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Pacific Islands Fisheries Science Center
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NOAA FISHERIES

Report to the Western Pacific Regional Fishery Management Council

Composite image of bigeye tuna prey, all collected during the bigeye tuna oceanography survey. Photo not to scale. Photo credit: Jonathan Whitney.

The Pacific Islands Fisheries Science Center (PIFSC or Center) administers and conducts scientific research and monitoring programs that produce science to support the conservation and management of fisheries and living marine resources. This is achieved by conducting research on fisheries and ocean ecosystems and the communities that depend on them throughout the Pacific Islands region, and by dedicating efforts to the recovery and conservation of protected species. The Center is organized into four major divisions: the Operations, Management, and Information Division (OMI); Fisheries Research and Monitoring Division (FRMD); Protected Species Division (PSD); and Ecosystem Sciences Division (ESD).

PIFSC continues to improve its science and operations through collaboration and integration across divisions, and increased communication, cooperation, and coordination with partners and stakeholders. In 2018, the Center developed a five-year framework for annual prioritization of research and monitoring activities in order to fully utilize the capabilities of PIFSC and its partners (e.g., NOAA Fisheries Pacific Islands Regional Office (PIRO); Western Pacific Regional Fishery Management Council (WPRFMC)). In 2019, the Center released an updated five-year science plan. All activity updates and reports herein are organized in accordance with the research themes (per the PIFSC Science Plan 2019–2023) outlined below.

1) Promote Sustainable Fisheries
2) Conserve Protected Species
3) Research to Support Ecosystem-based Fisheries Management (EBFM) and Living Marine Resource Management
4) Organizational Excellence

This report concludes with a listing of publications produced during this reporting cycle.

1. Promote Sustainable Fisheries

Main Hawaiian Islands Small Boat Scoping Meetings

Staff from FRMD and ESD participated in the Hawai‘i Small Boat Working Group (HSBWG), which held island-wide scoping meetings on the islands of O‘ahu, Kaua‘i, Moloka‘i, Hawai‘i, and Maui from April 25 to May 9, 2024. The scoping meetings were convened by the HSBWG, which is composed of representatives from NOAA Fisheries, State of Hawai‘i Department of Land and Natural Resources (DLNR), WPRFMC, Hawai‘i Fishermen’s Alliance for Conservation and Tradition, and the Pacific Islands Fisheries Group. The goal of the island-wide scoping meetings is to reconnect with the fishing communities on small boat fisheries issues affecting the island communities and solicit inputs to improve information for fisheries management and improve communications. PIFSC granted the Council with funds to support this important endeavor.

PIFSC maintained a strong consistent presence throughout the meeting series highlighting various PIFSC research activities, such as the uku total catch estimation pilot project, bottomfish biosampling, Hawai‘i small boat cost-earning survey, uku population genetics, tuna diet studies, and larval drift simulations. PIFSC staff answered questions from the fishing communities pertaining to fisheries research and data collection and provided information and contacts for future dialogue. Staff gathered notes about fisheries research and data needs expressed by the communities which can be used to support research priority development in the future. Additionally, staff promoted some of the ongoing projects that require fisher support like the pilot project to estimate total catch by sampling the Hawai‘i vessel registries and the population genetics of uku and the networking for the BioSampling Program and the Pelagic Research Program.

PIFSC is committed to enhance its engagement, transparency, and communication with the fishing communities through in-person meetings to build its network of fishers to support improved science and data collection. Going out to the communities as a unified group of agencies and fisher groups fosters partnership and brings better support for the fishing community.

Hawai'i Small Boat Fisheries Scoping Meeting participants in Hilo on May 2, 2024.

ISC Striped Marlin Peer-Review

Members of FRMD played an integral part in establishing and conducting the first ever external review for an International Scientific Committee for Tuna and Tuna-Like Species in the North Pacific Ocean (ISC) stock. Kristen Koch (Director Southwest Fisheries Science Center, U.S. delegation co-lead), Felipe Carvalho (PIFSC, FRMD Stock Assessment Program Leader, U.S. delegation co-lead) and Emily Crigler (FRMD) were instrumental in securing funding to support the review. The U.S. delegation has championed this effort to the ISC for the last few years. Contracting support from the Western and Central Pacific Fishery Commission Secretariat allowed three reviewers: Hiromu Fukuda (Japan), Simon Hoyle (New Zealand), and Ian Stewart (United States), to be enlisted to review the Western and Central North Pacific Ocean Striped Marlin (WCNPO-MLS) assessment. Management recommendations based on the WCNPO-MLS assessment are highly relevant to the Hawai'i longline fishery as the results of the assessment impact the current stock rebuilding plan.

Michelle Sculley (FRMD Stock Assessment Program and Chair of the Billfish Working Group) did an exemplary job ensuring a comprehensive presentation of the working groups material and was supported by Jon Brodziak (FRMD Stock Assessment Program—ISC Billfish Workgroup member) and other members of the working group. The in-person review meeting took place April 15–19, 2024 at the Institute of Oceanography, National Taiwan University (IONTU), Chinese Taipei and participants were hosted by Yi-Jay Chang (IONTU Associate Professor, ISC Billfish Workgroup member). Robert Ahrens (FRMD, ISC Vice Chair) chaired the review panel. Participants from Taiwan, Japan, the Pacific Community, and the United States participated in discussions with the peer review panel about how to improve the current stock assessment model in the future. A consensus report from the review panel has been submitted to the ISC and will be available following its presentation at the ISC Plenary Session June 17–25, 2024 in Victoria, B.C., Canada.

The ISC Billfish Working Group and the external peer review panel in Taipei, Chinese Taipei.

Guam Bottomfish Fishery Independent Survey

The Guam Fishery-Independent Survey Project is spearheaded by PIFSC but is funded by the Inflation Reduction Act (IRA) and the Cooperative Research Program (CRP). PIFSC is responsible for the overarching project and experimental design, ensuring that the methodologies and scientific inquiries align with broad research objectives, and conservation goals. The first year of this initiative marks a pilot study phase, which is fundamental to developing an operational survey in subsequent years. Alongside PIFSC, Lynker Technologies and the Pacific Islands Fisheries Group (PIFG) play crucial roles in handling the majority of the on-water logistics. This collaboration forms a strong foundation for building local capacity and creating standardized, replicable survey methods tailored to Guam's unique marine environment.

