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148th SSC

National Marine Fisheries Service
Pacific Islands Fisheries Science Center

June 2023

NOAA FISHERIES

Report to the Western Pacific Regional Fishery Management Council

*A school of black trevally (*Caranx lugubrius*) hides a lurking gray reef shark (*Carcharhinus amblyrhynchos*).*

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

Update on the Bottomfish Fishery-Independent Survey in Hawai‘i

The Bottomfish Fishery-Independent Survey in Hawai‘i (BFISH) is designed to provide accurate and precise estimates of species-specific, size-structured abundance and biomass for the main Hawaiian Islands (MHI) Deep 7 bottomfish stock (Figure 1). BFISH data are specifically designed to complement and enhance Deep 7 stock assessments conducted by the Pacific Islands Fisheries Science Center (PIFSC).

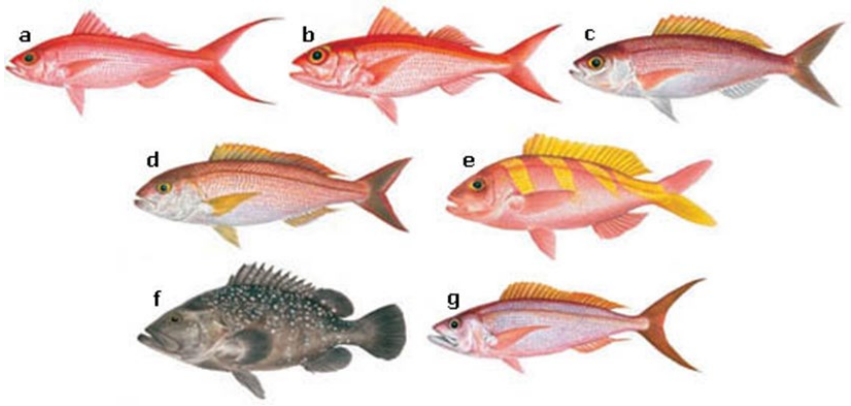

Figure 1. The main Hawaiian Islands "Deep- 7" bottomfish complex: (A) onaga (Etelis coruscans), (B) ehu (Etelis carbunculus), (C) kalekale (Pristipomoides sieboldii), (D) ‘ōpakapaka (Pristipomoides filamentosus), (E) gindai (Pristipomoides zonatus), (F) hapu‘upu‘u(Hyporthodus quernus), and (G) Lehi (Aphareus rutilans). Artwork by Les Hata (Hawai‘i DAR/DLNR).

BFISH is conducted annually across the eight islands of the MHI using two complimentary sampling gears: (1) cooperative research hook-and-line fishing; and (2) stereo video camera systems. These gears are deployed according to a stratified random sampling design within specific habitats across depths ranging from 75 to 400 m. In 2022, BFISH sampling was conducted from 31 July to 30 November. Sampling effort was purposely decreased from 750 primary sample units (PSU) in 2021 to 600 in the 2022 BFISH (Figure 2). This was done based on determination of optimal sampling effort required to achieve a specified coefficient of variation (CV, or precision) for species-specific biomass estimates used in MHI Deep 7 stock assessments, with appropriate buffers to account for uncertain vessel availability. Evolution of the survey design from an initial 9-strata survey (based on 2011–2015 Maui Nui experiments) to a refined 24-strata survey (based on 2016–2018 BFISH data) and the optimization of sampling effort have greatly improved survey precision.

