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NOAA FISHERIES

PACIFIC ISLANDS FISHERIES SCIENCE CENTER

# Report to the Western Pacific Regional Fishery Management Council

September 2021

*Main Hawaiian Islands Deep Bottomfish. Top : 'Ōpakapaka (pink snapper), Middle: Ehu (squirrelfish snapper), 'Ōpakapaka (pink snapper), Bottom: Onaga (longtail snapper) . Photo credit: PIFG-Pacific Islands Fisheries Group*

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*

**Review of Potential Mitigation Measures to Reduce Fishing-Related Mortality on Silky and Oceanic Whitetip Sharks (WCPFC Scientific Committee Project 101)**

The paper develops and applies a model for how silky (*Carcharhinus falciformis*) and oceanic whitetip (*C. longimanus*) shark might interact with longline gear in the western and central Pacific Ocean (WCPO) and potential reductions in mortality with two different management measures: 1) removal of shark lines and 2) transition from branchlines with wire leaders to monofilament leaders. Using Regional Observer Program (ROP) data, the study compared absolute values of total catch and total mortality across scenarios and the relative change in fishing related mortality from the status quo option given a conversion from wire to monofilament leaders, no shark lines used, and both a conversion to monofilament leaders and no shark lines. The analyses also explores reduction rates of both shark species under a variety of management scenarios, including banning both shark lines and wire leaders. The study provides an update to Harley et al. (2015) by using recently available observer information (2010–2018) on longline gear characteristics and spatial distribution of effort (2015–2019). The study used previous assumptions (Harley et al. 2015) on: 1) results of prior studies on catchability and survival and 2) spatial differences in the density of the two species.

The key conclusions of the current analyses are:

- Banning shark lines has the potential to reduce fishing mortality by 2.6% and 5.4% for silky shark and oceanic whitetip sharks, respectively (Table 1). These percentages are lower than predicted estimates from Harley et al. (2015) which may be explained by a decrease in use of shark lines in more recent observer data.
- Banning branchline wire leaders has the potential to reduce fishing mortality by 28.2% and 35.8% for silky shark and oceanic whitetip sharks, respectively (Table 1). These percentages are higher than estimates from Harley et al. (2015) and are perhaps due to improved characterization of gear use in the distant-water longline fisheries.
- Banning both shark lines and wire leaders has the potential to reduce fishing mortality by 30.8% and 40.5% for silky shark and oceanic whitetip sharks, respectively (Table 1).
- Submission of ROP observer data has increased in recent years. Future analyses would benefit from both in-zone and ROP data to estimate catchability effects for shark lines, wire and monofilament leaders, and further characterize WCPFC member longline gear characteristics.

*Oceanic whitetip shark*

*Table 1. Overall mortality rate (deaths/catch) for silky and oceanic whitetip sharks based on the status quo and each management scenario from the Monte Carlo analysis of the present study and Harley et al. 2015.*

| Management scenario | This study—median mortality reduction percentage | | Harley et al. 2015—median mortality reduction percentage | |
|---|---|---|---|---|
| | Silky shark | Oceanic whitetip shark | Silky shark | Oceanic whitetip shark |
| No shark lines | 2.6% | 5.4% | 14.7% | 23.3% |
| No wire leaders | 28.2% | 35.8% | 17.6% | 23.3% |
| No shark lines and no wire leaders | 30.8% | 40.5% | 29.4% | 40.0% |