The primary data collection activities of the project involve hook-and-line research fishing and the use of underwater stereo camera systems. These methods are designed to gather direct, fishery-independent data crucial for accurate and comprehensive assessments of fish populations. The collected biosamples will be provided to the PIFSC Life History Program, where they will be used for age and growth studies. These studies are essential for enriching the data used in the Guam Bottomfish stock assessment, offering detailed insights into the life cycles and growth patterns of key species, thereby enhancing the scientific foundation for sustainable fishery management decisions.

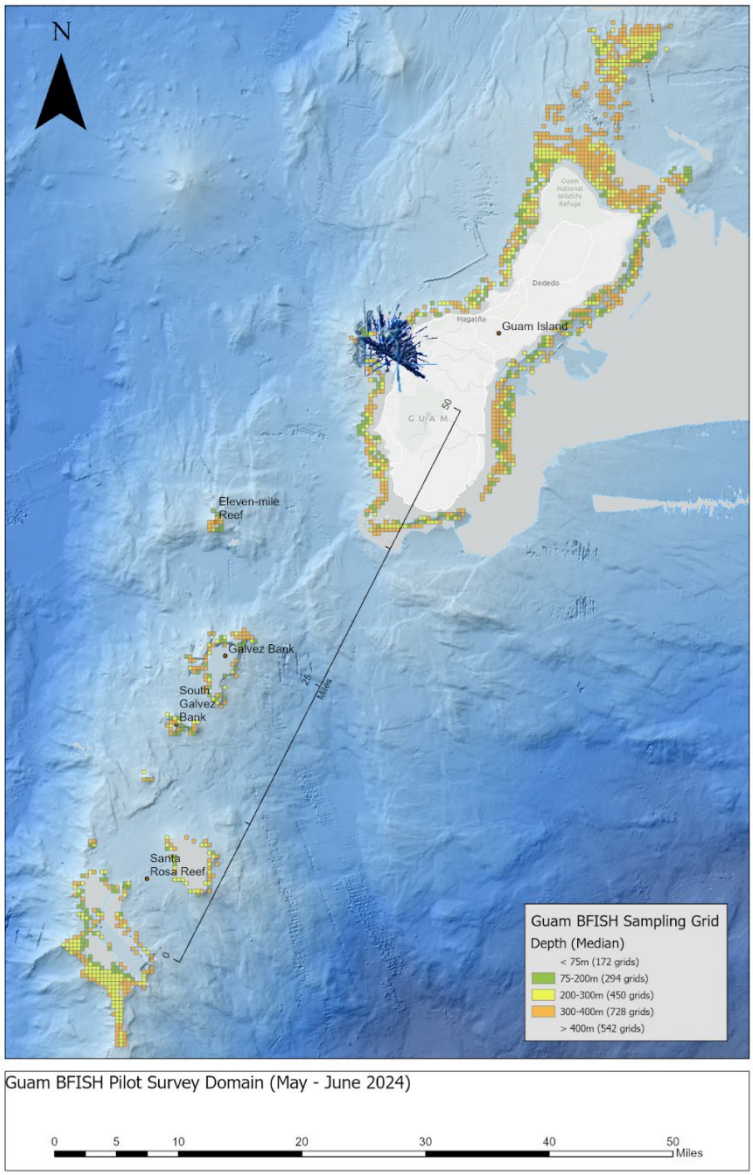

Figure 1. Survey domain for the 2024 pilots study leaading to a Guam Bottom Fishery-Independent Survey.

This integrated approach not only facilitates the collection of vital scientific data but also engages local communities and stakeholders. The project's commitment to incorporating local fishers and leveraging their expertise ensures that the survey methods are both effective and reflective of Guam’s fishing practices. By melding scientific research with community involvement, the Guam Fishery-Independent Survey Project is setting a new standard for the sustainable management of marine resources and fostering a deeper connection between local communities and conservation efforts.

The Guam Fishery-Independent Survey Project has been marked by several significant activities that have already taken place or are scheduled to occur shortly. The project

commenced with its first constituents meeting held on March 25–26, 2024, which saw the participation of over 35 stakeholders. This initial gathering was crucial for aligning the project's objectives with community expectations and gathering input from a broad spectrum of local stakeholders, including fishers, conservationists, and representatives from local government.

Participants in the first constituents meeting on the design and implementation of a cooperative research, fishery-independent survey for the Guam bottomfish stock.

Following the successful first meeting, a second constituents meeting is planned for June 4–5, 2024. This upcoming session is set to focus on the development of fisher-developed research fishing methods. The involvement of local fishers in crafting these methods is pivotal, ensuring that the techniques are not only scientifically sound but also practical and adapted to local conditions. This approach fosters a deeper sense of ownership and engagement among the community, which is essential for the long-term success of the project.

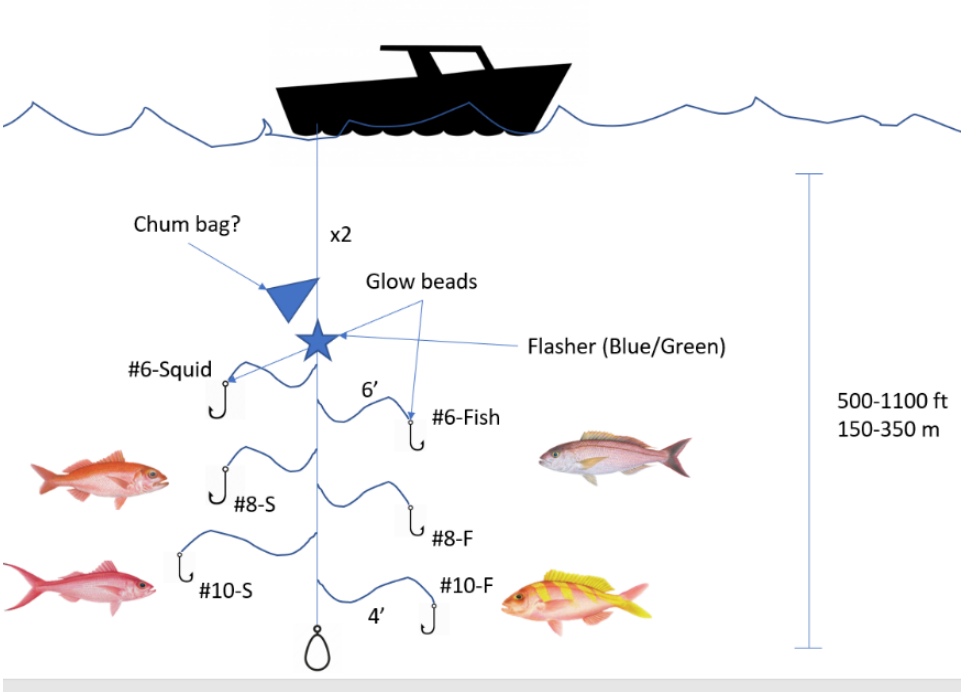

Figure 2. Diagram of the presumptive bottom standardized fishing rig to be used in the pilot bottom fish survey for Guam.

