NOAA FISHERIES

PACIFIC ISLANDS FISHERIES SCIENCE CENTER

The Pacific Islands Fisheries Science Center (PIFSC) conducts research in a wide variety of programs that may be of interest to the Western Pacific Fishery Management Council (Council). This report is organized around the research divisions of the PIFSC as a series of highlights.

Report to the Western Pacific Fishery Management Council

March 2015

PROTECTED SPECIES DIVISION (PSD)

Multi-agency Study Advances Knowledge of Green Turtles at Rose Atoll

From November 25 – December 1, 2015 Shawn Murakawa and Frank Parrish monitored green turtle nesting activity at Rose Atoll, American Samoa. They also deployed 11 satellite transmitters on nesters, conducted health assessments of the turtles, and collected tissue samples for analysis. They worked with collaborators Mark MacDonald, Department of Marine and Wildlife Resources (DMWR) and Carlo Caruso and Ricky Misa'alefua, National Park Service (NPS) who provided outstanding logistical and scientific support. Working with these partners increased the amount of work accomplished and allowed vital training and transfer of expertise between the staff. This research project has documented that green turtles leaving the nesting grounds of Rose Atoll migrate to foraging areas in Fiji, American Samoa, Vanuatu, Tahiti, the Solomon Islands and Papua New Guinea. Average migration time is 39 days and the researchers expect all tagged turtles to have completed this year's migrations by mid-February.

Collaborators in the 2014 Rose Atoll green turtle nesting survey included (from left) Shawn Murakawa, NOAA PIFSC; Ricky Misa'alefua, NPS; Mark MacDonald, DMWR; Capt. Russ Cox; First Mate Joey; Frank Parrish, NOAA PIFSC; and Carlo Caruso, NPS. *Photo by Jean Kenyon*

A Rose Atoll green turtle nester was released after a satellite transmitter was attached to her carapace. Location data sent to the satellite will enable scientists to track her ocean migrations. *Photo by Frank Parrish*

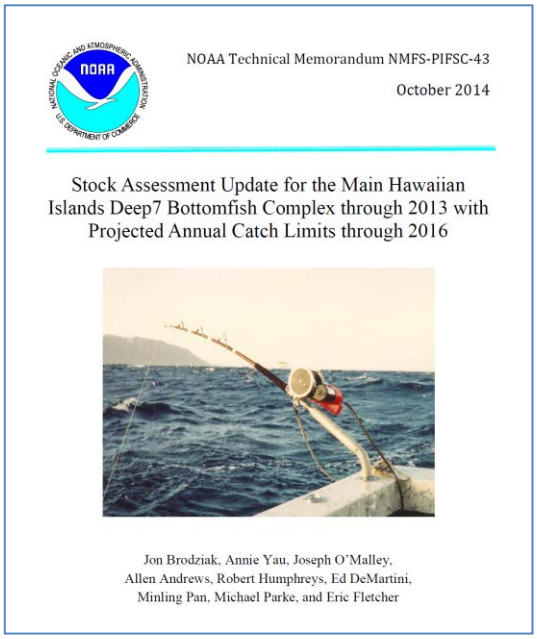
FISHERIES RESEARCH AND MONITORING DIVISION (FRMD)

Independent Peer Review of the 2014 Stock Assessment of Deep 7 Bottomfish in the Main Hawaiian Islands

PIFSC completed an independent peer review of the 2014 stock assessment of Deep 7 Bottomfish in the main Hawaiian Islands (MHI) through the Center for Independent Experts (CIE) in December 2014. This updated assessment was first presented to the Council in June 2014, and is published on the PIFSC website as NOAA Technical Memorandum NMFS-PIFSC-42 entitled, “Stock Assessment Update for the Main Hawaiian Islands Deep7 Bottomfish Complex through 2013 with Projected Annual Catch Limits through 2016”. The document is available at: http://www.pifsc.noaa.gov/library/pubs/tech/NOAA_Tech_Memo_PIFSC_42.pdf.

The CIE review panel was comprised of three subject matter experts and a Panel Chair, and was tasked with (1) reviewing the assessment methods to determine if they are reliable and properly applied, (2) evaluating the implementation of the assessment model, its configuration, assumptions, and input data and parameters, (3) assessing the scientific soundness of the estimated population

benchmarks and management parameters (e.g. MSY) and their potential efficacy in addressing the management goals stated in the Council FEP, (4) evaluating the adequacy, appropriateness, and application of the methods used to project future population status, (5) determining whether the assessment is considered to be the best scientific information available, and (6) recommending research priorities to improve our understanding of essential population and fishery dynamics necessary to formulate best management practices.



The MHI bottomfish stock assessment is published on the PIFSC website.

The CIE review panel unanimously concurred with PIFSC that the 2014 stock assessment methods for standardizing CPUE are an improvement over those used in the 2011 stock assessment. This improvement was attributed to the primary change in the standardization method, which was the splitting of the CPUE time series into two segments, one from 1949-1993 and another from 1994-2013. This enabled PIFSC analysts to include State of Hawaii Commercial Marine License number (CML), a unique identifier of fishers selling their catch, as a variable in the standardization of CPUE over the second time period; CMLs were not issued prior to 1994. Inclusion of the CML variable allowed the analysis to take into account fisher differences in CPUE. The CIE panel also concluded that the stock assessment model applied (Bayesian surplus production model with a shape parameter, process error, and observation error) was generally appropriate.

The panel had strong reservations regarding the quality of the available catch and effort data, and derived catch-per-unit-effort (CPUE) index of abundance, used in the stock assessment. Specifically, the panel raised concerns about the historical pre-1990 data used for CPUE calculation and estimates of unreported catch. Given the concerns with the input data, the Panel concluded that the stock assessment had serious flaws that compromised its utility for management and concluded that the assessment is not considered to be the best available science.