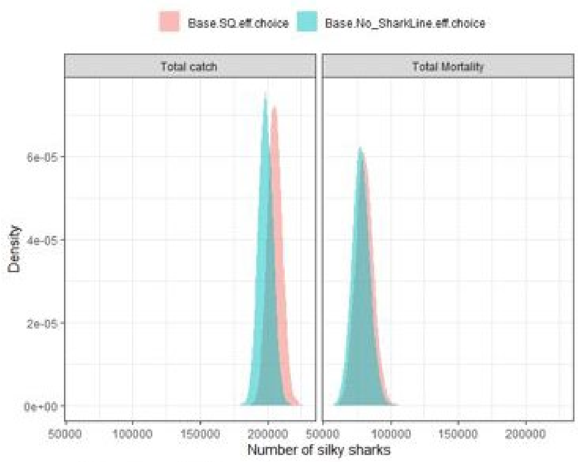



*Figure 1a. No shark lines*

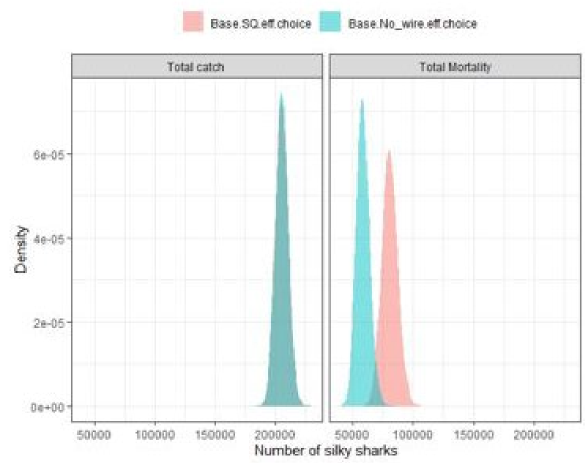



*Figure 1b. No wire leaders*

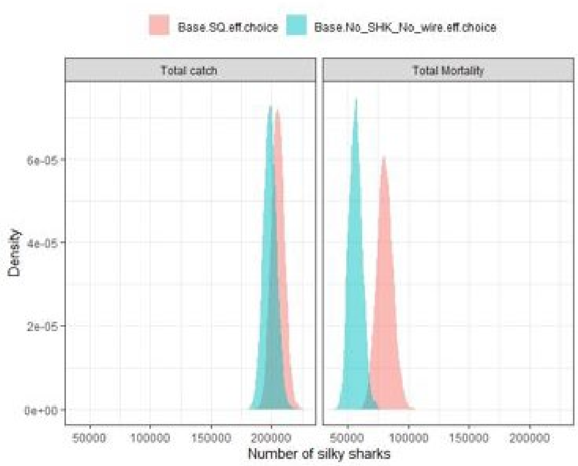



*Figure 1c. No shark lines and no wire leaders*

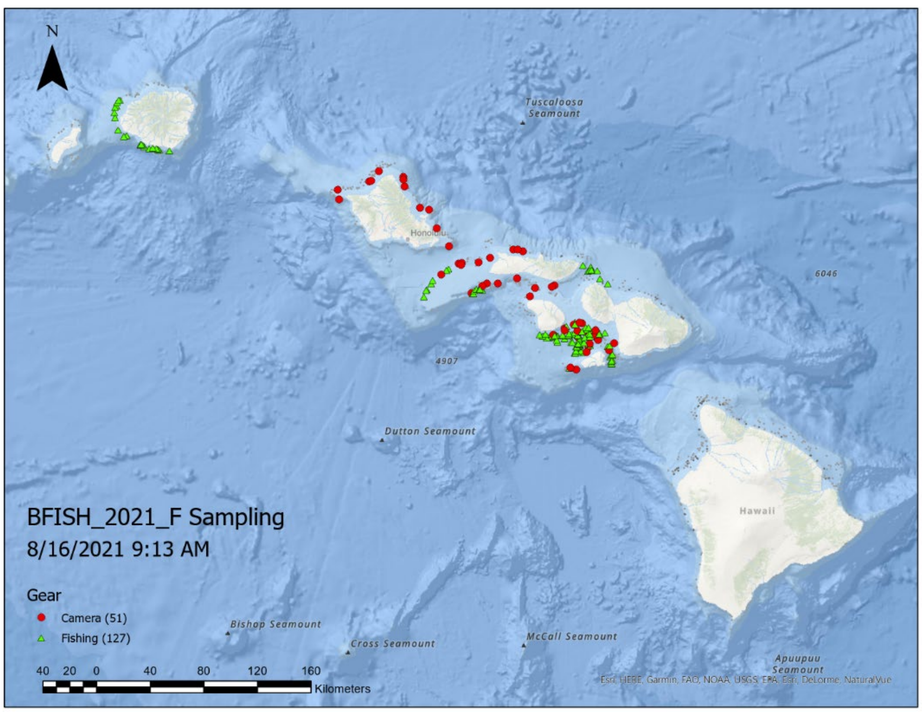
*Figure 1. One-off comparisons for oceanic whitetip sharks between the status quo (Base.SQ) and each management scenario in terms of the Monte Carlo distributions of catch (left side of the panel) and mortality (right side of the panel).*

**MHI Bottomfish Survey and Analysis**

*Figure 2. Various bottomfish.*

The 2021 Bottomfish Fishery-Independent Survey in Hawaii (BFISH) survey began 9 July 2021. As in 2020, BFISH field operations are being carried out entirely by cooperative research fishers with the Pacific Islands Fisheries Group (PIFG), with support from NOAA PIFSC, the Joint Institute for Marine and Atmospheric Research (JIMAR), the State of Hawaii, and the University of Miami Rosenstiel School of Marine and Atmospheric Research (UM-RSMAS).

As of 15 August, 53% (53 of 100) of assigned MOUSS camera sampling stations have been completed as have 20% (129 of 650) of research fishing stations, bringing the overall survey to a state of 24% completion (Figure below).




*A map showing 2021 BFISH sampling completed as of 15 August 2021.*

*Table 2. 2021 BFISH catch by species. Ehu (49 pieces), onaga (19 pieces), and ʻōpakapaka (11 pieces) make up the majority of the Deep 7 catch, while Green Eye Sharks (63 pieces) make up the majority of the bycatch. (Table below)*

| Species | Catch | Species | Catch |
|---|---|---|---|
| Deep 7 | 87 | Non-Deep 7 | 79 |
| Ehu | 49 | Green Eye Shark | 63 |
| Onaga | 19 | Kahala | 4 |
| Opakapaka | 11 | Pufferfish | 4 |
| Kalekale | 4 | none | 3 |
| Gindai | 3 | Eel | 2 |
| Hapuʻupuʻu | 1 | Taʻape | 1 |
| | | Hogo | 1 |
| | | Tako | 1 |
| Grand Total | 166 | | |

*Figure 3. Cooperative research fishermen at work on deck.*

The SOD Analysis and Evaluation Team is evaluating optimal frame rates for the MOUSS camera system within the BFISH survey. If feasible, a reduced frame rate would shorten the time required for video download and reduce data storage requirements.

The OceanEYEs crowdsourcing project utilizes volunteer citizen scientists to identify Deep 7 species from 2019 BFISH MOUSS camera data. Currently, the Analysis and Evaluation Team is assessing the accuracy of citizen scientist annotations to evaluate the best use for these data. In addition to education and outreach, OceanEYEs data extracted may be used to train automated machine learning models to move us closer to automated video annotation.

The OceanEYEs team has drafted a manuscript for submission to the American Fisheries Society journal, providing insight into the progress and lessons learned over the past year. Since this is a novel area, our paper can provide perspective to future citizen scientist projects as well as show how valuable community engagement is to the scientific process.

