

Pacific Islands Fisheries Science Center

Annual Report 2018



NOAA
FISHERIES

Message from the Director's Office

In fiscal year 2018, the Pacific Islands Fisheries Science Center published the 2019–2023 Science Plan, outlining our commitment to the advancement of science and operations that support the conservation and management of fisheries and living marine resources. The Center's achievements this year reflect our commitment to achieving the goals laid out in the Plan.

In support of sustainable fisheries, we conducted research expeditions to study fish life history in the Mariana Islands and collect fishery-independent data on the deep-7 bottomfish around the main Hawaiian Islands while advancing the capabilities of our survey technologies. Our researchers produced benchmark stock assessments for Guam's reef fish, the North Pacific swordfish, and the Pacific shortfin mako shark, and studied the survivorship of sharks after incidental catch in tuna longline gear.

We conserved protected species by conducting marine turtle nesting surveys in American Samoa and the Mariana Islands, and tagging turtles across the Pacific Islands. We established field camps in the Northwestern Hawaiian Islands to conduct a variety of activities to recover the Hawaiian monk seal. We used previous years' protected species survey data to assess the status of the loggerhead sea turtle population and Hawaiian monk seal, update maps for ESA-listed corals, and detect the presence of humpback whales in acoustic records through a collaborative effort with Google's artificial intelligence team.

In support of ecosystem-based fisheries and living marine resources, we conducted interdisciplinary and integrated coral reef ecosystem surveys of benthos, fishes, and oceanographic characteristics related to climate change in coastal waters of American Samoa and the Pacific Remote Islands Marine National Monument. We also hosted a science symposium for integrated research and management on the West Hawaii ecosystem and co-facilitated a multinational workshop on ocean acidification.

In efforts to achieve organizational excellence, we engaged in priority-based resource planning, stood up the PIFSC Science Council, a small team of subject matter experts focused on the enhancement and development of science initiatives, responded to the external review of the Economics and Human Dimensions Program, developed requirements for data collections, and established standards and best practices for data management. Further, we continue our efforts toward open access to data by developing public portals to our data collections and research results.

As we continue to expand our science and operations, we are pleased to share the Center's 2018 milestones and accomplishments.

- Mike and Evan



Mike Seki
Director



Evan Howell
Deputy Director

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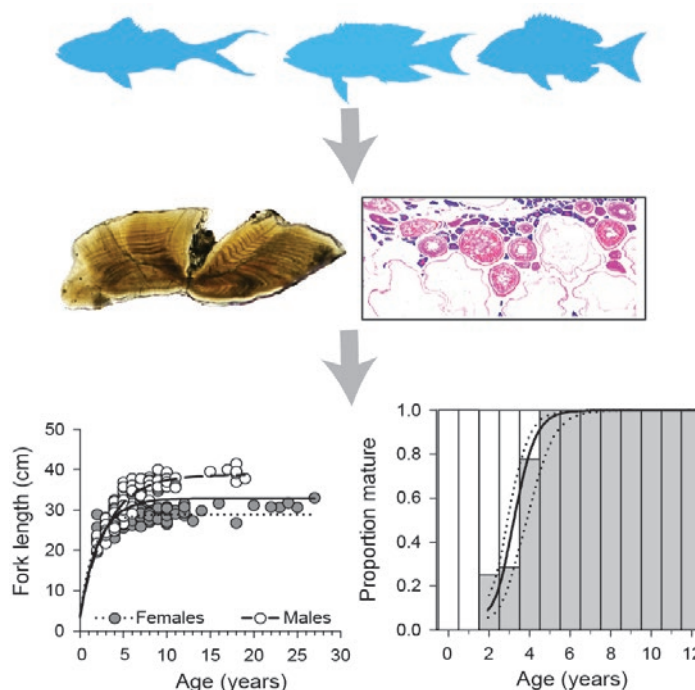
Promote Sustainable Fisheries

Core to our statutory and regulatory mandates are research priorities that PROMOTE SUSTAINABLE FISHERIES and CONSERVE PROTECTED SPECIES. This research includes stock and population assessments, conservation science, and data collection and analysis. We also conduct gap analyses to ensure our research priorities are relevant and continue to address current concerns and needs.

Fishery-independent science in support of stock assessments

Research Expedition: Fish Life-History Research in the Mariana Archipelago

Researchers aboard the NOAA Ship *Oscar Elton Sette* examined life-history patterns of commercially harvested coral-reef fishes and deepwater demersal fishes across the uninhabited islands of the Commonwealth of the Northern Mariana Islands. The research examined life histories across environmental and human gradients to derive data for use in stock assessments. Operations included hook-and-line specimen sampling of deep-slope (depths of 200–400 m) demersal fishes; snorkel-spearfishing of reef-associated fishes; CTD casts to collect vertical depth-profile oceanographic data to 200 m; and water and sediment sampling for environmental DNA analyses.



Journal Article: Mariana Archipelago Deepwater Fishes

These expeditions have provided researchers with enough data to describe the life history traits of two deepwater bottomfishes of the Mariana Archipelago, *Pristipomoides auricilla*, and Samoa Archipelago, *P. flavipinnis*. In this peer-reviewed journal article, they examine size and age structure of these exploited fishes, growth and mortality between fished and unfished areas of the archipelagos, and suitability of a maximum age natural mortality estimator:

O'Malley JM, Wakefield CB, Oyafuso ZS, Nichols RS, Taylor B, Williams AJ, Sapatu M, Marsik M. In review. **Impact of exploitation evident in age-based demography of the deepwater snappers *Pristipomoides flavipinnis* in the Samoa Archipelago and *P. auricilla* in the Mariana Archipelago.** For submission to *Fishery Bulletin*.

