National Marine Fisheries Service

Pacific Islands Fisheries Science Center

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NOAA FISHERIES

Report to the Western Pacific Regional Fishery Management Council

Credit: NOAA Fisheries/Jeff Milisen.

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

PIFSC Publishes Study on American Samoa Small Boat Fishing

In 2021, PIFSC implemented a survey to better understand the economic, social, and cultural characteristics of small boat fishing in American Samoa. In total, 33 individual small boat fishers responded: 73% from Tutuila and 27% from the Manu'a Islands. Most identified as Samoan (82%) and male (91%) with an average age of 50 years. The median self-reported household income was $17,500. A slight majority (55%) owned the boat on which they fished.

Table 1. Median vessel characteristics.

	TUTUILA	MANU'A
Boat length (ft)	30	30
Horsepower	205	60
Year built	2005	1998
Purchase price	$50,000	$10,000
Estimated current market value	$52,500	$19,000
Number of boats surveyed	8	9

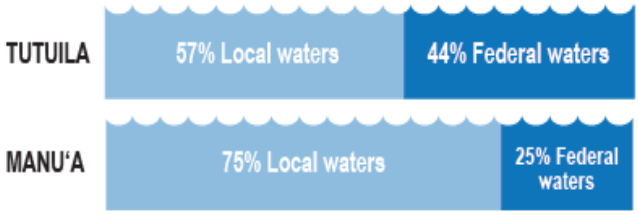

Figure 1. Average percent of time fishing in local and federal waters.

Respondents took an average of 43 boat fishing trips in 2020, and most (82%) fished in both local and federal waters. In the Manu'a Islands, 78% of fishers reported handline for deep water bottomfish as their primary gear while 35% on Tutuila, fishers relied predominantly on either spearfishing or trolling. On Tutuila, the largest percentage of respondents (38%) noted part-time commercial fishing as their primary fishing motivation. In the Manu'a Islands, 33% indicated that they fished primarily for subsistence and another 33% fished primarily for cultural reasons.

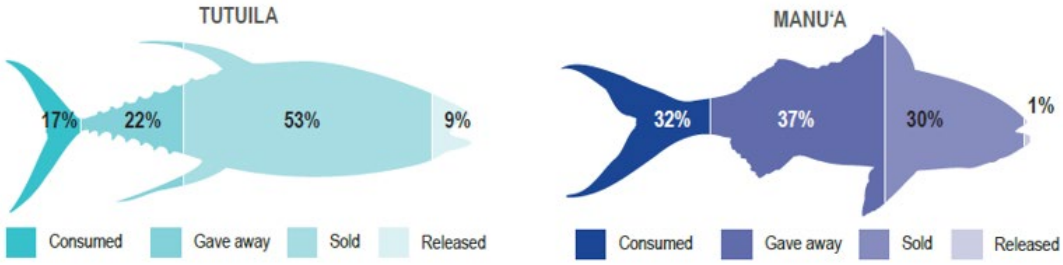

Figure 2. Survey responses: "In 2020, what percent of your catch was…?"

Bottomfish was the primary species group that respondents targeted to sell (39%), followed closely by reef fish species (35%). Nearly half (41%) of respondents indicated that bottomfish was their primary target to keep for personal and family consumption, while pelagic species were the top target to give away (54%). About 97% of fishers kept some of their catch for personal and family consumption. Approximately 90% of respondents sold a portion of their catch, contributing to an average of 39% of their personal income. Fifty-seven percent of fishers from Tutuila and 51% from the Manu'a Islands documented that half or more of their income came from fish sales. Fishers reported an annual median of $751 from fish sales in 2020. On average, 37% of this value came from reef fish, followed by pelagics at 28%, and deep water bottomfish at 20%. Overall, 38% of respondents sold to friends, neighbors, and coworkers. Fewer (29%) sold at roadside or farmers' markets, followed by 23% selling directly to restaurants and stores.

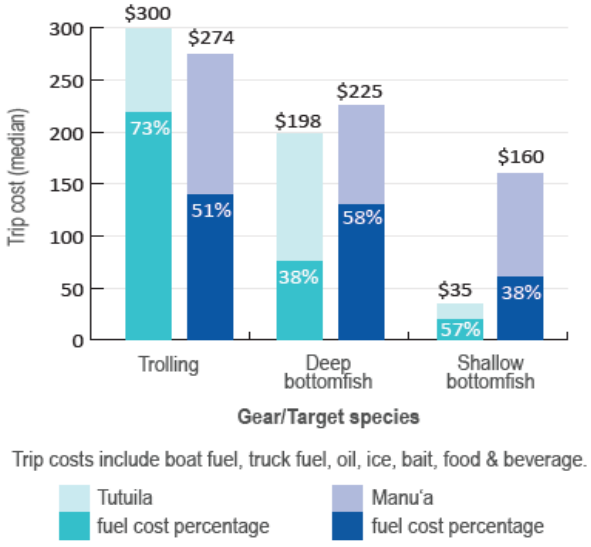

Figure 3. Median trip costs by gear/target species, 2020.