A suite of immediate and longer term improvements were suggested by the panel including (1) strengthening the program of fishery monitoring to ensure that the collection of catch and effort data is complete, accurate and documented, (2) investigating the development of a catch rate series using a subset of data from known “highliners”, fishers that have a history of good logbook completion, (3)

investigating new length-frequency information from biological sampling data and new age information by completing catch curve analyses, (4) given the problems with the development of a credible commercial catch rate time series, continuing development of fisheries-independent surveys of bottomfish abundance, (5) developing and implementing a large-scale tagging program which can provide alternative (to the assessment model) information on harvest rates, and (6) moving towards single species assessments as requisite data become available.

The review panel reports were completed in January 2015 and are available at https://www.st.nmfs.noaa.gov/science-quality-assurance/cie-peer-reviews/cie-review-2015.

Bottomfish Research Coordination Workshop

PIFSC convened the 2nd Bottomfish Research Coordination Workshop at the NOAA Inouye Regional Center during January 26-27, 2015. This workshop followed the 1st Bottomfish Science Coordination Workshop which was convened by PIFSC on February 25, 2013. These events were organized after the Western Pacific Regional Fishery Management Council (Council) requested that PIFSC coordinate all ongoing Hawaii bottomfish cooperative and fishery independent research efforts.

The goals of the 2nd Bottomfish Research Coordination workshop were (1) provide participants with updates about bottomfish research activities, (2) identify how this research can be used to inform and improve the science currently used to manage the bottomfish fishery, (3) develop collaborations and research recommendations to coordinate future bottomfish research, and (4) finalize a summary document describing current and future prioritized research on bottomfish in the MHI.

Attending were over 45 participants from government, academia, non-profit institutions, and industry including: PIFSC; Pacific Islands Regional Office (PIRO); University of Hawaii, Hawaii Pacific University, Hawaii Division of Aquatic Resources, the Pacific Islands Fisheries Group, the WPRFMC, and commercial bottomfish fishers.

After hearing 14 presentations about research projects classified under four major research themes, workshop participants brainstormed in small groups by theme about research gaps and future bottomfish research priorities. Participants then voted among all identified research priorities to come to a consensus on what they believed to be the most important future research efforts that will improve the science used for management of bottomfish resources in the MHI. The top 3 identified research priorities, in no particular order, were to:

1. operationalize a fishery-independent relative abundance survey;

2. update habitat maps using existing data from several sources to create a 4-D map that synthesizes knowledge on habitat associations and life history dependency on habitat to refine the design for fishery-independent survey design; and
3. conduct bottomfish life history studies that include age and growth, length-at-maturity, and natural mortality.

A consensus summary report is being written that will describe current research discussed at both workshops and also present future priorities. The draft report will be sent to all participants for comment prior to adoption. The final report will be publicly available and serve as a guiding document for future collaborative research on bottomfish in the MHI.

Project to Upgrade WPacFIN's Website

PIFSC's Insular Fisheries Monitoring Program (IFMP) includes staff and infrastructure to support the Western Pacific Fisheries Information Network (WPacFIN), a regional partnership which assists member fisheries agencies of Hawaii, American Samoa, Guam and the Commonwealth of the Northern Mariana Islands in meeting federal reporting requirements. IFMP maintains a public WPacFIN website to provide easy access to non-confidential summary fisheries data, however the website has been in need of an overhaul for several years. Developed in the mid-1990s, the website has evolved to meet many broad institutional needs, but falls short for some increasingly common needs of modern data users.

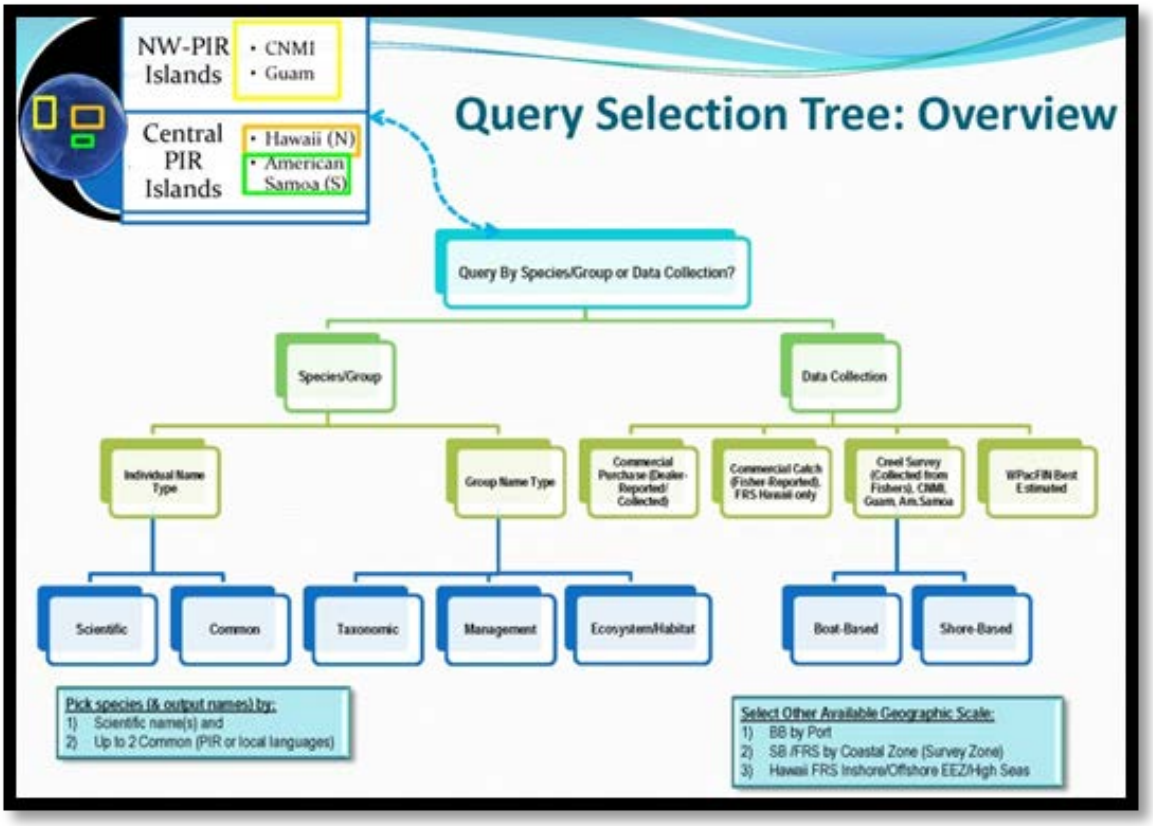
In 2014, WPacFIN competed for and obtained funds to complete a significant upgrade to its website. The new website design centers around a more flexible user-query capability catering to time series data queries for single or multi-species groups. It will provide a choice for users to view scientific and/or common names in a variety of languages, including Chamorro, Carolinian, Samoan, Hawaiian, English, and Pacific Islands Region (PIR) common name (e.g., names like onaga, monchong, wahoo, bonito, which are a combination of languages). As part of this project, WPacFIN is creating a unified species table that links scientific names to all island area species codes and is updated for taxonomic revisions.