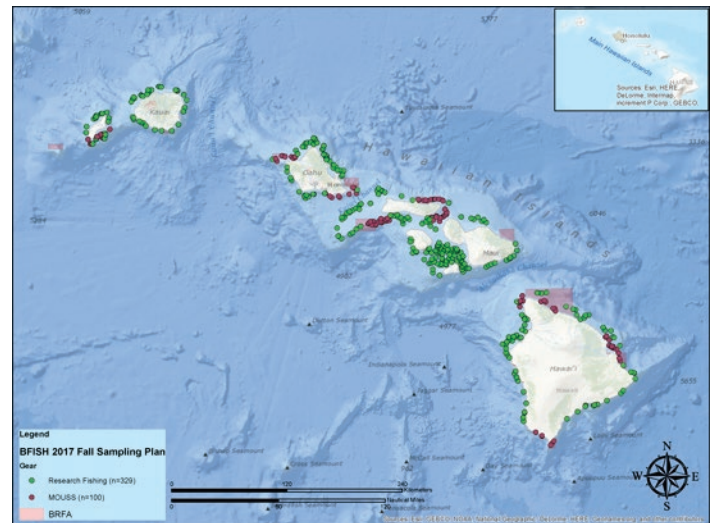
Research Expedition: Fishery-independent Survey for Main Hawaiian Islands Bottomfish Stock.

Researchers aboard the NOAA Ship *Oscar Elton Sette* conducted the fall 2017 bottomfish fishery-independent survey (BFISH) in the main Hawaiian Islands to maintain and enhance bottomfish stock assessments and to enhance our understanding of the culturally significant Hawaiian bottomfish fishery. BFISH was conducted by two teams:

1. The Pacific Island Fisheries Group cooperative research fishing team completed 325 stratified random sampling units over a 2-month sampling window.
2. The PIFSC Modular Optical Underwater Survey System (MOUSS) stereo-camera team completed 204 camera deployments within a 15-day sampling window.

The results of this and other BFISH surveys will be used to construct a fishery-independent estimate of biomass within the current and future main Hawaiian Islands deep-7 bottomfish stock assessments. Science blog:

[From the Barracks to the Berth: An Army Veteran's Experiences aboard a NOAA Ship](#)



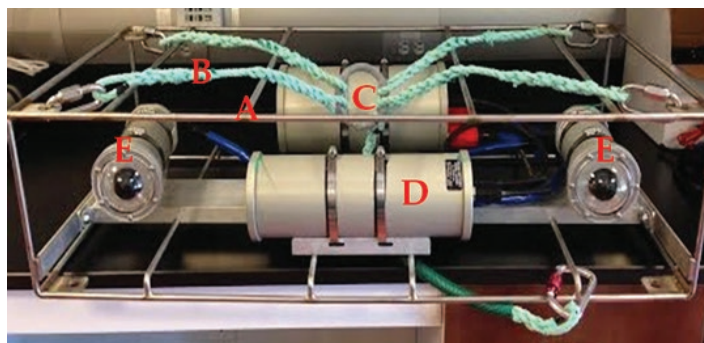
Journal Article: Technical Description of the Modular Optical Underwater Stereo System (MOUSS) Electronics

The Pacific Islands Fisheries Science Center deploys the MOUSS to estimate the species-specific, size-structured abundance of commercially-important fish species using in situ visual sampling of fish assemblages in Hawai'i and the Pacific Islands. This system is rated to 500 m with low-light, stereo-video cameras that enable identification, counting, and sizing of individuals at a range of 0.5–10 m. The modular nature of MOUSS allows for the efficient and cost-effective use of various imaging sensors, power systems, and deployment platforms.

Amin R, Richards BL, Misa WFXE, Taylor JC, Miller DR, Rollo AK, Demarke C, Singh H, Young GC, Childress J, Ossolinski JE, Reardon RT, Koyanagi KH. 2017. **The Modular Optical Underwater Survey System**. *Sensors*. 17(10):2309. <https://doi.org/10.3390/s17102309>.

MOUSS_Pi Display Interface

The Modular Optical Underwater Survey System (MOUSS) is used by all NOAA Fisheries science centers to study the status of fish stocks. Since its inception, however, the MOUSS has not had a display system to indicate camera status at deployment. Our scientists estimated that 7% of the deployments failed due to lack of camera readiness. This percent failure was equivalent to a full day of operation from a small boat or 1.5 days from a NOAA Ship on an average-length research expedition. Using off-the-shelf hardware and in-house software and 3D printer, they developed a MOUSS display system—the MOUSS_Pi—that guarantees both cameras are on before deployment.



A Modular Optical Underwater Survey System (MOUSS) unit showing (A) frame, (B) harness, (C) digital video recorder (DVR), (D) battery module, and (E) two camera modules.

The Moana360-degree Camera System

With recent advancements in terrestrial 360-degree optics, there are many low-cost, consumer-grade 360° cameras. Our scientists developed the Moana360, an underwater rig that is compatible with a range of these 360° cameras. We have field-tested the system in the waters surrounding O'ahu. Moana360 is rated for 500 m and records depth and temperature using an external sensor. It can be attached to a package such as the MOUSS or mounted on an autonomous underwater vehicle, remotely operated underwater vehicle, towed body, or other deployment platform.

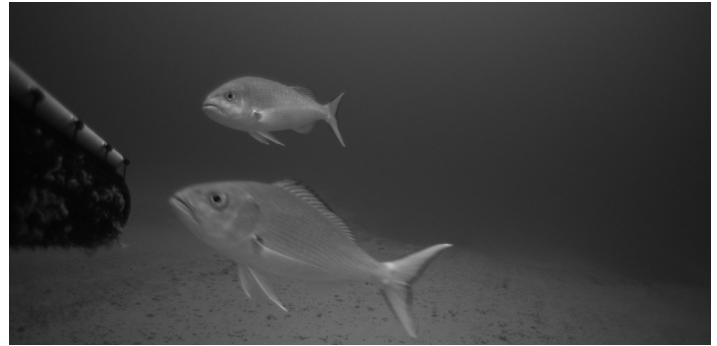


The Moana360 underwater rig is compatible with a range of small and large off-the-shelf 360-degree cameras.

Fishery-independent data streams in support of stock assessments

MOUSS Video Analysis

Analysis of 288 MOUSS stereo videos has provided size-structured fish abundance data from fall 2017's survey around the main Hawaiian Islands. Our stock assessment program now has data on the number and size of Deep 7 and other Pacific Island fish species identified in these videos, as well as location, temperature, depth, and distance from each fish. These fishery-independent data will be incorporated in the next Deep 7 bottomfish stock assessment.



Two opakapaka viewed from the modular optical under-water stereo system (MOUSS).

MOUSS Video Data Archiving and Publishing

The MOUSS video data set is a relatively large and expanding dataset that requires a well-planned and implemented system for data management and archival. The Big Earth Data Initiative has funded data archiving and publishing procedures that enable researchers from universities, federal and non-federal labs, and citizen scientists to access the data.