Trolling trips had the highest median trip cost in 2020 at $286, followed by deep water bottomfish at $215. Median shallow bottomfish trips cost $55, while spearfishing trips cost the least, with a median cost of $35. Boat fuel comprised the majority of trip costs for trolling (61%), deep water bottomfish fishing (47%), and shallow bottomfish (36%), while ice was the highest expense for spearfishing trips (43%). Median annual fishing expenditures such as fees, gear, and boat and trailer maintenance totaled to about $2,100 per vessel in 2020.

Considering the social aspects of fishing, nearly all fishers (97%) cited it as an important part of who they are, and 100% agreed that it is an important part of their culture. The survey solicited input from the community on suggestions for future research and management, and 85% of respondents provided comments. Fishers also rated the importance of various aspects of fisheries management and offered assessments of management performance.

The results of this survey underscore the importance of local catch for food security and as a vital source of income, particularly for nearshore and deep water bottomfish. These findings highlight where management can begin work with the community implementing actions and offering alternatives that may affect fishing and life in American Samoa.

Fisheries Research and Monitoring Division Scientists Provide a Bottomfish Stock Assessment Report Out to Manu'a Bottomfishing Communities

A team of PIFSC scientists from FRMD and SEES composed of Dr. Marc Nadon, Marlowe Sabater, and Mia Iwane traveled to the islands of Ofu and Ta'u in American Samoa to present the outcome of the 2023 Bottomfish Management Unit Species Benchmark Stock Assessment. The Ofu fishing community engagement meeting on June 22, 2023, drew 18 fishing community members including the most active bottomfish fisherman on the island. The meeting was opened by Trevor Tuiolosega, the Ofu Executive Office Manager. The young men of the village also attended who, according to Clint Ilaoa, a bottomfish hi-liner, are the next generation of fishermen for their village. Dr. Marc Nadon presented the outcomes of the benchmark stock assessment showing the nine species that were assessed were not being overfished and not subject to overfishing. Nadon noted that two species (asoama – *Aprion virescens* and palu loa – *Etelis coruscans*) were close to the overfished threshold and should be monitored closely. Nadon co-presented the report with Tepora Lavatai, staff from the American Samoa Department of

Figure 4. Caption: Scenes from Manu'a community engagement.

Marine and Wildlife Resources (DMWR), who translated the report into Samoan. DMWR is a partner in this engagement effort.

The fishers agreed on the change in stock status and stated that this is representative of what is occurring in the fishery. The assessment report was well received and the only active bottomfisher attested to the importance of contributing to the data collection. The scientists and fishers discussed bottomfish targeting and fishing techniques that contributed to the understanding of selectivity and the pattern of catch for savane (*Lutjanus kasmira*). The women of the community expressed their concerns regarding the intrusion of fishing boats from Western Samoa and Tutuila. They stated that the Manu'a resources are for Manu'a people.

The team traveled to the island of Ta'u on June 23, 2023, to meet with the fishing community regarding the outcome of the assessment. The meeting was attended by 13 fishers from the villages of Ta'u, Faleasao, and Fitiuta. Some of the attendees participated in the two prior meetings organized by PIFSC: 1) data workshop in February 2022; and 2) data workshop feedback in November 2022. Fishers were interested in the life history of different bottomfish species. They also attested to the catch of savane in Manu'a, but they do not target this species and avoid fishing for them because they prefer palu (deepwater snappers). Overall, the Ta'u fishers appreciated the efforts in keeping them updated on the bottomfish status and all the work that went into the new assessment.

The Tutuila BMUS stock assessment report-out was part of the 195th meeting of the Western Pacific Fishery Management Council at the Governor Rex Lee Auditorium in the village of Utulei on June 27, 2023.

Electronic Monitoring Video Expands Opportunities for Determining Post-Release Condition of Protected Species Following Fisheries Interactions

Protected species are incidentally captured in many different fisheries worldwide, but few of these interactions are independently verifiable if there are no observers aboard the vessel. National Standard 9 requires the Councils and NMFS to minimize bycatch and the mortality of bycatch to the extent practicable through the development of mitigation measures. Quantifying interactions with protected species is a precursor to reducing bycatch. Previous research conducted in the Pacific Islands indicates that protected species interactions can be detected in electronic monitoring (EM) video. However, to improve population assessments, it is also necessary to predict the likelihood that an animal will survive after an interaction.

Currently, human observers collect data needed by the National Marine Fisheries Service (NMFS) to monitor protected species interactions in the Hawai‘i longline shallow- and deep-set fisheries. However, the costs for observer coverage continue to rise, and presently, observers monitor only 20% of deep-set trips, while shallow-set trips have 100% observer coverage.