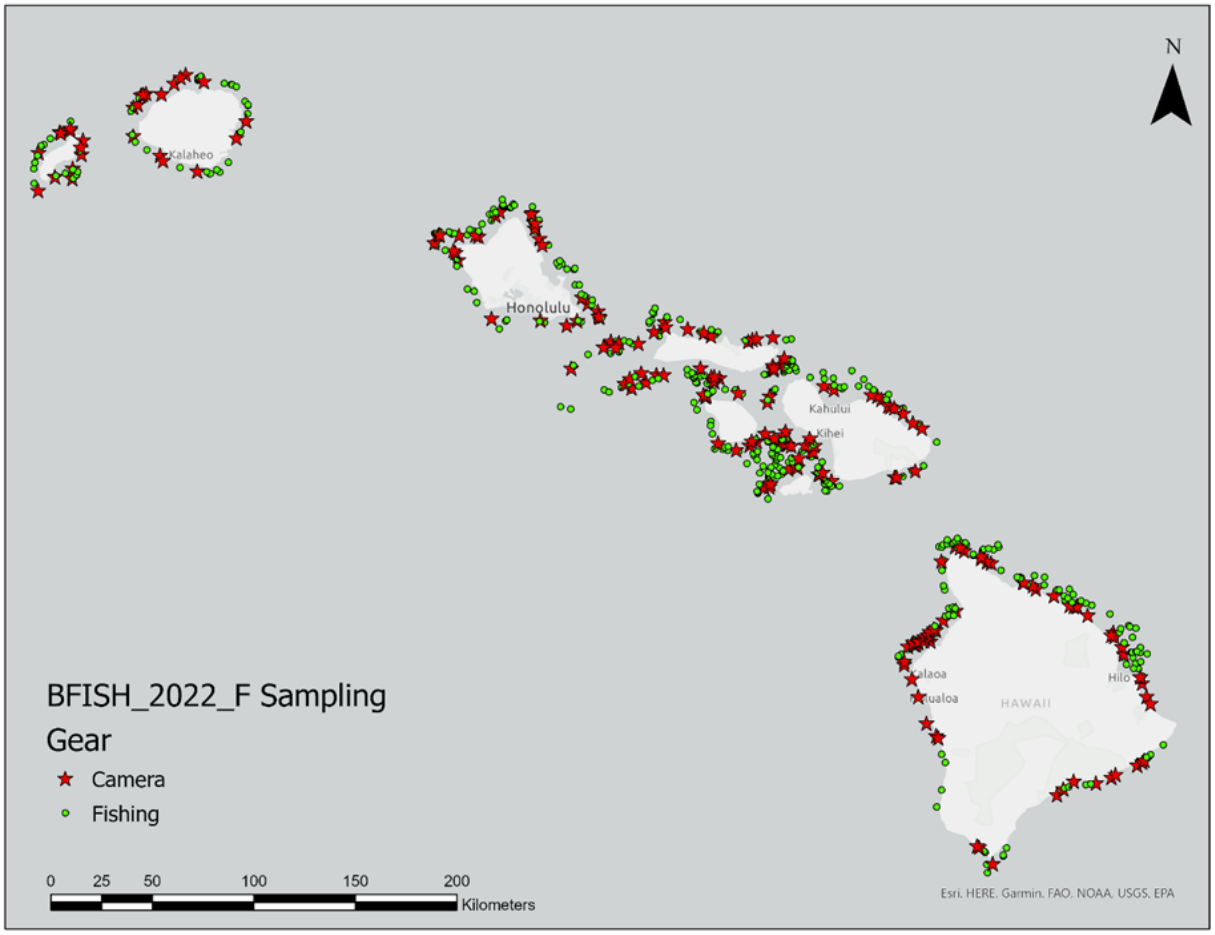

Figure 2. Map of 2022 BFISH sampling locations by gear type. Research fishing operations (green circles, n = 400) extended from Hawai'i Island in the southeast to Ni'ihau in the northwest. Camera operations (red stars, n = 200) were conducted around all islands except Ni'ihau and Kaua'i.

In 2022, Deep 7 complex biomass was estimated at 2.19 million kilograms (Table 1). ʻŌpakapaka, ehu, and onaga, the three principal species for which the survey design was developed, comprised approximately 71% total estimated Deep7 complex biomass of the survey. ʻŌpakapaka, ehu, and onaga stock biomasses were estimated at 0.89, 0.38, and 0.12 million kilograms, respectively. Estimated biomass appears to be relatively stable for most species across survey years (Figure 3). The apparent decline in ehu biomass from 2019 to 2022 warrants further investigation.

Table 1. Estimates of stock sizes for Deep 7 species from the 2022 BFISH survey: stock density (numbers per unit search area), exploited phase (≥ 29 cm FL) abundance (numbers,) and biomass (kilograms).

Species	Density	SE	Abundance	SE	Biomass	SE	CV (%)
ʻŌpakapaka	0.2315	0.0470	570,930.4	115,982.1	892,982.7	152,684.3	20.31
Lehi	0.2113	0.0809	521,103.1	199,420.8	433,343.7	158,671.2	38.27
Ehu	0.1620	0.0241	399,585.2	59,440.0	384,115.6	70,133.3	14.88
Kalekale	0.0663	0.0212	163,532.1	52,368.9	275,898.8	81,123.8	32.02
Onaga	0.0209	0.0065	51,467.7	16,086.6	120,024.0	33,365.1	31.26
Hapuʻupuʻu	0.0144	0.0051	35,532.3	12,490.1	29,332.8	9,730.7	35.15
Gindai	0.0025	0.0015	6,075.3	3,797.2	56,257.5	45,942.4	62.50
TOTAL					2,191,955.1	251,609.6	11.48