Our scientists have generated data archive packages of the MOUSS video based on the most recent specifications from the National Centers for Environmental Information. The data package includes instrument manuals, calibration and data processing methods, data format specifications, CSV metadata, and AVI optical stereo videos.



Researchers and crew deploy underwater cameras from a small boat off the NOAA Ship *Oscar Elton Sette*.

Journal Article: Marine Recreational Information Program (MRIP) Report on Pilot Surveys of Private Boat Fishing in Hawaii

This article describes the Hawai'i pilot survey designs, outlines results from the pilot surveys, compares the pilot surveys with the current surveys in Hawai'i, and provides recommendations on future directions for the Hawai'i Marine Recreational Fishing Survey.

Ma H, Ogawa TK, Sminkey TR, Breidt FJ, Lesser VM, Opsomer JD, Foster JR, Van Voorhees DA. 2018. **Pilot surveys to improve monitoring of marine recreational fisheries in Hawaii**. Fisheries Research. 204:197–208. <https://doi.org/10.1016/j.fishres.2018.02.010>.

Stock assessments for priority insular and pelagic species

Benchmark Stock Assessment for Guam Reef Fish

In February 2018, the benchmark stock assessment for Guam reef fish underwent the Western Pacific Stock Assessment Review's external peer-review process:

- Twelve of the 19 species-level assessments successfully passed the review.
- Four species were found to be undergoing overfishing.
- Seven species did not pass the review due to insufficient quality of the data.

A technical memorandum for the 2017 benchmark stock assessment of 19 Guam reef fish will publish in 2019.

Benchmark Stock Assessment for the North Pacific Swordfish

The Billfish Working Group of the International Scientific Committee for Tunas and Tuna-like Species in the North Pacific Ocean (ISC) finalized the North Pacific swordfish stock assessment in April 2018 in Shimizu, Japan. The working paper was authored by delegates from the United States, Japan, and Chinese Taipei.

Sculley M, Ijima H, Chang YJ. 2018. **A base-case model in stock synthesis 3.30 for the 2018 North Pacific swordfish (*Xiphias gladius*) stock assessment.** Pacific Islands Fisheries Science Center, PIFSC Working Paper, WP-18-005, 39 p.
<https://doi.org/10.7289/V5/WP-PIFSC-18-005>

The assessment determined that

- The North Pacific swordfish stock is not likely overfished and is not likely experiencing overfishing relative to MSY (maximum sustainable yield)-based or 20% of unfished spawning biomass-based reference points.
- Fishing mortality in 2016 was an estimated 45% of fishing mortality at maximum sustainable yield (FMSY) and spawning stock biomass in 2016 was 87% spawning stock biomass at maximum sustainable yield (SSBMSY).
- Current yields are approximately 2/3 of MSY harvest levels. Projections suggested that even with increased fishing mortality, the SSB would remain above SSBMSY through 2024.

In July 2018, the assessment was accepted as the best scientific information available at the ISC plenary meeting in Yeosu, Republic of Korea, and has been submitted to the Western and Central Pacific Fisheries Commission Scientific Committee and Northern Committee for management consideration.

Benchmark Stock Assessment for the Pacific Shortfin Mako Shark

With contributions from our researches in July 2018, the ISC Shark Working Group completed a draft report detailing the first stock assessment for the North Pacific shortfin mako shark:

Stock Assessment of Shortfin Mako Shark in the North Pacific Ocean Through 2016. Available at: <http://bit.ly/ShortfinMako2018>

The assessment indicated that

- The Pacific shortfin mako shark is likely not overfished and overfishing is likely not occurring relative to MSY-based abundance and fishing intensity reference points.

The ISC plenary accepted the assessment as the best scientific information available for stock status determination.

Catch and bycatch estimation and management-relevant analyses

Post Release Survivorship of Sharks in the Hawai'i and American Samoa Tuna Longline Fisheries

Reducing mortality to incidental sharks captured in high seas fisheries is a cross-regional management priority. Our researchers have trained observers in the Hawai'i and American Samoa tuna longline fisheries to apply survivorship archival tags (sPATs; Wildlife Computers Inc.) to sharks caught in good condition on commercial fishing trips. In 2018, our observers tagged 48 blue sharks, 28 bigeye thresher sharks, and 28 silky sharks.

The results from this tagging effort will provide post-release survivorship estimates from at-vessel condition and handling methods. These findings can be integrated into fisheries data to improve population projections for future stock assessments. With the blue shark survivorship data derived from several scenarios during this study, we began to explore the effects of accounting for post-release survival rates in the most recent blue shark stock assessment model.



The preliminary results of this project were presented to the IATTC Bycatch Working Group, the International Tuna Conference, and the quadrennial Sharks International meetings.

Conserve Protected Species

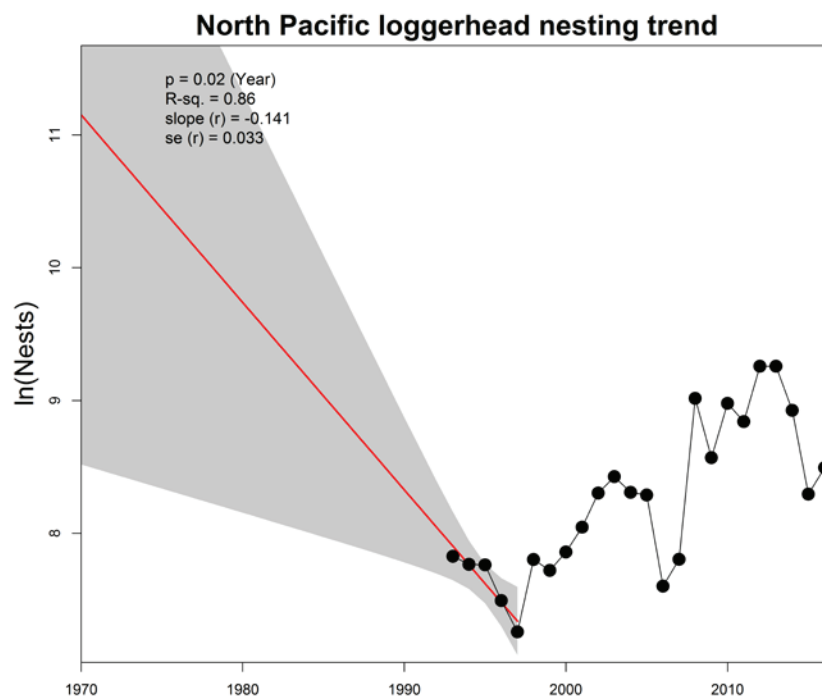
Protected species population assessments

