National Marine Fisheries Service
Pacific Islands Fisheries Science Center

September 2022

NOAA FISHERIES

Report to the Western Pacific Regional Fishery Management Council

Tuna larva caught in the 2-meter ring net during the Bigeye Tuna Oceanography cruise. (Photo: NOAA Fisheries)

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 five major divisions: the Operations, Management, and Information Division (OMI); Science Operations Division (SOD); 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 5-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 5-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

FRMD Back On The Road After Two Years: Marianas Fishery Agency and Fishing Community Engagement

PIFSC Fisheries Research and Monitoring Division (FRMD) is back on the road with a team of scientists and fisheries management specialists aiming to jumpstart community engagement after a two-and-a-half-year in-person hiatus due to the pandemic. The team, led by T. Todd Jones, included Marlowe Sabater, Rob Ahrens, Felipe Carvalho, Jenny Suter, Erin Bohaboy, Hongguang Ma, Toby Matthews, and Mia Iwane. The FRMD team traveled to Guam and Saipan from August 7 to 14, 2022, to meet with its territorial fishery agency partners, Guam Division of Aquatic and Wildlife Resources (DAWR), the Commonwealth of Northern Mariana Islands (CNMI) Division of Fish and Wildlife (DFW), the Guam Bureau of Statistics and Plans, fishing communities, and the advisers of the Western Pacific Fishery Management Council. The trip kicked off with a courtesy visit to CNMI Lt. Governor Arnold Palacios for a briefing on the mission objectives and updates on fisheries science activities.

Figure 1. Lt. Governor Arnold Palacios (middle), DFW Director Manny Pangelinan (right from the Lt. Gov), and Council Member John Gourley (second from the right) with staff from PIFSC FRMD and the Western Pacific Fishery Management Council (WPFMC) . Photo credit: Floyd Masga.

Lt. Governor Palacios reported that the bottomfish fishery in CNMI is slowly picking up; new fishermen are entering the fishery after the training conducted by Mr. Lino Tenorio made possible with funding received from the CNMI government through the Sustainable Fisheries Fund. The team met with the partner agency directors and program staff and discussed the data collection improvement plans, scientific support for developing the territorial bottomfish fishery management plans, and the future data workshop and support for a biosampling summit.

Figure 2. Felipe Carvalho (left) presenting the NMFS Cooperative Research Program at the Department of Agriculture Conference Room at the agency coordination meeting with the Guam DAWR.

The CNMI DFW and Guam DAWR expressed support for the development of a territorial bottomfish fishery management plan that would complement the federal fishery ecosystem plans to enhance the management of the bottomfish fisheries. The agencies also agreed on the next steps for the implementation of the Sellit Logit V2.0 and requested FRMD to conduct additional training on electronic reporting and data collection.

Figure 3. Staff from FRMD met with the representatives from Tasi-to-Table, Saipan Fishing Association, Inside Lagoon Fishing Association, Talaya Club, Tenorio and Associates, and Marianas APNEA Spearfishing Club at the WPFMC satellite office. Photo credit: Floyd Masga

The FRMD team reinitiated engagement with the fishing communities and met with the presidents of the Saipan Fishing Association, Inside Saipan Lagoon Fishing Association, Tasi-to-Table, Tenorio and Associates, Talaya Club, Marianas APNEA Spearfishing Club in CNMI, and Manny Duenas of the Guam Fishermen's Cooperative Association in Guam. These meetings aimed to build relationships to support PIFSC's data collection and research goals and evaluate the information needs of the fishing communities to provide scientific support to sustain their respective fisheries, particularly the federal bottomfish fisheries.

To better understand the data analyzed for stock assessments, some FRMD team members accepted the long-standing invitation from the bottomfishing communities to join them on the

boat and experience the fishery firsthand. The scientists noted how adaptable some fishermen are as they can quickly change the terminal gear and shift their fishing behavior to target different species. Despite the flexibility in the target species, the fishing itself targets particular species using the same gear. Scientists observed the whole process from gear and bait preparation to gear deployment and retrieval. The bottomfish fishermen shared their insight and specific skill sets as well as technical and ecological knowledge of their target species.

Some team members shadowed the DFW and DAWR creel surveyors to gain direct knowledge on the process. This shadowing supports the ongoing review of the creel survey design led by Rob Ahrens. The high turn-over in the data collection staff and the constant need for training new surveyors remains the biggest challenge in adhering to standard protocols and the survey design. There is also a need for outreach training for the creel surveyors since they interact directly with the fishing community.

Figure 4. Rob Ahrens shadowing staff from CNMI DFW to conduct a creel survey with local fishermen.

FRMD responded to the Council's request from its 191st meeting to conduct outreach and explain the creel survey system and the stock assessment process. FRMD staff participated as resource persons in the informal meeting hosted by the Council for its advisers from Guam and CNMI at the Gallery Room of the Hilton Resort and Spa on August 12, 2022. Staff from the Stock Assessment Program and the FRMD Directorate prepared a series of presentations and infographic materials to support the information exchange. The infographics were part of the information packets provided to the territorial agency partners and fishing communities throughout the trip. These infographics will also be valuable tools in future outreach events.

The Marianas partner agency and fishing community engagements are a milestone in maintaining productive, transparent, and collaborative partnerships between PIFSC and each of our stakeholders.

Figure 5. Infographic outreach materials to enhance understanding of the data collection, stock assessments and the multifaceted approach to improve the Pacific Island data enterprise.