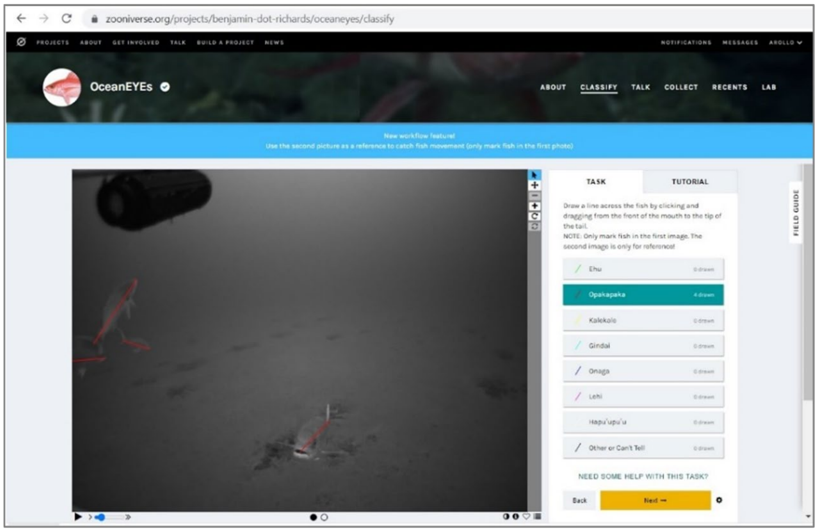



*Figure 4. Analysis and Evaluation photo: screenshot showing the OceanEYEs citizen science workflow on the Zooniverse platform. During the annotation process, the volunteer will mark fish on the screen with one of the preset line colors on the right. In this photo, all four of the fish are a deep-7 species, ‘ōpakapaka (*Pristipomoides filamentosus).

The Analysis Team is also working with the PIFSC Life History Program (LHP) and the University of Hawaii to start evaluating potential impact of temperature on Deep 7 species and essential fish habitat for 11 target species of Bottomfish Management Unit Species (BMUS) in American Samoa.

## 2. Conserve Protected Species

### Hawaiian Monk Seal Research Program

Field efforts at Kalaupapa, Molokai in partnership with the National Park Service

*Figure 5. Adult female Hawaiian monk seal, RA32, nurses her pup on Papaloa Beach, Kalaupapa.*

A total of 12 monk seal pups were born on the Kalaupapa Peninsula in 2021, with 10 surviving to weaning. The pups were born between April and June and all pups were weaned by the end of July.

National Park Service (NPS) staff, with guidance and oversight from the NOAA Hawaiian Monk Seal Research Program (HMSRP), monitored the mother-pup pairs, identified individuals, documented births and weanings, and bleach marked dependent pups to distinguish them from each other. NPS maintained direct communications with HMSRP staff, reporting seal survey information within 24 hours and alerting HMSRP in real time with any concerns. Of the non-surviving pups, one was found dead 3 days after birth and likely suffered from fetal distress, resulting in weakness, inadequate nursing, and a failure to thrive. The other pup disappeared several days after birth, presumed to have been washed out to sea in high surf conditions.

HMSRP staff worked in partnership with NPS staff to flipper tag and vaccinate (against morbillivirus) the 10 remaining pups around the time of weaning. A single HMSRP staff person traveled to Kalaupapa on three separate occasions between June and August to lead the tagging effort and train NPS staff in handling, flipper tagging, and vaccinating weaned pups. NPS staff acquired hands-on experience in seal restraint and tagging and the use of the pole syringe for vaccinations. The field missions were very productive; the pups were successfully tagged and vaccinated. NPS staff will carry out the remainder of the booster vaccinations on their own, a great testament to their partnership and dedication to monk seal recovery at one of the most important pupping locations in the main Hawaiian Islands.

*Figure 6. Weaned Hawaiian monk seal pups at Kalaupapa ready for flipper tagging.*

The 2021 Assessment and Recovery Field Camps Have Been Deployed!

Assessment and Recovery Camps are the foundation of NOAA's Hawaiian monk seal research and recovery efforts in the Northwestern Hawaiian Islands (NWHI). Except for 2020, when the field season was cancelled due to the pandemic, researchers have been deployed field camps in the NWHI annually to conduct population monitoring, critical for stock assessment, and undertake numerous activities to aid in the recovery of the population. This year, sixteen field staff members were deployed at five major reproductive sites in the NWHI to conduct Hawaiian monk seal population research and enhancement activities. Camps were established at French Frigate Shoals, Laysan Island, Lisianski Island, Pearl and Hermes Reef, and Kure Atoll, and haulout sites at Niihau, Mokumanamana (Necker) and Midway Atoll were surveyed during a cruise on the CV *Kahana II* conducted from July 10th through August 6th.

Field teams gather data on the number of pups born, number that survived to weaning, number marked, number of older animals identified, inter-atoll movements, causes of mortality, and other key demographic variables. The teams also vaccinate seals against morbillivirus and conduct a variety of other survival enhancing activities. Thus far, field teams have documented at least 147 pups born this year in the NWHI and have tagged 108 weaned pups as well as 24 juvenile seals that are either confirmed or probable 2020 pups. Enhancement activities conducted to date include collecting an undersized weaned pup at Midway Atoll and transporting it to Ke Kai Ola, the monk seal hospital on Hawaii Island, for rehabilitation and disentangling 4 seals; a weaned pup entangled in a giant derelict net ball in shallow water with multiple strands around its neck, a weaned pup with an eel cone on its muzzle, a juvenile with and spiral plastic around its neck, and an adult female with line around her neck. An additional seal was disentangled at Laysan Island by cooperating scientists on a March Marine Debris mission. Other enhancement actions by our field staff include freeing a seal and other wildlife entrapped in disintegrating infrastructure at Tern Island, translocating weaned pups from areas that historically have had high rates of shark predation, and detaching the umbilical cord of a pup whose placenta anchored it in the wave wash. Field research and enhancement activities will continue until September. The NOAA R/V *Oscar Elton Sette* is scheduled to depart Honolulu on 3 September, release the rehabilitated pup in the NWHI, pick up the five field camps, survey haulout sites at Lehua, Nihoa, Mokumanamana, and Midway Atoll, and return to Honolulu with all field personnel, equipment, and data on 30 September.