Updated Shallow-Water Substrate Maps of ESA-listed Corals

In April 2018, our researchers completed a multi-year effort to update hard and soft bottom shallow-water substrate maps for ESA-listed corals and their potential habitats in the Pacific. The updated maps now include Anatahan and Maug in the Northern Mariana Islands, Rose Atoll in American Samoa, and Howland, Johnston, Jarvis, Kingman, and Palmyra of the Pacific Remote Island Areas. With the exception of the Pacific Remote Island Areas, where existing information was scarce, new substrate maps were derived from high spatial resolution satellite imagery. Our researchers also incorporated benthic habitat information, ground-truthed data, and depth contours for each location. These products are available in the distribution information section at <https://inport.nmfs.noaa.gov/inport/item/34310>.

Loggerhead Population Status and Recovery Goal Analysis

Our Marine Turtle Biology and Assessment Program identified nesting recovery goals for the North Pacific loggerhead tri-national recovery plan. Using the numbers of nests counted from 1993 to 1997, our researchers back-estimated the total number of nests in 1970, which will serve as the recovery goal. They further allocated



North Pacific loggerhead nesting trend based on data from 1993 to 1997. Slope is the population growth rate estimate, suggesting a 14.1% decline in the population for 1993–1997 ($R^2 = 0.86$; $p\text{-value} = 0.02$). This estimate's mean and 95% confidence interval were used to backcast to 1970.

portions of the total nest abundance goal to six nesting beaches across three management units, based on the percentage of their contributions to the total nest counts from 2004 to 2015.

Our researchers presented these results in January 2018 at the 4th meeting of the Loggerhead Tri-National Recovery Team in La Jolla, California. Researchers from the United States, Japan, and Mexico agreed on the recovery goals and the final population assessment, and included these analyses in the recovery plan.

Technical Memorandum: Hawaiian Islands Cetacean and Ecosystem Assessment Survey (HICEAS) 2017

The Hawaiian Islands Cetacean and Ecosystem Assessment Survey (HICEAS) of 2017 was a large-scale ship survey for cetaceans and seabirds within U.S. waters surrounding the Hawaiian Islands. The primary goals of HICEAS 2017 were to collect data required to estimate the abundance and distribution, examine the population structure, and understand the habitat of cetaceans within this area. In 2018, our cetacean researchers catalogued all HICEAS 2017 visual survey data sets and descriptions of survey methods into a single report.

Yano KM, Oleson EM, Keating JL, Ballance LT, Hill MC, Bradford AL, Allen AN, Joyce TW, Moore JE, Henry A. 2018.

Cetacean and seabird data collected during the Hawaiian Islands Cetacean and Ecosystem Assessment Survey (HICEAS), July–December 2017. U.S. Dept. of Commerce, NOAA Technical Memorandum NOAA-TM-NMFS-PIFSC-72, 110 p. <https://doi.org/10.25923/7avn-gw82>.



Stock Assessment Report for the Hawaiian Monk Seal

Our researchers submitted to the Pacific Scientific Review Group a draft Hawaiian monk seal stock assessment report. The report analyzed the monk seal demographic database and information on serious injury and mortality through 2014, and included the following information:

- The minimum Hawaiian monk seal population size in 2016 (1,384 individuals, with a best total estimate of 1,415).
- Potential biological removal is 4.8 seals per year. Positive abundance trends since 2013 allowed us to calculate this number for the first time in many years.
- In 2016, there were no confirmed anthropogenic seal mortalities or serious injuries.
- In 2016, there were 11 documented cases of seal hookings. All were deemed non-serious injuries, although six cases would have been judged serious had they not been mitigated by capture and hook removal.



Researchers observe juvenile Hawaiian monk seal brought into captivity for rehabilitation.

Conservation research to improve protected species status

Marine Turtle Nesting Surveys in American Samoa

In December 2017, our researchers collaborated with the American Samoa Department of Marine & Wildlife Resources and the U.S. Fish and Wildlife refuge manager to conduct nesting surveys of green sea turtles at the Rose Atoll National Wildlife Refuge. We deployed satellite tags and temperature data loggers for climate impact studies, applied PIT/metal tags for long-term identification, and collected samples from Central South Pacific endangered green sea turtles. We also recorded our highest nesting rate to date—80 nesting turtles across Rose and Sand Islands.



Marine Turtle Nearshore Surveys the Mariana Islands

In October 2017 and August 2018, our researchers completed two research missions to survey sea turtles in the nearshore waters of Guam, Saipan, and Tinian. We observed 155 green and hawksbill sea turtles, capturing 40 for measurements and tagging 35 with satellite transmitters to study movements and habitat use.

We also provided hands-on training to local biologists and shared our research results in presentations to local and federal partners, including the Guam Department of Agriculture, Division of Aquatic and Wildlife Resources, the Commonwealth of the Northern Mariana Islands Department of Land and Natural Resources, the U.S. Fish and Wildlife Service, and the University of Guam Sea Grant.



Jessy Hapdei (contract diver/CNMI DLNR biologist; on left) and **Carlos Quintanilla** (Guam DAWR biologist; on right) back on the boat just after a snorkel dive survey during which they captured 7 green turtles near Cocos Island and Achang Reef Preserve at the southern tip of Guam.

Automated Approaches to Analyzing Acoustic Datasets for Humpback Whales

Our researchers have deployed long-term, bottom-mounted acoustic arrays allow us to listen for whale and dolphin vocalizations across the Pacific Islands over the past 10 years. In 2018, we collaborated with Google's Machine Learning team to develop an automatic detector for humpback whale calls in this extensive collection of acoustic recordings.

To develop automated detection of humpback whale calls, we generated and sent to Google a test dataset of hand-marked calls from a high-frequency acoustic recording package (HARP). In 1.5-second clips of HARP data, we are able to detect humpback whale calls with 90% precision and 85% recall. This detector will be used to determine changes in occurrence of humpback whales in the main Hawaiian Islands and the Northwestern Hawaiian Islands—an important goal for the Humpback whale National Marine Sanctuary.