When protected species interactions occur during an observed Hawai‘i longline trip, experts use the data forms and video footage collected by the observers to determine the likelihood of post-interaction mortality. They do this based on standardized criteria such as condition of the animal at the vessel and at release, hook or entanglement location, and the amount of fishing gear remaining on the animal upon release. PIFSC FRMD conducted research to ascertain if EM can provide the data necessary to determine mortality and serious injury for cetaceans and post-interaction mortality for sea turtles. This research is crucial to understand how EM can supplement the at-sea observer program in the Pacific Islands Region longline fisheries and to inform other developing EM programs for fisheries that incidentally interact with protected species.

EM staff and protected species experts collected and reviewed videos for protected species interactions from deep- and shallow-set trips. EM systems have been installed on volunteer Hawai‘i longline vessels in two separate deployments: 18 systems in 2017 installed by Saltwater, Inc., and 20 systems in 2021 installed by IKE solutions. Each system consisted of a computer and two cameras as well as sensors for GPS, hydraulic, and magnetic rotation, with computer and sensor configuration according to Carnes et al. (2019). In both deployments, dome-shaped security cameras were used with 3 megapixels and a resolution of 720p in the first deployment and 4 megapixels and a resolution of 1080p in the second deployment. All EM systems were equipped with a “rail” and a “deck” camera; the “deck” camera captured activities on deck while the “rail” was used to capture imagery of fish and protected species in the water or alongside the vessel.

Videos of cetacean interactions were reviewed to assess whether the data could be used to make determinations of mortality, non-serious injury, or serious injury based on criteria defined for small cetaceans (odontocetes except sperm whales). NMFS defines serious injury as, “an injury that is more likely than not to result in mortality.” If data are insufficient to establish injury severity, then the injury “cannot be determined” (NMFS 2012). The primary data needed to make this determination are species, location, and amount of attached fishing gear at capture and at release, and the condition and behavior of the animal at capture and release.

EM footage of sea turtle interactions was examined to determine if the data needed to assign a percent likelihood of post-interaction mortality could be collected. After video and data review, a percent likelihood of post-interaction mortality was selected from Table 1 in Ryder et al. (2006)[1] based on the assigned injury and release condition and whether the sea turtle was a hardshell or leatherback. Leatherbacks had a 5–10% greater likelihood of mortality for the same injury and release condition. An injury category was assigned (I–VI) based on the hooking or entanglement

[1] Ryder CE, Conant TA, Schroeder BA. 2006. Report of the Workshop on Marine Turtle Longline Post-Interaction Mortality. U.S. Dep. Commerce, NOAA Technical Memorandum. NMFS-F/OPR-29: 36.

location and whether the sea turtle was comatose or resuscitated. The release condition was based on the amount of attached fishing gear at release.

A total of 8 cetacean and 37 sea turtle interactions were reviewed for this study. When camera views and imagery were optimized and fisher handling was visible, we were able to make determinations of mortality, serious, and non-serious injury for cetaceans and assign a percent likelihood of mortality for sea turtles. If the fishers are observed on camera cutting the animals from the line or coiling the remaining line, then it may be possible to deduce the amount of trailing line and the likely severity of injury that may result from the interaction. In addition, EM may offer enhanced ability to collect information compared to observer data, such as on cetacean behavior or fisher handling.