West PacFIN Enhances Electronic Reporting in the Territories

Electronic reporting in the territories is no longer just an idea. TheLogit application suite, initially developed by the Western Pacific Fishery Management Council, is transitioning to the territorial fisheries agencies and PIFSC. The Logit application suite development team (WPacFIN and Sudokrew Solutions), in partnership with the Council, demonstrated the new Sellit Logit application (a component of the Logit application suite) to the territories in August and created accounts for data staff to test and provide feedback. The web-based application is user-friendly with a modern interface that resembles mobile applications, familiar to all. The Sellit Logit application allows commercial vendors to enter purchases in real-time and the data are immediately available in the cloud-based

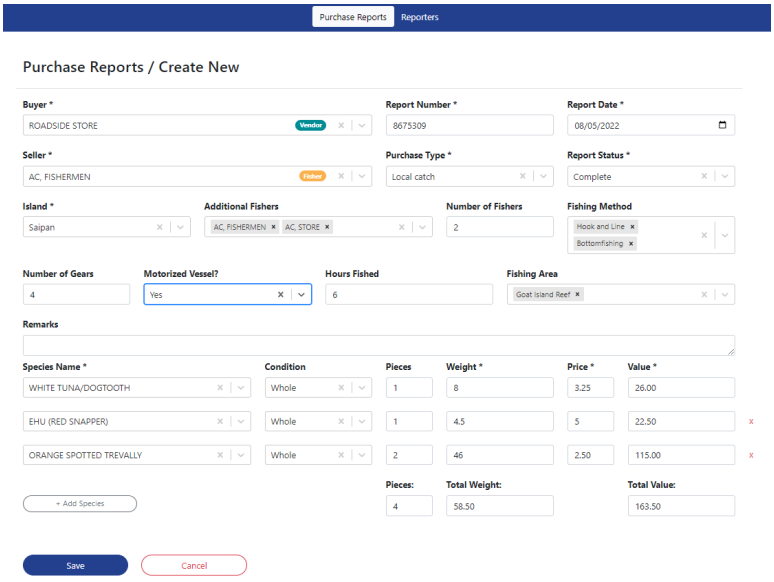

Figure 6. Purchase report interface in Sellit Logit application.

MySQL database.

More applications are needed to fully modernize the data collection systems for the territories; the goal is to replace all of the legacy FoxPro applications with modern web-based applications and cloud-based databases. This new system will eliminate many manual processes necessary for syncing the individual files from each data set and territory into the WPacFIN central data warehouse and provide users with real-time access to the data.

The development team envisions implementation of Sellit Logit by January 2023, after the user feedback and enhancement phase. The next development efforts will focus on fisher self-reported catch (Catchit Logit) for commercial and recreational fisheries. Electronic reporting improves monitoring of catch relative to annual catch limits (ACLs) by making catch data available to the monitoring program staff in near-real time. American Sāmoa and Guam are currently under 10-year rebuilding plans for the bottomfish species in Federal waters, enhancing the importance of timely estimates of catch.

PIFSC Science Operations Division Initiates the 2022 BFISH Survey

The fall 2022 Bottomfish Fishery-Independent Survey in Hawai‘i (BFISH) began July 30, 2022, with the departure of the Pacific Islands Fisheries Group (PIFG) Cooperative Research (CR) vessel *Ao Shibi IV* from O‘ahu to begin Modular Optical Underwater Survey System (MOUSS) sampling off the Kona coast of Hawai‘i Island. As of August 23, sampling has been completed in 197 of the planned 600 survey grids (122 camera, 75 fishing). Surveys are scheduled to run through the end of November 2022.

The NOAA Ship *Oscar Elton Sette* will also participate in this year's surveys, departing O‘ahu September 11, 2022, and returning October 3, 2022. The *Sette* will focus on camera deployments in the waters surrounding Ni‘ihau, Kaua‘i, and O‘ahu, with additional sampling at Penguin Bank, Moloka‘i, and Maui Nui. The *Sette's* deployment will contribute to the standard 2022 BFISH data set and will also focus on testing new artificial lighting systems and newer camera technology.

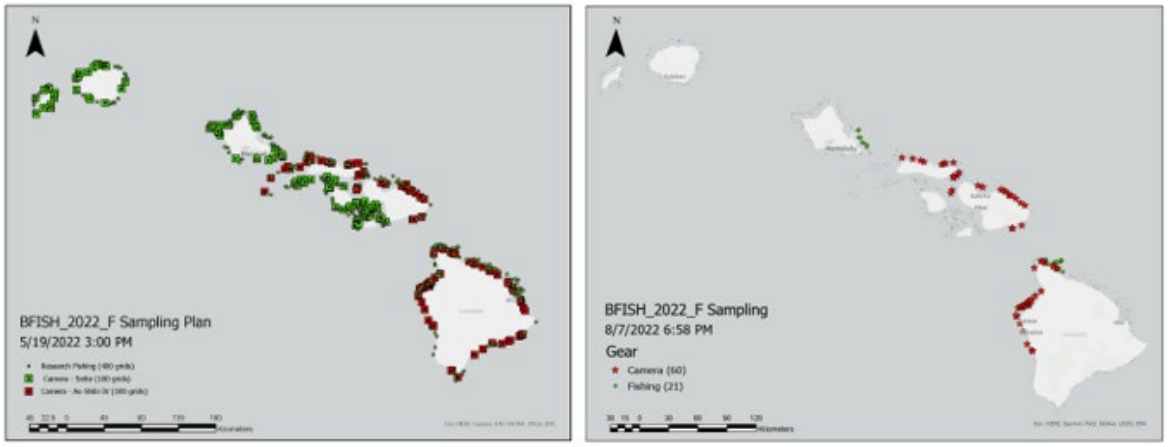

Figure 7. Maps of bottomfish sampling plan (left) and survey coverage through August 23, 2022 (right).

2. Conserve Protected Species

Hawaiian Monk Seal Research Program Documents Increased Pupping at Sites within Papahānaumokuākea Marine National Monument in 2022 Field Season

Field teams deployed in May have been collecting population data at all six major Hawaiian monk seal breeding locations within Papahānaumokuākea Marine National Monument. To date, at least 173 pups have been born this year; 40 pups at Lalo (French Frigate Shoals), 53 at Kamole (Laysan), 19 at Kapou (Lisianski), 27 at Manawai (Pearl and Hermes), 11 at Pihemanu (Midway), and 23 at Hōlanikū (Kure). At this point in the season, 16 more pups have been born this year than last year, and we have surpassed the highest number of pups born at these sites since 2004.

