA	San Roque/Pau Pau	145.764	15.256	Observation	CM	1										
10/25/17	SA	San Roque/Pau Pau	145.763	15.254	Observation	CM	1										
10/25/17	SA	San Roque/Pau Pau	145.761	15.254	Observation	CM	1										
10/25/17	SA	Aqua Reef	145.756	15.255	Capture-SatTag	EI	1	SPLASH	171251	50.3	14.8	U	0167817478	PI4829	PI4830	982.000167817478	982.000190690873
10/25/17	SA	San Roque	145.771	15.258	Observation	UN	1										
10/26/17	SA	Pau Pau Beach	145.771	15.258	Capture	CM	1			43.9	12.2	U	0364290671	PI4833	PI4834	982.000364290671	982.000364287318
10/26/17	SA	Pau Pau Beach	145.769	15.258	Capture	CM	1			39.6	8.4	U	0167837900	PI4835	PI4836	982.000167837900	982.000364285720
10/26/17	SA	Pau Pau Beach	145.779	15.264	Capture	CM	1	SPOT	171257	37.6	7.6	U	0364289669	PI4831	PI4832	982.000364289669	982.000364287481
10/26/17	SA	Pau Pau Beach	145.764	15.255	Capture-SatTag	CM	1	SPLASH	171245	59.5	28.4	U	0167817808	PI4837	PI4838	982.000167817808	982.000190656985
10/26/17	SA	Pau Pau Beach	145.764	15.255	Capture-SatTag	CM	1	SPLASH	171253	49.2	17.6	U	0190685388	PI4839	PI4840	982.000190685388	982.000190685776
10/26/17	SA	Wing Arch	145.794	15.276	Capture-SatTag	CM	1	SPLASH	171252	54.3	19.6	U	0364290508	PI4842	PI4841	982.000364290508	982.000190720976
10/26/17	SA	Wing Beach	145.786	15.270	Observation	CM	1										
10/26/17	SA	Pau Pau Beach	145.771	15.258	Observation	CM	1										
10/26/17	SA	Aqua Resort	145.764	15.255	Observation	CM	1										
10/26/17	SA	Wing Beach	145.794	15.277	Observation	CM	1										
10/26/17	SA	Wing Beach	145.794	15.277	Observation	EI	1										
10/27/17	SA	Outer Managaha	145.711	15.250	Capture-SatTag	CM	1	SPLASH	171254	46.3	13.8	U	0364284942	PI4843	PI4844	982.000364284942	982.000167816236

Table A4 (continued). Summary of 2017 turtle observations, captures, and satellite tag deployments from boat-based snorkel surveys in Guam, Saipan, and Tinian. Data fields as in Table A1.

Date	Isl.	Site	Longitude	Latitude	Type	Sp.	No.	Attach.	Argos ID	SCL	Mass	Sex	Turtle ID	L. Flipper	R. Flipper	Left PIT	Right PIT
10/27/17	SA	Outer Managaha	145.741	15.256	Capture	CM	1	SPOT	171259	42.1	10.0	U	0190220549	PI4847	PI4848	982.000190220549	982.000190557063
10/27/17	SA	transit / Sugar Dock	145.697	15.213	Observation	CM	1										
10/27/17	SA	Managaha	145.694	15.225	Observation	CM	1										
10/27/17	SA	Managaha	145.692	15.231	Observation	CM	1										
10/27/17	SA	South Managaha	145.696	15.238	Observation	CM	1										
10/27/17	SA	South Managaha	145.695	15.235	Observation	CM	1										
10/27/17	SA	Tanapag outer	145.750	15.255	Observation	CM	1										
10/27/17	SA	inside Managaha	145.705	15.234	Observation	CM	1										
10/27/17	SA	Tanapag Lagoon	145.697	15.206	Observation	CM	1										
10/27/17	SA	Tanapag	145.751	15.256	Capture	EI	1	SPOT	171258	42.4	33.0	U	0167828469	PI4845	PI4846	982.000167828469	982.000167831977

Table A5. Summary of 2018 turtle observations, captures, and satellite tag deployments from boat-based snorkel surveys in Guam, Saipan, and Tinian. Data fields as in Table A1.