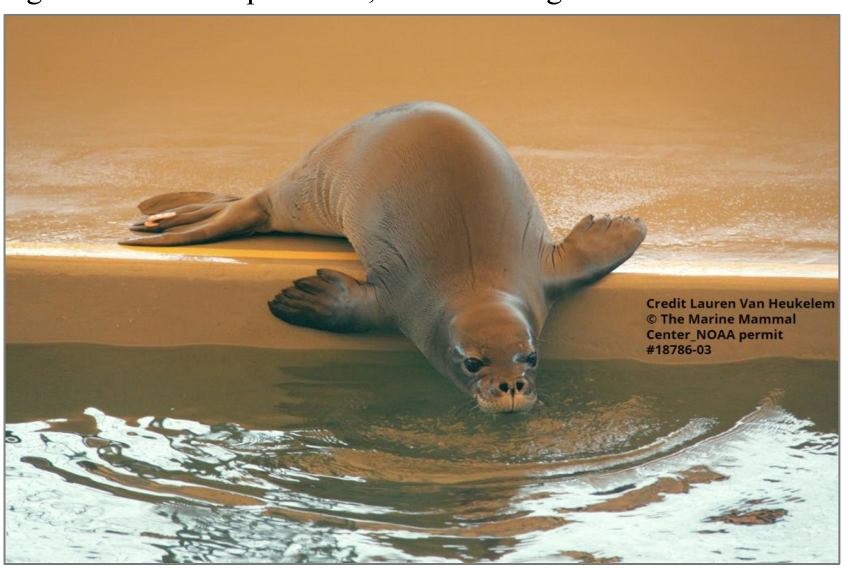



*Figure 7. PP08, rescued from Midway Atoll for malnutrition, is gaining weight at Ke Kai Ola.*

## Marine Turtle Biology and Assessment Program

Update on green turtle monitoring at French Frigate Shoals

*Figure 8. MTBAP researcher conducting surveys among numerous basking green turtles at French Frigate Shoals.*

Field researchers from the Marine Turtle Biology and Assessment Program (MTBAP) have been stationed on French Frigate Shoals (FFS) since mid-March and continue to collect important nesting and basking data on Hawaiian green turtles (*Chelonia mydas*). Through early August, the team has identified a total of 283 male turtles and 659 female turtles on Tern Island. These numbers for basking turtles far exceed numbers seen during previous monitoring seasons at that site. The team has also documented a total of 349 nests to date, and currently observes an average of 50 nesting turtles per night. A total of 11 green turtles have also been equipped with satellite tags, including three post-nesting females and two basking male green turtles at FFS, and another four gravid females and two males observed copulating on O'ahu. Nine of the 11 tags are currently still active and continue to transmit. Combined, these efforts and data support MTBAP's ongoing assessments of the Hawaiian green sea turtle population.

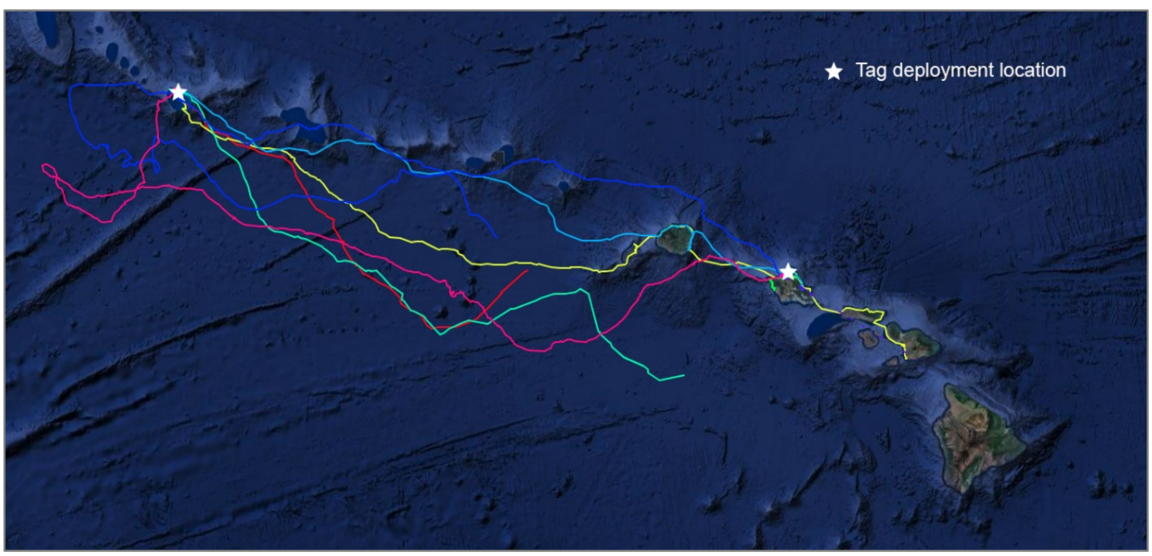



*Figure 9. Movement tracks of 11 green turtles equipped with satellite tags on French Frigate Shoals and O'ahu during 2021.*

Green turtle nesting on the main Hawaiian Islands

Evaluating the status of green turtles in the state of Hawaii has been a major focus for PIFSC for multiple decades. The overwhelming majority (> 95%) of Hawaiian green turtle nesting has historically been recorded at FFS in the Northwest Hawaiian Islands (NWHI). Nonetheless, in 2020, a substantial number of nesting events were recorded on the main Hawaiian Islands (MHI). MTBAP has been collaborating with USFWS to carry out nesting beach surveys on Oʻahu and provide capacity building training to partners. Although the 2021 nesting season is currently underway, approximately 150 nesting events have been documented to date, primarily along Oʻahu's north shore, with additional nests documented on Molokai, Maui, and Kauai. These findings, coupled with the major alteration of one of the primary remaining nesting habitats in the NWHIs (East Island) as a result of hurricane Walaka in 2018, have raised the possibility that the MHI may represent increasingly important nesting habitat for green turtles. The islands may offer protection and buffer against threats such as nesting beach loss due to climate change.