Lalo and Kamole host the largest subpopulations within Papahānaumokuākea, and this year's total of 53 pups at Kamole is truly impressive! The average number of annual births documented on Kamole has been 35.2 pups over the past 45-year period from 1977 to 2021 (pup totals not recorded in 2020), ranging from a low of 17 to a high of 58. This is only the second time on record that the number of births has reached 50 or more, and our field teams are monitoring to see if the final number of pups will surpass the island's long-standing record set over 2 decades ago in 1999. This is important news since Kamole is one of the top pup-producing locations across the entire Hawaiian Archipelago and accounts for about 20 percent of all Hawaiian monk seal pups born each year.

This news follows on the heels of another recent milestone: the endangered Hawaiian monk seal population surpassed 1,500 for the first time in more than 2 decades.

Figure 8. NOAA Fisheries biologists deploy to Papahānaumokuākea Marine National Monument each year to monitor the endangered Hawaiian monk seal population. These weaned pups were spotted during a previous deployment. Credit: NOAA Fisheries (Permit #848-1335).

Field Work for Two Multi-Year Acoustic Monitoring Projects

We completed the first of two ocean glider-based passive acoustic surveys for cetaceans in the waters around the main Hawaiian Islands (MHI). The remotely operated survey platforms allow us to collect additional presence data for cetacean species in the Pacific Islands Region and help us understand distribution and inform stock assessments, particularly in areas and seasons that are typically very difficult to survey and where data may be lacking.

From mid-April until early June, two Seagliders, each equipped with a passive acoustic recording system, surveyed the leeward and windward sides of the MHI. The gliders operate by continually diving between the sea surface and up to 1,000 m depth, over about 4–6 hours per dive. Along the way, they collect temperature and salinity data as well as high frequency (180 kHz sample rate) acoustic recordings that allow us to record almost all potential cetacean species in the area. Both gliders were deployed off Hawai‘i Island, flew in a zigzag pattern towards the southeast side of Kaua‘i, and then traversed to the west side of O‘ahu where they were recovered. They each traveled approximately 1,000 km.

Below is the map of the survey track lines: the black line is the planned track, with each of the way points labeled with an alphanumeric code (e.g., WW02 for windward waypoint #2 or LL06 for leeward waypoint #6); the red track shows the actual path the glider followed, with yellow dots for each surface location between dives; blue arrows show the depth averaged current that the glider experienced on that dive – bigger arrows mean stronger currents).

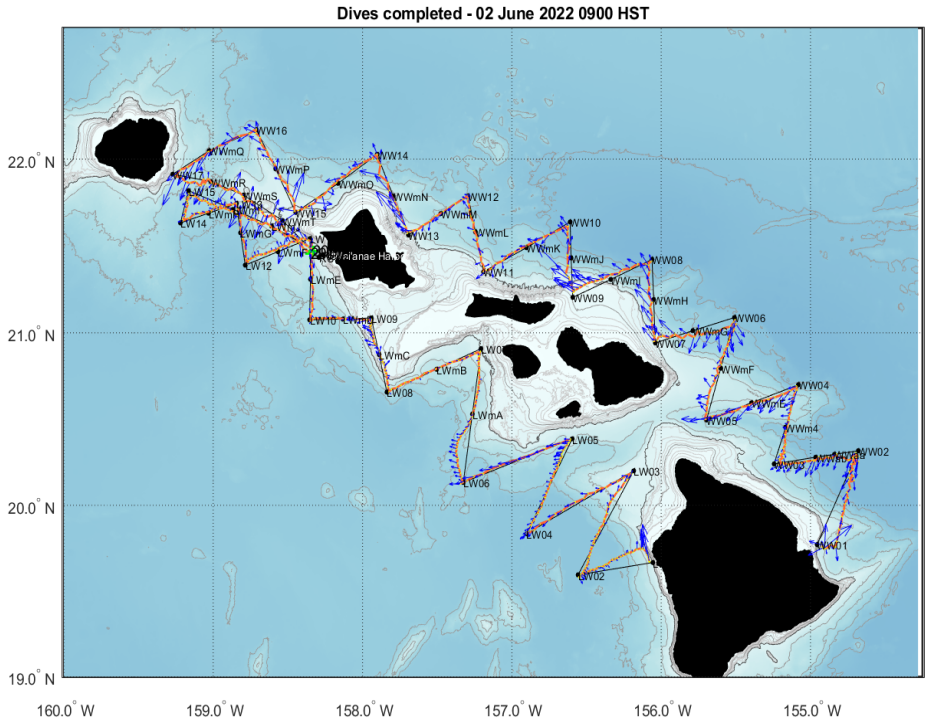

Figure 9. Map of survey track lines.

We are currently analyzing the acoustic data, focusing on identifying acoustic encounters with false killer whales and sperm whales to start (Fig. 10), with additional analyses to identify all the species we recorded.

