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Paci ic Islands Fisheries Science Center
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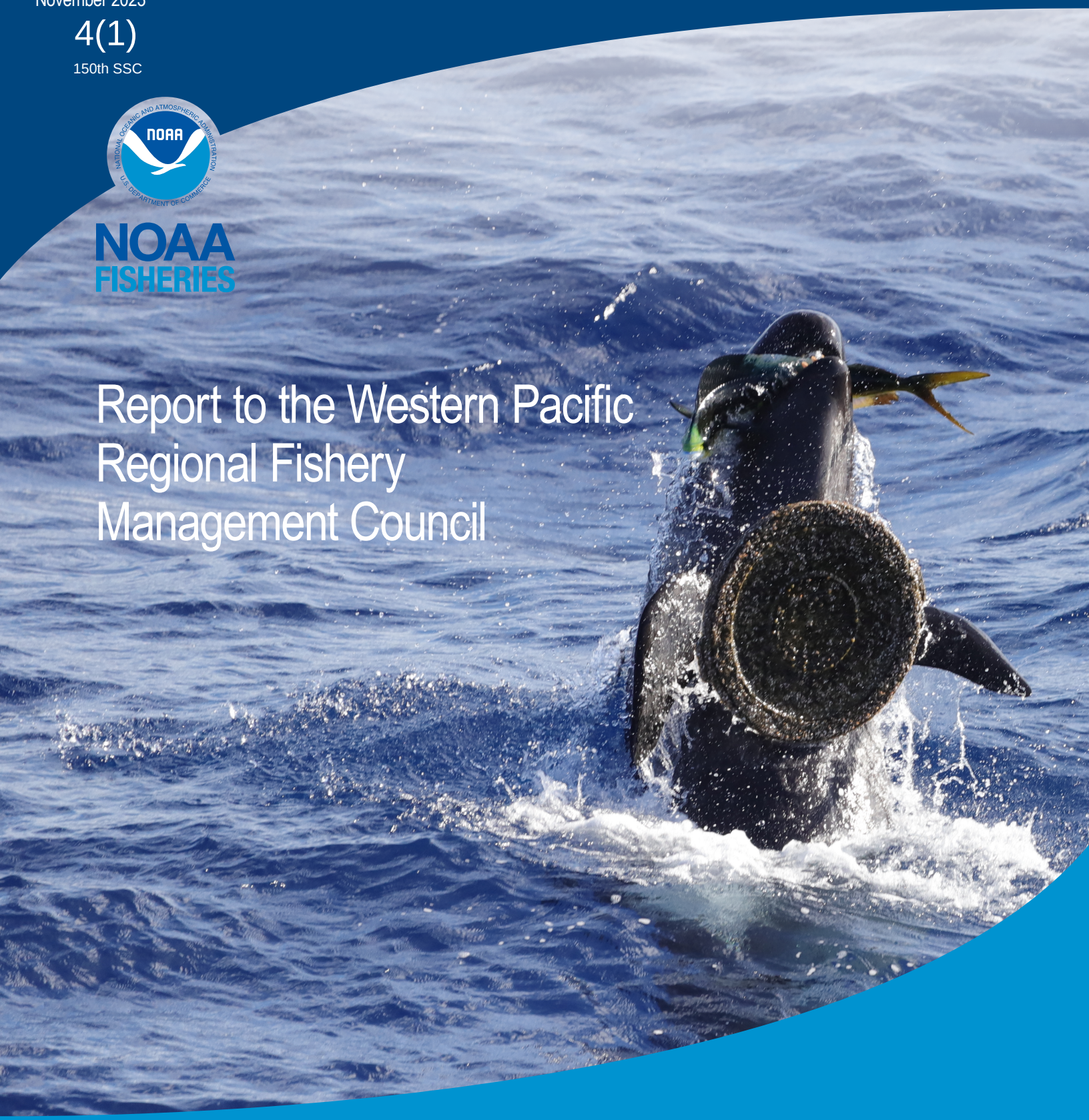
NOAA FISHERIES

# Report to the Western Pacific Regional Fishery Management Council



*A false killer whale attacks a mahimahi seeking refuge under a bucket lid.*
*Credit: NOAA Fisheries/Ernesto Vazquez (Permit #25754).*

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, ocean ecosystems, and the communities that depend on them throughout the Pacific Islands region (PIR), 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 (OMID); 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

### Deep 7 fishery engagement in preparation for WPSAR stock assessment review

The Island Fisheries Coordination Program, in collaboration with the Stock Assessment Program, convened two monthly fisher engagement meetings with the main Hawaiian Islands bottomfish fishers to discuss the upcoming benchmark assessment for the Deep 7 bottomfish management unit species complex. The assessment is scheduled for a regional peer-review on December 11-15, 2023. The fisher engagement series aims to create a collaborative space for fishers and scientists to learn from each other about the bottomfish fishery and the science behind the assessment. This engagement builds trust between the scientists and fishers and enhances the transparency and buy-in on the scientific products produced by the former.

The first meeting, which was held on September 22, 2023, focused on the assessment development process, the type of model used, and the different data used in the assessment. Scientists shared what information was considered in the assessment based on the decisions made during the Data Workshop held in March 2023. There was recognition of the uncertainties associated with the ratio estimator used to calculate the non-commercial catch and openness to discuss a single species assessment in the future for the three major bottomfish species: ʻōpakapaka (*Pristipomoides filamentosus*), onaga (*Etelis coruscans*), and uku (*Aprion virescens*). There were some fishers who also expressed concerns about single species management. The team introduced the concept of a research track as a way forward whereby scientists will work fishers step-by-step towards better data and assessment. The fishers expressed interest in participating in the research track process because it provides the scientist with near-real-time feedback rather than being consulted once the science product has been developed.

The second meeting occurred on October 27, 2023. Dr. Felipe Carvalho briefed the group about the results from the proposed base case model for the 2023 benchmark stock assessment. The base case showed the stock is still in good condition and the fishery is sustainable. Dr. Carvalho described the contribution of the fishery independent data to the assessment and the improvements made in handling such data in the model. The fishers expressed concern about the use of the BFISH data as an absolute measure of abundance because there is a large weight put on an assumption in the effective radius of the camera survey. They also expressed concern about the research on fishing being more representative of a non-commercial type of fishing, which contributes to the estimation of biomass. These concerns were partially addressed in the approach SAP is using for the 2023 benchmark assessment by using BFISH as a relative index of abundance along with the catch and CPUE data. The relative index of abundance from the BFISH survey, when used along with the CPUE and catch data, constitute the improvements in this benchmark assessment. The fishing community provided valuable input that can be used in the improvements in the BFISH and rationale that can be used by the scientist going into the peer-review. The projection of the overfishing limit was also presented and the level is similar to the 2021 assessment update.

The next fisher engagement is scheduled for December 1, 2023. The focus of this session is to pre-brief the fishing community on the upcoming stock assessment review. Fisher participation in the peer-review process is encouraged.


*Dr. Felipe Carvalho describing the new modeling software used in the 2023 benchmark stock assessment for the main Hawaiian island deep 7 bottomfish. Photo credits: NOAA Fisheries.*

**Fisheries Information System Highly Migratory Species Professional Specialty Group**

The Fisheries Monitoring Program recently hosted the Fisheries Information System (FIS) Pacific Highly Migratory Species Professional Specialty Group (HMS PSG), which was held in-person at the IRC from August 29-31. Jenny Suter and Ashley Tomita coordinated the meeting and Taylor Debevec (West Coast Region and FIS Quality Management and Continuous Improvement PSG) facilitated the meeting. The meeting brought together participants from the Pacific Islands and Southwest Fisheries Science Centers, Pacific Islands and West Coast Regional Offices, the Western Pacific Fishery Management Council, the Pacific States Marine Fisheries Commission, the state of Hawai'i Department of Aquatic Resources, the state of Washington Department of Fish and Wildlife, the Oregon Department of Fish and Wildlife, and NMFS FIS Program. The three-day meeting included updates on ongoing projects related to HMS data sharing and associated data modernization efforts between the two regions and multiple partners.