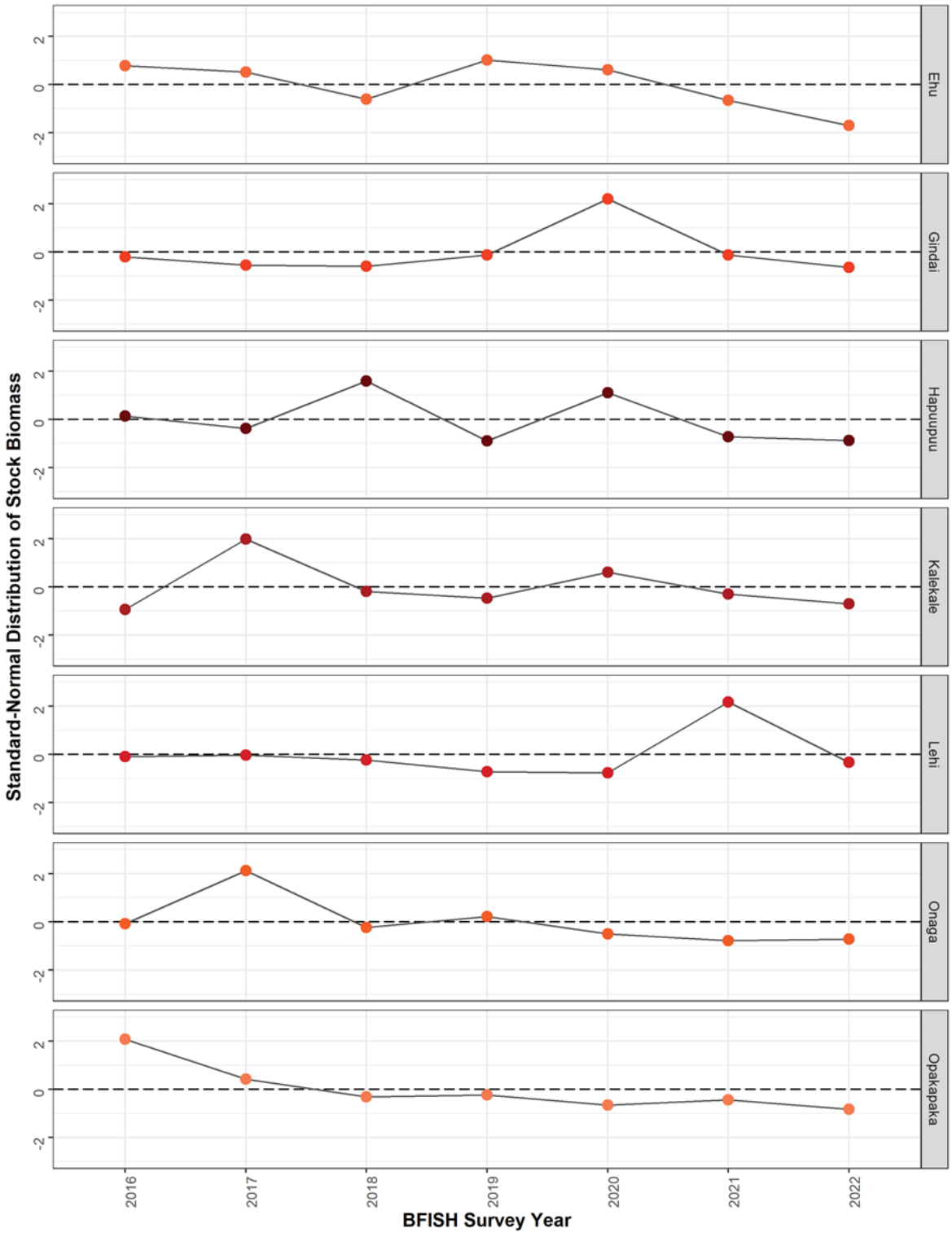

Figure 3. Standard-normal distribution of exploited phase (≥ 29 cm FL) stock biomass for the Deep 7 complex by species and year.

The 2022 BFISH survey for the Deep 7 complex achieved a high level of precision (Figure 4). CVs for exploited stock biomasses ʻōpakapaka, ehu, and onaga were 20.31%, 14.88%, and 32.02%, respectively. Under the composite experimental design that considered tradeoffs among the three primary species, future total sample allocations of approximately 500 PSU are likely adequate to achieve sufficient precision to support the needs of stock assessment and management decision-making.

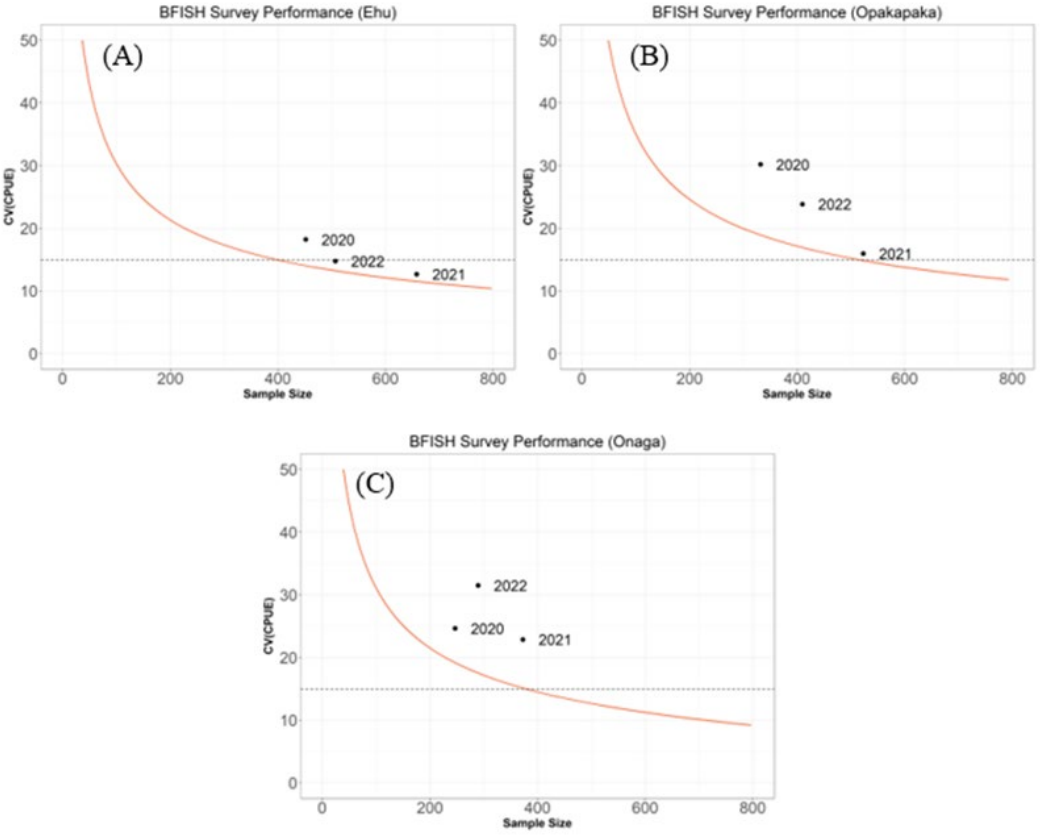

Figure 4. Species-specific 2020–2022 survey performance (coefficient of variation [CV] of population density) versus required sample size using Neyman allocation (orange curve) for the three BFISH design species: (A) ehu; (B) ʻōpakapaka; and (C) onaga. Target CV of 15% is indicated by the dashed horizontal line.

Complementary research is recommended to improve BFISH estimate precision and support Deep 7 stock assessments, including: (i) design analyses focused on reducing sampling effort to achieve optimal target CVs (e.g., through refinement of habitat metrics); (ii) linking survey spatial density estimates to those of the Fishermen's Reporting System (FRS) to improve spatial density estimates useful for BFISH domain stratification and further, the effective area fished by the bottomfish fleets for FRS CPUE estimation to support stock assessments; and (iii) analysis of wind stress impacts on effective nominal fishing effort and spatial stock abundance. Technical improvements to BFISH estimation include determination of effective camera sampling area and extending the depth range of cameras to those of cooperative fishers using non-obtrusive artificial lighting.

Overall survey design and logistics have matured to the point that given (1) population genetics to determine stock domains and (2) adequate mapping data for domain stratification, expansion of the BFISH Fishery-Independent Survey methodology into other U.S. Pacific territorial regions now appears practicable.