Field operations are scheduled to run from approximately June through September. These operations will primarily consist of research hook and line fishing, utilizing 2-3 boats, and will also include specialized camera training on an additional boat. The research fishing will allow for the collection of vital empirical data necessary for assessing fish stock health, while the camera training is aimed at equipping local teams with the skills needed to perform underwater visual surveys. These activities are designed to enhance the project's data collection capabilities and further involve local community members in scientific research endeavors.

Electronic Technologies Working Group Meeting Highlights

The Electronic Technologies Working Group (ETWG) met in Honolulu from April 23–25, 2024. Participants from all regions, Atlantic Highly Migratory Species (HMS) and NMFS Office of Science and Technology (OST) were in attendance. The ETWG discussed: 1) presentations on regional electronic technologies (ET) programs; 2) revising the national ET policy directive, electronic monitoring (EM) cost allocation procedural directive; sunsetting the regional ET implementation plans, and developing a strawman for a national ET roadmap; 3) Magnuson-Stevens Fishery Conservation and Management Act confidentiality rulemaking; 4) Paperwork Reduction Act compliance for eLogbook programs; 5) updates from national programs; and 6) updates on several technical memoranda that have been under development (EM data in stock

assessments, integrating protected resources data into EM programs, and white paper on eLogbook programs in the Northeast and the Pacific Islands).

WPRFMC staff and Hawaii Longline Association Executive Director (Eric) attended one session on April 24, 2024, to hear regional overviews and participated in a discussion on the Pacific Islands region EM issues and implementation.

Several of the ETWG participants on an auction tour, led by John Kaneko, Hawaii Seafood Council, and Eric Kingma, HLA.

2. Conserve Protected Species

SCOPE 2024

The Cetacean Research Program is presently at sea conducting the Survey for Continued Observation of Pseudorca Extent, or SCOPE 2024, an effort to collect biological samples of false killer whale to reduce uncertainty in population structure and range across the central Pacific. The survey is taking place southeast of Hawai‘i in a region of predicted high density of false killer whales, but where there is little or no prior survey effort or genetic samples that can contribute to delineation of false killer whale stocks.

We are collecting a wide variety of data streams to maximize the effort in this rarely surveyed area. Acoustic towed array data are being collected along survey lines starting 2.5 hours before sunrise, in order to localize any false killer whale groups in the area before visual effort starts, and continues until sunset. During daylight hours visual observer surveys are conducted, to visually locate and track any false killer whale groups. Additionally, opportunistic photo ID, biopsy, small boat launch, satellite tag deployment, and eDNA collection are conducted as needed for encountered false killer whale groups. Nightly conductivity-temperature-density (CTD) casts to collect water samples are being conducted. These data streams will inform future development of the Hawai‘i pelagic false killer whale management area.

Pearl Harbor sea turtle surveys and preliminary telemetry movements

Under a multi-year inter-agency agreement between NOAA and the Department of Navy, in January 2024, MTBAP conducted fieldwork to understand the presence, distribution, and habitat use of sea turtles in Pearl Harbor. Pearl Harbor is both a strategic military area and a resource rich wildlife habitat, yet, until the start of this project, research on the movement behavior of sea turtle species in the area was non-existent. Given this context, this study has important implications to future development and management efforts in the region.

Fieldwork included snorkel surveys consisting of two or more free divers swimming transects at various locations within Pearl Harbor to observe and identify turtles. Information on species, size, and sex of turtles was communicated via hand signals to staff on-board the small boat, who then recorded that information in addition to time and location (GPS). Whenever feasible, attempts were made by free diving (2–10 meters) to capture turtles resting/foraging on the seafloor or in caves, or swimming in the water column. Captured turtles were immediately brought to the surface, lifted into a boat, then processed on deck (Figure 3) or on shore.

All turtles were measured and equipped with metal Inconel flipper tags (for future identification), and turtles of appropriate condition were outfitted with satellite tags to understand their movements. The results of the fieldwork component of the project included:

- 6 days of in-water surveys,
- The observation of 81 green turtles and 1 hawksbill turtle,
- The capture of 30 green turtles and the deployment of 23 satellite tags.

As of May 6, 2024, 14 (60.9%) of the 23 deployed satellite tags are still transmitting. Most of the turtles have remained within Pearl Harbor, concentrating activities at multiple locations (Figure 4). These areas vary by individual, but there is overlap at several sites.