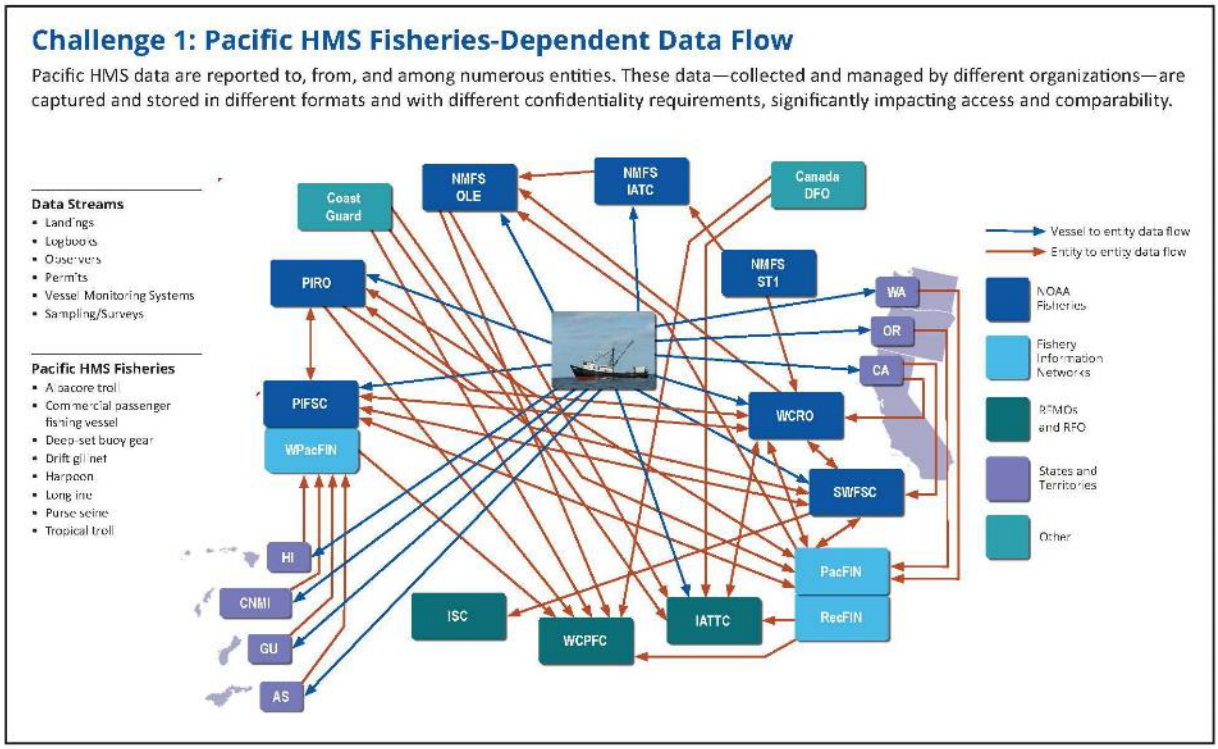



**Figure 1.** Current complex data flow process for Pacific HMS fisheries-dependent data.

Discussions were focused on ways to enhance data sharing, ensure alignment of work, and identify challenges and potential solutions for upcoming initiatives. Jenny Stahl, Brett Cooper, Michelle Sculley, and Rob Ahrens (FRMD), along with Minling Pan (ESD), Lynn Rassel (PIRO), and Mark Fitchett (Council) who participated in a panel discussion of HMS data users that helped the group understand how HMS data are used. T. Todd Jones, Keith Bigelow, Emily Crigler, Nathan Chan, Donnell Dy, Russel Ito, Chris Tokita, Brad Gough, Dios Gonzales, TJ Loo, and Jesse Copeland (FRMD) all participated in the meeting. Charles Littnan and Sarah Malloy inspired participants with opening remarks that encouraged the PSG to continue working

together to increase data accessibility through modernization and to speak up when leadership help is needed.

*Staff participating in the Fisheries Information System Pacific Highly Migratory Species Professional Specialty Group.*

**Pacific Islands region bycatch review**

During spring 2022, PIFSC initiated a comprehensive overview of the various aspects of NOAA-related fisheries bycatch within PIFSC, and the region more broadly, with an overarching goal to ensure that the work is securely funded and aims to meet the current and future management needs of the PIR. It was anticipated that the review would help identify gaps and areas for improvement, assist in planning for future needs within the PIR, and to help ensure that current bycatch related research and activities are appropriately designed, funded, coordinated, and successful in meeting the expressed needs of management. Specifically, the review sought to gain a better understanding of how PIFSC bycatch research aligns with the goals stated in the various NOAA, NOAA Fisheries and PIR guidance documents including 5-year strategic plans, national bycatch reduction strategy, and Council priorities, to identify current sources and types of funding (e.g., permanent, temporary) for bycatch activities and to establish the links between the resources and management needs, including identifying outstanding and priority issues for the future.

The PIR review was led by Yonat Swimmer and Emily Crigler (FRMD) and was implemented in three phases, which included online surveys & personal interviews with staff that work on bycatch related issues in PIFSC, PIRO and the Council as well as an analysis of NOAA and NOAA Fisheries guidance documents related to bycatch, and current PIR bycatch management needs. The overall review of bycatch related activities indicated that current bycatch work in the PIR is aimed at addressing a broad range of management needs—from more direct statutory

requirements through the Magnuson-Stevens Act, the Endangered Species Act (ESA), and the Marine Mammal Protection Act (e.g., record interactions, assess impacts to populations, and track and implement closures) to understanding and mitigating impacts of fisheries to protected species, and understanding bycatch interactions as they relate to the ecosystem.

The review culminated in August of 2023 with a PIR Bycatch Summit, which included experts from PIFSC, PIRO and the Council. Participants in the summit presented ongoing bycatch work in the region, and discussed ways to improve prioritization of work, promote collaboration, as well as leverage resources to increase efficiencies in future bycatch work in the PIR. Over 30 NOAA and Council employees participated in the summit.

*Left: Participants in the PIR Bycatch Summit presenting on current bycatch work in the region. Right: Participants in the PIR Bycatch Summit working together to discuss current bycatch priorities in the region.*

Overall, the review found that increased communication between NOAA, the Council, and industry partners would greatly enhance the efficiency of bycatch work in the region, both with regard to prioritization of bycatch work and efforts to secure funding for that work. Hosting an annual or biannual Bycatch Summit could improve communication and coordination among all parties and help to better align priorities and update personnel across the PIR on current bycatch updates and needs.

## 2. Conserve Protected Species

### Connectivity of the central west Pacific green sea turtle distinct population segment

1) Defining the central west Pacific green sea turtle distinct population segment

   The green turtle (*Chelonia mydas*) is found in tropical and temperate regions of the world's oceans. The status and conservation realities of green turtles populations around the globe vary and to recognize these differences, distinct population segments (DPS) were developed under the ESA, which allows for regional adaptations of management approaches (USFWS and NOAA 1996; Seminoff et al. 2015). A total of 13 green turtle DPS units are currently recognized including the central west Pacific (CWP) DPS, which encompasses most of the area commonly referred to as Micronesia, as well as parts of Melanesia (Seminoff et al. 2015). This DPS includes Guam and the Commonwealth of the Northern Mariana Islands (CNMI), the two regions will be referred to as "the Marianas" in this report. Research conducted by local and federal agencies in CNMI has shown distinct life-history patterns for green turtles foraging in local waters versus nesting on local beaches.

2) Satellite telemetry of Nesting Females

   A total of 35 satellite tags have been deployed on post-nesting green turtles in the Marianas (Figure 1) including three tags deployed during the most recent 2023 nesting season. Tracking shows females migrate to foraging grounds in various countries including Japan, Taiwan, Philippines, Indonesia, and the Federated States of Micronesia (FSM). Two females also remained local with one nesting in CNMI before migrating to a foraging ground on Guam, and one nesting on the west side of Guam (Spanish Steps) and then migrating to a foraging ground on the east side of the island.

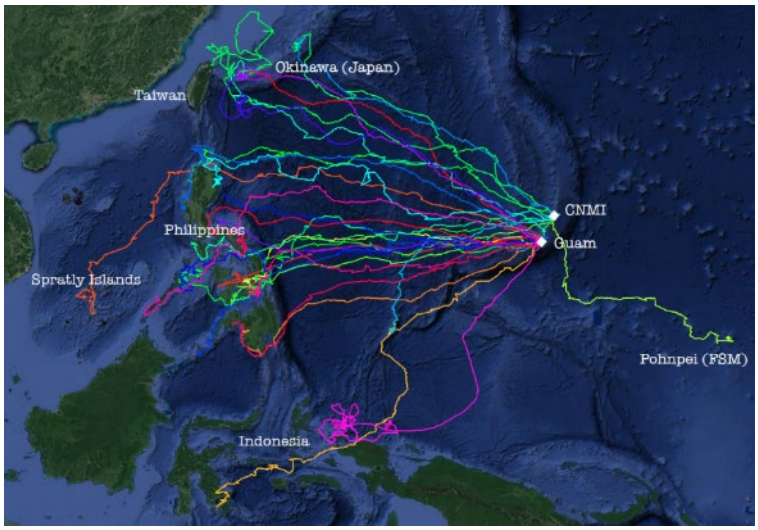



**Figure 2.** Tracks of post-nesting green turtles equipped with satellite tags on the Marianas between 2011 and 2023.

3) Origins of foraging green turtles

   Preliminary genetic analysis of skin samples collected from green turtles foraging around the Marianas is providing new insights into the origin of those turtles. The most recent genetic models indicated foraging turtles in Guam and CNMI primarily come from nesting beaches in the Republic of the Marshall Islands (91% and 78%, respectively), and Yap (FSM; 4% and 18%, respectively). Interestingly, the genetic findings also suggest the Marianas likely receives a limited number of turtles from nesting beaches in Malaysia, Japan, and Hawai‘i.

4) Understanding regional status of the CWP green turtle DPS

   The status of the CWP green turtle DPS is determined in large part by the number of females that nest on beaches throughout the region with the most important nesting sites located on Ulithi Atoll (FSM) and the Ogasawara Islands (Japan). These index sites have not been evaluated by NOAA in recent years, thus efforts are currently underway to either re-initiate research (Ulithi) or inquire about recent monitoring efforts (Japan). This includes a research effort at Ulithi starting in 2024, as well as renewed engagement efforts with Japanese partners, which will hopefully result in an understanding of updated nesting numbers for Ogasawara in the near future. Understanding current abundance and trends at high density nesting sites will provide the necessary context to evaluate the status of the DPS as a whole.

**2023 Hawaiian Monk Seal Research Program field season highlights**

Assessment and Recovery Camps (ARCs) are the foundation of NOAA's endangered Hawaiian monk seal research and recovery efforts in the Papahānaumokuākea Marine National Monument (PMNM). Researchers are deployed in annual field camps to monitor the population and undertake numerous activities to improve survival. In 2023, we piloted a new framework to maximize scientific value and recovery actions while creating efficiencies in bandwidth and budget by alternating years with full ARC field seasons at all PMNM sites with “ARC Light" years when field seasons will be shortened at all sites except Lalo (French Frigate Shoals), the site where the greatest number of interventions to increase seal survival occur. Implementing this framework, we deployed a 4.5 month field season at Lalo, and 2-3 week ARC Light field camps at Kamole (Laysan Island), Kapou (Lisianski Island), and Manawai (Pearl and Hermes Reef), and a 2 day survey at Hōlanikū (Kure Atoll). Four field staff members were deployed by M/V Kahana II on CH-23-01 during May 15-24 and a field camp was established at Lalo. Recovery activities conducted during the mission included releasing two rehabilitated yearlings collected at Lalo in 2022 and conducting surveys at Nihoa and Mokumanamana (Necker). Once deployed, field teams gathered data on the number of pups born, number that survived to weaning, number marked and tagged, number of older animals identified, inter-atoll movements, causes of mortality, and other key demographic variables and vaccinated seals against morbillivirus. An additional 11 field staff were deployed by M/V Kahana II on CH-23-02 during August 21-September 18, 2023, for the ARC Light field effort, which prioritized conducting lifesaving interventions, recording reproductive information, tagging weaned pups, and collecting data on juvenile survival.