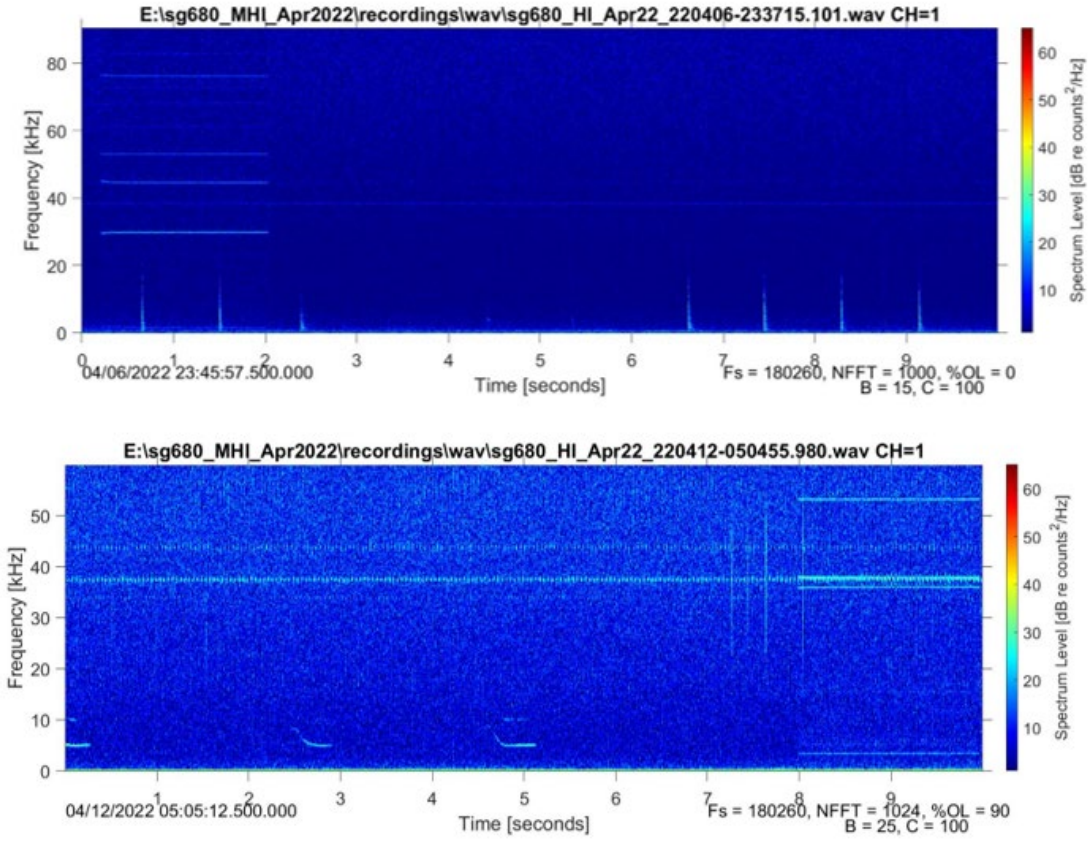

Figure 10. Spectrograms of whale interactions showing sperm whale clicks (top) and possible false killer whale whistles (bottom).

Additionally, NOAA's Cooperative Research Program (CRP) has been pushing forward on Phase 3 of the Longline Acoustic Monitoring Project. Our goals for the latest phase of this project are to deploy four recorders simultaneously on a single longline set, with the recorders spaced evenly across the gear. We are also collecting in-air recordings at various locations on deck of the fishing vessel. With additional underwater recorders and on-deck recordings, we hope to better capture, characterize, and identify the source of the vessel noise that we previously recorded and appears related to higher rate of depredation by false killer whales. We have now deployed four recorders and collected in-air recordings with five different volunteer fishing vessels and are analyzing these latest recording efforts as well as data collected on 15 more vessels.

This project is a collaborative and team-based effort which relies on close communication with the observer program to help facilitate these deployments. CRP team members are tasked with readying the equipment at very short notice when a vessel and observer become available, and cooperation with the longline fleet makes this research possible.

Figure 11. Photo of four recorders ready to be loaded up, and another photo of an enthusiastic captain and observer, ready to head out and deploy recorders. The observer is holding the in-air recording kit. Photo credit: Scott Alpuerto, Saltwater Inc.

Update on Nesting Green Turtle Habitat at French Frigate Shoals

MTBAP is drafting a report titled, "*The 2021 Summary Report for Green Sea Turtles (Chelonia mydas) at Lalo (French Frigate Shoals).*" The purpose of the 30-page report is to provide a comprehensive overview of green sea turtle research and monitoring activities for the 2021 field season in the Papahānaumokuākea Marine National Monument (PMNM). The data and analyses serve as the primary source of annual population assessment data for the Central North Pacific (CNP) Distinct Population Segment (DPS). The robust metrics and parameter distributions included would not have been possible without the intensive field efforts over the last five years. There were 652 confirmed nesting females at Tern Island, Lalo in 2021, which is the annual index of abundance for the population.

Below are two figures of interest, including novel data on male Hawaiian green sea turtles having a 2-year remigration interval!