The new WPacFIN website will also provide a basis for easy comparison of estimated commercial landings from different data sources, such as commercial dealer/vendor data (all areas), creel surveys (Guam, CNMI & American Samoa), and reported landings from fishermen (Hawaii only). Noncommercial landings estimates will be available from creel survey data for Guam, CNMI and American Samoa, with a link to Hawaii Marine Recreational Fishing Survey for Hawaii's noncommercial estimates. The goal is to make PIR fisheries landings data more readily accessible and easy to understand. Data collection forms and information

about each data collection (metadata) will be described generally. There will be links to WPacFIN partner websites, other NOAA websites, and websites that provide detailed taxonomic, photographic and life history information (e.g. Fishbase, World Registry of Marine Species, Integrated Taxonomic Information System, etc.). Data query results will be displayed as tables and graphs, and will be downloadable as Comma Separated Values (CSV) files with appropriate metadata.

The new website is scheduled to go live by October 2015. A draft view of the selection schematic for data queries on the new website is shown below.

SCHEMATIC QUERY STRUCTURE



ECOSYSTEMS AND OCEANOGRAPHY DIVISION (EOD)

MS Thesis Describes Mesophotic Fish Assemblages in the Au‘au Channel

Ray Boland recently received his Master of Science degree at Hawaii Pacific University after completing a thesis on mesophotic fish assemblages in the Au‘au Channel of the main Hawaiian Islands (MHI). Mesophotic coral ecosystems (MCEs) are found worldwide in the tropics and subtropics, at depths between 30 m and 150 m. The upper limit is where most scientific studies on scuba end and where a shift in species has been observed. The lower limit of this depth range is delineated by the coral’s ability to photosynthesize at low light levels. Worldwide, the mesophotic ecosystems are understudied when compared to shallower (< 30 m) and deeper (> 500 m) depths. Most coral reef research is conducted in shallow water (< 30 m) by scuba, while studies in deep water (> 150 m) require submersibles or Remotely Operated Vehicles (ROVs). Thus, MCEs have received very little scientific attention to date and remain a largely unexplored ecosystem. Boland investigated general associations of fish with habitat and depth and also did a comparison of shallow water (euphotic) reef fish with mesophotic reef fish for size, species richness, diversity and endemism.

Table 1. A comparison of fish species richness, diversity, endemism, and median fish length and weight between mesophotic and euphotic depths.

	Mesophotic	Euphotic
Species Richness	92	68
Simpson’s Diversity Index	0.861	0.931
Endemic species (percent of total species)	24%	19%
Median length (all fish) in cm	12.5	7.0
Median weight (all fish) in grams	30.77	8.87

Boland found that the fish assemblages are associated with substrate and that substrate changes with depth, so there is some stratification of fish assemblages with depth. Utilizing a Multi-Response Permutation Procedure (MRPP) analysis he was able to find relationships between five substrate categories and fish assemblages (Figure 1). The fish assemblage of the Rubble substrate was central in relation to Sand, *Montipora* coral beds and *Leptoseris* coral bed fish assemblages. Hard Bottom fish assemblages were only related to *Leptoseris* coral beds which is a logical association as *Leptoseris* tends to grow on Hard Bottom. From a habitat perspective, live coral beds, such as *Leptoseris* and

Montipora, harbor unique fish assemblages and likely support the greatest fish abundance and thus size, richness and diversity in the MCE depth zone.

The MRPP also found relationships within depth ranges (Figure 2). In general, the fish assemblages of 50-65m, 66-75m, 76-85m depth intervals are all inter-related and may be considered a single or "shallow mesophotic" fish assemblage. The 86-95m depth range is associated with only the 76-85m range and thus may be considered a "transition" fish assemblage. In depth intervals below 96m the fish assemblages were not related to each other or the "shallower" depths, but this may have also been affected by substrate as beyond 105 meters the substrate was predominantly Sand.

The comparison of the mesophotic fish assemblages with those of the euphotic zone indicated key differences. The mesophotic zone was where planktivorous fish dominated the food web, had larger fish with a greater number of species and had higher endemism than the euphotic zone (Table 1). Conversely the euphotic zone, where herbivorous fish dominated the food-web, supported higher species diversity, due to the more even distributions of fish abundance across species.

Connected depth types are not significantly different from one another in terms of their fish assemblages.