Date	Isl.	Site	Longitude	Latitude	Type	Sp.	No.	Attach.	Argos ID	SCL	Mass	Sex	Turtle ID	L. Flipper	R. Flipper	Left PIT	Right PIT
8/5/18	SA	Puntan Gloria	15.19275	145.77917	Capture-SatTagApplied	CM	1	SPLASH	171235	54.9	24.8	Unknown	364289464	PI4851	PI4852	982.0003643	982.0003643
8/5/18	SA	Puntan Gloria	15.19032	145.77907	Capture-SatTagApplied	CM	1	SPLASH	171255	47.1	15.8	Unknown	364268094	PI4849	PI4850	982.0003643	982.0003639
8/5/18	SA	Tank South	15.17515	145.79111	Observation	Cet	50										
8/5/18	SA	Puntan Halahai	15.18025	145.786	Observation	CM	1										
8/5/18	SA	Puntan Halahai	15.18025	145.78607	Observation	CM	1										
8/5/18	SA	Tank Beach	15.17704	145.78801	Observation	CM	1										
8/5/18	SA	Puntan Gloria	15.19407	145.77917	Observation	CM	1										
8/5/18	SA	Puntan Gloria	15.19195	145.77979	Observation	CM	1										
8/5/18	SA	Tank Middle	15.17332	145.79196	Observation	EI	1										
8/5/18	SA	Puntan Gloria	15.19467	145.77864	Observation	EI	1										
8/7/18	GU	Matala	13.32849	144.77489	Capture-SatTagApplied	CM	1	SPLASH	171233	44.7	11.8	Unknown	167801878	PI4855	PI4857	982.0001907	982.0001678
8/7/18	GU	Ipan Mobile	13.35817	144.77615	Capture-SatTagApplied	CM	1	SPLASH	171234	55.9	23.4	Unknown	402166215	PI4853	PI4854	982.0004022	982.0004022
8/7/18	GU	Ipan Mobile (gas)	13.35151	144.7767	Capture-SatTagApplied	CM	1	SPLASH	176760	69.8	45.2	Unknown	402167068	PI4858	PI4859	982.0004022	982.0004022
8/7/18	GU	PIC Golf Course	13.3705	144.77826	Capture-SatTagApplied	CM	1	SPLASH	176761	53.2	18.6	Unknown	402165739	PI4860	PI4861	982.0004022	982.0004022
8/7/18	GU	Talofofo	13.32849	144.7747	Observation	CM	1										
8/7/18	GU	Jones Beach	13.35423	144.77592	Observation	CM	1										
8/7/18	GU	Jones Beach	13.35532	144.77571	Observation	CM	1										
8/7/18	GU	Ipan Mobile	13.36427	144.77635	Observation	CM	1										
8/7/18	GU	Ipan Mobile	13.36586	144.77603	Observation	CM	1										
8/7/18	GU	Pirate's Cove	13.36733	144.7771	Observation	CM	1										
8/7/18	GU	Pirates' Cove	13.36728	144.77795	Observation	CM	1										
8/7/18	GU	PIC Golf course	13.36946	144.77766	Observation	CM	1										
8/8/18	GU	Pago Bay	13.42078	144.79427	Capture-SatTagApplied	CM	1	SPLASH	176762	50.0	12.6	Unknown	402166209	PI4862	PI4863	982.0004022	982.0004022
8/8/18	GU	Pago Bay	13.42332	144.7961	Capture-SatTagApplied	CM	1	SPLASH	176763	44.8	12.8	Unknown	402166137	PI4865	PI4864	982.0004022	982.0004022
8/8/18	GU	First Beach	13.40945	144.78636	Capture-SatTagApplied	CM	1	SPLASH	176764	47.9	13.6	Unknown	402165910	PI4866	PI4867	982.0004022	982.0004022
8/8/18	GU	Pago Bay	13.42061	144.79369	Observation	CM	1										
8/8/18	GU	Pago Bay	13.42065	144.79378	Observation	CM	1										
8/8/18	GU	Pago Bay	13.4227	144.79552	Observation	CM	1										
8/8/18	GU	Pago Bay	13.42476	144.79836	Observation	CM	2										
8/8/18	GU	Pago Bay	13.2413	144.79413	Observation	CM	1										