*Field staff surveying for weaned pups to tag at Kapou during ARC Light. PMNM Co-Manager's Permit PMNM_2023_001, NOAA Research and Enhancement Permit 22677.*

Other research and recovery objectives in the remote PMNM were the result of ever-increasing partnerships with organizations conducting work in PMNM. These included working with the U.S. Fish and Wildlife Services (USFWS) to release three rehabilitated yearlings at Kuaihelani (Midway Atoll) in March, joining a USFWS mission to Kamole to identify reproductive females and tag pups for a week in May, and sending a staff member to Kuaihelani to monitor seals and turtles during the USFWS Seabird Protection Project for a month starting in late June. HMSRP staff also facilitated the collection of opportunistic monk seal data by partners at Nihoa and Kuaihelani by USFWS and at Hōlanikū by state of Hawai'i Department of Land and Natural Resources biologists. Through a grant, HMSRP and the Papahānaumokuākea Marine Debris Project (PMDP) partnered to support PMDP's training and capacity to conduct surveys and disentangle seals, which will continue into 2024.

Cumulatively, this work enabled the documentation of at least 169 pups born in the PMNM this season, including at least 50 pups at Lalo, the highest number for this site since 2005. And, a Lalo mother gave birth to her 19th pup, the highest number for an individual female on record. The team at Lalo performed 25 survival enhancing activities such as translocating weaned pups away from areas with historic high shark predation, freeing wildlife entrapped in disintegrating infrastructure at Tern Island, and administering antibiotics to compromised seals. PMDP staff removed an eel from the nose of a pup at Kapou. At Lalo, shark predation on weaned pups was heavy at the beginning of the season, but trailed off and was last detected in July. The long term availability of pupping habitat at Lalo remains a concern in the face of climate change and sea

level rise; Trig Islet was not present during 2023, and Round, Mullet, and Shark Islets were awash by the end of September.

*Mother and pup Hawaiian monk seal on Shark Islet, which was awash in September 2023. PMNM Co-Manager's Permit PMNM_2023_001, NOAA Research and Enhancement Permit 22677.*

While deployed, monk seal field teams supported and collaborated with the PIFSC Marine Turtle Biology and Assessment Program team at Lalo and tagged and monitored turtles at Manawai. Field work was successfully completed and all field camp personnel, supplies, equipment, and data were collected from ARC Light sites by M/V Kahana II, which returned to Honolulu on September 18, 2023, and the Lalo Camp was picked up by NOAA R/V Oscar Elton Sette during cruise SE-23-03, which returned on October 3, 2023.

**Monk seal post-release survival**

PIFSC's Hawaiian Monk Seal Research Program (HMSRP) has partnered with the Marine Mammal Center's (TMMC) Ke Kai Ola (KKO) monk seal hospital since the facility opened in 2014. During 2014 to 2022, a total of 57 monk seals were admitted to KKO for treatment on 60 occasions (two seals have been admitted more than once). Most of the seals were admitted after presenting with malnutrition. Only three seals have died while in care: two died from toxoplasmosis (a lethal and untreatable disease) and one from severe head trauma sustained in the wild, likely from conspecific interactions. No seals have been deemed non-releasable and all other seals admitted to KKO have been released to the wild. Now PIFSC and KKO are engaged in an analysis that combines individual patient health and husbandry records with resighting and

telemetry data to evaluate factors that may influence survival of rehabilitated seals after they are released back into to wild. The objective is to explore opportunities to maximize positive outcomes for rehabilitation patients, thereby achieving the greatest benefit to the population through rehabilitation.

**HICEAS 2023 continues…**

Hawaiian Islands Cetacean and Ecosystem Assessment Survey (HICEAS) 2023 is underway with both the NOAA Ships *Oscar Elton Sette* and *Reuben Lasker* currently at sea. An abbreviated *Sette* leg 1 concluded July 28, 2023. *Sette* legs 2 and 3 were carried out with minor delays and completing survey transects in the furthest northwestern reaches of the study area. *Sette* leg 4 departed Honolulu Harbor on October 12, 2023 and has been surveying the central portion of the study area from O‘ahu to Lisianski, both near and offshore. *Lasker* leg 1 departed Vallejo, CA on October 24, 2023 and is en route to Hawai‘i, surveying along the transit. As of October 26, 2023, there have been 193 sightings and 304 detections of 20 cetacean species; the most commonly encountered cetacean species are Bryde’s whale and sperm whale. Although false killer whales have been detected by the acoustics team and seen by the visual team during off-effort pursuits of those detections, there have been no on-effort visual sightings of the species so far. As of October 26, 2023, the team counted 17,422 individuals of 46 seabird species (over 5,729 sighting events, including 157 feeding flocks). So far, the most commonly seen seabirds are wedge-tailed and short-tailed Shearwaters; a few highlight species encountered include the Pycroft’s petrel, Tahiti petrel, flesh-footed shearwater, Nazca booby, and merlin.

In addition to daily conductivity, temperature, depth casts (CTDs), the team has conducted plankton tows that will provide insight into the larval distribution of fisheries management unit species (MUS) and environmental DNA (eDNA) sampling to describe the pelagic food web. These plankton samples will be used to characterize the essential fish habitat for the larval stages for management unit species, presently a gap for the majority of MUS within the Hawai‘i Exclusive Economic Zone. eDNA samples are being collected from CTDs to characterize pelagic food webs across trophic groups from phytoplankton to marine mammals. So far, 69 plankton tows, 17 eDNA CTD casts (equating to 51 individual replicates), and 5 CTDs attached to drifting acoustic spar buoy recorders (DASBRs) for subsurface hydrographic measurements have been completed. Survey techs have maintained fluorometry filtering throughout the legs and flying fishes and squid have been collected to better understand their diet and foodweb role throughout the region in collaboration with academic partners at Hawai‘i Pacific University.

Maps below show *Sette*’s cetacean survey effort, sightings, and detections; not shown is *Lasker* making its way to Honolulu from the U.S. West Coast. Also participating in the project are staff from other NOAA Science Centers (NEFSC, SEFSC, SWFSC), a NOAA Teacher at Sea, graduate students from University of Hawai‘i at Mānoa, Oregon State University, and Scripps Institution of Oceanography.

HICEAS 2023 was scheduled for 181 days at sea across both survey vessels, but delays due to ship repairs and personnel issues have led to loss of 35 days thus far. Such losses have primarily reduced the opportunity to deploy and recover drifting acoustic recorders, a key component to

our assessment efforts for deep-diving beaked whales, and a primary tool for describing the distribution of baleen whales in the study area.