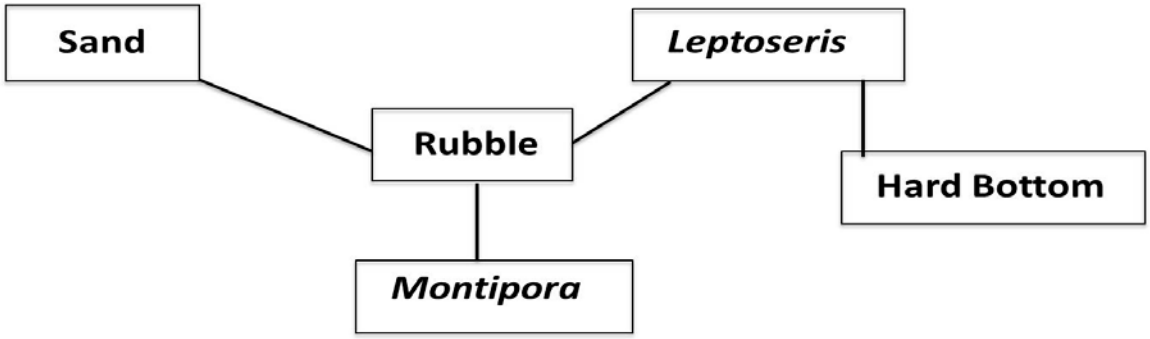


Figure 1. Multi-Response Permutation Procedure relationships for substrate categories. Connected substrate types are not significantly different from one another in terms of their fish assemblages.

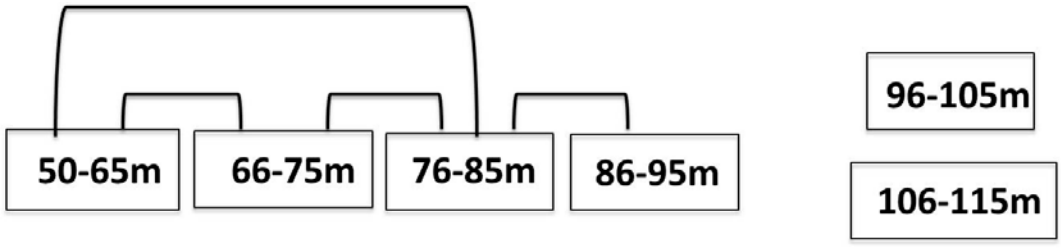


Figure 2. Multi-Response Permutation Procedure relationships for the depth domains.

Improving Capacity of Stock Assessment for Sea Turtles: Using Ocean Circulation Modeling to Inform Genetic Mixed Stock Analysis

A basin-wide hatchling green turtle connectivity simulation was undertaken using demographic data for green turtles in the Pacific Ocean and Eastern Indian Ocean coupled with output from a global circulation model. The demographic data include location of nesting, seasonality of nesting, and predicted reproductive output (estimated number of hatchlings) patterned over time and space, as well as knowledge of key foraging grounds. A global circulation model was used to drive the movement of simulated hatchling turtles. We used this model to simulate the rookery source for juvenile green turtle bycatch in the American Samoa longline (ASLL) fishery. Genetic analysis of 27 green turtles from the ASLL fishery bycatch to date indicate a mixed source of rookeries including some haplotypes that are common and present at several widespread nesting sites as well as other haplotypes not presently assigned to any particular geography, hence the present interest in better understanding oceanographic dispersal patterns.

This project is supported by the NMFS Sea Turtle Assessment RFP from the Office of Science and Technology's Assessment and Monitoring Division with co-PIs Peter Dutton, Michael Jensen (both SWFSC), and Donald Kobayashi (PIFSC).

The connectivity simulation covered a large geographic domain (Figure 1) spanning 90 degrees of latitude centered over the equator (45°S to 45°N) and 100 degrees of longitude nearly centered on the international dateline (90°E to 70°W). This geographic domain covered all of the monitored nesting and key foraging locations for green turtles in the Pacific Ocean and Eastern Indian Ocean as well as likely oceanographic transport pathways to and from these locations. The simulated hatchling turtles were released from 38 nesting beach sites across the entire Pacific Ocean and Eastern Indian Ocean in scaled daily amounts reflective of the known demographics and tracked for 3 years. Daily positions were tabulated during years 2 and 3 into a large rectangular region south of the equator approximately representing the high-seas longline fishing grounds of the longline fishing fleet based in American Samoa (Figure 1).