8/8/18	GU	Pago Bay	13.42496	144.80066	Observation	CM	1										
8/8/18	GU	Pago South	13.41589	144.79034	Observation	CM	1										
8/8/18	GU	First Beach	13.40886	144.78563	Observation	CM	1										
8/8/18	GU	Tagachang	13.4056	144.78487	Observation	CM	1										
8/8/18	GU	Ilig North	13.39769	144.78287	Observation	CM	3										
8/8/18	GU	Jeff's North	13.36628	144.77768	Observation	CM	1										
8/8/18	GU	Jeff's North	13.36762	144.77841	Observation	UN	1										
8/9/18	GU	Outside Channel	13.2414	144.69032	Capture	CM	1			58.1	26.2	Unknown	402166256	PI4868	PI4869	982.0004022	982.0004028
8/9/18	GU	Cocos Island North	13.23836	144.65907	Capture	CM	1			58.3	28.2	Unknown	402170849	PI4870	PI4871	982.0004022	982.0004022
8/9/18	GU	Cocos Island South	13.23627	144.6557	Capture	CM	1			53.6	18.4	Unknown	402171385	PI4880	PI4881	982.0004022	982.0004022
8/9/18	GU	Cocos Island South	13.23351	144.65128	Capture-SatTagApplied	CM	1	SPOT	171260	36.9	6.4	Unknown	402165610	PI4872	PI4873	982.0004022	982.0004022
8/9/18	GU	Achang Preserve	13.24093	144.69608	Capture-SatTagApplied	CM	1	SPLASH	176766	63.9	33.6	Unknown	402166392	PI4874	PI4875	982.0004022	982.0004022
8/9/18	GU	Achang Preserve	13.24082	144.6969	Capture-SatTagApplied	CM	1	SPLASH	176765	64.7	37.6	Unknown	402166065	PI4876	PI4877	982.0004022	982.0004022
8/9/18	GU	Achang Preserve	13.24082	144.6969	Capture-SatTagApplied	CM	1	SPOT	171261	41.4	9.4	Unknown	402169532	PI4879	PI4878	982.0004022	982.0004022
8/9/18	GU	Cocos Island South	13.23018	144.64484	Observation	Cet	40										
8/9/18	GU	Achang channel	13.24497	144.68921	Observation	CM	1										
8/9/18	GU	Achang channel	13.24397	144.68991	Observation	CM	1										
8/9/18	GU	Achang channel	13.24364	144.69035	Observation	CM	1										
8/9/18	GU	Achang channel	13.24284	144.69131	Observation	CM	1										
8/9/18	GU	Achang channel	13.24113	144.69232	Observation	CM	1										
8/9/18	GU	Achang channel	13.24115	144.69022	Observation	CM	1										
8/9/18	GU	Outside Achang channel	13.24078	144.69141	Observation	CM	3										
8/9/18	GU	Babi Island	13.23684	144.68044	Observation	CM	1										
8/9/18	GU	Cocos Island South	13.23266	144.64851	Observation	CM	1										
8/9/18	GU	Cocos Island South	13.2325	144.64841	Observation	CM	2										
8/9/18	GU	Achang Channel	13.25009	144.68768	Observation	CM	1										
8/9/18	GU	Outside Achang channel	13.24135	144.69165	Observation	UN	1										
8/10/18	GU	So. Of Pati/Anderson E	13.50938	144.90158	Observation	CM	1										
8/10/18	GU	So. Of Pati/Anderson E	13.50785	144.8978	Observation	EI	1										
8/10/18	GU	So. Of Pati/Anderson E	13.50869	144.90025	Observation	EI	1										
8/10/18	GU	Laderas Towers	13.44087	144.8197	Observation	EI	1										

Table A6. Summary of 2019 turtle observations, captures, and satellite tag deployments from boat-based snorkel surveys in Guam, Saipan, and Tinian. Data fields as in Table A1.