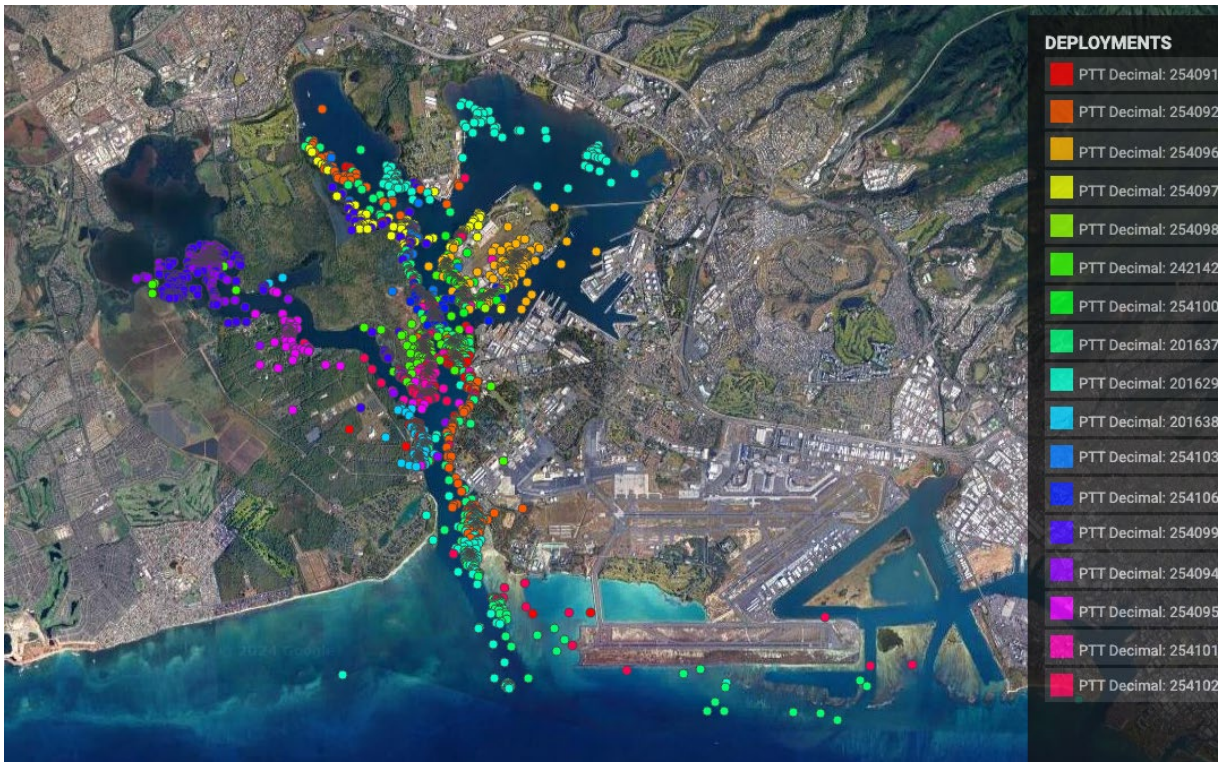

Figure 3. Locations (points) of various green turtles equipped with satellite tags after being captured in Pearl Harbor, indicating the use of multiple locations.

Two of the turtles equipped with satellite tags departed Pearl Harbor after tagging. The first was a subadult turtle (PTT# 201629) measuring 74.1 cm straight carapace length that was originally captured on January 16, 2024 near the mouth of Pearl Harbor. The turtle stayed in that same approximate area for the first two months of tracking, then migrated further into Pearl Harbor for the next three weeks, then migrated out of the harbor on a migration that involved stops on Maui, Molokaʻi, Kauaʻi, and Niʻihau (Figure 4). The turtle recently left Niʻihau and is currently in waters just north of Kauaʻi.

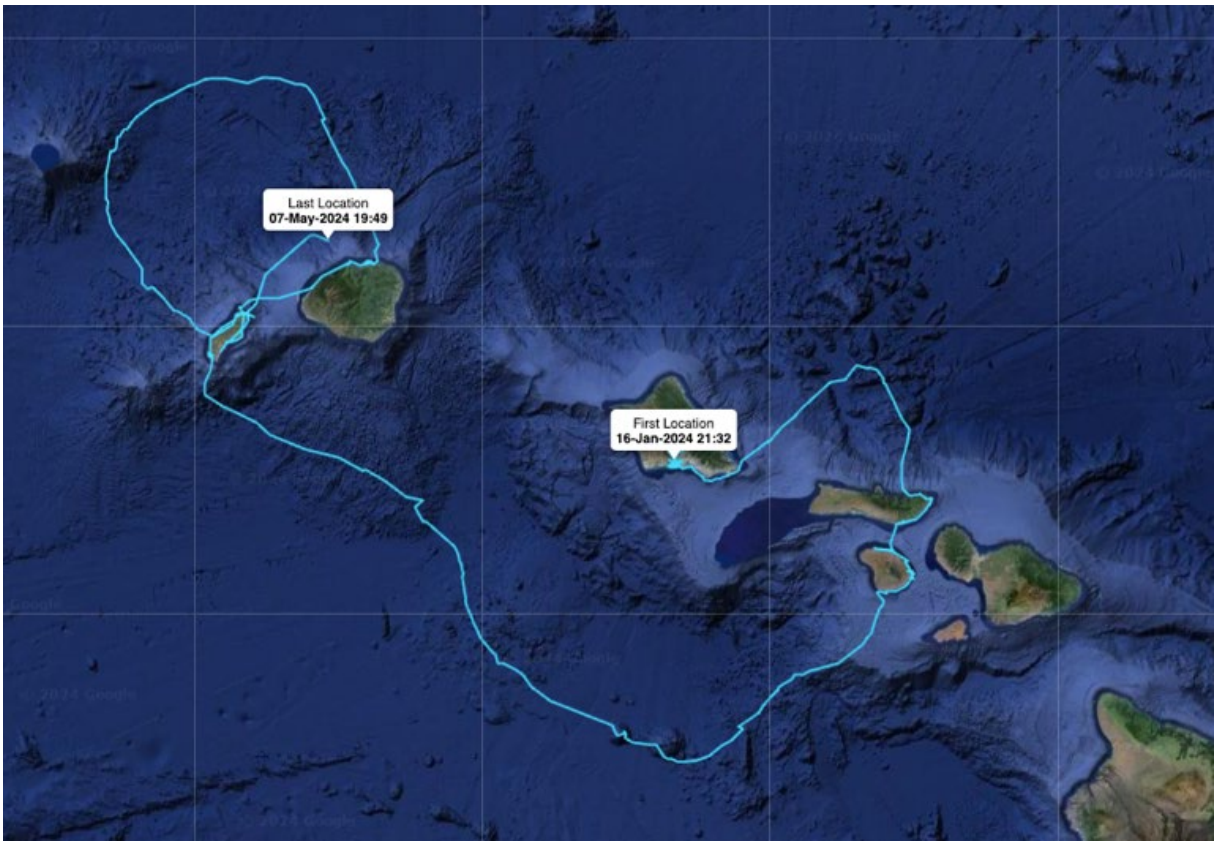

Figure 4.Moement track of the subadult sea turtle PTT# 201629.