We are now expanding the collaboration to include other species and data types in order to develop a robust machine-learning model that can be implemented on a wide variety of marine mammal calls in NOAA cloud-based acoustic data.

Science Blog: [OK Google: Find the Humpback Whales](#)



Hawaiian Monk Seal Assessment and Recovery Camps in the Northwestern Hawaiian Islands

Every year, our researchers transit to the Northwestern Hawaiian Islands to monitor the Hawaiian monk seals for population assessment and to aid the population's recovery. Hawaiian monk seals are one of NOAA Fisheries' eight protected Species in the Spotlight. These field camps are the foundation of NOAA's research and recovery efforts for monk seals.

This year, our staff hired and trained field researchers and coordinated two research expeditions aboard NOAA Ships to supply the remote camps for a 4-month field season. During that time, 16 field staff lived at 5 (of 6) major monk seal reproductive sites: French Frigate Shoals, Laysan Island, Lisianski Island, Pearl and Hermes Reef, and Kure Atoll. We also conducted short-term fieldwork at Midway Atoll, Ni'ihau, Nihoa, and Necker Islands.

Our field teams gathered population data on the number of pups born, number that survived to weaning, number marked, number of older animals, inter-atoll movements, causes of mortality, and other key demographic variables. We also vaccinated seals against morbillivirus, and initiated a movement study by deploying flipper-mounted GPS tags on weaned pups at Pearl and Hermes. In addition to that, we disentangled seals, reunited pups with their moms, freed seals and other wildlife entrapped in a disintegrating structure at Tern Island, translocated weaned pups away from areas with high shark predation, fished for predatory sharks, treated abscesses and administered antibiotics to otherwise compromised seals, and identified and captured seals in need of rehabilitation and de-worming.

While deployed, our field teams also conducted conservation activities in collaboration with the U.S. Fish and Wildlife Service and State of Hawai'i, as well as efforts toward the conservation of sea turtles and birds.

Science Blogs: Field Notes: [Science and Stewardship in the Northwestern Hawaiian Islands](#)

and [Saving Seals in the Northwestern Hawaiian Islands during Hurricane Season](#)



Hawaiian monk seal RK60 and her pup, hauled out on the beach.



Hawaiian monk seal rests on the sand at Midway Atoll (Photo: NOAA Fisheries).



Checking for Hawaiian monk seal rehab candidates on North Island of Pearl and Hermes Reef (Photo: NOAA Fisheries).

Data Report: Predicted take of Protected Species in the Shallow-set Longline Fishery

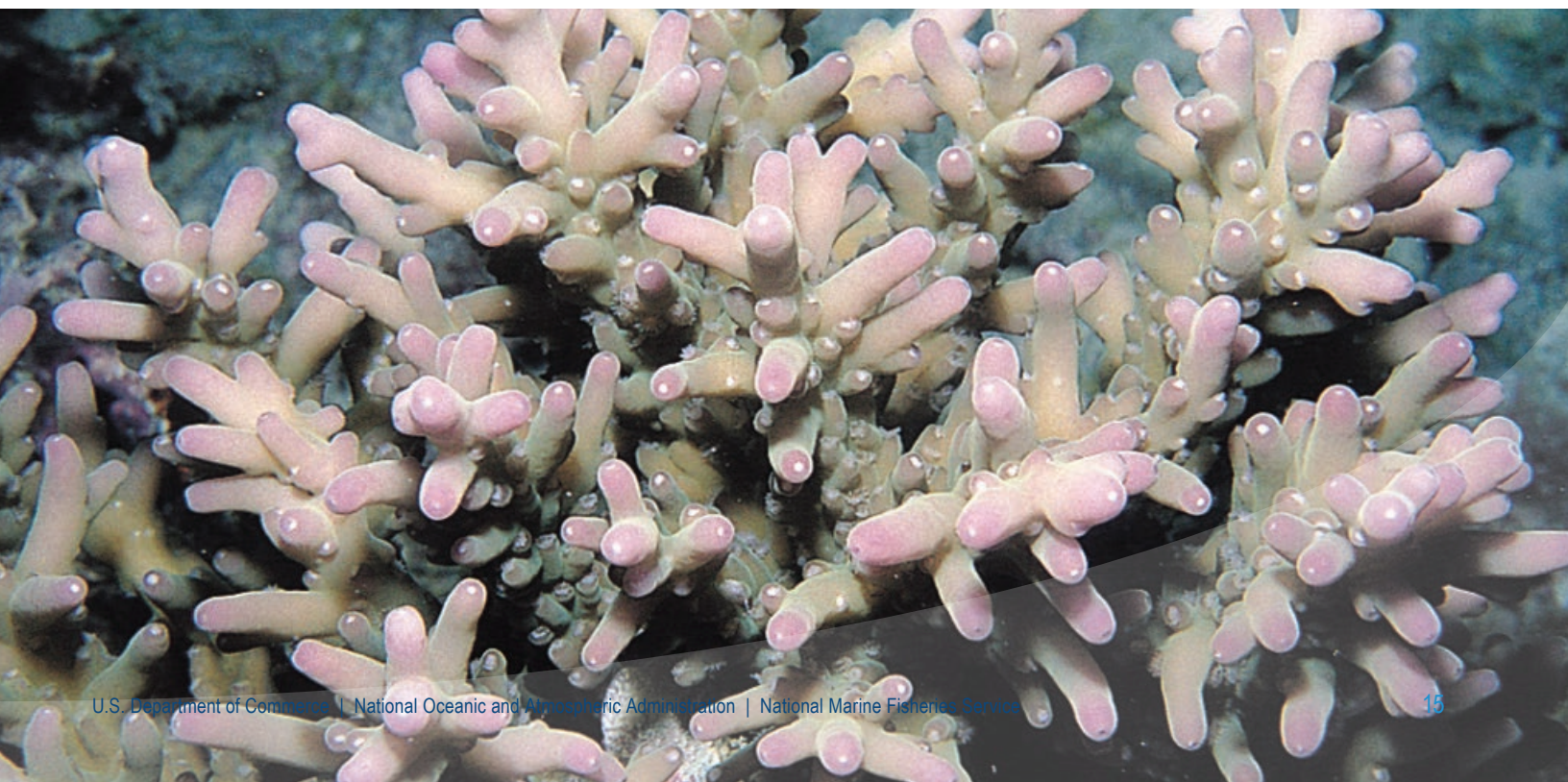
For use in an upcoming biological opinion to reauthorize the Hawai'i shallow-set longline fishery under Endangered Species Act, we estimated the values and methods for calculating predicted take of protected species by the fishery in the following report:

McCracken ML. 2018. **Hawaii permitted shallow-set longline fishery estimated anticipated take level for Endangered Species Act listed species.** Pacific Islands Fisheries Science Center, PIFSC Data Report, DR-18-014, 18 p.