Main Hawaiian Islands Deep 7 Bottomfish Data Workshop

The Fisheries Research and Monitoring Division (FRMD) Stock Assessment Program (SAP) and the Island Fisheries Coordination Program (IFCP) convened the 2023 Data Workshop for the Main Hawaiian Islands Deep 7 Bottomfish benchmark stock assessment. The workshop was held at the NOAA Fisheries Honolulu Service Center at Pier 38 on March 23 and 24, 2023. During the first data workshop held in 2016, Deep 7 bottomfish fishers provided valuable insights into the data used in the 2018 benchmark assessment. The data and analysis significantly improved the assessment. The next benchmark assessment is scheduled for delivery to the Western Pacific Regional Fishery Management Council and its Scientific and Statistical Committee (SSC) in 2024. Seven fishers from Oʻahu, Maui, Kauaʻi, and Hawaiʻi Island participated in the discussion. Three staff from Hawaiʻi Division of Aquatic Resources, one Council SSC member, and one advisory panel provided their input.

Fishers confirmed the trends in the relative abundance for the seven species reflect what they experienced in the past six years and commented on the declining catch and effort over the past decade. The fishers also expressed great interest in how the scientist utilized the Hawaiʻi Marine Recreational Fishing Survey (HMRFS) to inform the non-commercial portion of the total catch. Previous assessments utilized a ratio estimator from old studies examining the estimated proportion of commercial to non-commercial catch. SAP is consulting with fishers on using the HMRFS data because this source of non-commercial data has not been explicitly incorporated in previous stock assessments. The SAP staff presented the various ways they are handling the wave-to-wave fluctuations in the catch rate from the survey, including the use of statistical smoothers. Fishers expressed concern regarding the representativeness of the HMRFS data in describing the total non-commercial catch for deep 7 bottomfish. From their perspectives, a generalized survey like HMRFS may not fully capture the non-commercial deep 7 bottomfish fishery, and the uncertainty around the point estimate may have unforeseen effects on the stock status and the projection of catch for ACL management.

At the end of the data workshop, SAP welcomed the participation from the bottomfish fishery stakeholders and concluded that the new statistical approach will be considered in the assessment as an alternative scenario to the previous ratio estimator approach. Both approaches will be presented for consideration by the Western Pacific Stock Assessment Review (WPSAR) panel.

Some of the participants will be invited to participate in the public WPSAR review of the 2024 benchmark stock assessment scheduled for December 2023.

Figure 6. Dr. John Syslo, lead analyst for the 2023 main Hawaiian Islands Deep 7 bottomfish benchmark assessment, presented on the new data and analyses that will be included in the next benchmark assessment.

2. Conserve Protected Species

Hawaiian monk seal population update

In 2022, NOAA Fisheries and partners monitored the Hawaiian monk seal population throughout the species' range. The estimated total population size in 2022 was 1,605 (95% confidence 1,512–1,743). About 75% of the seals occur in the Northwestern Hawaiian Islands and the remaining 25% in main Hawaiian Islands. After decades of declining numbers, the population of monk seals has increased on average by 2% per year since 2013—a slow but steady rise over a full decade.

NOAA Fisheries and partners continue to address threats to monk seal recovery. In 2022, a total of 68 life-saving actions were conducted, including moving pups to safer locations, disentangling seals caught in marine debris, de-hookings, and various medical interventions performed on the beach and at The Marine Mammal Center's Ke Kai Ola monk seal hospital.

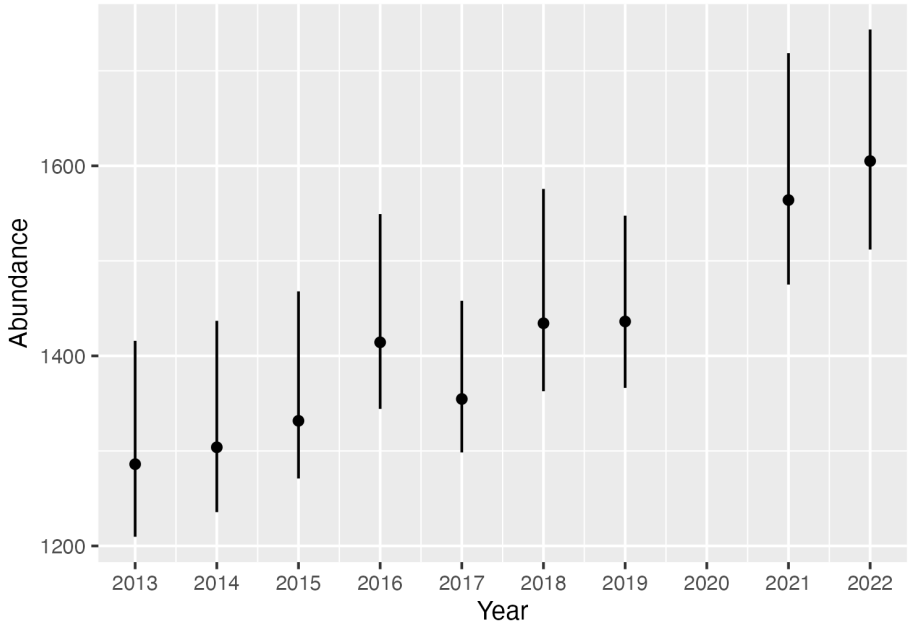

Figure 7. Total Hawaiian monk seal abundance estimates (circles) and 95% confidence intervals (vertical lines) from 2013 to 2022.

Figure 8. A Hawaiian monk seal pup just prior to being disentangled from a large mass of marine debris by NOAA Fisheries staff. Photo: Sarah Glover (NOAA Fisheries).