The second was an adult female (PTT# 254094) measuring 94.7 cm straight carapace length that was captured on January 14, 2024 in a cave across the channel (Waipio Peninsula) from the southernmost point of Ford Island. This turtle moved into the West Loch of Pearl Harbor and remained there for the approximate first month of tracking, then departed on a long-distance migration to Kapou, presumably to nest. This is the first migration recorded via satellite telemetry of a nesting size female green turtle between the main Hawaiian Islands and Kapou.

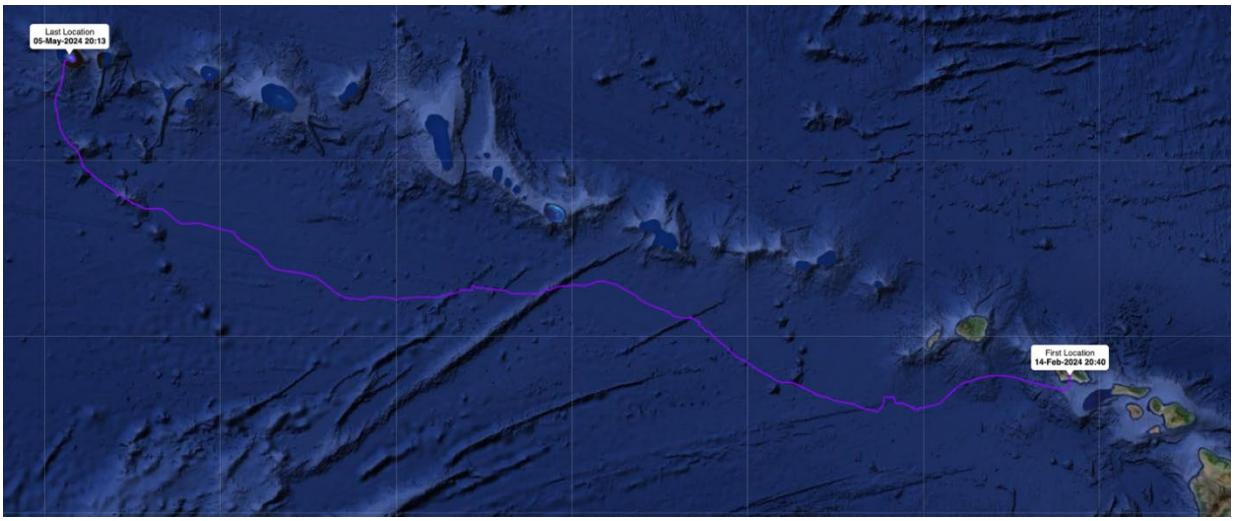

Figure 5.Movement track of the adult female green turtle PTT# 254094.

Satellite tagging of loggerhead sea turtles bycaught in Hawai‘i shallow-set longline fisheries

Approaches to reduce loggerhead and leatherback sea turtle bycatch in the Hawai‘i longline fisheries include the development of species distribution models and EBFM tools aimed at establishing spatio-temporal regions of potential high sea turtle bycatch. To refine and improve upon loggerhead species distribution models (i.e., EBFM tools), there is a need to deploy satellite tags on loggerhead sea turtles that interact with the Hawai‘i longline fisheries. Although satellite tags have been previously deployed on North Pacific loggerhead turtles, these tags were deployed on turtles that were primarily 1) released in the western North Pacific Ocean, 2) raised in captivity, and 3) deployed 15+ years ago.

As a result of these caveats, there is a need for newer, more recent movement data to inform our contemporary models. To address this gap, in 2021, PIFSC PSD and FRMD researchers—in close collaboration with the Pacific Islands Observer program—organized, developed, and implemented a post-hooked sea turtle satellite tag deployment project. These efforts included a tag deployment training module for fishery observers and the deployment of satellite tag kits for loggerhead sea turtles to the observers of the Hawai‘i shallow-set longline (SSLL) fisheries.

To date, a total of 51 satellite tags have been deployed on loggerhead sea turtles bycaught in the Hawai‘i SSLL fishery (Figure 6). This satellite tagging effort has helped generate critical, fundamental movement data needed to improve the accuracy of the Protected Species Ensemble Random Forest (PSERF) model. Further efforts to increase the deployment of satellite tags on post-hooked turtles in the Hawai‘i SSLL

fisheries will help facilitate increased movement data collection and PSERF model accuracy.

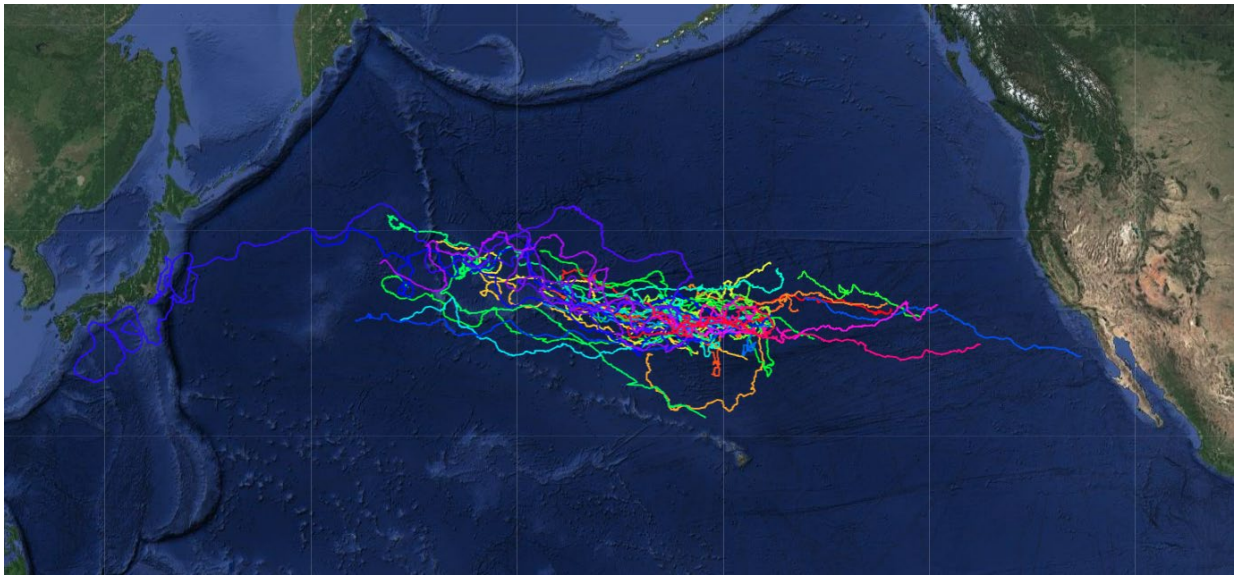

Figure 6. Post-hooking movement patterns of 51 loggerhead sea turtles bycaught in the HI SSLL fishery between 2019 and 2024.