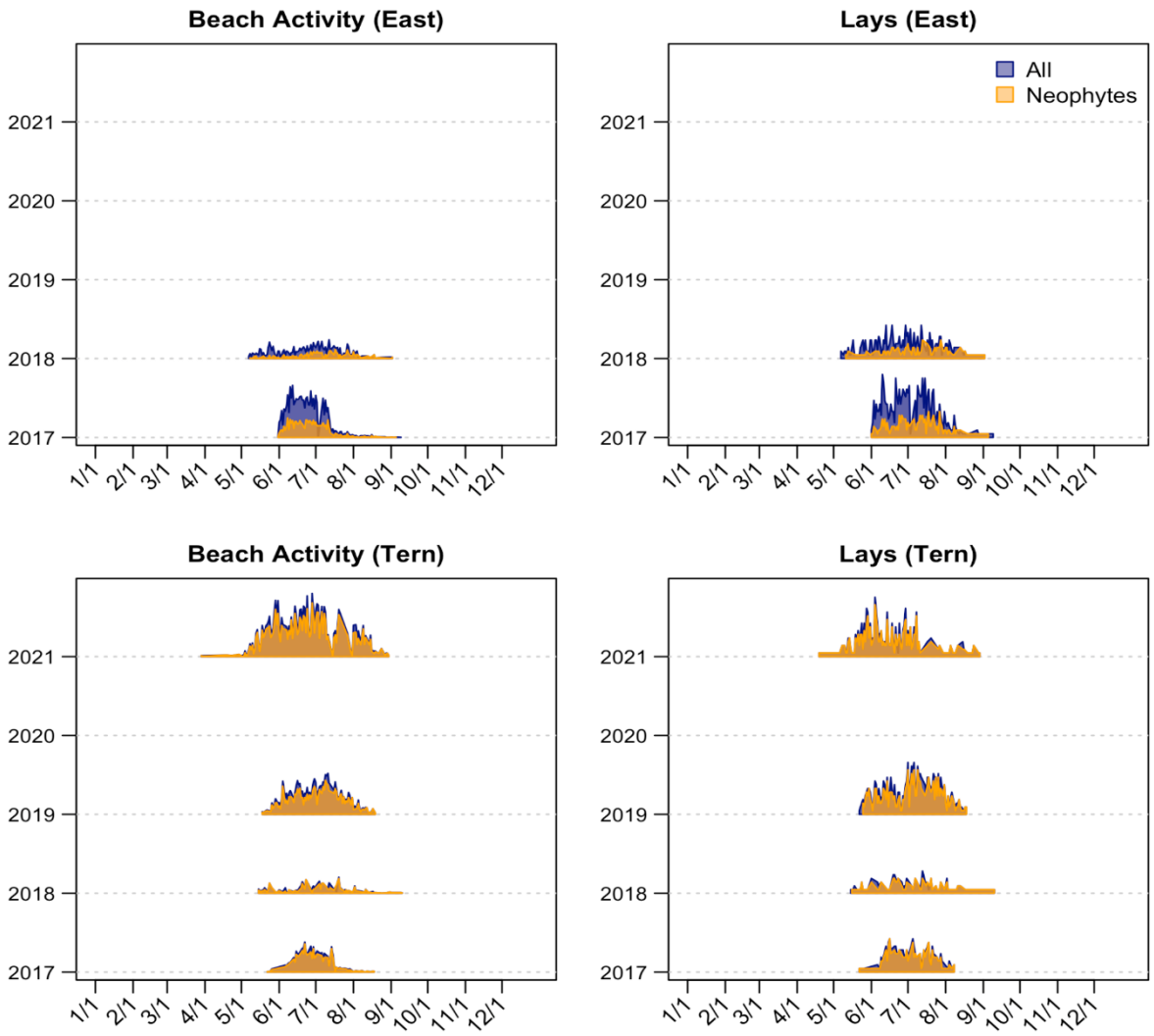

Figure 12. Annual empirical density distributions (2017–2021) of green turtle nesting activities recorded at East and Tern Islands, Lalo, as the season progresses from March through August. "Beach activity," left panels, includes all events where a nesting female was observed on a night survey to be crawling up the beach, body pitting to begin nesting, digging a chamber, laying eggs, covering the chamber, or crawling down the beach. "Lays," right panels, only includes observations of turtles laying eggs. Neophytes, in orange, refers to nesting females observed for the first time across the whole sampling time frame.

After 44 years of tagging efforts, many of the turtles observed on East Island (top panels) in 2017–2018 were previously tagged (in purple). On Tern Island (bottom panels), it was not until 2019 and 2021 when we observed our tagged turtles returning to the island. These data also demonstrate how little movement there had been of tagged turtles between East and Tern Islands prior to Hurricane Walaka.

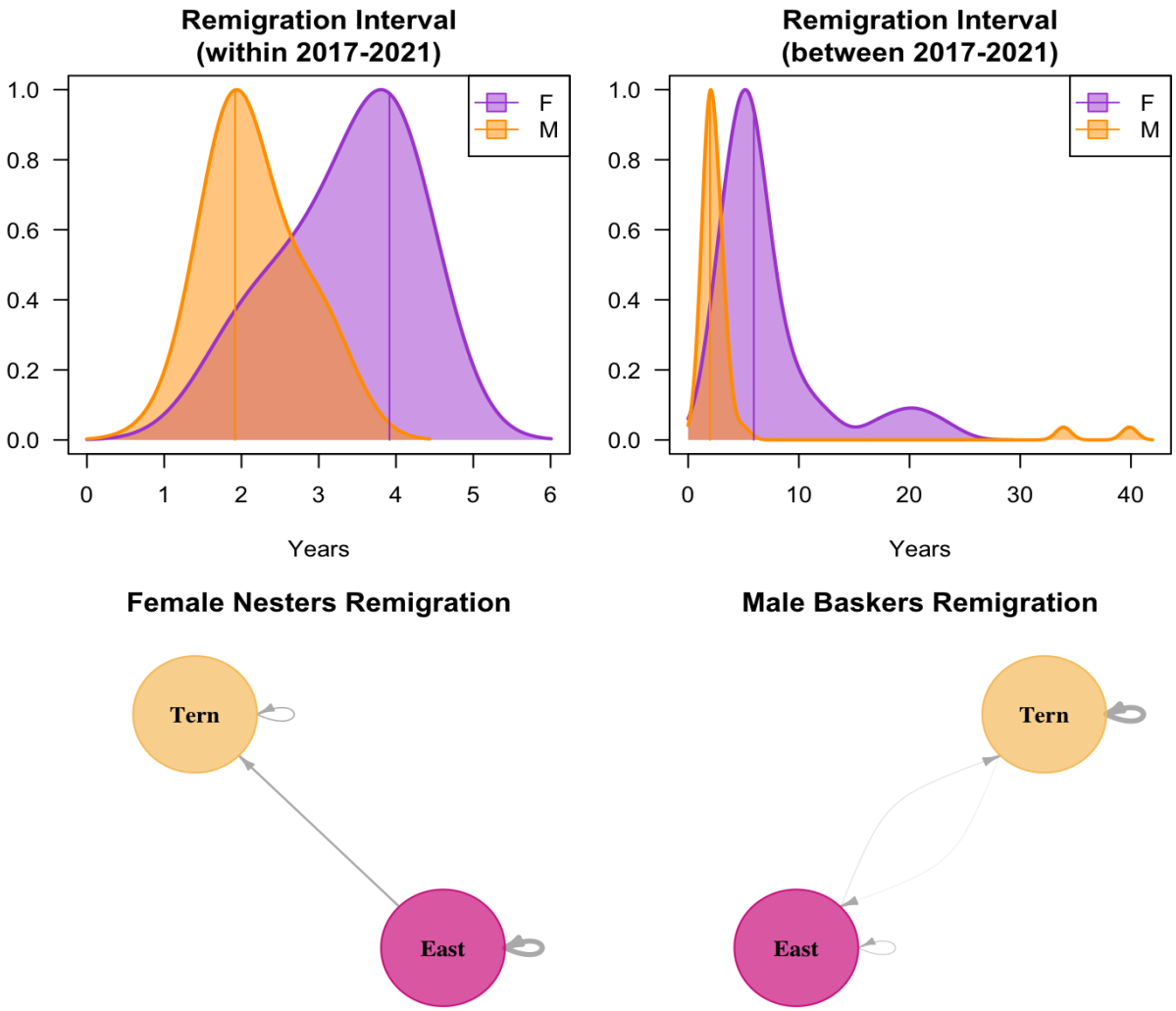

Figure 13. Remigration interval for nesting events where both the initial and return event occurred within 2017–2021 (top left) and for nesting events where only the return event was between 2017 and 2021 (top right) split by female nesters (purple) or basking males returning between 2017 and 2021.