Record Number of Satellite Tags Deployed on Loggerheads Interacting with the Hawai‘i Shallow Set Longline Fishery

Approaches to reduce loggerhead sea turtle bycatch in the Hawai‘i shallow set longline fishery (HI SSLL) include the development of species distribution models and ecosystem-based fisheries management tools aimed at establishing spatio-temporal regions of potential high sea turtle bycatch. Satellite tags deployed on loggerhead turtles interacting with the HI SSLL generate key data for these modeling tools and help us understand post-hooking behaviors and survival rates, which have direct implications for modeling and management decision making. Although satellite tags have been deployed on North Pacific Ocean loggerheads in the past, the turtles were primarily (1) released in the western North Pacific Ocean, (2) raised in captivity, and (3) deployed 15+ years ago, thus are not necessarily representative of turtles interacting with the fishery today. Given this context, in late 2021, PIFSC‘s Marine Turtle Biology and Assessment Program (MTBAP) initiated an effort to deploy tags on loggerheads that specifically interact with the HI SSLL. Now in its third season, the research team, led by MTBAP’s Dr. Alexander Gaos and including staff from FRMD (Dr. John Wang) and the PIRO’s Observer Program (Michael Marsik, Meghan Ploudre, and Jamie Marchetti), continues to deploy satellite tags on post-hooked loggerheads within the fishery. Between December 2022 and April 2023, a total of 19 post-hooked loggerheads were equipped with satellite tags—the most tags deployed in a

single season of the project to date (previous record was 13 tags in 2022). This brings the grand total of tags deployed since 2021 to 41 (Figure 9). The tagging project has helped generate critical movement data which informed a recent scientific publication that re-evaluated the effectiveness of the Turtlewatch tool and will be highly relevant to other modeling and fishery management efforts in the near future. During the 2022–2023 season, Dr. Gaos also developed a new technique for attaching satellite tags to the turtles' shells that (1) reduced application time and (2) increased tag retention time, thus improving tagging efficiency and research products, respectively. Dr. Gaos also developed a new observer training video that gave a step-by-step visual and verbal guide to applying a satellite tag using the new technique. Combined, these efforts will generate contemporary movement data on more representative turtles that can better inform management decision making.

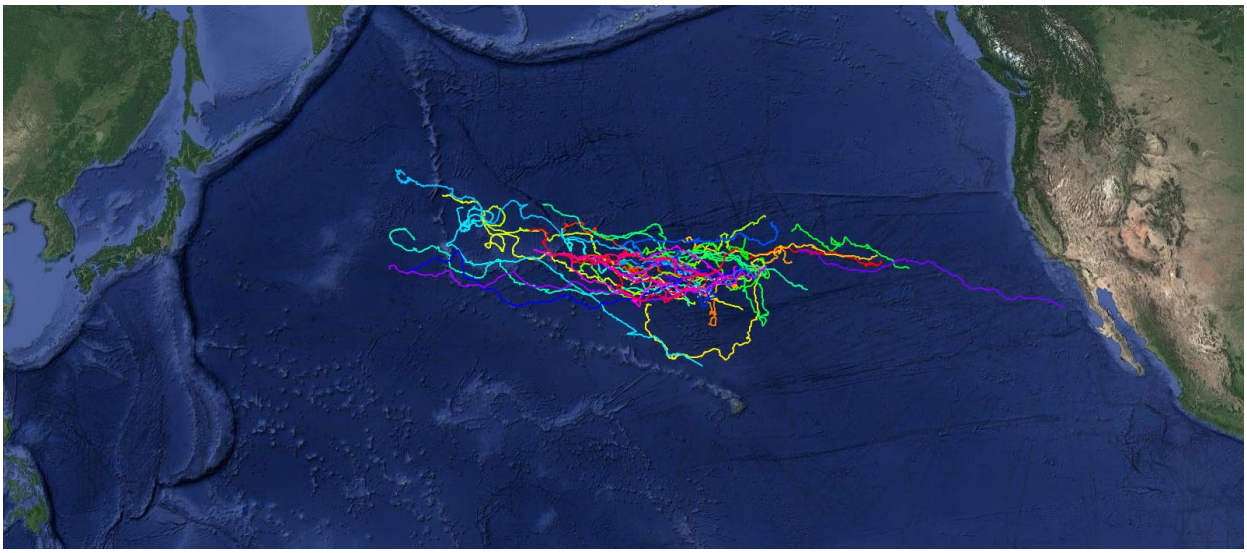

Figure 9. Tracks of 41 satellite tags deployed on loggerhead turtles interacting with the HI shallow-set longline fleet between December 2021 and April 2023.

41st International Sea Turtle Symposium

MTBAP and partners from the Pacific Islands Region (PIR; attendees from O'ahu, Maui, Guam, and American Sāmoa) attended the 41st International Sea Turtle Symposium in Cartagena, Colombia, March 18–24. PIFSC attendees included Summer Martin, Camryn Allen, Shawn Murakawa, Alexander Gaos, Yonat Swimmer (FRMD), Laura McCue (PSSP), Brittany Clemans (CIMAR), Marylou Staman (CIMAR), and Josefa Muñoz (UH graduate student, federal student volunteer). Sea Turtle Recovery Coordinator Irene Kelly represented PIRO. Collectively, the team chaired 8 sessions (In-water Biology and Fisheries & Threats), gave six oral presentations, presented 2 posters, served on 2 expert panels (one on the role of technology in advancing community conservation and one on relevant careers), served as Travel Grant chair, and facilitated the Oceania Regional Meeting. Additionally, partners from Maui Ocean Center Marine Institute (turtle stranding response and rehabilitation) presented 2 posters and one oral