Additionally, the general life-history paradigm for this loggerhead population is that after hatching in Japan, juveniles develop in the central North Pacific before migrating back to Japan as adults. A small proportion of those juveniles are also thought to migrate to the west coast of Mexico for development. Despite these commonly held beliefs, empirical evidence has remained lacking. Nonetheless, several of the tagged loggerheads have provided evidence for both distribution pathways with two juveniles crossing the eastern Pacific barrier and migrating into the waters of western Mexico, and another adult sized turtle migrating into reproductive waters of Japan (Figure 6). Having direct evidence of these movement pathways can support ongoing research into population dynamics and population viability analysis.

Designing tagging technologies for the direct attachment of satellite tags onto leatherback sea turtles.

As with loggerhead sea turtles, approaches to reducing leatherback sea turtle bycatch in the Hawai‘i longline fisheries also include the development of species distribution models (e.g., PSERF) for EBFM. Unlike hardshell turtles, techniques to attach satellite tags that require boarding leatherback sea turtles onto a vessel are not practical in a fishery setting. In response to this gap, PIFSC researchers in collaboration with NOAA Office of Protected Resources’ marine turtle veterinarian, WPRFMC, and Wildlife Computers (a leading wildlife telemetry solutions company) initiated the design of new

tagging technologies that would enable vessel-side tagging of bycaught leatherback sea turtles.

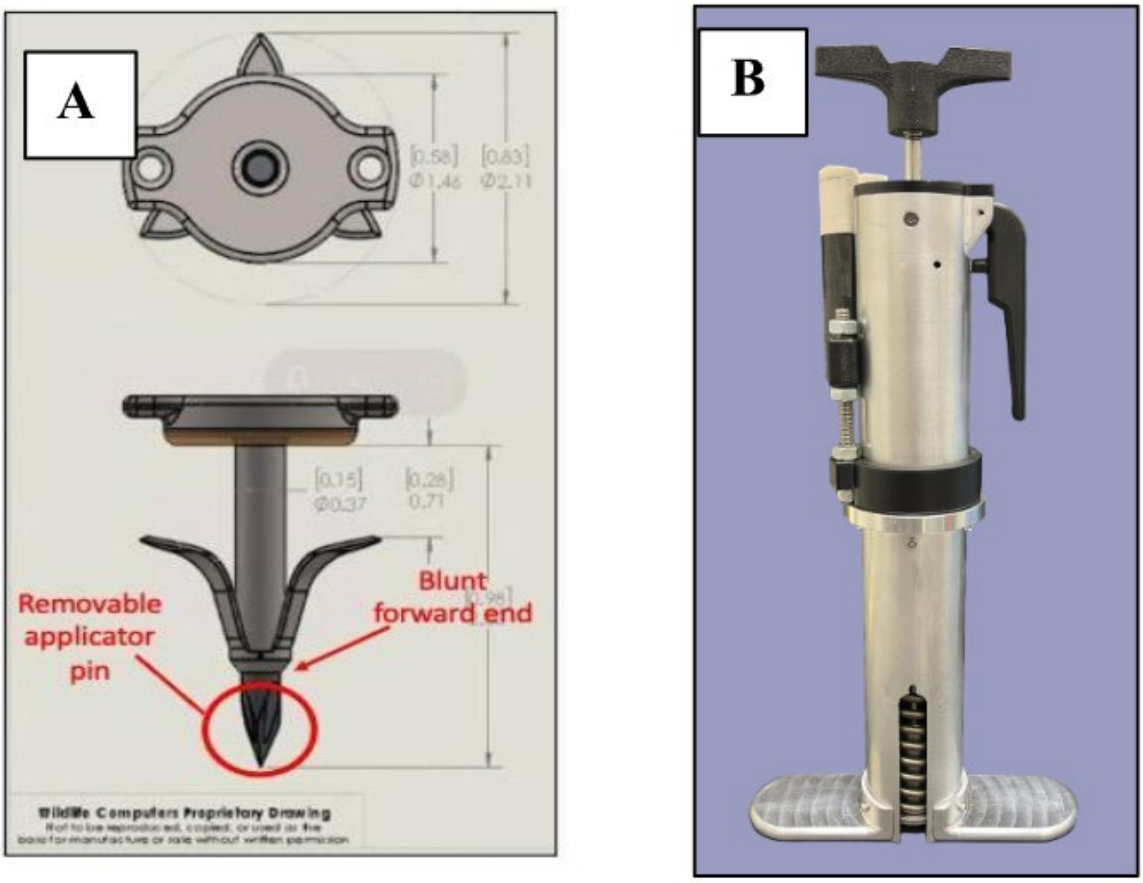

Figure 7. Two of the primary components of the new leatherback tagging technologies, including A) tag head (or anchor), and B) deployment device.

In previous reports to the Council, we discussed the design and production of two of the main components necessary for tagging leatherback turtles in this manner, which include: A) a tag head (i.e., tag anchor) designed specifically to safely implant in leatherback sea turtle carapaces, and B) a deployment device that results in the precise implantation of the tag head into the turtle's carapace.

More recently, the team made major advancements on the design of the third primary component necessary for leatherback tagging from the deck of fishing vessels—a power assisted extension pole that can attach to the deployment device. This will enable a tagger to use the pole to reach down to a leatherback (sometimes 2–4 m below, depending on the vessel's freeboard) that has been brought alongside a fishing vessel to trigger implantation of the tag. The pole extension trigger (Figure 8) is the top component of the tagging device. Multiple one-meter sections can be added between

the extension trigger and the deployment device to allow for multiple different heights depending on need.