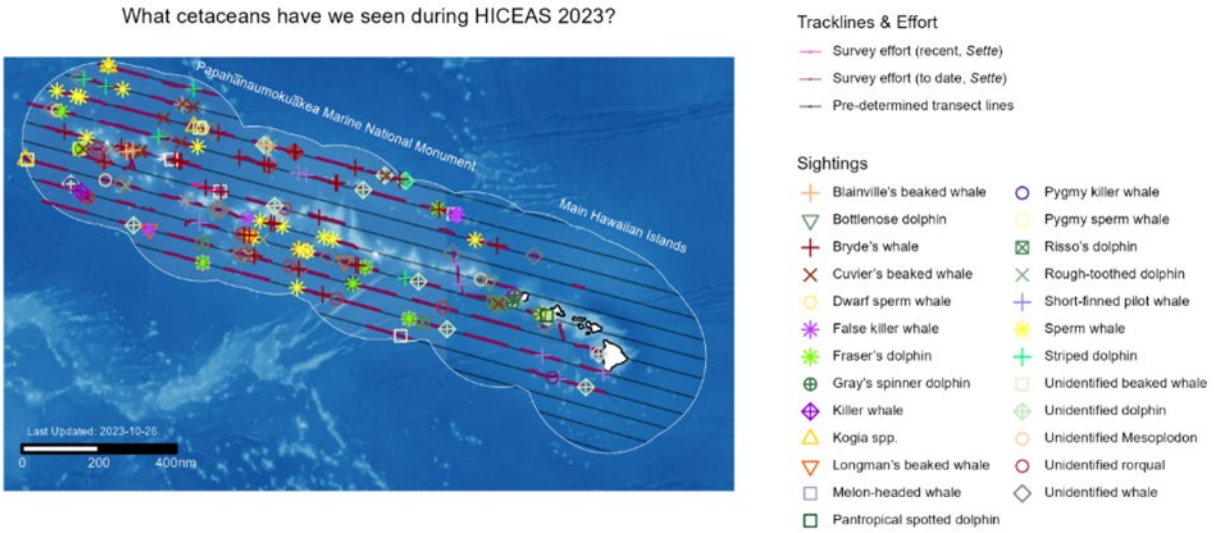



**Figure 3.** Represents the cetaceans seen while surveying during HICEAS 2023.

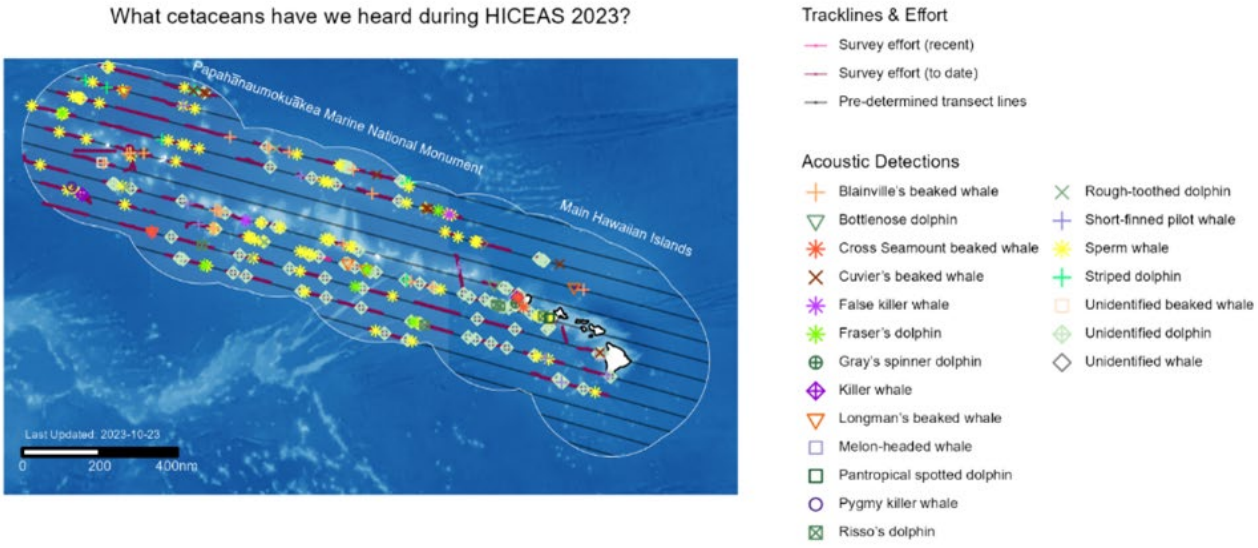



**Figure 4.** Represents the cetaceans heard while surveying during HICEAS 2023.

*A false killer whale attacks a mahimahi seeking refuge under a bucket lid. Credit: NOAA Fisheries. Photographer: Ernesto Vazquez (Permit #25754).*

*Longman's beaked whales. Credit: NOAA Fisheries. Photographer: Paul Nagelkirk (Permit #25754).*

***Left:*** *Acoustician Alexa Gonzalez carries the Drifting Acoustic Spar Buoy Recorder (DASBR) float and satellite signal buoy and Erik Norris carries the CTD device in preparation for deployment. Credit: NOAA Fisheries. Photographer: Suzanne Yin.* ***Right:*** *Top left: Scientist Jessica Perelman holds up a petri dish with fish larvae collected from one of the night-time net tows when these species occur closer to the surface at about 50 m depth. Top center: Tuna larvae can be easy to pick out from a petri dish, but the best view is from under a microscope. Top right: Scientist Andrea Schmidt concentrates on carefully picking out fish larvae from a petri dish full of other larvae and planktonic critters. Bottom: Larvae sorting quickly becomes a party as scientists and ship's officers gather to learn and help with picking out the target species. Credit: NOAA Fisheries. Photographer: Yvonne Barkley and Jessica Perelman.*

For more information, check out NOAA Fisheries' HICEAS 2023 website!

## 3. Research to Support Ecosystem-Based Fisheries Management and Living Marine Resource Management

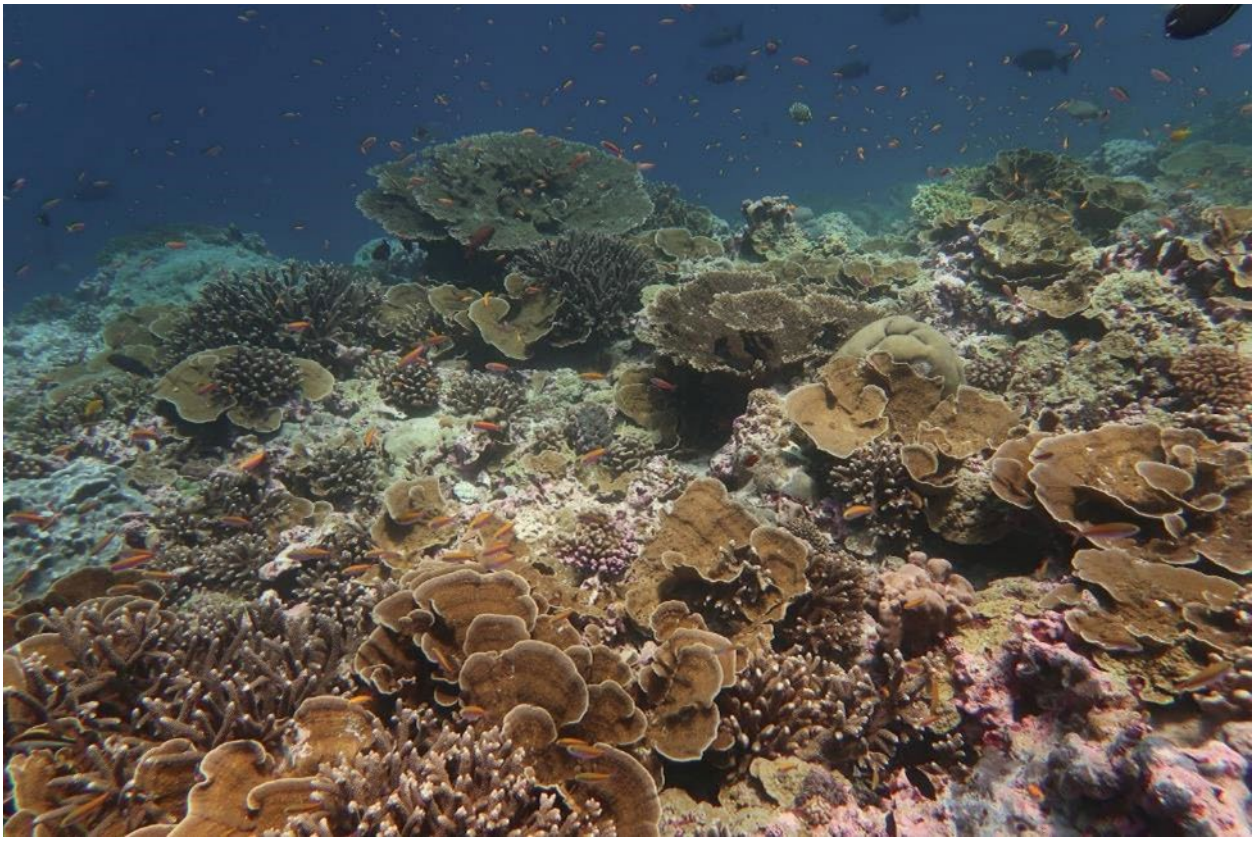
### RICHARD Mission

The RICHARD (*Rainier* Integrates Charting, Hydrography, and Reef Demographics) mission aboard the NOAA Ship *Rainier* has completed coral reef research and hydrographic surveys around the islands of American Samoa and the Pacific Remote Island Areas (PRIA). This joint NOAA mission included diver-based surveys to collect information on corals, fish, and changing ocean conditions as part of the NOAA National Coral Reef Monitoring Program (NCRMP) and concurrent hydrographic surveys to map the ocean floor.

Rainier departed Honolulu in early March 2023 and arrived in American Samoa after conducting surveys around Baker and Howland Islands, part of the PRIA.

*A giant grouper (Epinephelus lanceolatus) hangs out under a school of black jacks (Caranx lugubris). Photo credit: NOAA Fisheries. Photographer: Ari Halperin.*

The reefs in these remote protected areas are home to diverse and extensive coral reefs, teaming with schools of fish including manta rays and reef sharks. Studying these remote locations allows us to better understand the environmental drivers and ecosystem conditions that support such high diversity and provides critical information to guide conservation and management in more populated locations.

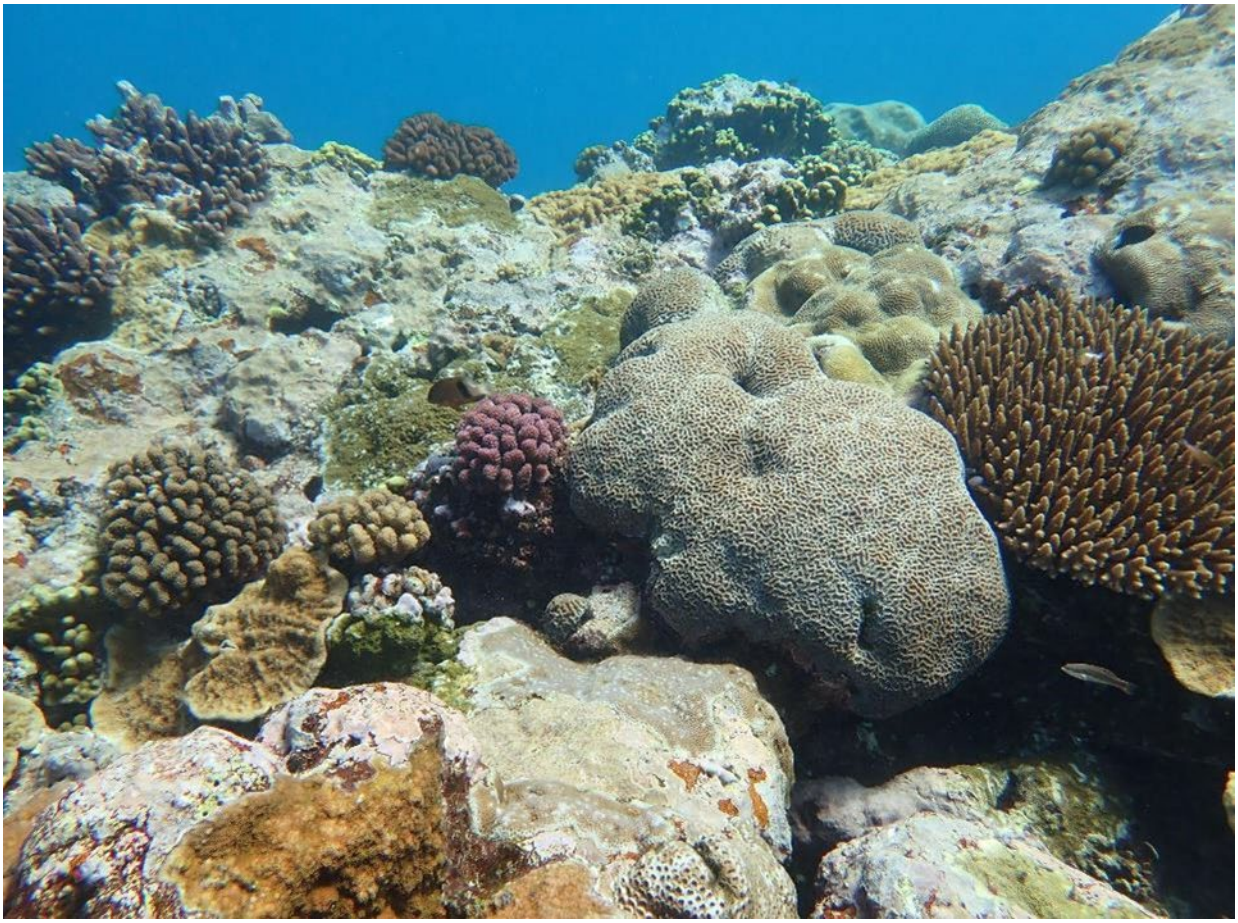


*Schools of small colorful anthias cloud the waters on the south side of Baker Island's shallow reef before it drops into the abyss. These fish eat small animals that float in the water called zooplankton. A lot of zooplankton usually means a lot of anthias, which are signs of a healthy reef. Photo credit: NOAA Fisheries. Photographer: Joy Smith.*