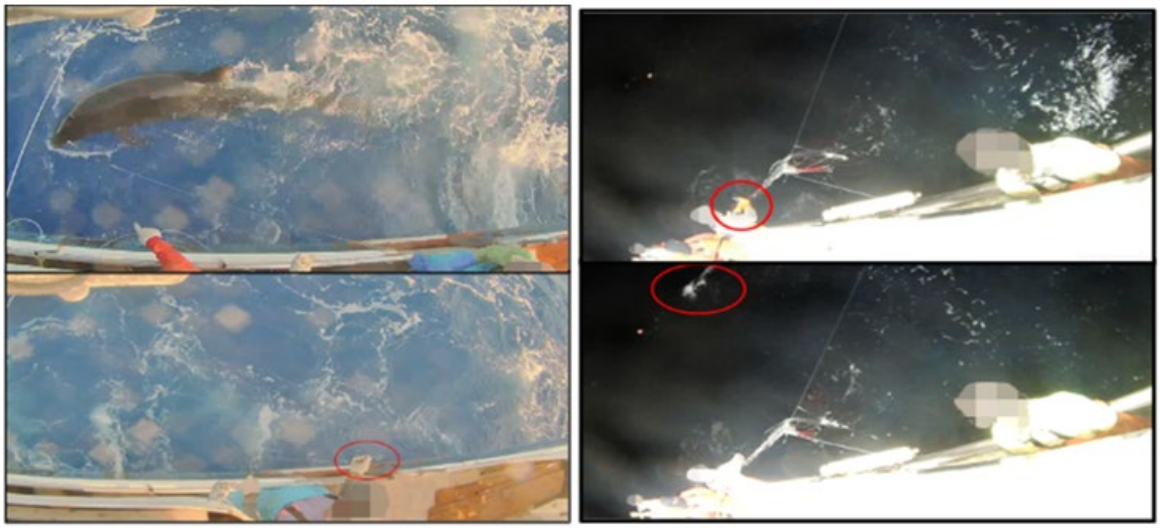

Figure 5. (left) EM video showing dislodged visible hook on a cetacean, which may lead to a non-serious injury determination if no other case-specific factors suggest a serious injury; (right) EM video showing line cut from a cetacean at a distance, which would result in a serious injury determination.

There were sufficient data to determine mortality, non-serious, or serious injury for 6 of the 8 cetacean interactions. Limited field of view, dirty cameras, and orientation of the "rail" cameras hindered some observations for the 2017 camera deployments; however, observations were improved after optimization in 2021. Although it is possible that more injury determinations will need to be assigned as "cannot be determined" for cetacean interactions from EM trips compared to those with an at-sea observer, EM footage may allow for determinations even on unobserved trips. Our study showed that even when cetaceans were not brought close to the vessel following protected species handling guidelines, it is possible that in some cases an injury determination could be made.

Our study demonstrated that the percent likelihood of mortality can be assigned with certainty for most sea turtles that are caught in the Hawai‘i longline fisheries based on data collected from EM video. Generally, we could assess the injury and release condition of sea turtles as the majority were boarded and released with all fishing gear removed. However, for those released with trailing line or released from fishing gear while still in the water, there may be uncertainty

in the injury or release condition resulting in a more conservative determination that potentially inflates the percent likelihood of mortality. With improved camera settings and resolution used in the second deployment, we were able to assign an injury category with certainty for 86% of the sea turtle interactions compared to 43% from the first deployment.

This research demonstrates that EM-collected data can provide an alternative data stream to improve estimates of protected species bycatch and quantify the impacts fisheries have on their populations. This is particularly important as many international pelagic longline fisheries have limited observer coverage yet interact unintentionally with protected species.

Modern Computing and Tackling Technical Debt in the Pacific Islands Region

The Stock Assessment Program (SAP) is leading an investigation on the "High throughput computing for stock assessment" (htc4sa) pilot project. High throughput computing (HTC) is the use of a distributed or high performance computing (HPC) network to efficiently run many independent computational jobs simultaneously. In this context, that means running multiple stock assessment models at the same time.

This project directly supports NOAA's mission of conserving and managing coastal and marine ecosystems by utilizing existing HPC resources to advance the quality of stock assessments which form the basis of science-based management of marine resources. The current framework for developing stock assessments traditionally involves an analyst sequentially testing individual, alternative model configurations to arrive at a single best base case model. This inefficiency limits the amount of model configurations an analyst can explore in the amount of time allocated for developing the stock assessment. Furthermore, there is a growing movement away from basing management off of a single best base case model, but rather on an ensemble of models which can more appropriately capture the total uncertainty in stock status. Ensemble modeling has a larger computational overhead due to the development of multiple models, and this requires access to HTC in order to be feasible.

Applying HTC approaches to stock assessment has multiple benefits:

1. Increases efficiency: A single analyst can evaluate multiple model configurations, leading them to more rapidly identify an optimal model structure.
2. Automation, transparency, and reproducibility: Running models in an HTC environment necessitates users to manipulate input and output via a script rather than by manually editing them. This script based approach facilitates testing alternative model configurations and leads to improved transparency, reproducibility, and documentation since all changes to input/output files are captured in the script.
3. Multi-model inference: There is a natural extension to solving the computational challenge of efficiently running multiple models in that it greatly facilitates the use of ensemble models and simulation work as a part of research or a management strategy evaluation.

To date, the SAP has developed and documented workflows for running stock assessment models in two different HTC environments: Open Science Grid (OSG) and NOAA's Hera HPC system.

The outcome of this pilot project will be to develop and document generalizable workflows for running existing stock assessment platforms (e.g., Stock Synthesis, FIMS, etc.) in high-throughput environments to facilitate the script based, 'simultaneous' exploration of multiple alternative model configurations.

The Fisheries Monitoring Program (FMP) and Fisheries Reporting and Bycatch Program (FRBP) work together to collect, verify, analyze, and report on catch and effort data to support fisheries management in the Pacific Islands Region (PIR). The programs are making strides in tackling technical debt by building new databases, applications, and processes to support regional data needs.