Date	Isl.	Site	Longitude	Latitude	Type	Sp.	No.	Attach.	Argos ID	SCL	Mass	Sex	Turtle ID	L. Flipper	R. Flipper	Left PIT	Right PIT
9/3/19	SA	King Fisher	15.22032	145.78979	Observation	UN	1										
9/3/19	SA	Forbidden Island	15.16096	145.79276	Observation	EI	1										
9/3/19	SA	Forbidden Island North	15.16241	145.79338	Observation	CM	1										
9/3/19	SA	Laolao North E	15.15462	145.76976	Observation	CM	1										
9/3/19	SA	Laolao North E	15.15226	145.77202	Observation	CM	1										
9/3/19	SA	Laolao North E	15.15212	145.77258	Observation	CM	1										
9/3/19	SA	Forbidden Island North	15.16259	145.79272	Capture-SatTagApplied	CM	1	SPLASH	176781	50.3		Unknown		PI6131	PI6132	982.0004106	982.0004022
9/3/19	SA	Laolao North E	15.1521	145.77249	Capture-SatTagApplied	CM	1	SPLASH	178563	50		Unknown		PI6129	PI6130	982.0004106	982.0004086
9/3/19	SA	Laolao North E	15.15126	145.77376	Capture-SatTagApplied	CM	1	SPLASH	178564	62.9		Unknown		PI6128	PI0342	982.0004086	4A0CI62558
9/3/19	SA	Laolao North E	15.15436	145.77104	Capture-SatTagApplied	CM	1	SPLASH	178562	63.3		Unknown		PI6126	PI6127	982.0004086	982.0004086
9/4/19	SA	Dan Dan	15.14416	145.7442	Observation	UN	1										
9/4/19	SA	Dan Dan	15.12857	145.74779	Observation	EI	1										
9/4/19	SA	Dan Dan	15.15601	145.75043	Observation	CM	1										
9/4/19	SA	Dan Dan	15.15474	145.75012	Observation	CM	1										
9/4/19	SA	Dan Dan	15.15357	145.74974	Observation	CM	2										
9/4/19	SA	Dan Dan	15.14614	145.74576	Observation	CM	1										
9/4/19	SA	Dan Dan	15.14831	145.74667	Observation	CM	1										
9/4/19	SA	Dan Dan	15.14844	145.74677	Observation	CM	1										
9/4/19	SA	Dan Dan	15.13119	145.74623	Observation	CM	1										
9/4/19	SA	PIC reef	15.13068	145.6844	Observation	UN	1										
9/4/19	SA	Dan Dan	15.1525	145.74948	Capture-SatTagApplied	EI	1	SPLASH	178565	72.6		Female		PI6134	PI6133	982.0004086	982.0004086
9/4/19	SA	Dan Dan	15.15189	145.74945	Capture-SatTagApplied	CM	1	SPLASH	178566	65.5		Unknown		PI6135	PI6136	982.0004106	982.0004106
9/5/19	SA	CK Channel	15.15343	145.68985	Observation	CM	1										
9/5/19	SA	Fishing Basin	15.18951	145.70235	Observation	CM	1										
9/5/19	SA	CK Channel	15.1427	145.69019	Observation	CM	3										
9/5/19	SA	North of Kingfisher	15.22574	145.79242	Observation	CM	1										
9/5/19	SA	North of Kingfisher	15.22583	145.79266	Observation	CM	1										
9/5/19	SA	West of Kingfisher	15.20503	145.78209	Observation	CM	1										
9/5/19	SA	Old Man by the Sea	15.20685	145.78072	Observation	CM	1										
9/5/19	SA	NW of Marine Beach	15.19495	145.77873	Observation	UN	1										