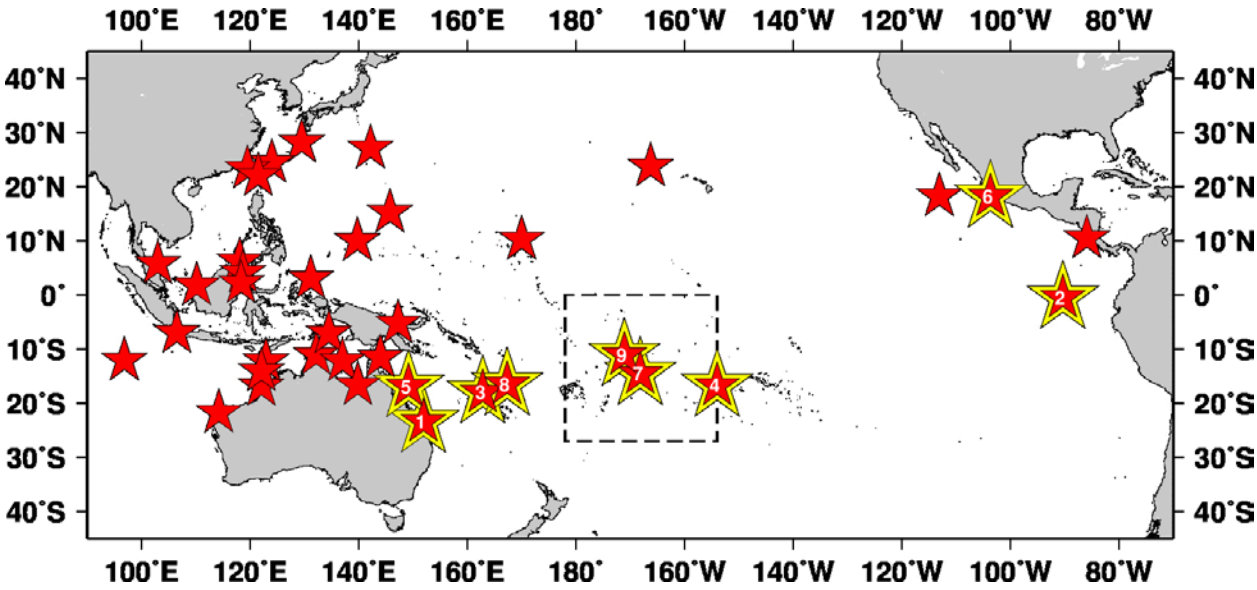


Figure 1. Geographic study domain of the green turtle connectivity simulation project. Black rectangle south of equator (dashed lines) represents the tabulation grid of the fishing grounds for the American Samoa longline fleet. Red stars indicate the 38 green turtle nesting sites. Red stars with yellow outline represent the 9 nesting sites that cumulatively represent >98% of simulated bycatch contribution in the longline fishing grounds. The number within the star symbol represents ranked order of contribution, with 1 being largest contributor.

The findings indicate that there is excellent correspondence between the observed genetic information and the simulated connectivity patterns using oceanographic circulation modeling. This coupled approach could provide much finer resolving power toward identifying rookery origins in fishery bycatch by ruling out certain rookeries that share certain widespread haplotypes as potential sources of the American Samoa longline fishery bycatch. For example, productive rookeries for green turtles such as in Malaysia (Turtle Island), off northern Australia (Raine Island, Lacepede Island), and western Australia (North West Cape) appear to have relatively little representation in simulated bycatch off American Samoa, despite their prodigious hatchling outputs and the presence of certain geographically widespread haplotypes identified in the bycatch. On the other hand, much of the simulated bycatch can be attributed to 9 rookeries in the Eastern Pacific (Galápagos, Michoacán), French Polynesia (Mopelia), New Caledonia (Huon Atoll), Vanuatu, American Samoa (Rose Atoll, Swains Island), and off the southern Great Barrier Reef to the Coral Sea (Heron Island, Northeast Herald Cay). These 9 rookeries are estimated to contribute more than 98% of the turtles in the longline fishing region (Figure 1). While there is excellent congruity between the 2 types of data in reaching a holistic understanding of rookery origins, the results of the genetics analysis are limited by the small sample size (n=27) to date.

As a first step, the ocean circulation modeling results are being used to inform improvements in the Bayesian mixed stock analysis for genetic stock assignment. Another analysis will examine trajectory intersections for green

turtles with their juvenile and adult foraging grounds across the Pacific Basin and other regions of specific concern. Management and conservation implications are being explored and will be presented fully in a forthcoming manuscript.

CORAL REEF ECOSYSTEM DIVISION (CRED)

Expedition to Midway and Pearl & Hermes Atoll Removes Plastics, Derelict Fishing Nets and other Marine Debris

Field staff of the marine debris removal mission sort through a pile of debris including plastics and derelict fishing gear.

In October of 2014, CRED's marine debris removal team spent several days removing thousands of pieces of plastics and other marine debris from Midway Atoll National Wildlife Refuge. The Refuge is home to three million nesting birds, including the world's largest population of albatrosses. Many of these birds are killed each year by the ingestion of plastic debris. Each team surveyed several transects of shoreline, cleaning up debris 10 centimeters or larger in size, as well as bottle caps and lighters, since these tend to be eaten by birds. They picked up 7,436 hard plastic fragments, 3,748 bottle caps, 1,469 plastic beverage bottles, 477 lighters, dozens of buoys, ropes, and floats, toys, toothbrushes, laundry baskets, shipping crates, a firefighter's hat, and other lost or discarded objects of human activity. In addition, marine debris divers removed derelict fishing gear and nets from the area's coral reefs. The team spent several days cutting apart a "super net" at Pearl and Hermes Atoll that weighed 11.5 tons. In addition to removing nets, the team cut free three entangled green sea turtles. The grand total weight of derelict fishing gear and plastics removed was over 51 metric tons.

In addition to the nets and plastics, the team found and removed two thirty-foot boats that were potentially debris from the March 2011 Tohoku tsunami in Japan. On one beach, the team conducted an accumulation survey with the intent of understanding how quickly debris accumulates, and whether there are any particular areas that function as debris "hotspots".