PIFSC NCRMP benthic team visited 153 sites around the islands of Swains, Ta'ū, Ofu, Olosega, and Tutuila, and Rose Atoll, where scientists identified and assessed the health of existing coral colonies and counted the number of new coral babies. They also collected imagery which will be analyzed later at 394 sites across all 7 island areas. The images that were collected will be used to generate three-dimensional models of the reef. After years of developing this method, data from these three-dimensional models, instead of diver observations, will be used to calculate summary metrics at Howland and Baker.

*Brittany Huntington conducting a coral demographic survey on the Acropora-rich reefs of north Tutuila Island Photo Credit: NOAA Fisheries. Photographer: Mia Lamirand.*

The reefs at Swains Island showed early signs of recovery of shallow water corals, which experienced significant mortality, especially *Pocillopora* spp., following the 2015/2016 mass bleaching event. We only recorded 2 COTS on or off our transects during the entirety of the leg. Scars from the corallivorous snail *Drupella* were far more common. We saw *Drupella* scars at many sites, but snails were rarely visible during the daytime at depths less than 60'.



*The forereefs of Ofu and Olosega are home to a diverse coral community including ESA-listed taxa such as Isopora crateriformis, Photo credit: NOAA Fisheries. Photographer: Damaris Torres-Pulliza.*

Rose continues to live up to its reputation with high crustose coralline algae (CCA) cover, and some sites recorded with high densities of *Acropora* and *Pocillopora*. Cyanobacteria was highly abundant around the former shipwreck site, but was also present in low to moderate abundance at many of the forereef sites we visited.

*The shallow reefs of Swains Island are dominated by pink crustose coralline algae and branching* Pocillopora *corals. Photo credit: NOAA Fisheries. Photographer: Courtney Couch.*

PIFSC NCRMP Fish Team assessed reef fish populations by identifying, counting, and estimating the size of fish at 218 survey sites. Preliminary data from the fish surveys can be found below. NCRMP surveys provide the majority of coral reef fisheries, habitat, and climate data available to the government and villages of American Samoa.

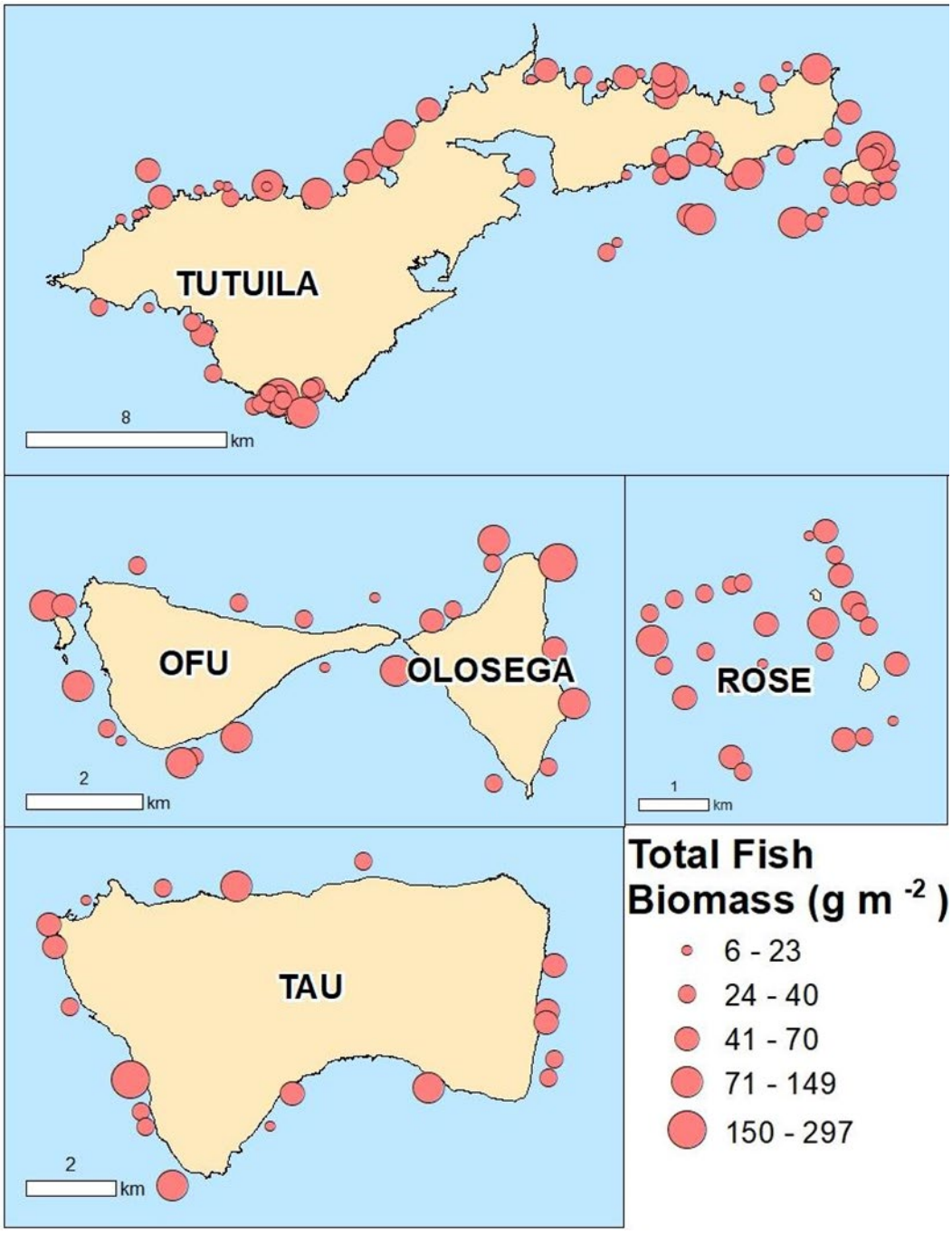



**Figure 5.** Mean total fish biomass at sites surveyed.

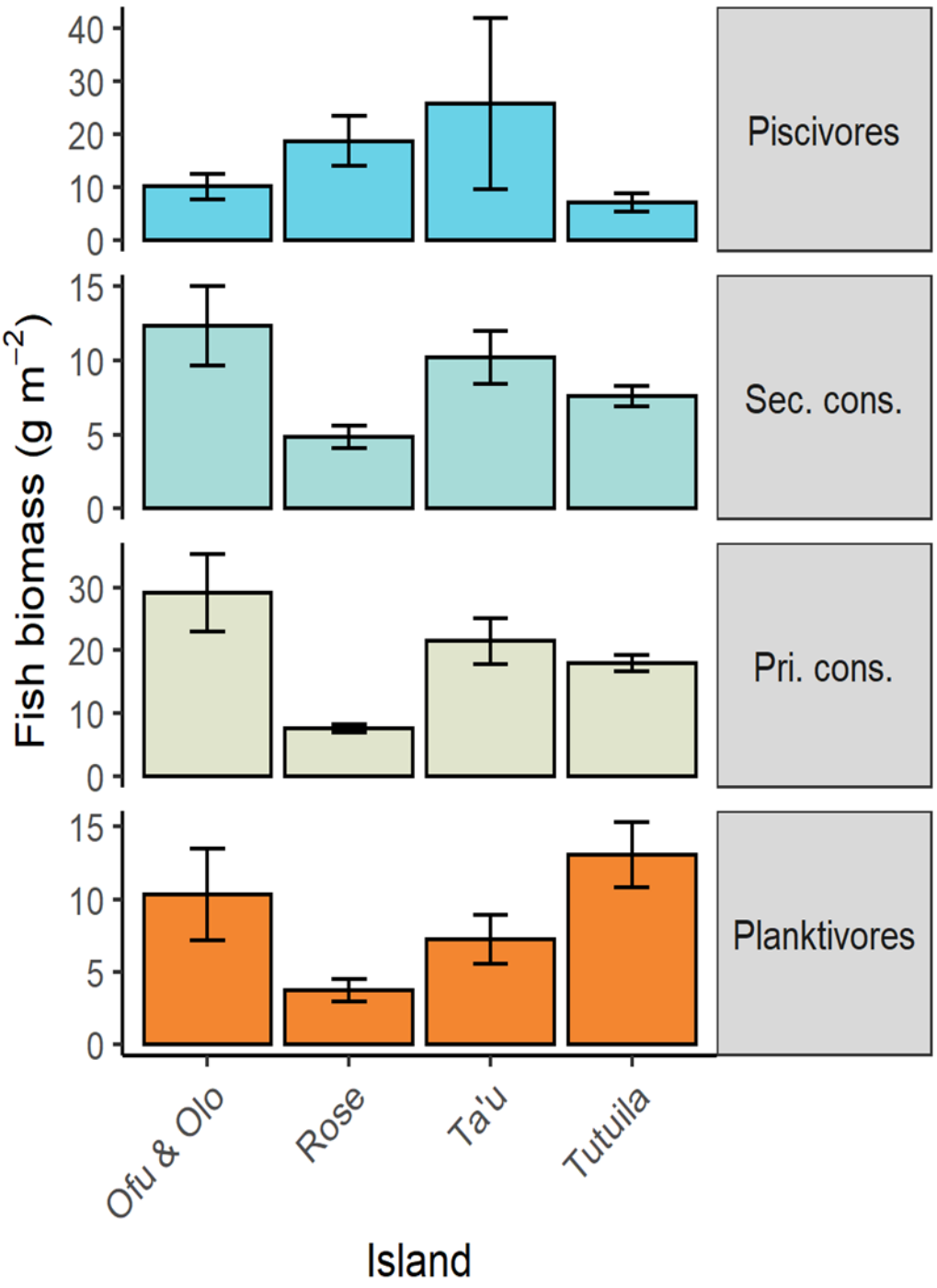



**Figure 6.** Primary consumers (Pri. cons.) include herbivores (which eat plants) and detritivores (which bottom-feed on detritus), and secondary consumers (Sec. cons.) are largely omnivores (which eat a variety of fish and invertebrates) and invertivores (which eat invertebrates). Ofu and Olosega are represented together as 'Ofu & Olo'.