9/5/19	SA	CK Channel	15.14845	145.6951	Observation	CM	6										
9/5/19	SA	Fishing Basin	15.18837	145.70215	Observation	CM	1										
9/5/19	SA	San Jose Channel	15.1726	145.69562	Observation	CM	1										
9/5/19	SA	Fishing Basin	15.18756	145.70169	Capture	CM	1					Unknown		PI6141	PI6142	982.0004086	982.0004106
9/5/19	SA	Fishing Basin	15.18865	145.70197	Observation	CM	2										
9/5/19	SA	South Fishing Base	15.19054	145.70233	Observation	EI	1										
9/5/19	SA	South Fishing Base	15.1916	145.70305	Observation	CM	1										
9/5/19	SA	South Fishing Base	15.19201	145.70311	Capture	CM	1			44.8		Unknown		PI6143	PI6144	982.0004086	982.0004086
9/5/19	SA	South Fishing Base	15.19177	145.70309	Capture	CM	1			40.1		Unknown		PI6145	PI6146	982.0004086	982.0004106
9/5/19	SA	South Fishing Base	15.1911	145.7023	Observation	CM	1										
9/5/19	SA	Fishing Basin	15.18832	145.7021	Observation	CM	1										
9/5/19	SA	Fishing Basin	15.19016	145.70218	Capture-SatTagApplied	CM	1	SPLASH	178567	55.4		Unknown		PI6137	PI6138	982.0004086	982.0004857
9/5/19	SA	Fishing Basin	15.18804	145.70171	Capture-SatTagApplied	CM	1	SPLASH	178568	67.4		Unknown		PI6140	PI6139	982.0004086	982.0004086
9/7/19	GU	Lafac	13.57287	144.94794	Observation	CM	1										
9/7/19	GU	Lafac	13.57471	144.9492	Observation	CM	1										
9/7/19	GU	Pati to EOD	13.60133	144.94368	Observation	CM	1										
9/7/19	GU	Pati to EOD	13.60126	144.94272	Observation	CM	1										
9/7/19	GU	Anao Point	13.55724	144.93993	Observation	UN	1										
9/7/19	GU	Pati to EOD	13.6012	144.94322	Observation	CM	1										
9/7/19	GU	Pati to EOD	13.60126	144.94183	Capture-SatTagApplied	CM	1	SPLASH	178569	67.5		Unknown		PI6147	PI6148	982.0004086	982.0004086
9/8/19	GU	Tarague	13.61824	144.90417	Capture	CM	1			52.6		Unknown		PI6154	PI6153	982.0004086	982.0004086
9/8/19	GU	Scuba Cut	13.60805	144.90721	Observation	UN	1										
9/8/19	GU	Tarague	13.20476	144.90337	Observation	CM	1										
9/8/19	GU	Tarague	13.61824	144.90417	Observation	CM	1										
9/8/19	GU	Sirena	13.61466	144.90634	Observation	CM	1										
9/8/19	GU	East EOD	13.60124	144.94228	Observation	EI	1										
9/8/19	GU	South of Pati Preserve	13.52796	144.93042	Observation	CM	1										
9/8/19	GU	Tarague	13.61584	144.90558	Capture-SatTagApplied	CM	1	SPLASH	178570	64.6		Unknown		PI6149	PI6150	982.0004086	982.0004086
9/8/19	GU	Tarague	13.62097	144.9034	Capture-SatTagApplied	CM	1	SPLASH	178571	59.6		Unknown		PI6151	PI6152	982.0004086	982.0004086
9/9/19	GU	Ritidian Channel	13.65802	144.8618	Observation	CM	1										
9/9/19	GU	Ritidian	13.63265	144.83956	Observation	UN	1										