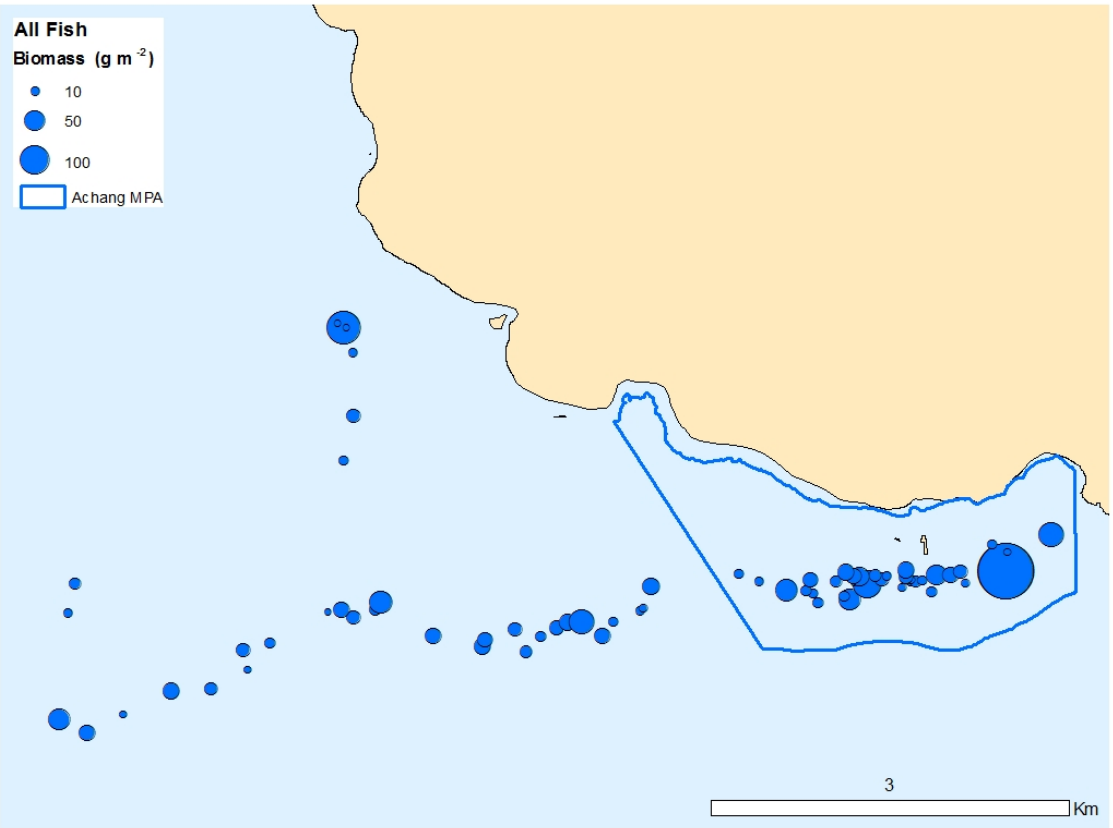
An assortment of plastic debris was found with this bird carcass at Midway Atoll National Wildlife Refuge.

Reef Fish Surveyed in Guam's Manell-Geus Watershed

Located at the southern tip of Guam, the Manell-Geus watershed is a Habitat Focus Area under NOAA's Habitat Blueprint. The site includes fringing, barrier, and patch reefs, some of Guam's most extensive seagrass beds, its second largest mangrove stands, and the island's only shallow-water lagoon. These resources support cultural and subsistence harvests as well as a number of tour operations. NOAA Habitat Blueprint efforts in this area aim to improve habitat for hundreds of fish and coral species and the largest aggregation of ESA-listed sea turtles documented in Guam's waters while improving important local fishing grounds and building community resilience to climate change impacts. The Manell-Geus project centers on improving coral reef, seagrass, and mangrove habitats through watershed restoration, infrastructure improvements, and range of community based projects. The watershed includes the village of Merizo, recognized for its fishing tradition.

In September and October of 2014, members of the Coral Reef Ecosystem Division's fish team participated in reef fish surveys in the Manell-Geus waters. The work was a collaborative effort between CRED and NOAA-PIRO colleagues in Guam. Despite two typhoons threatening the area during their visit, divers performed 54 reef fish surveys over the course of ten days. The resulting data, along with data from 19 additional surveys performed by Guam partners, were analyzed and a summary report was compiled for NOAA colleagues in Guam. Data collected were intended to establish a baseline fish and benthic data set for comparison with future data collected after implementation of Habitat Blueprint

initiatives. In addition to the fish surveys, a one-day fish survey training workshop was provided to local stakeholders.



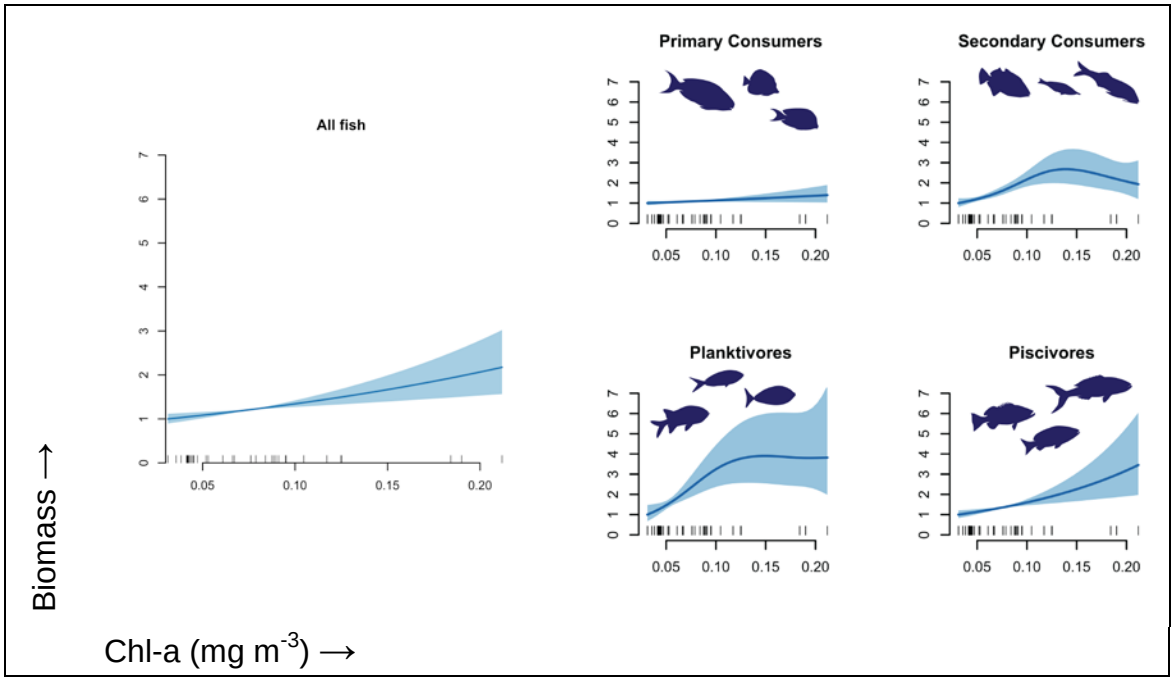
Estimates of total fish biomass (gm/m^2) at each of the survey sites within the Manell-Geus watershed area. Blue line identifies the boundary of the Achang Marine Preserve.