<https://doi.org/10.25923/9qy7-wz62>.

Research to Support Ecosystem-based Fisheries and Living Marine Resources Management

The Center's RESEARCH TO SUPPORT ECOSYSTEM-BASED FISHERIES AND LIVING MARINE RESOURCE MANAGEMENT (EBFM) highlights our commitment to research that supports a more holistic approach to species management. We are focusing on cross-divisional collaboration and integration, ecosystem dynamics and relationships, and monitoring programs that assess the status and trends of ecosystem indicators. Our goal is to advance the science conducted to promote sustainable fisheries and conserve protected species.

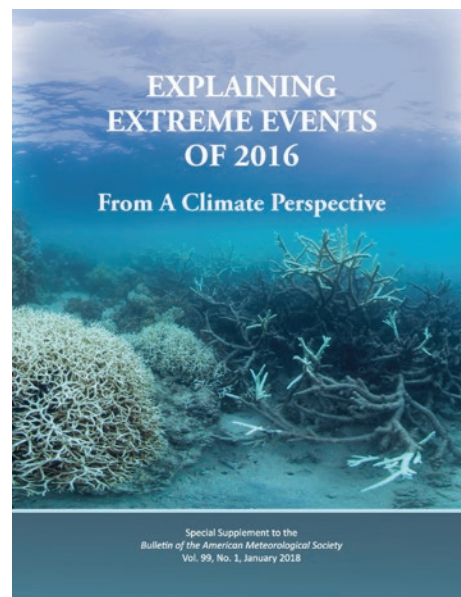


Ecosystem and human community dynamics

Peer-reviewed Journal Article: Ecological Impacts of the 2015–16 El Niño in the Central Equatorial Pacific

In a special issue of the *Bulletin of the American Meteorological Society*—Explaining Extreme Events of 2016 from a Climate Perspective—we analyzed oceanographic and biological time series data sets to assess the magnitude and severity of the 2015–16 El Niño in the central equatorial Pacific. We concluded that record-setting sea surface temperatures linked to an anthropogenic-forced trend during the 2015–16 El Niño disrupted coral reef and seabird communities in the central equatorial Pacific. More specifically, the long-term warming trend in the Indo-Pacific warm pool has coincided with a warming trend across the central equatorial Pacific during major El Niño events. These culminated in record-high sea surface temperatures and Chlorophyll-a anomalies across the central equatorial Pacific. Disruptions were especially prevalent at Jarvis Island, where catastrophic coral bleaching and mortality were observed.

Brainard RE, Oliver T, Venegas R, Heenan A, Vargas-Ángel B, McPhaden MJ, Rotjan R, Mangubhai S, Williams I, Cohen A, Flint E, Hunter SA. 2017. **Ecological impacts of the 2015/16 El Niño in the central equatorial Pacific.** Bull Am Met Soc. doi:10.1175/BAMS-D-17-0128.1.



West Hawai'i Integrated Ecosystem Assessment Science Symposium

In December 2017, PIFSC convened the third West Hawai'i Integrated Ecosystem Assessment Symposium in Kailua-Kona, Hawai'i. The symposium was themed *Bridging the Gap between Science and Management*, and the opening presentation titled, "Implementing Ecosystem-Based Management: A Conceptual Framework for Providing Science Advice," was given by PIFSC Director Michael Seki. The symposium included over 45 presentations, outreach exhibits, and interactive discussion sessions and attracted over 200 attendees representing the many ocean-use sectors of West Hawai'i.

Event Information and Speakers: [Symposium on West Hawaii's Marine Ecosystem](#)



Status and trends of ecosystem, habitat, and socioeconomic indicators

Special Publication: West Hawai'i Integrated Ecosystem Assessment (IEA) Ecosystem Status and Trends Report

The West Hawai'i IEA has produced the second Ecosystem Status Report for West Hawai'i. The overarching goal of this interdisciplinary report is to provide a suite of indicators that span the social-ecological system for the purposes of assessing and tracking the status of West Hawai'i's marine ecosystem. We present 29 indicators, ranging from climatic and oceanographic drivers of ecological change to social pressures and activities. This report is intended to provide a practical means to assess changes in ecosystem attributes in relation to the efficacy and achievement of resource management objectives.

Gove JM, Lecky J, Walsh WJ, Ingram RJ, Leong K, Williams I, Polovina J, Maynard J, Whittier R, Kramer L, et al. 2019. **West Hawai'i integrated ecosystem assessment ecosystem status report**. Pacific Islands Fisheries Science Center, PIFSC Special Publication, SP-19-001, 46 p. <https://doi.org/10.25923/t3cc-2361>.

Science Expedition: American Samoa Reef Assessment and Monitoring Program

The Pacific Reef Assessment and Monitoring Program is a 3-year rotational program that has been ongoing since 2000 in support of NOAA's National Coral Reef Monitoring Program. We conduct interdisciplinary and integrated coral reef ecosystem surveys of benthos, fishes, and oceanographic characteristics related to climate change in coastal waters of American Samoa and the Pacific Remote Islands Marine National Monument. In 2018, we conducted ecosystem surveys in the Territory of American Samoa, including Tutuila, Aunuu, Ofu, Olesega, Ta'u, and Swains Islands; Rose, Palmyra, and Kingman Atolls; and Baker, Howland, and Jarvis Islands of the Pacific Remote Islands Marine National Monument.

Between May and August, our researchers surveyed each island or atoll ecosystem for abundance, diversity, distribution, and size of corals, reef fishes, invertebrates, and algae. Our research activities included scuba dives (1,787), benthic rapid ecological assessments (209), and fish rapid ecological assessments (351). We also measured biological, physical, and chemical drivers using instruments such as subsurface temperature recorders (130) to monitor vertical thermal structure, autonomous reef monitoring structures (42) to measure cryptobiota diversity, and calcification accretion (225 deployed/213 recovered) and bioerosion monitoring units (70 deployed/40 recovered) to measure rates of change of accretion and bioerosion of calcium carbonate.