The Western Pacific Fisheries Information Network (WPacFIN) team successfully launched the new commercial purchases (aka Sell it Log it) web application (version 2) in mid-2023 that replaced three separate databases and applications used by the American Samoa Department of Marine and Wildlife Resources, the Guam Bureau of Statistics and Planning, and the Commonwealth of the Northern Mariana Islands Department of Fish and Wildlife. The application uses Amazon Web Services (AWS), hosted by the Pacific States Marine Fisheries Commission (PSMFC). In version 1 of Sell it Log it, the Council owned the AWS account, and the team successfully migrated the account and application to PSMFC. additionally, the team is training agency staff to use Metabase to query and build data reports for the commercial purchase data. Feedback from agencies has been very positive.

Recently, the Archipelagic and Pelagic Plan Teams recommended using a procedure developed by SAP to estimate catch and effort from the creel surveys for SAFE report statistics. WPacFIN and SAP worked together to automate an r-script directly linked to the WPacFIN mySQL database with results stored directly in the database forming the basis of all the SAFE report summaries of catch and effort by species, method, etc.

The longline data team continues to provide elog support to new and seasoned captains in both Honolulu and Pago Pago. The team traveled to Pago Pago twice in 2023 to train captains and deployment was very successful. FMP and FRBP recognize that the longline database needs a major overhaul and have been using a process mapping technique to capture the current state of data collection, storage, and reporting processes and will engage with PSMFC for a database modernization project.

The South Pacific Tuna Treaty (SPTT) data team continues to improve the data validation modules, iFIMs import module, and data entry application. The updated data entry application for unloading data allows users to view catch estimates from the regional purse-seine log (RPL), and the final out turn (FOT) application shows catch estimates from the unloading data, improving the accuracy of the data entry across all three data sets.

The Life History Program (LHP) has three distinct databases that they manage: sample tracking, biological data, and the international sample tracking database. FMP and LHP are beginning a project together to integrate the sample tracking and biological databases into one. The groups have started to meet regularly to examine the data and existing processes.

FMP/FRBP staff continue to regularly participate in the NOAA Fisheries Information System (FIS) program. Two FMP/FRBP staff attended the FIS Legacy Data Workshop in La Jolla in April 2023. The staff wrote four FIS proposals for FY24 to fund these continued projects to tackle technical debt in the PIR.

2. Conserve Protected Species

A Deep Dive into Hawaiian Monk Seal Post-Mortem Diagnostics

From June 21 through 23, 2023, the NOAA Hawaiian Monk Seal Research Program (HMSRP) brought together diagnosticians, clinicians, technicians, and field response personnel to do a deep dive into advanced monk seal necropsy and post-mortem diagnostic skills. This is increasingly important as local capacity for stranding response grows but challenging to facilitate as individuals are spread across multiple islands. There are also (fortunately) relatively few opportunities to practice and share techniques on this endangered species, and dead animal stranding events cannot be planned.

Thanks to the generosity of The Marine Mammal Center, two juvenile elephant seal carcasses that were previously frozen were provided so that the group could schedule hands-on sessions in the laboratory. Veterinary and stranding response personnel from neighboring islands attended in person, and those that attended remotely were able to participate in classroom discussion sessions. World-renowned marine mammal veterinary pathologist, Dr. Katie Colegrove, from the University of Illinois Zoological Pathology Program, attended as the contract pathologist for the HMSRP. She provided crucial links between the sampled tissues she examines on slides and the sampling personnel on the ground who collect them. She also offered key perspectives from her work with other taxa that will improve the forensic capacity in our region.

The HMSRP is gathering input from the workshop to refine its necropsy protocols for all collaborators and working to establish partnerships to enable advanced imaging (such as CT scans) for more carcasses prior to dissection. While necropsies are unfortunate to have to conduct, we will continue to pursue excellence in determining causes of death so that we can provide the highest quality information to stakeholders and decision-makers.

Figure 6. Participants at the Advanced Necropsy Training Workshop prepare for a hands-on session in the PSD Necropsy Laboratory at the NOAA IRC.

Fostering a deeper understanding of the HMSRP's toxoplasmosis risk model for managers and stakeholders

Toxoplasmosis is a disease caused by infection from the protozoan parasite *Toxoplasma gondii*. The parasite completes its life cycle through sexual reproduction inside the intestines of felids. As the definitive hosts of *T. gondii,* infected cats shed 100s to millions of oocysts (parasite zygotes encased inside hardy thick-walled cysts) in their feces. Because *T. gondii* oocysts are environmentally hardy (they can even survive wastewater treatment), they contaminate landscapes and flush into the ocean via surface runoff. Toxoplasmosis is the leading disease impacting Hawaiian monk seals, primarily affecting those in the human inhabited MHI. This has been a focus of HMSRP's research since it emerged as a significant population threat in 2015.