Coral Reef Survey Data Used to Assess Human, Environmental, and Oceanographic Drivers of Coral Reef Fish Assemblages at U.S. Pacific Islands

In a collaborative study involving the CRED, FRMD, University of Hawaii, and University of Victoria (Canada), coral reef visual survey data collected by CRED and partners was used to assess the relative importance of a range of human, oceanographic, and environmental drivers on reef fish assemblages at U.S. Pacific coral reef areas (Hawaii, Mariana Archipelago, American Samoa, and the Pacific Remote Island Areas).

Coral reefs around U.S.-affiliated Pacific islands and atolls exhibit a wide range of oceanographic conditions and levels of human population. Using data

collected during Pacific Reef Assessment and Monitoring Program (Pacific RAMP) expeditions, the study examined the relative influence of these and other factors (e.g., coral cover, structural complexity, wave energy, sea-surface temperature, island type) on coral reef fish biomass. The dataset represented >2,000 hours of underwater observation at 1,934 sites, across ~40 islands and atolls. Consistent with previous studies, reef fish biomass was substantially lower at islands where human population density was higher. But, importantly, the study also demonstrated that other factors, particularly oceanic productivity, influenced reef fish assemblages. Among survey locations, reef fish biomass was over twice as high at locations with the highest levels of oceanic productivity compared to islands with the lowest oceanic productivity, and the biomass of planktivores and piscivores was about 4 times as high. Results from this study emphasize that U.S. Pacific coral reef areas do not all have equal ability to sustain large stocks of reef fish, and that natural conditions vary substantially amongst locations. A manuscript describing this work has been accepted for publication by PLoS One as "*Human, Oceanographic and Habitat Drivers of Central and Western Pacific Coral Reef Fish Assemblages*" by Ivor Williams, Julia Baum, Adel Heenan, Kate Hanson, Marc Nadon, and Rusty Brainard.



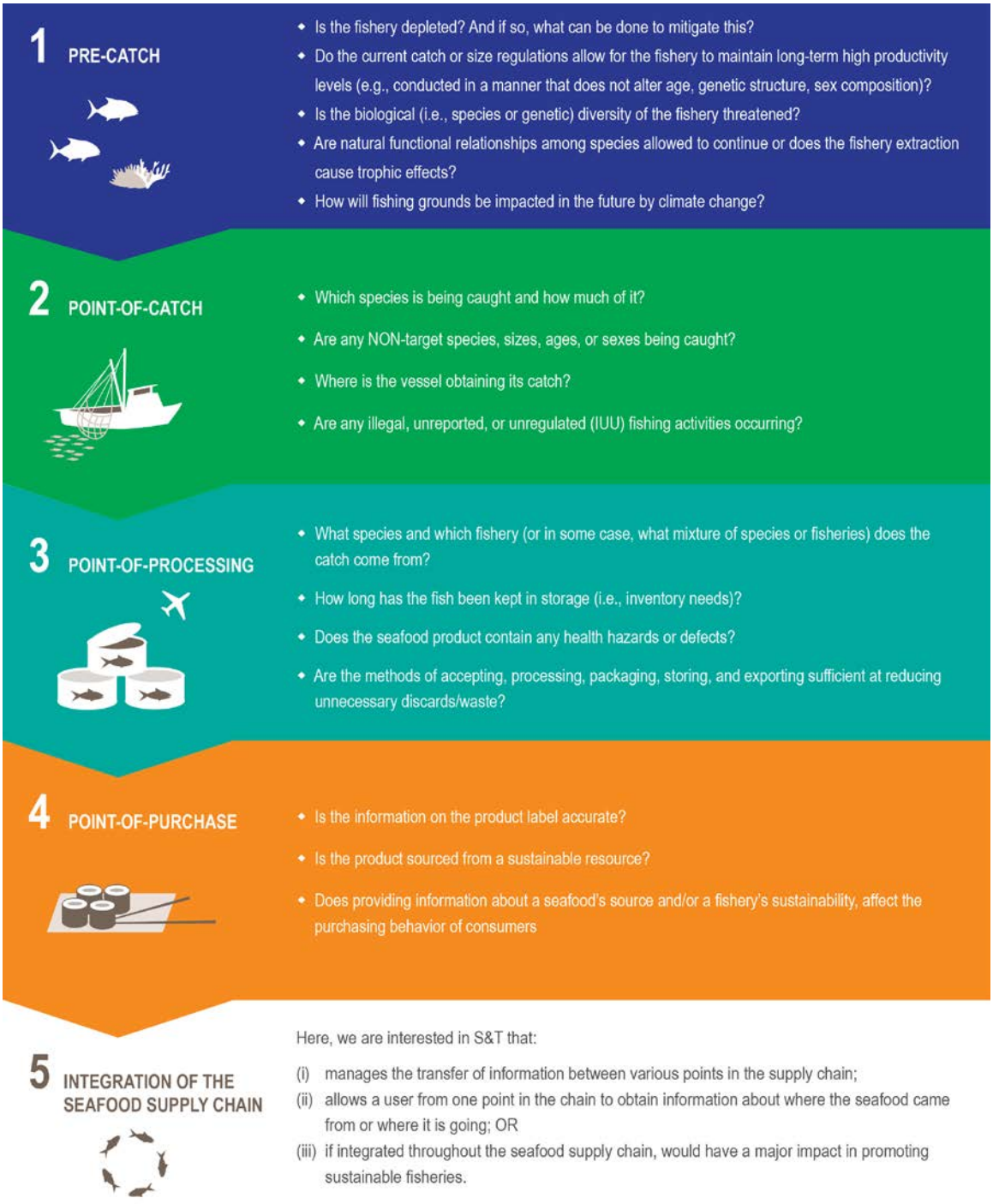
Modeled relationships between Island-scale longterm mean oceanic productivity (measured as chlorophyll-a concentration) and relative biomass of reef fish for all reef fishes (left graph) and by trophic group (right graphs).