This survey effort supported joint projects with partners from San Diego State University and Scripps Institution of Oceanography, as well as the execution of terrestrial surveys by US Fish and Wildlife Service at the Howland, Baker, Jarvis, and Rose Atoll Wildlife Refuges. We also collected coral cores in collaboration with Woods Hole Oceanographic Institution, photomosaic surveys at climate monitoring sites in collaboration with Scripps Institution of Oceanography, and water samples for microbial analyses in collaboration with San Diego State University and the University of Hawai'i. Support for this mission was also found across the Center, the Joint Institute of Marine and Atmospheric Research, the NOAA Diving Program, the American Samoa Department of Marine and Wildlife Resources, the National Marine Sanctuary of American Samoa, the Hawai'i Institute of Marine Biology, and the Scripps Institution of Oceanography.

Fourth IOC-WESTPAC Workshop on Monitoring of the Ecological Impacts of Ocean Acidification on Coral Reefs

In December 2017, Pacific Islands Fisheries Science Center researchers co-facilitated the fourth IOC-WESTPAC Training Workshop on Research and Monitoring the Ecological Impacts of Ocean Acidification on Coral Reef Ecosystems in the Western Pacific. Over 40 participants from 9 countries gathered in Phuket, Thailand to review the past year's progress toward a regional ocean acidification observing network initiated in 2015.

During the 2-day workshop, participants finalized standard operating procedures for ocean acidification monitoring programs. Most participating countries have been taking great steps toward developing ocean acidification monitoring systems at select pilot sites. Some countries have already implemented the procedures, while others are securing budgets to begin monitoring programs. Proposed activities include national training workshops, mutual learning and study visits between ocean acidification pilot sites, and inter-calibration between labs.

The workshop also featured the latest development of the Global Ocean Acidification Observing Network (GOA-ON), indicators for sustainable development goals (SDG 14.3), and the ocean acidification monitoring program in the subpolar coastal region.

Integrated Size- and Species-based Food Web Model, mizerNPAC

In collaboration with the Alaska Fisheries Science Center and the University of Tasmania, our researchers developed a hybrid size- and species-based food web model from an existing size-based food web model. The model incorporates the primary commercially valuable fish for Hawai'i's longline fishery with ecosystem-based climate projections for this fishery.

The model also includes common bycatch species such as lancetfish and blue shark. Preliminary results suggest that shallower-living species like mahi-mahi and wahoo will be most impacted by climate change, and that both fishing and climate change may lead to smaller-sized fish across all species. We presented preliminary results at the Symposium on the Effects of Climate Change on the World's Oceans.

Organizational Excellence

We invest in our staff and infrastructure to foster an inclusive, engaged, and innovative workforce to achieve organizational excellence. Through positive interactions and relationship building, we maintain collaborative and cooperative research partnerships, resulting in communication, mutual understanding, and resource sharing.

High-performing and inclusive workforce

External Review of Economics and Human Dimensions Program: Response

The NOAA Fisheries Economic and Human Dimensions Programs underwent external peer review in 2017. The external review panel for the Pacific Islands program was comprised of experts from the University of Florida, Alaska Fisheries Science Center, University of Hawaii, University of Washington Sea Grant, and Coastlines Group LLC. The panel learned about information needs, priorities, and research activities that are relevant to current economics and human dimensions research programs at the Center, and provided input on ways to improve the

quality of these programs. In 2018, our program's lead researchers completed a formal response, including an action plan for program adjustments based on recommendations from the panel.

Read the background information and PIFSC response at <https://www.fisheries.noaa.gov/event/external-review-economics-and-human-dimensions-program-pacific-islands>

Priority-based Resource Planning Process

In 2018, NOAA Fisheries initiated a pilot project to prioritize and rank activities within each financial management center. Our staff participated in this pilot with the goal of improving our internal process for allocating resources. We projected annual overhead and labor costs, providing historical reports and feedback for refinements during each phase. All of these efforts culminated in the development of an annual priority-based resource process timeline.

Partner, stakeholder, and public engagement

Technical Memorandum: CAPSTONE and Deep-sea Coral Research

In May 2014, scientists and resource managers representing stakeholders from government, academia, and conservation groups developed a 3-year exploration and research plan for the Pacific Islands. From 2015 through 2017, the Deep-sea Coral Research and Technology Program allocated resources to the Center and partners to conduct priority research.

In May 2018, after the 3-year program ended, we held a workshop to review its accomplishments and suggest improvements for future work. Scientists from NOAA, various universities, and other agencies that were directly involved in planning and operations presented preliminary research results and discussed successes and challenges of the 3-year effort funded by the national deep-sea coral program.

The following technical memorandum outlines the proceedings, which had several goals: (1) review major outcomes of the exploration and research effort; (2) identify how the exploration and research results support improved scientific understanding of deepwater biogenic habitats and management information needs in the Pacific Islands; and (3) identify remaining research needs and recommend future partnerships and fieldwork for the Deep Sea Coral Research and Technology Program in the Pacific Islands.

Parke M. 2018. **Deep Sea Coral Research and Technology Program: Pacific Islands deep-sea coral and sponge 3-year research wrap-up workshop May 23–24, 2018.** U.S. Dept. of Commerce, NOAA Technical Memorandum NOAA-TM-NMFS-PIFSC-78, 36 p. <https://doi.org/10.25923/wect-ry70>.



Requirements for the Hawai'i Division of Aquatic Resource's Online Dealer Reporting System.

In 2017, we conducted a value stream mapping exercise with participation from the Hawai'i Division of Aquatic Resources, staff from the Western Pacific Fisheries Information Network, and the Hawai'i Information Consortium. During this process, the team identified action items to produce business rules for the Hawai'i Division of Aquatic Resources' Online Dealer Reporting System. We documented these requirements, which informed the developer's statement of work with review from WPacFIN staff and HDAR in 2018. The Online Dealer Reporting System is scheduled to for completion in 2019.