On July 10 and 12, 2023, the NOAA HMSRP hosted the 2023 Toxoplasmosis Risk Management Scenario Workshop. This forum provided a space for agency stakeholders to meet with scientists and evaluate outdoor cat management scenarios for O'ahu using a toxoplasmosis risk modeling tool developed by the HMSRP.

On day 1 of the workshop, participants were introduced to the intended use, assumptions, and limitations of the risk model. To illustrate these, we developed and used our Toxoplasmosis Risk

Modeling App (hereafter "model" or "app") in which users can manipulate factors shaping *T. gondii* oocyst contamination to visualize exposure risk across the landscape. Adjustable model parameters include cat abundance, Toxoplasma oocyst shedding rate, and habitat occupancy. As the user varies those inputs, the model produces maps of oocyst contamination across O'ahu. The resulting data can be run through a hydrological model to assess the role of watershed structure, rainfall, and runoff in nearshore oocyst contamination. In a series of guided and open discussions at the workshop, participants generated a range of hypothetical management scenarios to use as model inputs.

The initial workshop discussion envisaged outcomes and planning strategies for a best case toxoplasmosis management scenario on a 10-year timeline. This optimistic scenario comprised 30–70% reductions in each cat population, eliminating cats from conservation lands, and reducing cats in agricultural areas. Other ideas included a worst-case scenario in which all cat populations increase.

Model results and group discussion revealed a few major insights:

- Colony cats were by far the greatest oocyst contributor relative to other cat types; generally, only large reductions in colony cat numbers produced favorable results.
- Adjusting locations (rather than size) of cat populations may not change oocyst numbers but could significantly affect coastal export in the hydrological model (e.g., if fewer cats occupy urban land with impervious surfaces) and/or provide other conservation benefits.
- As large watersheds have high oocyst export due to size alone, catchment area could be one additional consideration when prioritizing locations for cat management.

On day 2, the group explored potential challenges and roadblocks associated with certain management actions which will be compiled for managers to use in prioritization and decision-making. We are drafting a report which highlights major workshop findings and jumping-off points for continued development of collaborative management strategies to curb toxoplasmosis in the main Hawaiian Islands (MHI).

HICEAS is Underway

The Hawaiian Islands Cetacean and Ecosystem Survey (HICEAS) 2023 is underway. HICEAS is designed to collect the data necessary to conduct density analyses for cetaceans within the exclusive economic zone around Hawai'i. This survey is supported by the local R/V *Oscar Elton Sette* and west coast based R/V *Reuben Lasker*, scheduled to join the survey in October. The project requires 180 days at sea to survey the full EEZ; this year it will continue through early December. Overall HICEAS includes:

- visual and passive acoustic line-transect surveys for cetaceans,
- visual strip-transect surveys for seabirds,
- deployment and recovery of Drifting Acoustic Spar Buoy Recorders (DASBRs) to remotely monitor for cetaceans and collect distribution and density data for deep-diving

whales and baleen whales not commonly seen from the ship,
- morning CTD casts with water samples for fluorometry measurements to compare with satellite-derived products,
- evening CTD casts with water collection for eDNA to examine distribution of a full range of species, including squids, fishes, plankton, and cetaceans, and
- overnight Isaacs-Kidd midwater trawls to examine distribution of larval fish, including various management unit species (MUS).

Although scheduled to begin in late June, a prolonged staffing issue on *Sette* and some last minute repairs to the fuel tank resulted in a lengthy delay. Leg 1 finally departed July 22 for 7 days at sea. Those days were spent ensuring most of the operations were running smoothly, including new net tow methods to characterize the pelagic ecosystem more thoroughly. The short leg included 7 cetacean sightings, 18 acoustic detections, 412 seabirds of 16 species, 1 CTD cast for eDNA, deployment and recovery of 2 DASBRs, and 5 net tows.

Leg 2 departed August 4 for 29 days at sea. This leg will kick off survey operations in earnest, heading to the northwest edge of the study area over the next several days, returning September 1.

Keep up on HICEAS progress at our website, updated daily with completed tracklines, visual sightings, and acoustic detections, and updated often with new stories of our daily adventures.