This difference in remigration between males and females has huge implications for the breeding population's operational sex ratio as males appear to be reproducing twice as often as females. With nesting beach temperatures shifting due to global climate change, the population's primary sex ratio, or sex ratio of embryos at the time of hatching, is predicted to skew female. However, this feminization could be offset if males are contributing to the population more often than females.

3. Research to Support Ecosystem-Based Fishery Management (EBFM) and Living Marine Resource Management

Summer 2022 Bigeye Tuna Oceanography Cruise

The PIFSC-wide bigeye tuna (BET) initiative, launched in 2019, focuses on supporting ecosystem-based fisheries management for bigeye tuna in Hawai‘i. The initiative is a cross-divisional effort to prioritize research that will improve our understanding of bigeye tuna ecology and the environment that supports the Hawai‘i-based fishery. Research focuses on describing the population and stock structure and on better understanding variability in the North Pacific ecosystem that influences recruitment and the distribution of bigeye tuna and their prey. The strength of the BET initiative lies in the Center's pelagic expertise and promoting cross-divisional and institutional collaborations.

In June and July, PIFSC conducted a 21-day Bigeye Tuna Oceanography Cruise aboard the NOAA Ship *Oscar E. Sette* to sample the physical, chemical, and biological habitat characteristics in one of the most productive areas of the Hawai‘i-based deep-set longline fishing grounds. In addition to collecting comprehensive data about ecosystem structure in the region, the survey collected scombrid larvae that may elucidate spawning grounds for bigeye and other tunas. Efforts to conduct the survey in FY20 and FY21 were abandoned due to COVID-19, but it was again prioritized for FY22.

Figure 14. The bigeye oceanography cruise science party.

With a party of 16 PIFSC scientists and university partners (Fig. 14), the expedition collected samples along a meridional transect (at 150° W) east of the Hawaiian Islands running from approximately 30° N to 10° N (Fig. 15). This transect covers a steep gradient in subsurface physical and biogeochemical conditions, from relatively warm and oxygen-rich waters of the subtropical gyre to cooler and oxygen-depleted waters towards the equator. This transect is also coincident with a gradient in catch-per-unit-effort in the deep-set longline fishery, with high catch rates of bigeye tuna in the north and relatively low catch rates in the south. While these broad biogeochemical and fisheries gradients are fairly well described, the scientific understanding of the ecological conditions to link changes in the oceanographic properties to fisheries production remain poorly understood. This survey focused on collecting information on the lower and

intermediate trophic levels (i.e., phytoplankton, zooplankton, and micronekton) that will help to fill the gap in understanding between ocean biogeochemistry and the region's top predators. The frequency of sampling was designed to capture the large-scale changes in mean conditions and in diel vertical migration along the biogeochemical gradient.

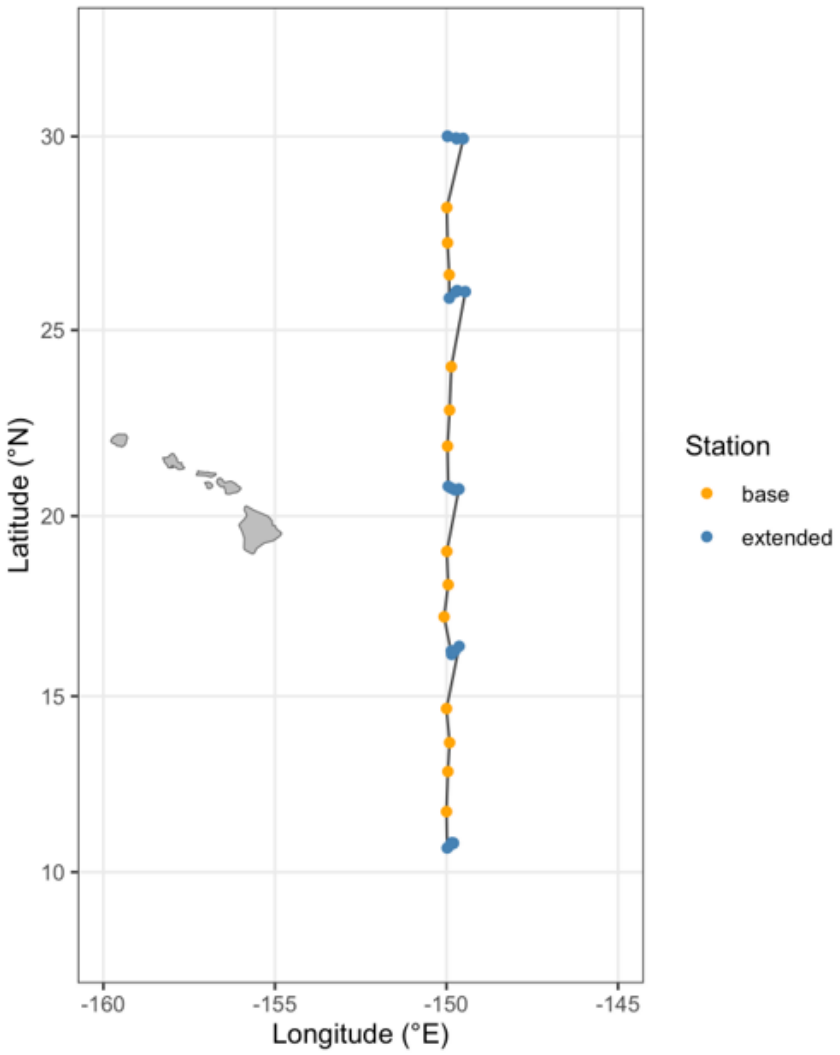

Figure 15. The transect along 150° W from 30° N to 10° N consisted of "base stations" and "extended stations." Base stations included conductivity, temperature, and depth (CTD) casts and water collection for biogeochemical sampling, microbial RNA work, bongo net tows for mesozooplankton, and 2-m ring net tows for micronekton. This included about five hours of sampling and focused on a single interval of either daylight or darkness. Extended stations were held for a 24-hour period, allowing sampling during day and night at the same location. Sampling at these stations included CTD casts, water collection (biogeochemical sampling, microbial RNA work, and environmental DNA (eDNA)), multiple opening/closing net and environmental sensing system (MOCNESS) tows, and Isaacs-Kidd midwater trawling (IKMT).