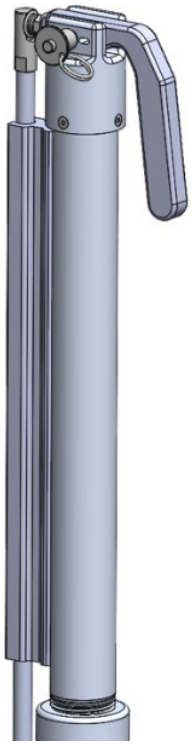

Figure 8. Design of the third primary component of the new leatherback tagging technologies, a pole extension that will allow for implantation from a raised deck.

In August/September of 2024, PIFSC staff will be working with staff from two other NOAA science centers to test the novel tagging anchor alongside the traditional pygal attachment method on leatherbacks in the Atlantic (where the species is much more common) as “proof of concept”. This will represent a crucial step in getting the method and device approved for use on Pacific leatherbacks caught in the Hawaii SSLL fishery. Several countries are eagerly awaiting the outcome of these initial trials for potential implementation in local research initiatives, including New Zealand where bycatch of western Pacific leatherback turtles has recently emerged as a problem.

Bluetooth Tags for Hawaiian Monk Seals and Hawaiian Green Sea Turtles

Brief history of project

In 2018, PSD’s monk seal and sea turtle research teams decided to test putting Bluetooth® tags on seals and turtles to enable field biologists to easily detect which animal they were looking at without relying on other close-up methods of detection, such as natural or applied markings. This is like an AirTag® for seals and turtles. This

idea later morphed into using a combined long range (LoRa) and Bluetooth tag (BoRa), so we could use LoRa technology to track animals that visit an atoll, even when no field staff were there. We had a third-party company design two versions of these tags with smaller ones having nine months of battery life (for seals) and bigger ones with three–year battery life (for turtles). LoRa technology allows data to be transmitted up to 16 km range to a LoRa receiver, which can then send the data via the internet to a portal or mobile app for viewing.

Current status

We have decided to focus our current technological development efforts on the Bluetooth tags for seals and turtles; something that will be particularly useful in advancing our population monitoring efforts in areas where terrestrial habitat loss is threatening the existence of these species. PSD was recently awarded IRA funds to further develop this tool at Lalo in the Papahānamokuākea Marine National Monument (PMNM).

Future aspirations

1. We are going to evaluate various Bluetooth tag options combined with a mobile app to allow quick identification of animals within a 15 m radius of field staff.
2. Other possibilities with Bluetooth tags are to monitor all animals visiting a particular area using a Bluetooth scanner installed in that area and to use drones fitted with Bluetooth scanners to monitor animals in an area.

The Upcoming 2024 Hawaiian Monk Seal Field Season

The Hawaiian Monk Seal Research Program (HMSRP) is currently completing preparations for the upcoming 2024 field season. Field staff will establish field camps and conduct monk seal research at four of the six major breeding locations within (PMNM), at Lalo (French Frigate Shoals), Kamole (Laysan Island), Kapou (Lisianski Island), and Manawai (Pearl and Hermes Reef). Fortunately, the U.S. Fish and Wildlife Service (USFWS) and DLNR maintain year-round presence at Kuaihelani (Midway Atoll) and Hōlanikū (Kure Atoll) respectively, which are the other two major breeding locations, and conduct bi-weekly monk seal surveys to monitor the population at those sites.

HMSRP and other agencies have expanded partnerships in recent years with the goal of increasing their mutual capacity to conduct critical work in PNMN, given the budgetary constraints and logistical challenges of working in this remote area. Additionally, this year, we will be undertaking our most extensive utilization of partnerships and capacity building to date with staff from the Marine Turtle Biology and

Assessment Program (MTBAP), the Papahānaumokuākea Marine Debris Program (PMDP), USFWS. DLNR will assist with monk seal research, and HMSRP will support partners as they undertake their own research objectives.

HMSRP teams will depart Honolulu onboard the M/V *Imua* on May 29 and June 7, 2024. Updates from the season will be shared in the next report.

3. Research to Support EBFM and Living Marine Resource Management

Makapu‘u Precious Coral Bed Survey

In fiscal year (FY) 2025, the NOAA Fisheries Deep Coral and Sponge Research and Technology Program will return to the Pacific Islands. Last active in the Pacific Islands from 2015 to 2017 with the Campaign to Address Pacific Monument Science, Technology, and Ocean Needs (CAPSTONE) program, these multi-year science efforts rotate across the nation due to the high costs of deep-sea research.

To prepare for this return, we surveyed our partners to understand their priorities and are gearing up for a workshop to finalize the full science plan. However, an opportunity emerged in FY24, before funding was received, to address a near-term Council priority: surveying the Makapu‘u precious coral bed and updating its assessment.

This survey, conducted in partnership with NOAA Research’s Office of Ocean Exploration Research and the Ocean Exploration Trust, will utilize one day at sea on the R/V *Nautilus* to survey the Makapu‘u precious coral bed. While the primary objective is to gather data for assessing its precious coral resources, a secondary goal is to delineate the furthest and deepest boundary.

With this data, PIFSC will calculate maximum sustainable yield (MSY) and facilitate essential fish habitat (EFH) determination for Hawaiian precious corals. This activity will enable us to reevaluate MSY for the Makapu‘u bed and compute MSY proxies for any new conditional beds identified in the precious coral EFH amendment.

Using Uncrewed Marine Systems to assess near-island gradients in productivity around the main Hawaiian Islands

The Hawaiian Archipelago sits squarely in the North Pacific subtropical gyre, one of the least productive ocean areas on the planet. Yet, paradoxically, the Hawaiian Islands are home to a highly productive marine ecosystem that houses a high diversity of marine species and a variety of dolphins and whales, supports numerous insular and pelagic fisheries, and contains an extensive and highly diverse coral reef ecosystem. To that end, the Hawaiian Island chain represents an oasis in an otherwise barren ocean seascape.

Near-island ocean dynamics provide essential energetic subsidies to pelagic and nearshore higher trophic groups in Hawai‘i. However, ocean conditions proximate to islands are radically undersampled, owing to ship accessibility issues and satellite limitations. Further, remote sensing of the ocean is limited to observations at the surface, which may or may not be representative of ocean conditions below the surface.

The Hawai‘i Integrated Ecosystem Assessment recently completed a mission using uncrewed marine systems known as wave gliders to survey phytoplankton biomass and other key ocean parameters near each of the main Hawaiian Islands (Figure 9). Data collected will provide novel insight into ocean dynamics that underpin Hawai‘i-based fisheries and support ecosystem-based fisheries management in the region.