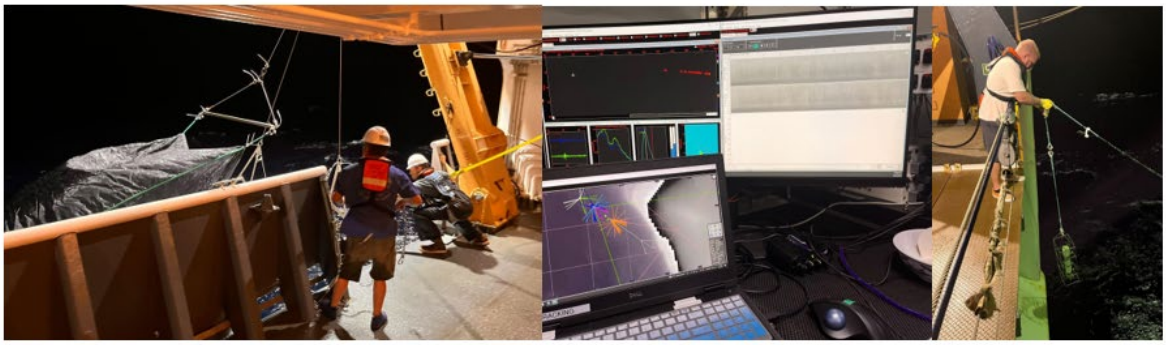

Figure 7. Leg 1 highlights—Deploying the IMKT to fish for pelagic larva, acoustically tracking dolphins off the Kona coast, and deploying the DASBR with CTD attached to monitor sub-surface conditions. Photos: Erin Oleson.

Update from Green Sea Turtle Field Research at Lalo (French Frigate Shoals)

PIFSC's Marine Turtle Biology and Assessment Program's (MTBAP) team of three field researchers (lead Alex Reininger and assistants Andrew Glinsky and Shelbie Ishimaru) has been stationed at Tern Island at Lalo since May 18th. Tern Island has been the location of our team's camp and data collection since Hurricane Walaka severely damaged East Island (the former primary research site since 1973) in 2018. However, given the increased size and elevation of

East Island, this year our team was able to safely establish a temporary camp there with the goal of conducting nighttime nesting surveys and deploying data loggers into nests, allowing for the collection of female abundance, nest temperature, and nest excavation data from East for the first time since 2018. On Tern Island, the combined marine turtle and monk seal researchers continue to survey for and mitigate wildlife entrapments in the degrading seawalls and other infrastructure. During the last two weeks, the turtle team has been transitioning to reduced nighttime survey effort and starting hatchling sampling. The team will return to Honolulu in early October. Below is a summary of the data they have collected as of August 2, 2023.

Total turtles identified/tagged

- Lalo: 748 turtles (501 females, 245 males, 2 juveniles)
- Tern Island: 430 turtles (274 females, 154 males, 2 juveniles)

Tern basking surveys

- Peak number: 125 baskers/day (May 29) – 44M, 76F, 5U
- Current weekly average: 12 baskers/day

Tern nesting surveys

- Peak number = 58 nesters/night (June 30)
- Current weekly average = 29 nesters/night

East Island mini camp

- Week 1:
    - Average number of basking turtles per day: 23 (compared to 73 on Tern during the same week)
    - Average number of nesting turtles per day: 33 (compared to 46 on Tern during the same week)
- Week 2:
    - Average number of basking turtles per day: 17 (compared to 46 on Tern during the same week)
    - Average number of nesting turtles per day: 26 (compared to 32 on Tern during the same week)

Tern Island entrapments

- 53 turtles (51 adults, 2 juveniles) released alive

Figure 8. Nesting green turtle punctured by the degraded seawall at Tern Island after being entrapped behind it and attempting to return to the water.

Supporting Leatherback Conservation Projects in Indonesia

Drs. Alexander Gaos (PSD) and John Wang (FRMD) completed an extremely productive 17-day research trip to Indonesia in June during which they undertook various activities that greatly enhanced PIFSC's role and standing in Western Pacific (WP) leatherback research and conservation. During this trip, the PIFSC researchers

- participated in the 2023 Indonesia Sea Turtle Symposium, including: (1) giving a keynote presentation, (2) co-authoring several presentations, (3) meeting with partners from the University of West Papua and the NOAA SWFSC to discuss future collaborations on WP leatherback programs, (4) presenting the NOAA Species in the Spotlight *Partner in the Spotlight Award* to Hero Ohoiulun (image below) and WWF Indonesia for their leadership of WP leatherback conservation in the Maluku province (Indonesia);
- visited villages and met with community leaders in the Kei Islands where NOAA supports work by WWF Indonesia to reduce a traditional hunt of leatherback turtles;

- applied satellite tags to two post-nesting leatherbacks in Buru Island (image below) where NOAA supports WWF Indonesia to monitor leatherback nesting and protect nests;
- organized over 200 leatherback skin samples from the Kei Islands and Buru Island projects in preparation for upcoming genetic analysis; and
- held meetings, gave presentations, and discussed various leatherback-related topics with several national and provincial leaders from the Indonesian Ministry of Marine Affairs and Fisheries (MMAF) and the National Research and Innovation Agency (BRIN), as well as with staff from USAID and the U.S. Embassy.

Figure 9. Left: Dr. Alexander Gaos presents a NOAA Species in the Spotlight Partner in the Spotlight Award to Hero Ohoiulun and WWF Indonesia for their leadership of WP leatherback conservation in the Maluku province (Indonesia). Right: a nesting leatherback satellite tagged on Buru Island with WWF Indonesia.