During the cruise, the science party conducted 44 CTD casts, providing water for 920 fluorometry samples, 230 nutrient samples, 230 flow-cytometry samples, 230 samples for carbonate chemistry and ocean acidification, and 900 L of water for eDNA analyses. For assessment of the vertical and horizontal variability in zooplankton and micronekton, the team completed ten MOCNESS tows filtering approximately 80,000 m^3 of water, eight IKMT tows, 13 bongo tows, 13 2-m ring net tows, and collected active acoustics data along 3,500 nautical miles. On each CTD cast, high-frequency images of plankton and detritus were captured by an underwater vision profile. In an ancillary project associated with NOAA's Pacific Marine Environmental Lab, six Argo floats were deployed along the cruise track.

Processing the suite of different types of samples is currently underway. Hypotheses that will be explored after data processing is complete concern relationships between the depth of the oxycline and the vertical distribution of zooplankton; between the availability of nutrients and the size structure of the plankton community; and among the taxa collected in zooplankton nets and those detected by genomic sampling and acoustic signatures from the scientific acoustic system. The collection of tuna larvae is also exciting and points to spawning habitat, but further genetic analyses are required to identify the species caught.

Ultimately, the data collected will improve understanding of how bigeye tuna habitat and that of their prey will respond to future climate variability and change. Changes in the availability of dissolved oxygen and spatial shifts in the steep gradients between the well-oxygenated, oligotrophic subtropical gyre and the more eutrophic, low-oxygen waters to the south and east are expected as a consequence of climate change. Predicting how bigeye tuna habitat (and their availability to the Hawai‘i-based fishery) will change is a key objective of the larger bigeye tuna initiative.

Figure 16. Tuna larva caught in the 2-meter ring net during the bigeye tuna oceanography cruise.

Regional Fisher Observations Recognized Through Published Data Reports

Hawai‘i fishers Roy Morioka and Clay Tam initiated a fisher observations procedure in 2020 to integrate traditional and local ecological knowledge into scientific and management processes across the U.S. Pacific Islands Region. The information provided by fishers captured social, economic, biological, physical/oceanographic, and management events that occurred during the year. A formal fisher observations section, largely focused on COVID-19 impacts, was presented in a narrative format in the 2020 pelagic and archipelagic Stock Assessment and Fishery Evaluation (SAFE) reports.

During 2021, Morioka and Tam, in collaboration with a working group of the Western Pacific Fishery Management Council (WPFMC) Social Science Planning Committee and staff, finalized a more structured framework for eliciting regional fisher observations. This revised procedure was implemented in February 2022 at two public meetings with regional fishers. Observations were collected via detailed notes taken by PIFSC and WPFMC staff. These notes were evaluated using qualitative data analysis techniques, whereby segments of text were ‘coded’ or binned by thematic categories. The meeting notes were first coded using general categories defined by the SEEM (Social, Economic, Ecological, and Management uncertainty) process. These general topics were then categorized by subthemes, which were further organized by management unit species. This iterative coding process allows more detailed tracking of data in specific fisheries that can be analyzed along with fishery-dependent and fishery-independent data streams. These fisher observations were recently published as PIFSC data reports (see references below) and incorporated into the 2021 pelagic and archipelagic SAFE Reports.

The fisher observation process empowers fishers to share their experiences over the course of one year. This helps to build trust with fishers and fishing communities by showing them that their voices contribute valuable social, economic, and ecological information about fisheries and ecosystems. Their observations can introduce information that becomes a starting point for scientific inquiry or may offer an explanation of natural phenomena. Narratives based on fisher observations are a powerful means to understand and improve science and management of marine ecosystems. By continuing to collect these data, we can build a time series of fisher observations. Together, the two data reports listed below represent another step towards improving relationships with fishing communities, documenting their observations as valuable data and continuing a path towards ecosystem-based fisheries management.

Ayers A, Leong K, Hospital J, Tam C, Morioka R. 2022. Hawai‘i fisher observations data summary and analysis. Pacific Islands Fisheries Science Center (U.S.), editor. doi:10.25923/aepb-m302. https://repository.library.noaa.gov/view/noaa/43046.

Ayers A, Leong K, Hospital J, Tam C, Morioka R. 2022. Guam & CNMI fisher observations data summary and analysis. Pacific Islands Fisheries Science Center (U.S.), editor. doi:10.25923/wmv2-y197. https://repository.library.noaa.gov/view/noaa/43045.

Update on RICHARD Mission in the Marianas

The RICHARD (*Rainier* Integrates Charting, Hydrography, and Reef Demographics) mission concluded with a 9-day leg that included both mapping and collecting critical bottomfish biological information by the PIFSC Life History Program. Scientists aboard the NOAA Ship *Rainier* recovered High Frequency Acoustic Recording Packages (HARPs) in Pagan and Saipan. They redeployed HARPs in Saipan for long-term monitoring of cetaceans in the Pacific Islands Region. The RICHARD mission continues to experience significant delays due to COVID-19 (~25% of planned ship operational days lost) which have impacted NOAA's National Coral Reef Monitoring Program (NCRMP) surveys. The scientific team still managed to complete the primary NCRMP mission objectives in the majority of the region thanks to strong support and flexibility from the *Rainier* crew and creative use of small boats and shore based dives. On the bright side, we were also able to use the delays to accomplish more than originally planned on some secondary projects, including dedicated surveys of the Piti Bombs Guam Marine Protected Area and advancement of a pilot effort to collect carbonate budget data on coral reefs. Below is a list of accomplishments through Leg 6, or July 14 as well as an image of the mapping progress in the region during this same time period. We also joined with our local NOAA liaisons and regional partners to complete well attended public outreach events in both Guam and Saipan in July and August 2022.