Loggerhead turtle satellite tag deployments and tracking in the Hawaii shallow-set longline fishery

Over the past several months, MTBAP has coordinated with staff from the Fisheries Research and Monitoring Division (FRMD) and PIRO's Observer Program to deploy satellite tags on loggerhead turtles (*Caretta caretta*) incidentally captured by the Hawaii shallow-set longline fishing fleet. Twelve satellite tagging kits were prepared and provided to observers, leading to the deployment of seven tags during 2021. Six of the seven tags demonstrated movements across the North Pacific Ocean. Data generated by the tags will be used to better understand impacts, such as post-interaction horizontal movements, dive behavior, and mortality, which can support fisheries management decision making. These data also feed directly into the EBFM spatial modeling project.


*Figure 10. Tracks of six loggerhead turtles after being incidentally captured in the Hawaii shallow-set longline fishery.*

Loggerhead attempts to nest at French Frigate Shoals

Loggerhead turtles in the North Pacific Ocean nest exclusively in Japan. Given this context, MTBAP's research team was extremely surprised when a loggerhead turtle emerged at FFS and made several attempts to dig egg chambers before returning to the ocean in early May 2021. The turtle measured 111.6 cm (curved carapace length) and was equipped with flipper tags (PI6546 and PI6549), which will allow for identification if the turtle is observed again in the future.

*Figure 11. A loggerhead turtle attempting to nest at French Frigate Shoals.*

**The Mariana Archipelago Cetacean Survey**

The PIFSC Cetacean Research Program (CRP) conducted the first comprehensive EEZ-wide survey for cetaceans and seabirds within Guam and the Commonwealth of the Northern Mariana Islands—the Mariana Archipelago Cetacean Survey (MACS)—from May to July 2021. MACS is the fourth survey of the five-year partnership between NOAA Fisheries, the Bureau of Ocean Energy Management, and the U.S. Navy, known as PacMAPPS, or the Pacific Marine Assessment Program for Protected Species. The CRP conducted visual and passive acoustic surveys aboard the NOAA R/V *Oscar Elton Sette* during daylight hours when weather permitted, surveying 8,633 km of trackline during 59 days at sea. There were 77 cetacean sightings of at least 12 species, as well as groups of dolphins and whales that could not be identified to species.

*Sperm whales*

*False killer whales*

The most frequently sighted species during the project were sperm whale, false killer whale, and pantropical spotted dolphin. Approximately 2,300 photos were collected for individual or species identification and two biopsy samples were collected from false killer whales. There were 245 acoustic detections of cetaceans on the towed hydrophone array and 1,534 sightings of 32 species of seabirds reported by the seabird team. The most frequently sighted species included Short-tailed Shearwater, Red-footed Booby, and Wedge-tailed Shearwater.

*Figure 12. The MACS project also had a designated seabird observer during the daytime effort. Species seen included the Red-footed Booby (top left), Brown Booby (top right, pictured with flying fish), Brewster Brown Booby (bottom left), and White-tailed Tropicbird (bottom right).*

Oceanographic sampling was conducted with twice daily CTD casts when conditions permitted. A total of 79 CTD casts were conducted. Long-term stationary acoustic recorders (HARPs) at Saipan, and Pagan were recovered and redeployed. In addition to data collection occurring aboard the ship, 22 drifting acoustic recorders (DASBRs) were deployed to acoustically monitor for whales and dolphins throughout the survey area. The DASBRs drift on ocean currents providing an independent survey effort from the ship. The DASBR dataset is especially important for examining the distribution and abundance of deep-diving and often cryptic beaked whales.

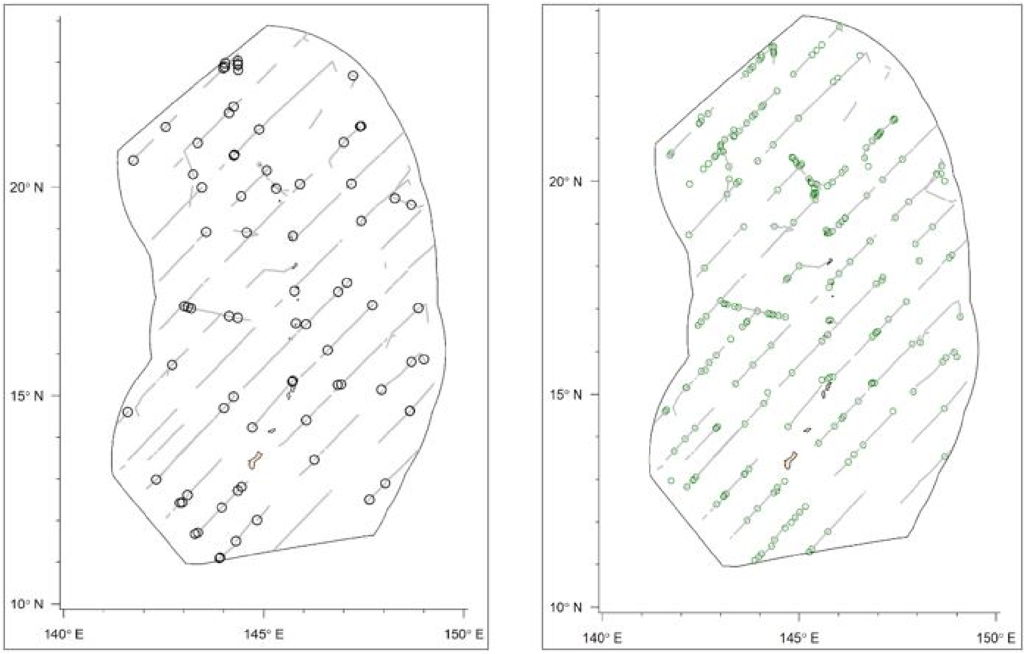



*Figure 13. Survey tracklines (gray lines) with locations of cetacean sightings (left map, black circles) and passive acoustic detections (right map, green circles).*