Additionally, as part of "Sea Turtle Week," NOAA released a web story and a podcast titled, "Recovering Endangered Indo-Pacific Leatherback Turtles" and "Protecting Leatherbacks Across the Globe," respectively. Combined, the two outreach materials highlight NOAA's work with Western Pacific (Indo Pacific) leatherback turtles, with a focus on PIFSC support for work in Indonesia, which hosts more than 75% of Western Pacific leatherback nesting.

- Web story "Recovering Endangered Indo-Pacific Leatherback Turtles": https://www.fisheries.noaa.gov/feature-story/recovering-endangered-indo-pacific-leatherback-turtles
- NOAA "Dive in" Podcast "Protecting Leatherbacks Across the Globe": https://www.fisheries.noaa.gov/podcast/protecting-leatherbacks-across-globe

3. Research to Support EBFM and Living Marine Resource Management

PIFSC Scientists attend The 5th Symposium on the Effect of Climate Change on the World's Ocean

The 5th Symposium on the Effects of Climate Change on the World's Ocean (ECCWO5) was held in Bergen, Norway, on 17–21 April. This meeting is held every three to five years and brings together an international group of scientists and communicators working at the intersection of climate change, ocean use, and oceanography. The group includes physical oceanographers, fisheries experts, economists, engineers, photographers, and more. Roughly 450 in-person and 250 online attendees from 71 countries participated in ECCWO5, including Drs. Phoebe Woodworth-Jefcoats and Hingling Chan from PIFSC.

The majority of the ECCWO5 topics were fisheries relevant. The sessions included:

- Smart fishing for climate change mitigation and adaptation,
- Transitioning from vulnerable to resilient and viable fisheries social-ecological systems,
- Beyond species on the move: emerging climate change impacts on the spatial dynamics of marine species, from detecting to forecasting and projecting,
- Improving pathways for delivery of multi-disciplinary ocean observations into marine assessments across multiple scales,
- Using Management Strategy Evaluation to establish robust fishery management in a changing ocean, and
- Coupling social science and economics in integrated marine climate modeling efforts.

The Smart fishing… session focused entirely on emerging technologies that reduce the carbon footprint of fisheries operations. Such technologies range from route optimization to supply-side efficiencies to gear improvements that resulted in reduced fuel consumption.

The Beyond species on the move… session featured a range of presentations on how climate change is already and is projected to further alter species distributions. Two presentations were particularly relevant to the Pacific Islands region. One highlighted NOAA's Distribution and Mapping tool, which provides publicly accessible fisheries-independent data on the distribution of Deep 7 bottomfish species in the main Hawaiian Islands. The other talk included visualizations of how North Pacific albacore use thermal corridors during migration and tied this to recent species distribution modeling work for this and other species.

In the Improving pathways for delivery of multi-disciplinary ocean observations… session, Dr. Woodworth-Jefcoats presented the ocean and climate indicator chapter of the pelagic SAFE report. She focused on the Pelagic Plan Team's longstanding efforts to enhance climate awareness by making these indicators publicly accessible and straightforward to interpret. This

session also featured a talk on similar work being done in support of the Northeast region's State of the Ecosystem reports.

In the Coupling social science and economics… session, Dr. Chan presented her research on how trip distance in the Hawai'i-based deep-set longline fishery is affected by climate change and variability. She has found that each degree (Celsius) increase in SST leads to a 4.2% (100 km) increase in trip distance. Sea surface temperatures across these fishing grounds have increased by 0.9 ºC in the past 38 years and are projected to warm by about another 2 ºC over the remainder of the 21st century barring the implementation of robust emissions reductions. This means that rising SSTs are among the long-term factors affecting Hawai'i's deep-set fishery. Conversely, strong El Niño and La Niña events resulted in reduced trip distances. Different species are affected differently by these events, with greater bigeye tuna catch rates during El Niño events and greater yellowfin tuna catch rates during La Niña events.

Overall, ECCWO5 was an inspiring return to the in-person exchange of scientific information featuring particularly well-delivered presentations. For those interested in viewing conference presentations, professional-quality recordings are available on the meeting website (subject to presenters' permission).

4. Organizational Excellence

Administrative Reports

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Ayers A, Leong K, Hospital J, Tam C, Morioka C. 2023. 2022 Hawai'i fisher observations data summary and analysis. Pacific Islands Fisheries Science Center, PIFSC Data Report, DR-23-12, 24 p. https://doi.org/10.25923/qv15-dm14

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McCracken M, Cooper B. 2023. Estimation of bycatch with seabirds, sea turtles, bony fish, sharks, and rays in the 2022 permitted American Samoa longline fishery. Pacific Islands Fisheries Science Center, PIFSC Data Report, DR-23-06, 1 p. https://doi.org/10.25923/mrva-ab86

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