Fish:

- 232 stationary point count (SPC) surveys
- 209 photoquad site surveys
- 130 SfM belt surveys
- 79 conductivity-temperature-depth (CTD) casts + water samples
- 495 dives

Benthic:

- 161 benthic REA surveys.
- 161 photoquad surveys
- 161 crown of thorns starfish surveys
- 130 structure from motion photogrammetry (SfM) belt transects
- 543 dives

OCC:

- 61 CTD + water samples
- 59 subsurface temperature recorders (STRs) deployed / 59 STRs recovered
- 85 calcification accretion units (CAUs) deployed / 79 CAUs recovered
- 100 bioerosion monitoring units (BMUs) deployed / 92 BMUs recovered
- 25 SfM fixed site surveys
- 45 photoquad site surveys
- 8 diel suite deployment for carbonate chemistry

- 497 dives

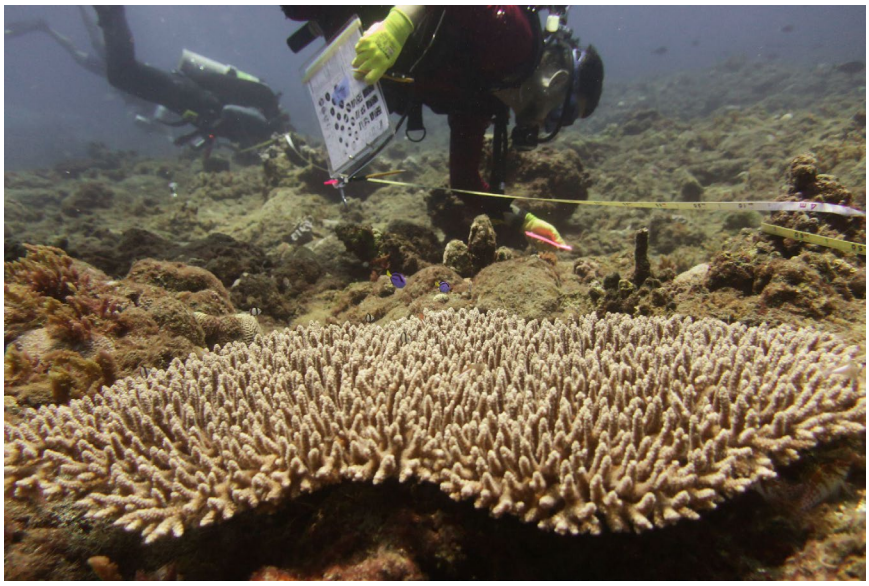

Figure 17. Benthic divers completed a rapid ecological assessment (REA) along a transect with an *Acropora* front and center in Pagan.

Figure 18. Diver conducting carbonate budget surveys off of Gab Gab Beach in Guam.

Figure 19. Image from the Saipan outreach event including tours of the NOAA Ship *Rainier*.

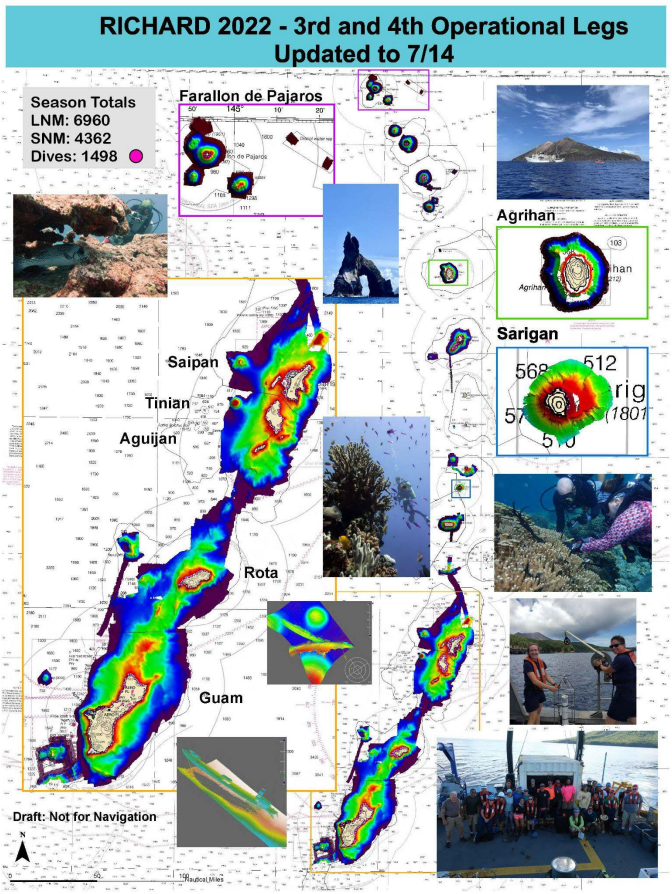

Figure 20. A representation of the hydrographic and NCRMP survey coverage as of July 14, 2022. Colors on the map represent depth from red (shallowest) to purple (deepest).

4. Organizational Excellence

Administrative Reports

Hall R, Parke M. 2022. PIFSC-PIRO ecosystem-based fisheries management workshop April 6-7, 2021, final report. Pacific Islands Fisheries Science Center, PIFSC Administrative Report, H-22-02, 42 p. https://doi.org/10.25923/5f6x-sk11.

Lamirand M, Lozada-Misa P, Vargas-Angel B, Couch C, Schumacher BD, Winston M. 2022. Analysis of benthic survey images via CoralNet: A summary of standard operating procedures and guidelines (2022 update) Pacific Islands Fisheries Science Center, PIFSC Administrative Report, H-22-03, 129 p. https://doi.org/10.1111/fme.12567.

Schemmel E, O'Malley JM. 2022. Territorial fish life history sample inventory 2022. Pacific Islands Fisheries Science Center, PIFSC Administrative Report, H-22-05, 130 p. https://doi.org/10.25923/8p3b-fz89.

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Data Reports

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