*Figure 14. Before MACS, Longman's beaked whales were only acoustically detected in the region, with no visual sightings documented in literature. Longman's beaked whales were seen by the MACS team on May 18, 2021.*

## 3. Research to Support EBFM and Living Marine Resource Management

### Community Participation Trends in Hawaii Commercial Fisheries

PIFSC scientists have recently published a report that applies methodologies developed by NMFS social scientists to assess community participation and social vulnerability for select Hawai‘i commercial fisheries from 2000 to 2018. For this analysis, fishing communities are defined at geographic scale of Census County Division (CCD), resulting in 41 communities considered in this report. Fisheries chosen for analysis include the pelagic longline, small boat Highly Migratory Species (HMS), Deep 7 bottomfish, uku, and nearshore and reef fisheries. Community participation is assessed through a Fishing Engagement Index (FEI) and metrics detailing community contributions to regional fisheries (Regional Quotient) and fishery importance to local communities (Local Quotient) relative to a fishery-specific 3-year baseline period. In addition to these fishery participation parameters, community social vulnerability indicators were developed to examine environmental justice, economic factors that can affect individual or community resilience and adaptability to change, and gentrification pressure indicators.

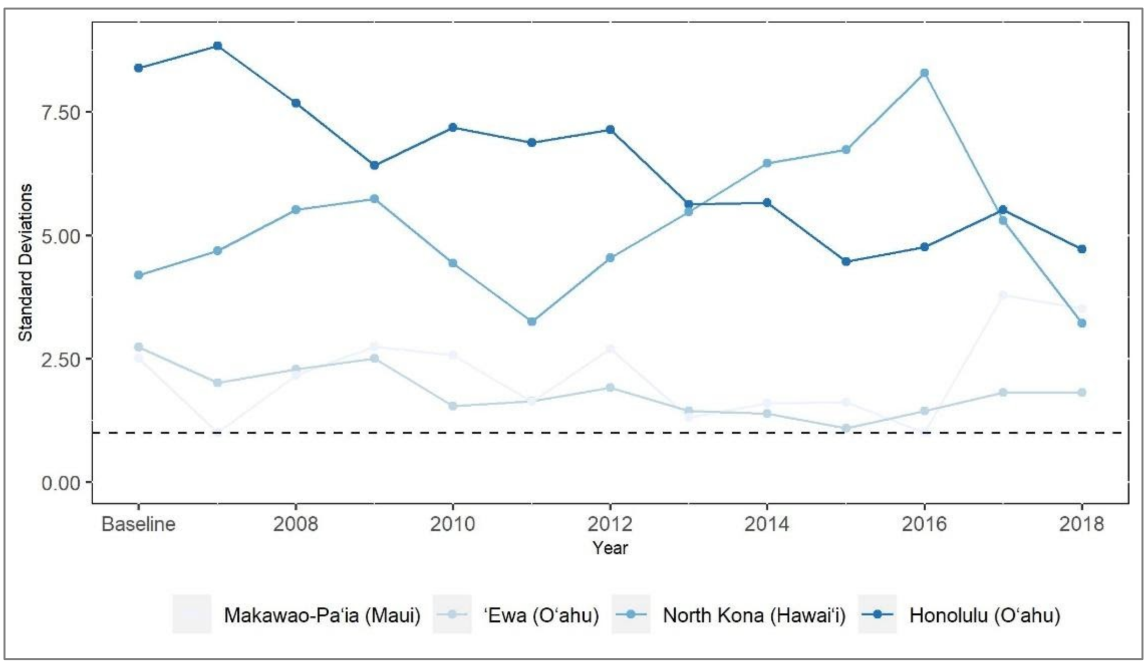



*Figure 15. Fishing Engagement Index (FEI) scores for highly engaged communities in the Deep 7 bottomfish fishery.*

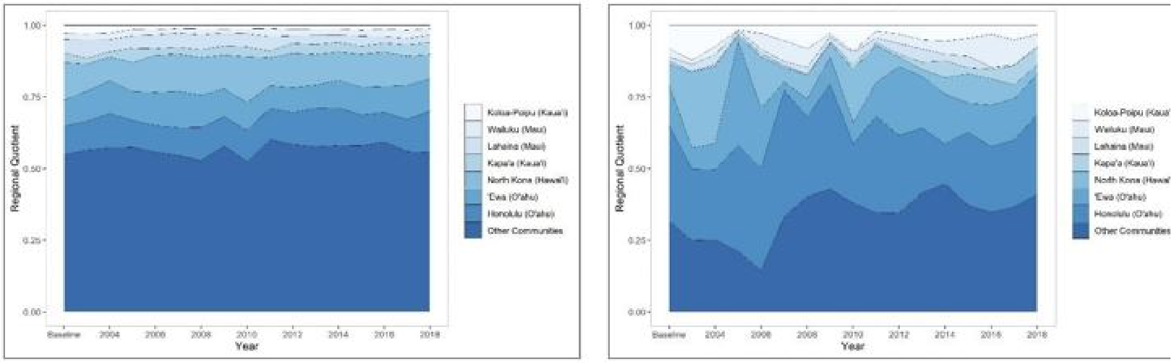



*Figure 16. Trends in regional quotient shares of active commercial uku fishers (left) and uku revenues (right), by community.*