Figure 9. Wave Glider sampling path through the main Hawaiian Islands

Bigeye Tuna Oceanography Survey 2024

The bigeye tuna oceanography survey spent 28 days on the NOAA Ship *Oscar Elton Sette* between March 18 and April 14, 2024, characterizing the changes in pelagic ecosystem structure associated with open ocean eddies. The purpose of this survey was to comprehensively sample the physical, chemical, and biological habitat characteristics in open ocean eddies with the intent to improve understanding of the effects of oceanographic and climate variability on pelagic ecosystems.

Composite image of bigeye tuna prey, all collected during the bigeye tuna oceanography survey. Photo not to scale. Photo credit: NOAA Fisheries. Photographer: Jonathan Whitney.

Two eddies to the south of the Hawaiian Islands were sampled: a cyclonic eddy about 80 miles southwest of O‘ahu and an anticyclonic eddy about 325 miles south of O‘ahu, in an area with substantial longline vessel activity. In order to better understand how changes in oceanographic conditions propagate through the pelagic food web, we are interested in the whole ecosystem, from phytoplankton to megafauna.

Taking a size-based approach to sampling (e.g., using a suite of gear types that target organisms of different sizes and swimming abilities) allows us to more readily integrate the data into size-based ecosystem models. Because most of the HMS species NOAA manage to undergo diel vertical migration (DVM), sampling was replicated day and night to capture differences due to DVM. During the survey, we used a combination of shipboard (ADCP, CTD, EK80) and towed gear (Cobb trawl, Tucker, IKMT, and bongo) to sample the physical, chemical, and biological environment.

Water collection during CTD casts gives us estimates of size-fractionated Chl-a concentrations and phytoplankton biomass and allows for eDNA analysis of the holistic pelagic ecosystem from microbes to megafauna. A variety of net tows gives estimates of total and size-fractionated biomass (bongo), provide information on the distribution and abundance of ichthyoplankton (including highly migratory species; IKMT) and micronekton (tucker), and provide samples for forage and diet analysis as well as voucher specimen for genetic libraries.

Active acoustics gives us estimations of relative biomass and composition of target species and micronekton (i.e., HMS and protected species forage). The integration of all these methods coupled in space and time provides a robust characterization of the pelagic ecosystem in cyclonic and anticyclonic eddies. Resolving the links between oceanographic processes and ecosystem structure is needed to advance the objectives of NOAA's Climate, Ecosystems, and Fisheries Initiative and progress towards EBFM.

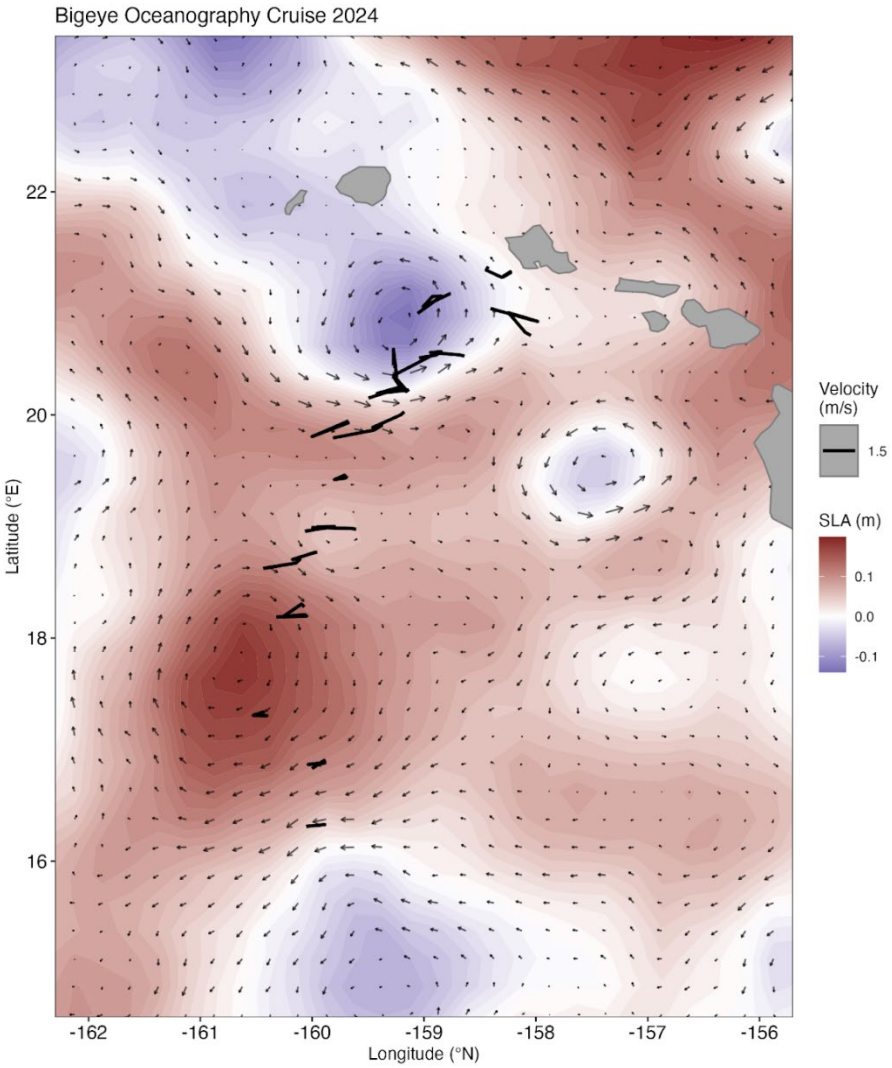

Figure 10. Sampling locations for the bigeye tuna oceanography survey.

4. Organizational Excellence

Administrative Reports

Ahrens R, Crigler E. 2024. Observer coverage levels and the precision of take estimates. Pacific Islands Fisheries Science Center, PIFSC Administrative Report, H-24-01, 10 p. https://doi.org/10.25923/ne62-n866

Data Reports

Bigelow K. 2024. Catch and effort of U.S. purse seine vessels inside and outside U.S. EEZ Pacific Islands Fisheries Science Center, PIFSC Data Report, DR-24-04, 13 p. https://doi.org/10.25923/jnma-xz97

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