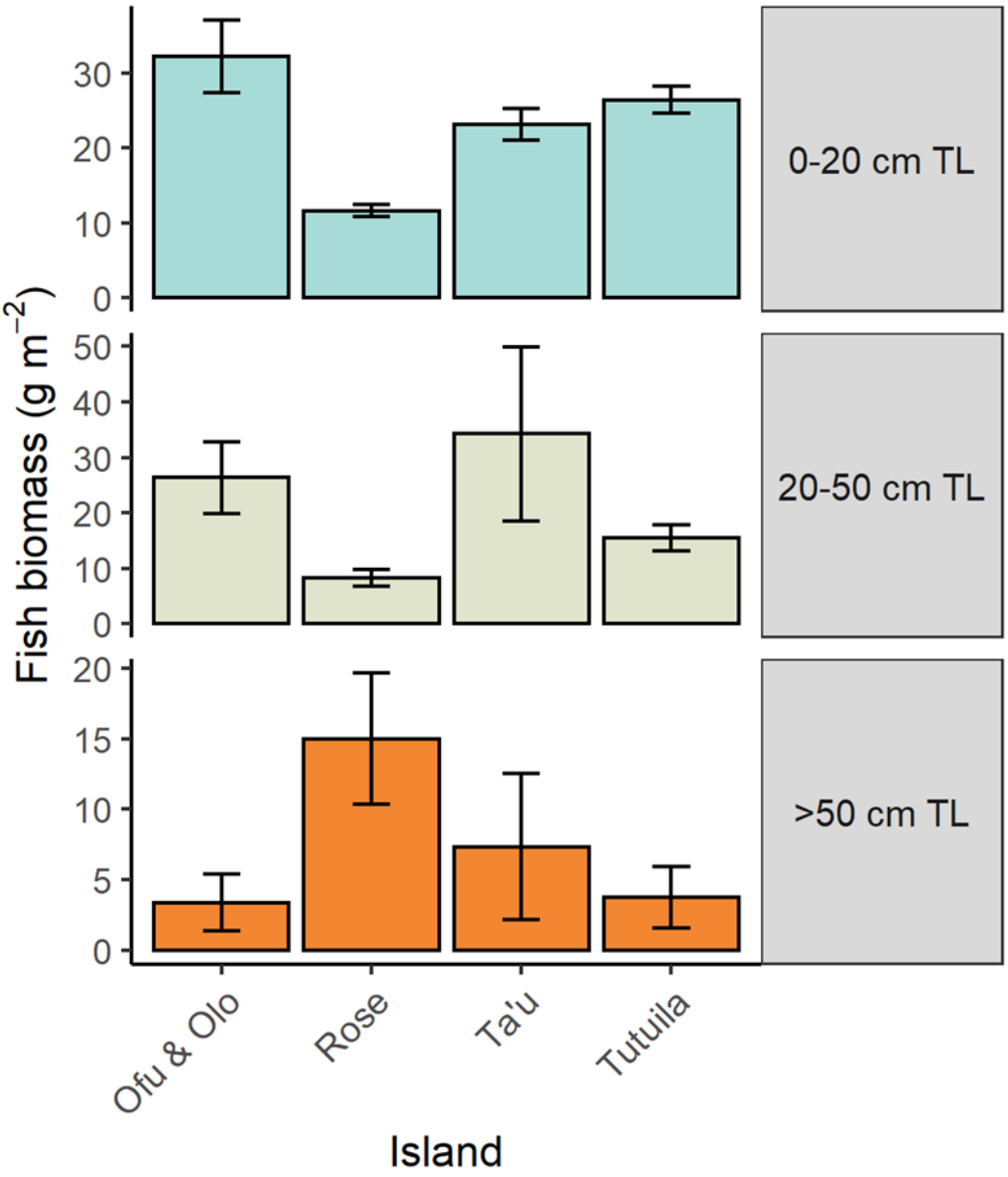


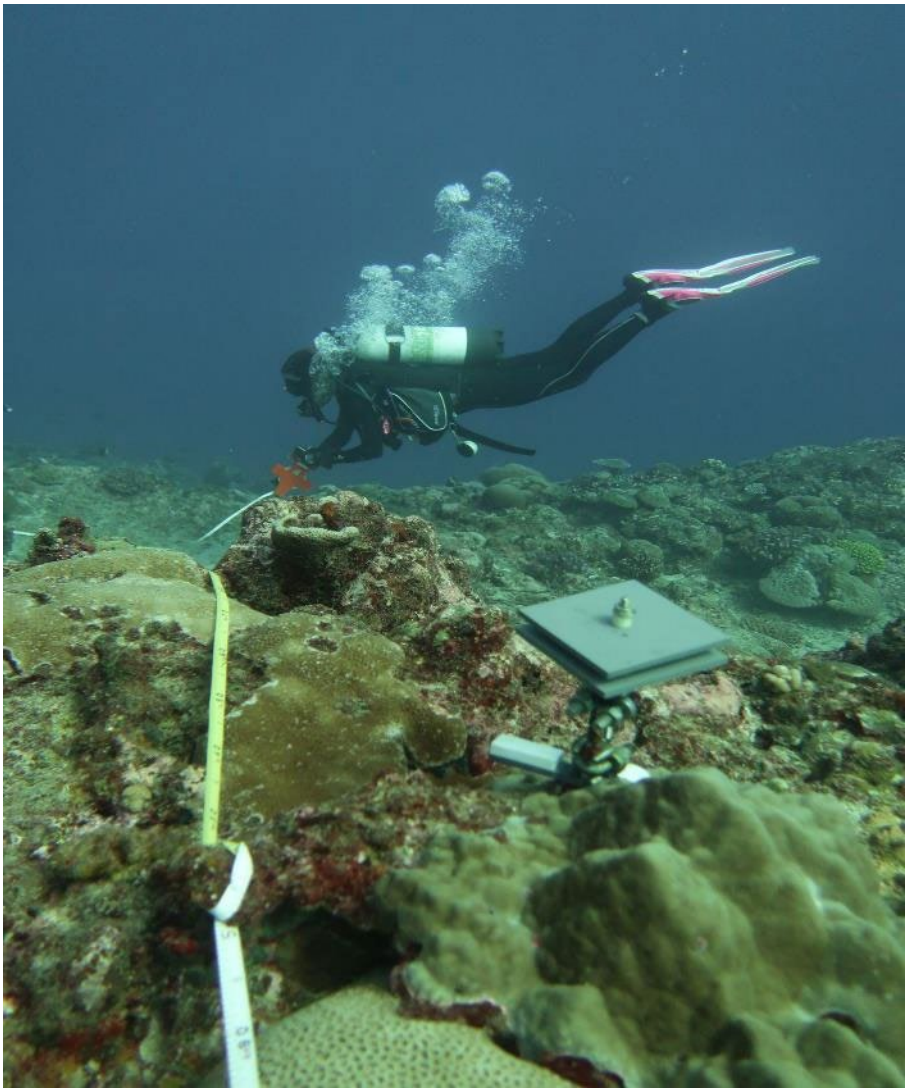

**Figure 7.** Mean fish biomass per size class (± standard error). Fish measured by total length (TL) in centimeters (cm). Ofu and Olosega are represented together as 'Ofu & Olo'.

*A fish diver swims over a massive Porites spp. coral at Tutuila. Photo credit: NOAA Fisheries. Photographer: Jeff Milisen.*

Additionally, scientists deployed acoustic recorders at deep depths (~350 m) around Baker and Howland Islands. These instruments can monitor ocean noise from vessels. Recorders were installed in shallower waters to capture coral-reef soundscapes, which include sounds that indicate the frequency and presence of organisms, such as the popping of snapping shrimp, or the scrapes of parrotfish eating. Noisy reefs are rich with life, whereas quiet reefs can indicate an ecosystem in poor condition, so soundscapes can also provide information about the relative health of coral reefs.