9/9/19	GU	Ritidian Channel	13.65739	144.86092	Observation	CM	1										
9/9/19	GU	Ritidian Channel	13.65751	144.86034	Observation	CM	1										
9/9/19	GU	Jinapsan	13.63054	144.89435	Observation	CM	1										
9/9/19	GU	Jinapsan	13.63143	144.89346	Observation	CM	1										
9/9/19	GU	Jinapsan	13.63198	144.89334	Capture-SatTagApplied	CM	1	SPOT	171263	40.8		Unknown		PI6159	PI6160	982.0004086	982.0004086
9/9/19	GU	Jinapsan	13.63131	144.89311	Capture-SatTagApplied	CM	1	SPLASH	178572	44.4		Unknown		PI6157	PI6158	982.0004086	982.0004086
9/9/19	GU	Jinapsan	13.63085	144.89397	Capture-SatTagApplied	CM	1	SPLASH	178573	84.9		Male		PI6155	PI6156	982.0004086	982.0004086
9/9/19	GU	Ritidian Channel	13.65731	144.86	Capture-SatTagApplied	CM	1	SPLASH	178574	47.6		Unknown		PI6161	PI6162	982.0004086	982.0004086
9/9/19	GU	Ritidian Channel	13.65691	144.86034	Capture-SatTagApplied	EI	1	SPLASH	178575	43		Unknown		PI6163	PI6164	982.0004086	982.0004086
9/9/19	GU	Ritidian Channel	13.65668	144.86066	Capture-SatTagApplied	CM	1	SPLASH	178576	48.6		Unknown		PI6165	PI6166	982.0004086	982.0004086

Table A7. Summary of 2016-2019 cetacean observations boat-based snorkel surveys in Guam, Saipan, and Tinian. Spinner dolphins (Stenella longirostris) and possibly bottlenose dolphins (Tursiops truncatus) were the only species observed. Cetacean observations were not recorded in 2013-2015.

Date	Island	Site	Type	Species	Animals	Longitude	Latitude	Notes
10/26/16	TINIAN	circumnavigate	Observation	CET	2	145.672	14.994	spinner dolphins
10/26/16	TINIAN	circumnavigate	Observation	CET	10	145.666	14.960	spinner dolphins
10/29/16	SAIPAN	transit to Managaha	Observation	CET	20	145.704	15.223	spinner dolphins
10/29/16	SAIPAN	Tanapag Lagoon	Observation	CET	7	145.713	15.229	spinner dolphins
11/1/16	GUAM	transit to Bile Bay	Observation	CET	30	144.660	13.277	spinner dolphins
10/25/17	SAIPAN	transit Sugar Dock to Pau Pau	Observation	CET	10	145.714	15.253	bottlenose dolphins?
10/25/17	SAIPAN	transit Pau Pau to Sugar Dock	Observation	CET	>1	145.691	15.235	bottlenose dolphins?
10/27/17	SAIPAN	Managaha	Observation	CET	2	15.255	145.758	bottlenose dolphins?
10/27/17	SAIPAN	South Managaha	Observation	CET	20	15.252	145.714	spinner dolphins
8/5/18	SAIPAN	Tank South	Observation	CET	50	15.175	145.791	spinner dolphins
8/9/18	GUAM	Cocos Island South	Observation	CET	40	13.230	144.645	spinner dolphins
9/5/19	SAIPAN	Old Man by the Sea	Observation	CET	3	15.211	145.784	spinner dolphins
9/8/19	GUAM	Pati Preserve	Observation	CET	3	13.571	144.947	spinner dolphins
9/9/19	GUAM	Hagatna Harbor	Observation	CET	20	13.486	144.753	spinner dolphins