presentation on collaborative work with PIFSC. The program coordinator from the Hawaiian Island Hawksbill project, Kelleigh Downs, gave an oral presentation on collaborative research. Another graduate student from UH, Alison Meeth, gave an oral presentation on collaborative work. Participants in the Oceania/Pacific Islands Regional Meeting (including MTBAP and their collaborators) were featured in the cover photo (Figure 10) of an online Colombian News article titled, "More than 600 scientists, biologists and experts in Sea Turtles will be in Cartagena," regarding the International Sea Turtle Symposium. Following that article, a local reporter requested an interview with Indigenous sea turtle scientists from the PIR (Figure 11). Sefa Muñoz is Chamorro, a NOAA volunteer, and a University of Hawai'i at Mānoa PhD student; Phinah Liusamoa is an American Sāmoan and an American Sāmoa DMWR Turtle Biologist; and Chanel Browne is a Hawaiian and Sea Turtle Coordinator at Maui Ocean Center Marine Institute (a NOAA PIR partner). They were asked to share their backgrounds and explain how valuable and necessary it is to include Indigenous communities in this international forum. Shawn Murakawa also explained how her background as an O'ahu "local" has influenced her role as a NOAA Fisheries Biologist. Undoubtedly, PIFSC/PIR attendance and participation at this meeting after four years gave MTBAP and collaborators high visibility as international leaders in sea turtle research and conservation and was an uplifting team building experience. Not only is the sea turtle-related research of PIR relevant to conservation and fisheries management in the Pacific, but the ongoing collaborative work has also demonstrated its global significance.

Figure 10. Participants in the Oceania/Pacific Islands Regional Meeting (including PIFSC MTBAP and their collaborators) were featured in the cover photo of an online Colombian News article titled, "More than 600 scientists, biologists and experts in Sea Turtles will be in Cartagena," regarding the International Sea Turtle Symposium.

Figure 11. A local reporter interviews Indigenous sea turtle scientists from the PIR. From left to right, Sefa Muñoz is Chamorro, a NOAA volunteer, and a University of Hawai‘i-Mānoa PhD student; Phinah Liusamoa is American Sāmoan and an American Sāmoa DMWR turtle biologist; Chanel Browne is a Hawaiian and Sea Turtle Coordinator at Maui Ocean Center Marine Institute (NOAA PIR partner).

Hawaiian Monk Seal Population Assessment and Tagging on Moloka‘i

From April 25–27, 2023, the PIFSC Hawaiian Monk Seal Research Program (HMSRP) staff led a research and capacity building mission to the west end of Moloka‘i to conduct Hawaiian monk seal surveys, apply bleach marks and flipper tags to seals, and develop stronger relationships with partners amidst great turnover and change over the past 3 years. The team was comprised of personnel from the HMSRP, PIRO Protected Resources Division, State of Hawai‘i Division of Aquatic Resources (DAR), National Park Service at Kalaupapa, Hawai‘i Marine Animal Response (HMAR), and members of the Moloka‘i community. Each day the group hiked 8–10 miles along the coastline in search of untagged seals, hoping to find some of the 2020 Moloka‘i-born seals that were never flipper tagged during the pandemic. They were able to successfully flipper tag two previously untagged seals, including one of the 2020 Moloka‘i–born seals, as well as re-tag an adult male that had completely lost his original tags. These newly applied flipper tags will aid in identifying these seals in the future and contribute to our ability to

calculate population estimates and monitor vital rates. Such markings also make monitoring stranded seals more efficient for the entire stranding network.

This field mission also provided experience and training to partners in seal handling, tagging, seal behavior, and risk assessment and decision making related to monk seal field work. All of these skills will aid in capacity building for stranding response activities and population monitoring with our Maui Nui partners. Lastly, this trip helped create a foundation for relationship building, open communication, and collaboration amongst the various partners involved with monk seal conservation and science on Molokaʻi.

Figure 12. April 2023-Molokaʻi monk seal assessment and tagging team out in the field near Laʻau Point.

Figure 13. Team members from NOAA Fisheries, DAR, and HMAR prepare to capture a three year old seal for flipper tagging.

3. Research to Support EBFM and Living Marine Resource Management

PIFSC Researchers Assess Climate Factors on Hawai‘i Longline Fleet’s Spatial Movement

A recent publication in PLOS Climate entitled, “How climate change and climate variability affected trip distance of a commercial fishery,” examines how changes in sea surface temperature (SST) and ENSO events have affected trip distance for the Hawai‘i deep-set longline (HI DSLL) fleet. Changes in climate factors affect the distribution of various tuna species differently due to their unique physiological adaptations and preferred habitats. As the resulting spatial distributions of tunas alter in response to climate change and climate variability, the distribution of fishing effort will, in turn, be affected. Using a quantitative model and 30 years of fishery-dependent data and environmental variables, this study found that the higher the SST of the fishing grounds of the HI DSLL, the longer trip distance, whereas ENSO events could result in shorter trip distances, possibly due to changes in catch rates of different tuna species through spatial redistribution during El Niño and La Niña events.

Using 30 years of logbook data, Figure 14 shows that the higher the SST of the Hawai‘i longline fishing grounds, the higher the latitude and the further east the HI DSLL fleet operated. The study found that a 1º increase in SST is associated with a 4.2% (100 km) increase in trip distance. This could be due to the opposite correlation between SST and trip CPUE, and a lower CPUE could induce longer trip distance as more time is required to search for target species. If SST continues to increase, this could lead to smaller supply of fresh pelagic fish in Hawai‘i as it could become more economical for vessels to land their catches on the West Coast.