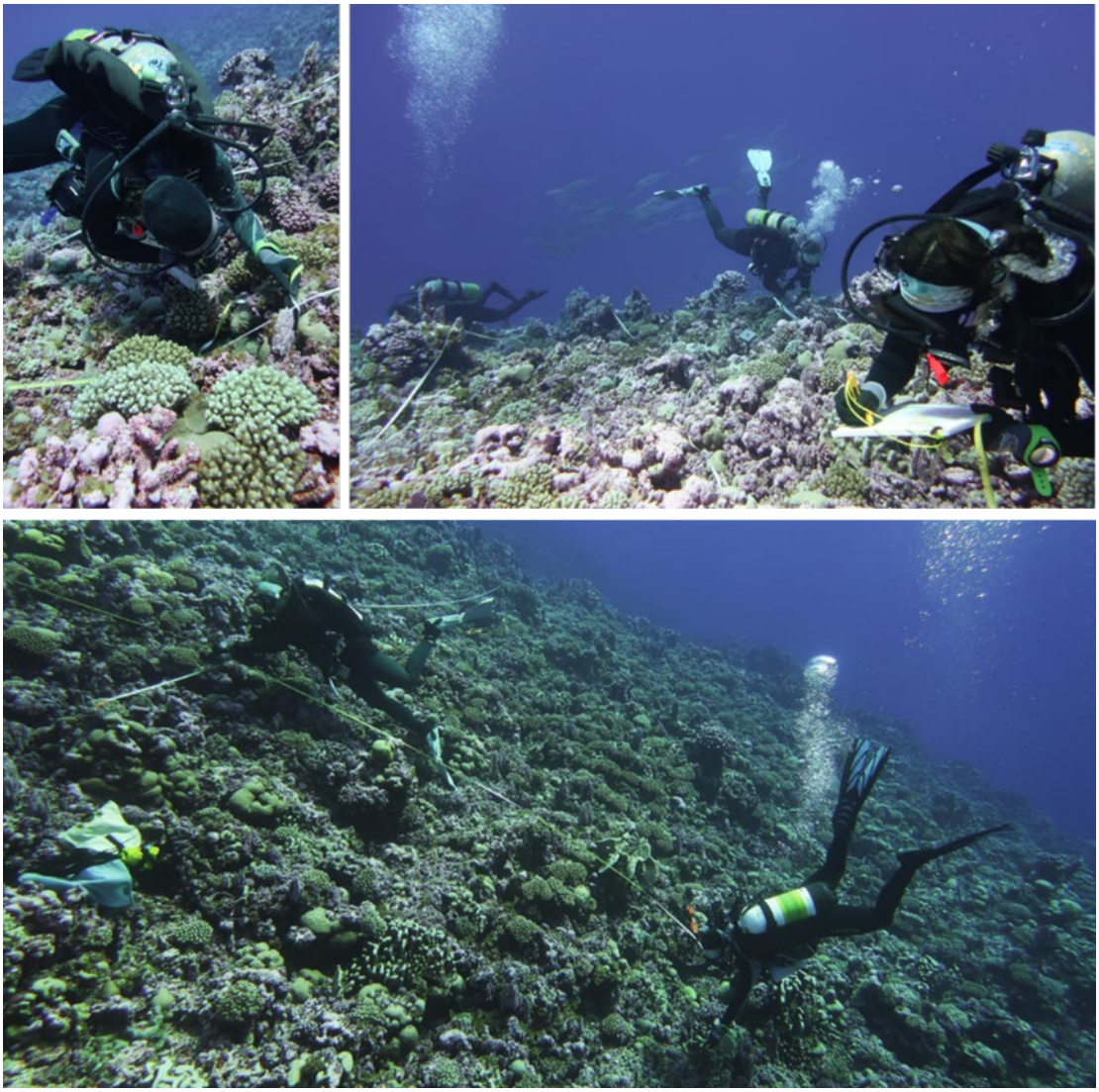
*A diver uses a bag filled with air to help deploy an acoustic recorder. Photo credit: NOAA Fisheries. Photographer: Jeff Milisen.*

PIFSC NCRMP Climate Team completed the four priority transects and associated fixed sites in Tutuila at Fagatele, Fagasa, Vatia, and Aunu‘u. Subsurface temperature loggers (STRs) were retrieved and collected at all sites. PIFSC scientists will use data from the STRs to monitor marine heatwaves and collect seawater samples. Photoquad surveys (PQ) were conducted at each site at 5m, 15m and 25m. Calcium Accretion Units (CAUs) and Bioerosion Monitoring Units (BMUs) were retrieved and deployed at the mid-depth (15m) sites. These units allow the team to measure how long-term trends in ocean acidification impact corals. CTD casts were conducted at all sites and water samples were collected for carbonate chemistry including four additional offshore CTD casts and water samples around the island of Tutuila. This team deployed an impressive 78 temperature recorders, collected 161 water samples, and deployed 85 calcification accretion units.



*Scientist Joy Smith rolls up the transect tape from a photoquad survey after the OCC Team installed calcification accretion units (CAUs) and bioerosion units (BMUs) Photo Credit: NOAA Fisheries. Photographer: Ari Halperin.*

Climate team divers conducted the final year of pilot carbonate budget assessments at Fagatele Bay, Tutuila, and Rose Atoll. This method surveys both reef building organisms (like corals and crustose coralline algae), and eroding organisms (like parrotfish and urchins). This assessment estimates how much of the habitat is growing and shrinking over time. Tracking these metrics is increasingly important under a rapidly changing climate, and will be incorporated into routine monitoring starting next year.



*A team of divers carries out a carbonate budget survey at Rose Atoll. Credit: NOAA Fisheries.*

*The OCC Team assisted NOAA Sanctuaries scientist Valerie Brown while she programmed the oceanographic instruments in the $CO_2$ buoy that monitors ocean acidification in Fagatele Bay. Photo credits: NOAA Fisheries. Photographers: Joy Smith (top); Jeff Milisen (bottom).*

The NOAA National Marine Sanctuary of American Samoa (NMSAS) team joined the cross-NOAA mission for one leg to support the Deep Coral Reef Ecosystem Study program funded by NOAA National Centers for Coastal Ocean Science (NCCOS). Scientists conducted deep-sea coral ecosystem surveys at Swains Island and Ta'ū. These coral ecosystems extend from 100 feet to more than 500 feet below the surface. They are a significant part of the coral reef ecosystem in American Samoa, but only a handful of sites have ever been explored, and the team conducted the first ever technical dives in Swains Island and Ta'ū deeper than 130 feet!

*Technical divers and support divers hover above giant Porites corals in the Valley of the Giants in the Ta'ū unit of the National Marine Sanctuary of American Samoa after surveying mesophotic reefs. Credit: NOAA Fisheries and National Marine Sanctuary of American Samoa. Photographer: Jason Leonard.*

The National Ocean Service (NOS) Hydrographic Team conducted hydrographic surveys in the shallow areas around the islands using small boats, and the ship surveyed 24 hours using their new deep sonar that can map down to 10,000 meters. Surveys were completed around Howland, Baker, Tutuila, Swains Island, Ta'ū, Ofu and Olosega, and Rose Atoll. In addition to bathymetric data, OCS acquired backscatter data to assist in seabed habitat characterization efforts. Furthermore, water column data and water level data were acquired to provide critical baseline data for future ocean studies. These data will support the international and collaborative Seabed 2030 initiative to map the world's oceans by 2030, as well as provide critical feature and depth information to update NOS nautical charting products and services. Many of these islands have not been mapped in several decades. The hydrographic survey data for all NOAA surveys is publicly available on the National Centers for Environmental Information (NCEI) website. The data for this project will be available about 12 to 24 months after the completion of the survey work and will be applied to nautical charts after that time.

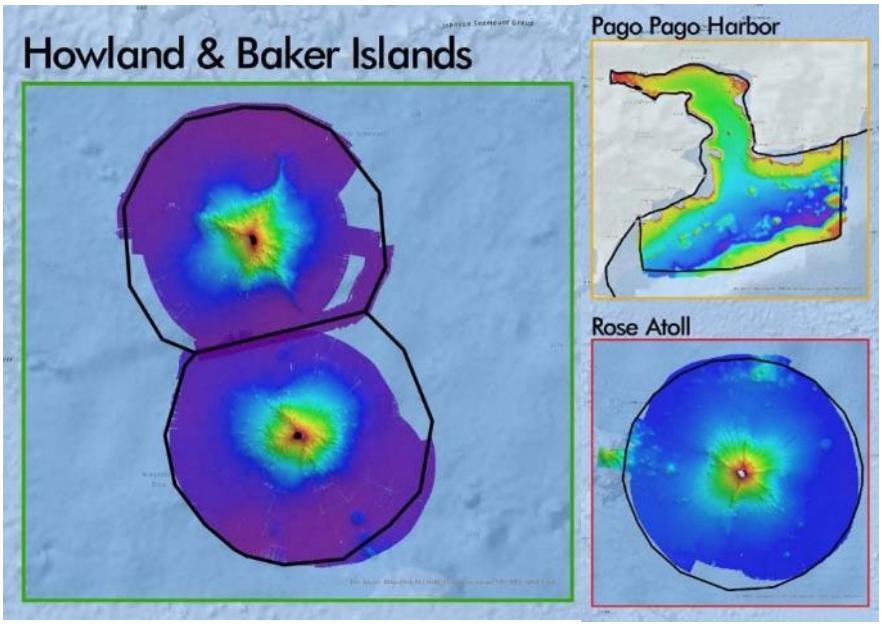



**Figure 6.** Bathymetry from Howland and Baker Islands, Pago Pago Harbor in Tutuila, and Rose Atoll. Credit: NOAA Office of Coast Survey

Outreach events were held throughout the field season including two in Pago Pago, American Samoa and one in Apia, Samoa. Each event drew large numbers of students, families, and government officials, who got a chance to tour the *Rainier* and learn about the coral and mapping surveys through hand-on science stations.

*Scientist Candace Alagata coaching a young student on how to take water samples using the Niskin bottle and weight (left picture). Scientists Juliette Verstaen and Candace Alagata describing the various data instrumentation typically deployed at OCC fixed sites to American Samoa students. Photo credit: NOAA Fisheries: Ray Boland.*


*NOAA Ensign Matt Hedderick gives a ship tour to Samoa government student interns. Photo credit: NOAA Fisheries. Photographer: Ray Boland.*

*NOAA Scientist Nathan Hayes explains what a typical fish team's diving equipment and gear setup looks like. Photo credit: NOAA Fisheries/Ray Boland.*

Due to a fire on board the *Rainier*, the final leg of FY23 NCRMP was canceled, resulting in complete loss of fish, benthic, and climate surveys around Jarvis Island and Palmyra Atoll. Moreover, Kingman Reef was not surveyed and Howland and Baker Islands were under-surveyed during this mission (with the exception of fish surveys). Failure to survey these important PIR creates a likely eight-year data gap in the NCRMP time series that began in 2000 (last NCRMP PRIA survey was 2018, next planned return is 2026).