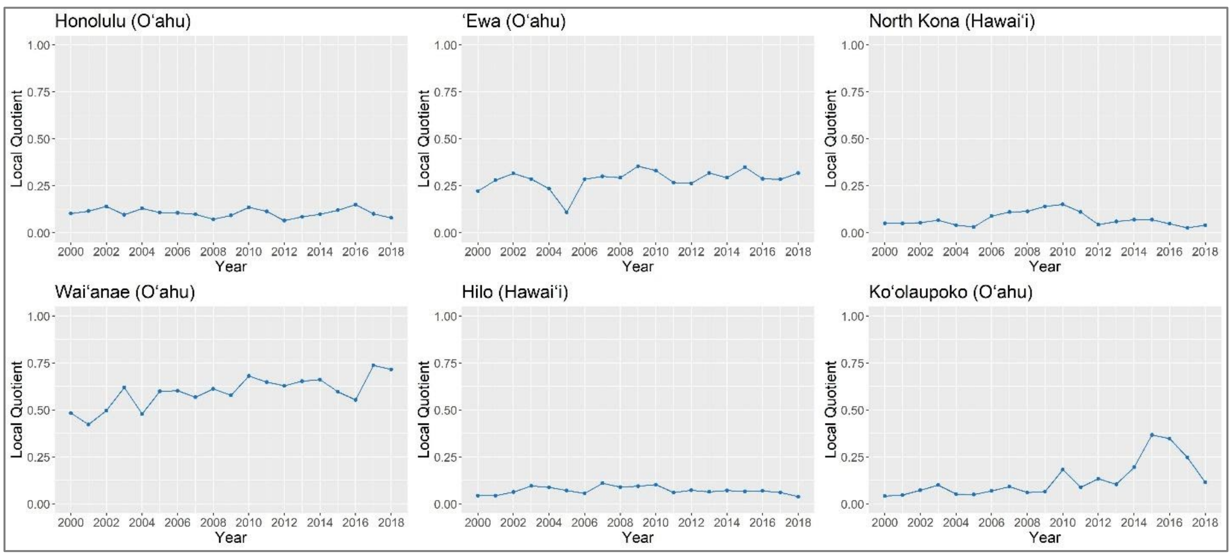



*Figure 17. Trends in local quotient revenue shares for nearshore and reef fisheries, by select communities.*

In addition to supporting WPFMC Human Community research priorities (HC1.1.5, HC1.1.8), fishery managers can use these metrics to: satisfy MSA National Standard 8 requirements; improve assessments required under the National Environmental Policy Act (NEPA), such as Social Impact Assessments; and provide insights to support future community engagement and outreach. The findings in this report lay an important foundation for understanding community participation in Hawaiʻi commercial fisheries, establish a baseline for future monitoring, and produce opportunities for future work to refine and explore additional applications of these indicators.

Hospital J, Leong K. 2021. Community participation in Hawaiʻi commercial fisheries. NOAA Technical Memorandum. NMFS-PIFSC-119, 89p. https://doi.org/10.25923/p4aj-k323

## NCRMP Dive Surveys Around O‘ahu

From 7 June through 1 August 2021, scientists/divers from the NOAA PIFSC Ecosystem Sciences Division (ESD) completed 22 days of small boat and diving operations conducting coral reef ecosystem assessments around O‘ahu, Hawai’i. Three field teams (Oceanography and Climate Change [OCC], Benthic, and Fish) visited a total of nine fixed and 45 random sites across hard-bottom forereef.

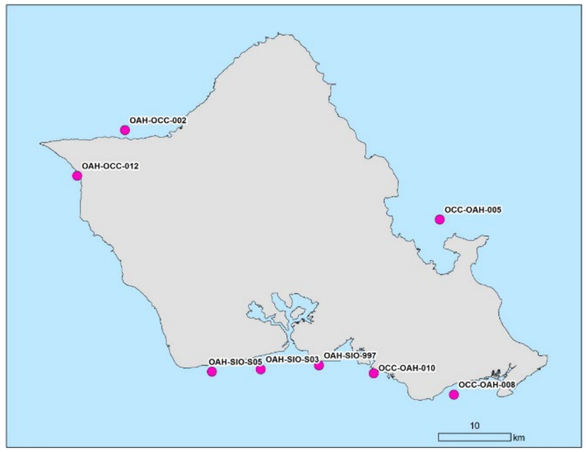



*Figure 18. Fixed site locations around O‘ahu.*

At fixed sites, the OCC team was able to test and further develop their carbonate-budget survey methods across a variety of different coral reef habitats under different environmental regimes. This testing included conducting side-by-side surveys using different methods in order to understand the feasibility of incorporating the finalized protocols into the upcoming FY22 National Coral Reef Monitoring Program (NCRMP) surveys. The OCC team also collected water samples paired with CTD casts that will be analyzed for continued tracking of temporal changes in carbonate chemistry. Temperature STR loggers that measure in-situ temperature data and diel suites that collect numerous physicochemical parameters were also deployed at fixed sites.