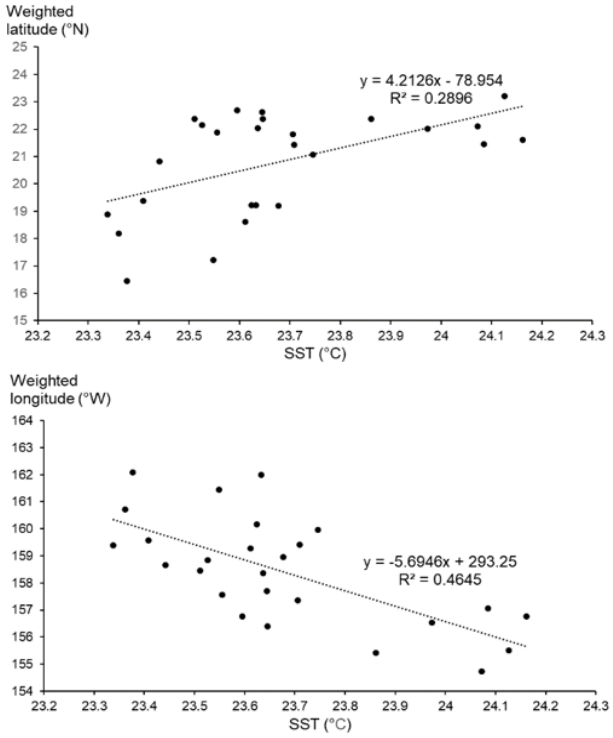

Figure 14. Annual effort-weighted mean haul latitude (top) and annual effort-weighted mean haul longitude (bottom) vs. 5-year running mean SST for fishing grounds, 1995–2020. Source: Chan (2023).

Some studies have found that ENSO events affect the preferred habitat and distribution of different tuna species in the North Pacific Ocean vertically, horizontally, and northward. Being in the middle of the North Pacific Ocean, the Hawai‘i longline fleet experienced higher trip-level CPUE for bigeye, skipjack, and non-tuna species during El Niño conditions, and higher trip-level CPUE for yellowfin and albacore during La Niña conditions. The study found that an increase in Oceanic Niño Index (ONI) from 0 to 1 corresponds to a 5.0% (114 km) decrease in trip distance. The negative relationship of trip distance with ENSO events suggests that the Hawai‘i longline fleet took advantage of the changes in spatial distributions of different tuna species during ENSO events and utilized its locational advantage to travel in different directions in the Pacific Ocean to achieve higher CPUE that occurred closer to the Honolulu port, thereby shortening its travel distance.

It is important to note that although the model result predicts an increase in trip distance with rising ocean temperatures, the future effect is expected to be small, as it takes a long time for ocean temperature to increase by one degree. Projections showed that SST in the WCPO will increase by 2.5˚C to 3.5˚C by 2100 under the “business-as-usual” greenhouse gas emissions RCP8.5 scenario. Therefore, higher SST can be considered a long-term impact on the fishery. On the other hand, ENSO events could happen in any year and will probably be more frequent and more extreme in the future, leading to greater influence on trip distance. The model results show non-climate factors such as fisheries management policies, biomass, and diesel price also affected trip distance. Area closures that affected access and bigeye biomass that influences the ease of finding fish had larger effects on trip distance than climate factors.

The estimated changes in travel distance were linked with a trip cost model presented in Chan and Pan (2021)[1] to determine the changes in estimated trip costs due to climate change and variability. Using the estimated trip cost model for the Hawai‘i longline fishery and the mean trip distance (2,356 km), Table 1 shows the estimated trip cost impacts due to changes in trip distance based on climate and non-climate factors. SST changes have relatively low impacts on trip costs (~1%); ENSO events have larger (~1% to 9%) effects on trip costs, whereas fisheries management imposes more notable impacts on trip costs.

[1] Chan HL, Pan M. 2021. Fishing trip cost modeling using generalized linear model and machine learning methods–A case study with longline fisheries in the Pacific and an application in Regulatory Impact Analysis. PLOS One. 16(9). https://doi.org/10.1371/journal.pone.0257027

Table 2. Estimated trip cost impacts based on trip distance model in Chan and Pan (2021) and trip cost model in Chan and Pan (2023)[2]

	Estimated percentage change in trip costs
SST fishing ground	1.1%
ONI = 1/-1	-1.3%
ONI = 2/-2	-4.7%
ONI = 3/-3	-9.3%
Diesel	-0.5%
Biomass of bigeye	-1.5%
Biomass of non-bigeye	-0.1%
Closures in WCPO	11.9%
Closures in EPO	-4.3%

Gender and Fisheries Research Highlights Cultural Dimensions Critical to Regional Fisheries

The National Marine Fisheries Service Equity and Environmental Justice Strategy has acknowledged the marginalization of territorial communities in fisheries research and management. Such marginalization also manifests in the invisibilisation of subsistence and cultural fishing practices in research and management considerations. A recent study from CIMAR, American Sāmoa DMWR, and PIFSC staff published in the 37th edition of the Secretariat of the Pacific Community's (SPC) Women in Fisheries Information Bulletin supports an improved understanding of fishing practices of women and *fa'afafine* in American Sāmoa.[3] This work is part of a larger effort to devote more intentional and rigorous attention to regional fisheries to ensure that cultural fishing practices flourish in perpetuity. It was also motivated to increase social science capacity in territorial communities.

The role of gender and gendered social systems within fisheries is an emerging topic, highlighting the limitations of our understanding of fisheries and their overarching socioecological systems, as well as perpetuating marginalization along gender lines. To elucidate the dimensions of fisheries that are often invisibilised under dominant approaches to studying them, we conducted semi-structured interviews with 28 women and *fa'afafine* in American Sāmoa about their fisheries practices and their broader relations and interactions with the seas.

Four key themes that emerged from the interviews were: (1) the significance of intergenerational relationships for the perpetuation of fishing knowledges and practices; (2) the critical role of cultural subsistence in the form of locally caught fish for elder care; (3) the cultural prominence

[2] Chan HL. 2023. How climate change and climate variability affected trip distance of a commercial fishery. PLOS Clim 2(2): e0000143. https://doi.org/10.1371/journal.pclm.0000143

[3] Fisk JJ, Matagi N, Kleiber D. 2023. Gleaning the expanse: Gender and invisibilised dimensions of fisheries in American Samoa. Women in Fisheries Information Bulletin 37, p. 7-10. https://www.spc.int/DigitalLibrary/Doc/FAME/InfoBull/WIF/37/WIF37_07_Fisk.pdf

of fisheries-related practices that would usually be excluded from fisheries studies, particularly domestic labor, art, and design; and (4) the need for a more expansive understanding of, and engagement with, gender in order to include the experiences and insights of people of all genders, particularly those outside of the dominant binary categorization imposed especially on Indigenous communities via colonialism.