International Science Committee for Tuna and Tuna-like Species in the North Pacific Ocean Plenary

Our Center's Director, Dr. Michael Seki, led the United States delegation at the 2018 ISC in Yeosu, Republic of Korea, where three assessments were accepted by the ISC Plenary:

1. The first benchmark assessment of shortfin mako shark in the North Pacific.
2. New benchmark assessment for Western–Central North Pacific swordfish.
3. Updated new stock assessment for Pacific bluefin tuna.

Stock status and conservation advice for these species were generated for consideration in the fall meetings of the Western and Central Pacific Fisheries Commission.

U.S. Science Delegation to the Western and Central Pacific Fisheries Commission

In August 2018, our staff led the United States delegation to the 14th meeting of the Western and Central Pacific Fisheries Commission Scientific Committee in Busan, Korea. We compiled a briefing book and organized the delegation, which included eleven scientists, fishery managers, and industry representatives. The delegation reviewed working and informational papers, attended presentations, and made recommendations within each thematic session: stock assessment, data and statistics, ecosystem and bycatch, and management issues. To support developing conservation measures to prevent overfishing and reduce bycatch, and considering additional measures for tropical tunas, the Commission took these recommendations into consideration at its Technical and Compliance meeting (September 2018) and Commission meeting (December 2018).

Center-wide coordination, communication, and collaboration

Framework for the PIFSC Priority-based Resource Planning Process

Using the priority-based resource framework, we developed a schedule and proposed plan for the Center's annual planning and prioritization process. The plan was implemented in preparation for fiscal year 2019, identifying activities, creating a scoring rubric, and compiling activity plans for all proposed activities. The scoring process resulted in a final rank order to use for effective planning and budgeting.

Pacific Islands Fisheries Science Center, Science Council

In 2018, we formed the Pacific Islands Fisheries Science Center Science Council to provide input and make recommendations on the Center's long-term and annual science priorities. The Science Council's scope includes activities related to science and research that support management and maintain the scientific rigor and independence necessary to uphold scientific integrity and transparency at the Center.

Western Pacific Fisheries Information Network Website

The Pacific Islands Fisheries Science Center and the Joint Institute for Marine and Atmospheric Research have improved and modernized the Western Pacific Fisheries Information website. The site now includes a fisheries statistics section that accommodates flexible user-generated data queries for non-confidential data from five sources, each with 1–5 types of data. User queries are now available to our staff, with the intention to make them available to the public in the near future.

Infrastructure investments and data management

Public Access to Research Results

Guided by the NOAA Fisheries 3-year PARR Implementation Plan, we made fisheries data publicly accessible in a machine-readable format. These data include all non-confidential collections from commercial fisheries and other surveys of catch and landings, and are accessible at <https://inport.nmfs.noaa.gov/inport/item/10487>.

Public Access to PIFSC Data Sets

To support the PARR Implementation Plan, we facilitated public access to scientific data sets by creating three software modules and a shared database. The bulk download module automates the process of generating and validating bulk download packages for data sets. The URL verification module checks public accessibility of the download URL defined for a given data set in InPort. The data set information application allows users to view summary and detailed data set reports and allows authorized users to define and update custom data set information and view and annotate package validation errors. A bulk download guidance document provides step-by-step instructions for using the modules, InPort, and NCEI's S2N tool to document data sets, generate bulk download packages, resolve/annotate package validation errors, and submit them for archival.

Management of Conductivity, Temperature, and Depth Data

To improve our research data management capabilities, our applications developers created a centralized database to store operational information, survey metadata, and processed data for all shipboard conductivity, temperature, and depth (CTD) records. This data is now directly accessible by any of our authorized users in the Oracle enterprise database. We also have an import module that automatically processes CTD data files on our network. An existing data validation module systematically performs data quality checks on processed CTD data. This project integrated software standards and best practices and reused existing software modules to achieve its final status.

Standards and Best Practices for Data Management and Development

To improve our overall research data management capabilities, we created standards and best practices in the areas of data management, application development, database development, documentation, and version control. A subset of application development and version control standards and best practices were reviewed by our software development team, and three standards and one best practice were compiled in a document for leadership and all staff.

Centralized Tools and Procedures for Data Management and Development

To standardize common data management and development activities, we developed a database logging module in which application-level information is collected for auditing and debugging. To implement a repeatable process for database module upgrades, we also developed a database version control module and corresponding standard operating procedures. The documentation and two database modules were reviewed by two software development professionals, and final versions were shared with leadership and all staff.

Modular High Sensitive Optical Spectrometer

Using relatively low-cost components, we built the Maya2000PRO-VIS, a modular miniature high-sensitive spectrometer covering the spectral range of ~350–850 nm. This spectrometer measures irradiance and reflectance with both natural and artificial light sources, collecting spectrum in the field and lab environment. We will use the spectrometer for research and development, including a MOUSS artificial light study.

Expand science endeavors

Internal Report: Pacific Reef Assessment and Monitoring Project Modification for FY2019–2023

In fiscal year 2018, we engaged in a review and planning process to determine the core sampling needs for the Pacific Reef Assessment and Monitoring Program (Pacific RAMP). Pacific RAMP operations and data from the prior decade were evaluated in separate efforts that considered budget, workload/diver fatigue, and statistical sampling power. This report was presented to staff as the findings of this analysis, describing the field effort and cost required to achieve the statistical power necessary to deliver the highest-priority coral reef ecosystem data to the National Coral Reef Monitoring Program.

Williams I, Oliver T, Samson J, Parrish F. 2018. **Pacific reef assessment and monitoring project modifications for FY 2019–2023**. Pacific Islands Fisheries Science Center. PIFSC Internal Report.

Establish a PIFSC Advanced Technology Coordination Committee

To identify, evaluate, develop, or acquire advanced tech solutions for the Center based on priorities and needs, we established the PIFSC Advanced Technology Coordination Committee. The first meeting of this committee was held in April 2018.

Low-cost Autonomous Surface Vehicle

We built an autonomous surface vehicle with off-the-shelf parts. In-water testing concluded that the Blue Robotics T200 thrusters were sufficient to move a small surface vehicle for research needs. The hull used for testing would only allow operating in fair weather conditions. Thruster, power, and control box are able to use any small hull of opportunity depending on the need of the mission. This feature allows great versatility. Remote operations worked well in the field, the vehicle was able to maneuver around floating obstacles with ease, and the no tiller tank drive thruster setup allowed for a tight turning radius.

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