NCRMP surveys in the American Samoa region also experienced significant impacts from staffing and other delays that caused a 31% loss in planned NCRMP operational days in the region. Only benthic surveys, not fish or climate surveys, were conducted around Swains Island.

Therefore, only limited baseline data exist around Swains Island prior to planned mammal eradication and no subsurface temperature data exists in advance of the 2023 forecasted heat stress event. The percentage of fish surveys completed in American Samoa ranged from 54-73% of the initial target numbers of surveys per island (Ofu & Olosega [66%], Rose [54%], Ta'ū [63%], Tutuila [73%]). Note, however, that certain reef areas within each island were sufficiently surveyed—achieving or even surpassing historical numbers of surveys—whereas other areas were under-surveyed or not surveyed at all. See the charts below for individual survey counts.

| FISH TEAM | TOTALS THRU 8/10/23 |
|---|---|
| Dives | 771 |
| SPC surveys | 359 |
| PQ sites | 358 |
| SfM belts | 89 |
| CTD/Water Samples | 80 |

| BENTHIC TEAM | TOTALS THRU 8/10/23 |
|---|---|
| Dives | 562 |
| Belt surveys | 147 |
| PQ sites | 150 |
| SfM belts | 81 |
| CTD/ Water samples | 0 |
| COTS | 150 |

| CLIMATE TEAM | TOTALS THRU 8/10/23 |
|---|---|
| Dives | 235 |
| CTD/Water Samples | 73 |
| STRs Deploy | 67 |
| STRs Recovered | 55 |
| CAUs Deployed | 67 |
| CAUs Recovered | 81 |
| BMUs Deployed | 83 |
| BMUs Recovered | 31 |
| SfM | 25 |
| PQ | 42 |
| Diel Suite | 0 |
| Carb Budgets | 5 |

| TOTALS ALL TEAMS | TOTALS THRU 5/12/23 |
|---|---|
| CTD/Water Samples | 153 |
| Dives | 1568 |
| PQ sites | 550 |
| SfM belts | 170 |

| OTHER | TOTALS THRU 5/12/23 |
|---|---|
| Sounds Traps Deployed | 7 |
| Tide Buoy Deployment | 1 |

**Figure 7.** Total NCRMP surveys/samples/collections completed by teams during the 2023 RICHARD mission.

## 4. Organizational Excellence

### Data Reports

[FRMD] Pacific Islands Fisheries Science Center. Fisheries Research and Monitoring Division (2023). USA purse seine vessels operating in the Western and Central Pacific Fisheries Commission area. https://doi.org/10.25923/w720-2k96

[FRMD] Pacific Islands Fisheries Science Center. (2023). Catch and effort of Pacific Islands Region longline vessels inside Pacific Remote Island Area Exclusive Economic Zone. https://doi.org/10.25923/qjcc-mn28

Nakachi A, Leong K, Mastitski A, Norman K, Weng C, Wise S. (2023). Compilation of fishing definitions in NOAA Fisheries law and policy. https://doi.org/10.25923/tkqr-bq21

### Technical Memorandum

Escontrela Dieguez D, Lee R, Kindinger TL, Couch CS, Charendoff J. 2023. Quantifying Corallivory from structure-from-motion models U.S. Deptartment of Commerce. NOAA. Pacific Islands Fisheries Science Center. NOAA Technical Memorandum. NMFS-PIFSC-149. https://doi.org/10.25923/c64k-gh75.

Ingeman, Kurt and Kindinger, Tye L. (2023). American Samoa JCR-FMP: PIFSC ESD analysis. https://doi.org/10.25923/7f0d-q794

Ingeman, Kurt and Kindinger, Tye L. (2023). Guam JCR-FMP : PIFSC ESD analysis. https://doi.org/10.25923/352q-sk62

Schmidt, Andrea L. et al. (2023). Larval ecology of Uku (Aprion virescens) in the Main Hawaiian Islands: a review from historical data. https://doi.org/10.25923/aevx-hr06

Stahl, Jennifer P. et al. (2023). The role of electronic monitoring in assessing post-release mortality of protected species in pelagic longline fisheries. https://doi.org/10.25923/zxfv-5b50

### Journals

Couch, C. S., Oliver, T. A., Dettloff, K., Huntington, B., Tanaka, K. R., & Vargas-Ángel, B. (2023). Ecological and environmental predictors of juvenile coral density across the central and western Pacific. In Frontiers in Marine Science (Vol. 10). Frontiers Media SA. https://doi.org/10.3389/fmars.2023.1192102

Drazen, J. C., Clark, B. H., Gove, J. M., Phipps, J. E., Copeland, A. M., Lecky, J., Green, J. A. M., Kobayashi, D. R., Turner, J. R., Whitney, J. L., & Williams, G. J. (2023). Near-island enhancement in mesopelagic micronekton assemblages off Hawai‘i. In Deep Sea Research Part I: Oceanographic Research Papers (Vol. 199, p. 104107). Elsevier BV. https://doi.org/10.1016/j.dsr.2023.104107

Hakala, S., Watari, S., Uehara, S., Akatsuka, Y., Methot, R., & Oozeki, Y. (2023). Governance and science implementation in fisheries management in Japan as it compares to the United States. In Marine Policy (Vol. 155, p. 105670). Elsevier BV. https://doi.org/10.1016/j.marpol.2023.105670

Hoyle, S. D., Campbell, R. A., Ducharme-Barth, N. D., Grüss, A., Moore, B. R., Thorson, J. T., Tremblay-Boyer, L., Winker, H., Zhou, S., & Maunder, M. N. (2024). Catch per unit effort modelling for stock assessment: A summary of good practices. In Fisheries Research (Vol. 269, p. 106860). Elsevier BV. https://doi.org/10.1016/j.fishres.2023.106860

McCullough, J. L. K., Henderson, E. E., Trickey, J. S., Barlow, J., Baumann-Pickering, S., Manzano-Roth, R., Alongi, G., Martin, S., Fregosi, S., Mellinger, D. K., Klinck, H., Szesciorka, A. R., & Oleson, E. M. (2023). Geographic distribution of the Cross Seamount beaked whale based on acoustic detections. In Marine Mammal Science. Wiley. https://doi.org/10.1111/mms.13061

Pires, R., Aparicio, F., Baker, J., Pereira, S., Caires, N., Cedenilla, M., Harting, A., Menezes, D., & Fernández de Larrinoa, P. (2023). First demographic parameter estimates for the Mediterranean monk seal population at Madeira, Portugal. In Endangered Species Research (Vol. 51, pp. 269–283). Inter-Research Science Center. https://doi.org/10.3354/esr01260

Portner, E. J., Mowatt-Larssen, T., Carretero, A. C.-L., Contreras, E. A., Woodworth-Jefcoats, P. A., Frable, B. W., & Choy, C. A. (2023). Harnessing a mesopelagic predator as a biological sampler reveals taxonomic and vertical resource partitioning among three poorly known deep-sea fishes. In Scientific Reports (Vol. 13, Issue 1). Springer Science and Business Media LLC. https://doi.org/10.1038/s41598-023-41298-9

Ransome, N., Frisch-Jordán, A., Titova, O., Filatova, O., Hill, M., Cheeseman, T., Bradford, A., Urbán R, J., Martínez-Loustalot, P., Calambokidis, J., Medrano-González, L., Burdin, A., Fedutin, I., Loneragan, N., & Smith, J. (2023). A trans-Pacific movement reveals regular migrations of humpback whales Megaptera novaeangliae between Russia and Mexico. In Endangered Species Research (Vol. 52, pp. 65–79). Inter-Research Science Center. https://doi.org/10.3354/esr01263

Richardson, L. E., Heenan, A., Delargy, A. J., Neubauer, P., Lecky, J., Gove, J. M., Green, J. A. M., Kindinger, T. L., Ingeman, K. E., & Williams, G. J. (2023). Local human impacts disrupt depth-dependent zonation of tropical reef fish communities. In Nature Ecology & Evolution (Vol. 7, Issue 11, pp. 1844–1855). Springer Science and Business Media LLC. https://doi.org/10.1038/s41559-023-02201-x

Schemmel, E., & Brown-Peterson, N. J. (2023). Handling Effects on Histological Identification of Female Reproductive Status: Examples from Tropical Deepwater Snappers. In Fishes (Vol. 8, Issue 8, p. 406). MDPI AG. https://doi.org/10.3390/fishes8080406

Watson, J. T., Ames, R., Holycross, B., Suter, J., Somers, K., Kohler, C., & Corrigan, B. (2023). Fishery catch records support machine learning-based prediction of illegal fishing off US West Coast. In PeerJ (Vol. 11, p. e16215). PeerJ. https://doi.org/10.7717/peerj.16215

Zamborain-Mason, J., Cinner, J. E., MacNeil, M. A., Graham, N. A. J., Hoey, A. S., Beger, M., Brooks, A. J., Booth, D. J., Edgar, G. J., Feary, D. A., Ferse, S. C. A., Friedlander, A. M., Gough, C. L. A., Green, A. L., Mouillot, D., Polunin, N. V. C., Stuart-Smith, R. D., Wantiez, L., Williams, I. D., … Connolly, S. R. (2023). Sustainable reference points for multispecies coral reef fisheries. In Nature Communications (Vol. 14, Issue 1). Springer Science and Business Media LLC. https://doi.org/10.1038/s41467-023-41040-z

**Special Publications**

Ma, H. (2023). Non-commercial catch estimation for Deep 7 bottomfish in the main Hawaiian Islands. Pacific Islands Fisheries Science Center (U.S.). https://doi.org/10.25923/2MBE-XH91