Even further, the results of this study illustrate how fisheries and the seas function as a nucleus through which people situate themselves and their identities as well as their communities and cultures, obtain sustenance both materially and emotionally, and facilitate their broader tapestry of relations and cultural practices. Fisheries manifest and implicate far beyond the bounds of the practice of fishing itself. Fisheries research and management should recognize and consider this fuller scope of seascape relationalities in order to ensure efficacy and equity in our work.

Update on the RICHARD Mission to American Sāmoa and the Pacific Remote Islands

Figure 15. Joao Garriques conducts photoquad surveys on a beautiful reef at Baker Islands. Credit: NOAA Fisheries/Ari Halperin

The RICHARD (Rainier Integrates Charting, Hydrography, and Reef Demographics) mission aboard the NOAA Ship *Rainier* has been conducting coral reef research and hydrographic surveys around the islands in American Sāmoa and the Pacific Remote Island Areas. This joint NOAA mission includes 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 and headed towards Baker and Howland Islands to kick off the surveys. The reefs in these protected areas are home to diverse and extensive coral reefs, teeming with schools of fish, including manta rays and reef sharks. Studying these remote locations helps us better understand the environmental drivers and ecosystem conditions that support such high diversity and provides critical information to guide conservation and management in more densely populated locations.

During the RICHARD mission, PIFSC scientists will complete the NCRMP dive surveys while National Ocean Service (NOS) scientists conduct hydrographic surveys in the shallow areas around the islands using small boats. The ship surveys continuously, using sonar that can map down to 10,000 meters. For the islands of Ofu, Olosega, Rose, Swains, Tutuila, and Taʻū, the hydrographic survey data will be integrated with recently acquired LiDAR data into seamless, high-resolution maps from ridge to deep water. Many of these islands have not been mapped in several decades.

*Figure 16. A school of black trevally (*Caranx lugubris*) hides a lurking gray reef shark (*Carcharhinus amblyrhynchos*). Credit: NOAA Fisheries*

The *Rainier* arrived in American Sāmoa in late March, the first time a NOAA ship was in the region since before the pandemic. While in port, Commanding Officer Captain Casanova, Operations Officer Lieutenant Walker, and Dr. Jennifer Samson (PIFSC NCRMP Lead), along with American Sāmoa Department of Marine and Wildlife Resources (DMWR) Deputy Director Selaina Vaitautolu, met with the Lieutenant Governor Talauega E.V. Ale to discuss the RICHARD mission. This meeting was followed by a tour of the ship that included Secretary of Sāmoan Affairs Paramount Chief Mauga Asuega, Manu'a District Governor Paramount Chief Hudson, and Representatives from Swains and Manu'a. Captain Casanova and Dr. Samson also gave a brief presentation on the RICHARD mission and answered questions at the

Figure 17. Dramatic drop off around Swains Islands with pink hues from the crustose coralline algae. Credit: NOAA Fisheries/Courtney S. Couch

Figure 18. Fatu Rock (Flowerpot Rock) near the entrance of Pago Pago Harbor. Credit: NOAA Fisheries/Damaris Torres-Pulliza

Office of Sāmoan Affairs meeting. There was also an outreach event with over 180 junior high and high school age students that included a tour of the *Rainier* bridge and dive chamber, plus science activities set up by the NCRMP fish, benthic, and climate teams, and the National Marine Sanctuaries of American Sāmoa (NMSAS). All of the students (and NOAA staff) were highly engaged and very enthusiastic about the different activities.

Once underway again, the crew aboard the *Rainier* began coral and mapping surveys around the islands of American Sāmoa, including Tutuila, Aunuʻu, Taʻū, Ofu, Rose, and Swains, before heading back to Honolulu for a mid-season repair period. The return transit included another stop at Howland and Baker Islands to complete the surveys that were started on the journey to American Sāmoa. Below are some current summary statistics from the NCRMP component of the RICHARD mission.

In June, *Rainier* will depart for the second half of the mission, with plans to survey the Kingman Reef, Palmyra Atoll, and Jarvis Island, and complete surveys around American Sāmoa. The NOAA National Marine Sanctuary of American Sāmoa (NMSAS) staff will join this 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).

The RICHARD mission will continue conducting surveys in the region until the *Rainier* returns to Honolulu at the end of September. All data, including updated electronic navigational charts, will be available to the public, usually within a year of collection. High resolution mapping products, along with updated coral reef data, will provide critical data and tools for federal and local marine resource management to help refine essential fish habitat, better understand the relationship between coral reef health and fish abundance, and project impacts of climate change. The biological data complement long-term coral reef monitoring efforts of local agencies and will be used to support American Sāmoa's Coral Reef Fisheries Management Plan currently in development.

FISH SURVEYS	TOTALS THRU 5/12/23
Dives	189
SPC surveys	79
PQ sites	173
SfM belts	51
CTD/Water Samples	25

CLIMATE SURVEYS	TOTALS THRU 5/12/23
Dives	53
CTD/Water Samples	21
STRs Deploy	21
STRs Recovered	10
CAUs Deployed	25
CAUs Recovered	19
SfM	4
PQ	15

BENTHIC SURVEYS	TOTALS THRU 5/12/23
Dives	562
Belt surveys	147
PQ sites	150
SfM belts	81
COTS	150

ALL SURVEYS	TOTALS THRU 5/12/23
CTD/Water Samples	46
Dives	804
PQ sites	338
SfM belts	132

Figure 19. Total climate, fish, and benthic surveys completed by the RICHARD mission as of May 12, 2023.

4. Organizational Excellence

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