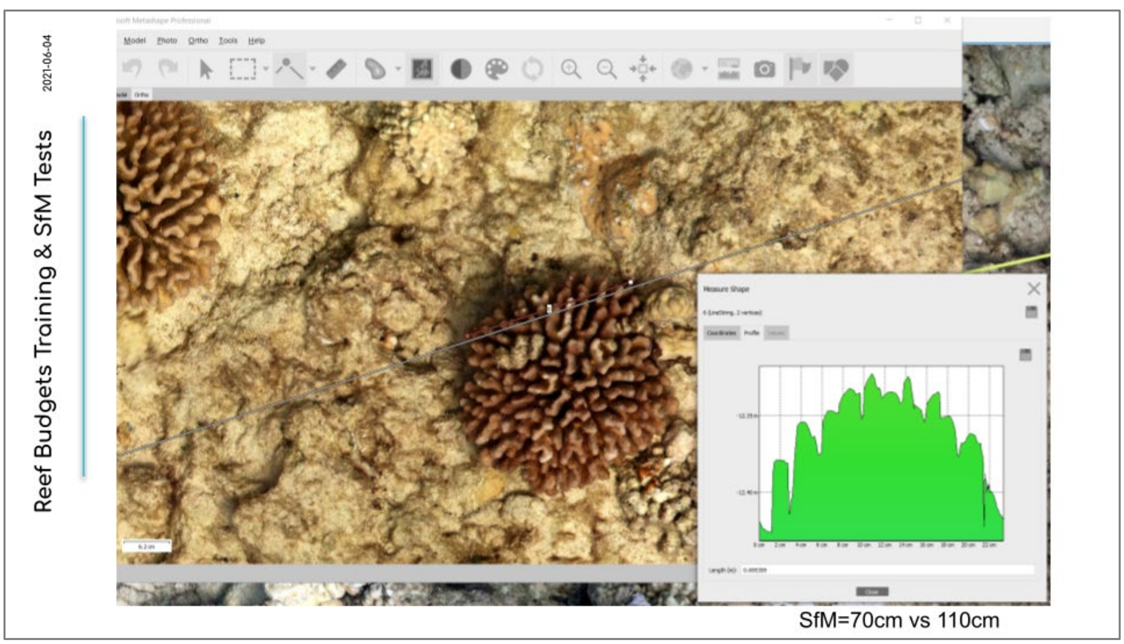



*Figure 19. Carbonate Budgets training and Structure from Motion tests to determine best survey methods for determining reef carbonate budgets to support National Coral Reef Monitoring Program’s climate surveys.*

The Benthic team was successful in documenting coral condition and health prior to any thermal-stress events that could potentially lead to coral bleaching in the upcoming months. The last documented heat stress event that caused coral bleaching peaked in late September through the end of October in 2019. Structure-from-Motion (SfM) imagery was collected at fixed sites to assess the benthic communities and continue to track any shifts in condition or health of coral colonies. To help spatially orient users of the SfM-derived models that are built from such imagery, the team also collected ground-control points (GCPs) to use as geographical references (i.e., geolocation). At random sites around O‘ahu, the Benthic team also trained new staff in the benthic rapid ecosystem assessment demographic survey method and conducted pilot urchin surveys.

The Fish team performed Stationary Point Count (SPC) fish surveys at random sites around each of the fixed sites (Figure 7). During these surveys, divers counted and visually estimated the size of all present fish species within the survey area. Lastly, all three field teams collected water samples paired with CTD casts (described above) and captured benthic imagery via photoquadrats and SfM procedures (spirals or belt transects) to increase the overall sampling of these forms of data collection across both random and fixed sites.

*Figure 20. Fish diver preparing to perform Stationary Point Count (SPC) fish surveys at a site on the southern coast of O‘ahu.*

# 4. ***Organizational Excellence***

This section lists administrative reports, data reports, internal reports, journal articles, special publications, NOAA technical memos, and working papers that PIFSC staff published between 12 May and 19 August 2021.

### Administrative Reports

Robinson S, Battaile B, Hale J, Wilson K. 2021. Classifying Hawaiian Monk Seal Foraging Behaviors Using Metrics Based on Triaxial Accelerometry: Pilot Data, Evaluation, and Future Research Recommendations. Pacific Islands Fisheries Science Center, PIFSC Administrative Report, H-21-05, 44p. https://doi.org/10.25923/fadf-cx48.

### Data Reports

Bigelow K, Carvalho F. 2021. Statistical and Monte Carlo analysis of the Hawaii deep-set longline fishery with emphasis on take and mortality of Oceanic Whitetip Shark. Pacific Islands Fisheries Science Center, PIFSC Data Report, DR-21-006, 12 p. https://doi.org/10.25923/a067-g819.

Bradford AL. 2021. Injury Determinations for Marine Mammals Observed Interacting with Hawaii and American Samoa Longline Fisheries During 2019. Pacific Islands Fisheries Science Center, PIFSC Data Report, DR-21-004, 3 p. https://doi.org/10.25923/2srr-ae43.

McCracken M, Cooper. 2021. Hawaii Longline Fishery 2020 Seabird and Sea Turtle Bycatch for the Entire Fishing Grounds, Within the IATTC Convention Area, and Seabird Bycatch to the north of 23°N and 23°N-30°S. Pacific Islands Fisheries Science Center, PIFSC Data Report, DR-21-005, 11 p. https://doi.org/10.25923/6ygk-1b64.

Mercer T. 2021. Summary of documented human-caused mortality, serious injury and non-serious injury in Hawaiian monk seals: supporting documentation for the 2021 Stock Assessment Report. Pacific Islands Fisheries Science Center, PIFSC Data Report, DR-21-008, 19 p. https://doi.org/10.25923/p7ys-sk67.

### Internal Reports

Baker J, Harting A, Johanos T, Mercer T. 2021. Population Summary for Hawaiian Monk Seals in 2020. Pacific Islands Fisheries Science Center, PIFSC Internal Report, IR-21-007, 33 p.

Johanos T. 2021. Hawaiian Monk Seal Presence at Johnston Atoll. Pacific Islands Fisheries Science Center, PIFSC Internal Report, IR-21-009, 7 p.

Johanos-Kam TC. 2021. Hawaiian Monk Seal Entanglements in Hagfish Trap Cones, 2000-2020. Pacific Islands Fisheries Science Center, PIFSC Internal Report, IR-21-008, 4 p.

### Journal Articles

Banerjee SM, Stoll JA, Allen CD, Lynch JM, Harris HS, Kenyon L, Connon RE, Sterling EJ, Naro-Maciel E, McFadden K, et al. 2021. Species and population specific gene expression in blood transcriptomes of marine turtles. BMC genomics. 22:1-6. https://doi.org/10.1186/s12864-021-07656-5.

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