Science and Technology for Improved Management of Fisheries in the Coral Triangle: Results of a Survey

What types of science and technology (S&T) innovations are currently being used or developed to improve our understanding of fisheries and our ability to manage them? Which of these technologies could be implemented in Southeast Asia and the Coral Triangle region in order to promote sustainable management of their trans-boundary fisheries? These are questions being asked by the USAID-Regional Development Mission for Asia (RDMA). Answers were provided by a team of NOAA and Department of Interior employees through a survey designed under the leadership of CRED.

The framework of the survey was based on the seafood supply chain, defined as the entirety of stakeholders that are responsible from catching seafood to bringing it to the consumer's plate, including key steps along the path. The survey divided the seafood supply chain into the following four activity categories: 1) pre-catch, 2) point-of-catch, 3) point-of-processing or packaging, and 4) point-of-purchase or consumption. In addition, there was a fifth category–integration of the seafood supply chain–that highlighted the need for S&T innovations that could link together the various steps in the seafood supply chain (see diagram below). For each point along the seafood supply chain, the survey asked participants to select the most appropriate S&T innovation that, if implemented in the next five years, would have the greatest impact on improving the overall management of trans-boundary fisheries in Southeast Asia and the Coral Triangle. The survey collected input from 63 participants including representatives of all six NMFS fisheries science centers, the NMFS Office of Science and Technology, the NMFS Office of Law Enforcement, the NMFS Office of Seafood Safety, and others from offices across NOAA and the Department of the Interior.

For pre-catch management needs, the most frequently selected S&T innovation was stock assessment analysis. For improvement at point of catch, both electronic monitoring and better equipped observers were solutions most often suggested, though cost was seen as a major barrier to electronic monitoring. At point-of-processing or packaging and point-of-purchase or consumption, seafood safety and quality testing were the most commonly offered ideas. For integrating the seafood supply chain, electronic reporting was the most suggested innovation, followed by smartphone or crowd sourcing apps and integrated ecosystem and socioeconomic models.



The stages of the seafood supply chain highlighted in the S&T survey.

Workshop on Research and Monitoring of the Ecological Impacts of Ocean Acidification on Coral Reef Ecosystems

The UNESCO Intergovernmental Oceanographic Commission (IOC) WESTPAC Workshop on Research and Monitoring of the Ecological Impacts of Ocean Acidification on Coral Reef Ecosystems took place in Phuket, Thailand, 19-21 January 2015. Attending were 42 participants from Bangladesh, Cambodia, China, Indonesia, Japan, Korea, Malaysia, Philippines, Thailand, United States of America and Vietnam. Assistance in organization and facilitation was provided by CRED staff.

Workshop participants exchanged information on existing and proposed ocean acidification monitoring and research approaches, methods, and techniques at global, regional and national levels. They also established an ocean acidification monitoring and research network in the Western Pacific and its adjacent regions by bringing together regional experts who have been engaged in ocean acidification research and monitoring.

In view of the pressing need to draw the attention of high-level policy makers and relevant stakeholders in the region to ocean acidification issues, the workshop established a task force to start formulating an outreach flyer on ocean acidification and its socio-economic impacts in the region. Technical assistance will be provided by CRED and the NOAA Ocean Acidification Program.

With the NOAA National Coral Reef Monitoring Program (particularly its Pacific Reef Assessment and Monitoring Program) as a case study, the workshop recognized great challenges and gaps in monitoring ecological impacts of ocean acidification on coral reef ecosystems in the region. There is a limited understanding on ecosystem responses to ocean acidification, yet a critical need exists to develop meaningful projections of future impacts of ocean acidification on marine ecosystems, especially on coral reefs in the region. Such information is needed to enable fisheries managers, marine resource managers, and policy makers to develop effective long-term mitigation and adaptation strategies for the people of the region. The workshop stressed the importance of developing a

joint long-term program to monitor the impacts of ocean acidification on coral reefs in the region, building on existing coral reef monitoring initiatives.

To this end, the workshop selected several pilot sites as a starting point for developing the regional monitoring program based upon the strong interests and recommendations received from participants. A table for monitoring capacity analysis was also developed and will be distributed to participants willing to join the effort, with a view to analyzing the current monitoring capacity, identifying common monitoring methods, and working toward development of a consistent, comparable and cost-effective "Standard Operating Procedure" for all pilot sites.

Participants expressed their appreciation for the technical assistance of NOAA in organizing of this event. A second workshop was tentatively scheduled for late August or early September 2015.

SCIENTIFIC OPERATIONS

A Web-based GIS for the Marianas Trench Marine National Monument

PIFSC launched a new project in 2015 funded by the Pacific Marine National Monuments to develop a pilot web-based geographic information system (GIS) mapping tool for the Mariana Trench Marine National Monument (MTMNM). This project will serve as a test case to effectively integrate coral reef monitoring data, fisheries cruise survey data, and other marine, oceanographic and ecosystem data collected by PIFSC and local natural resource agencies. The long-term goal is for this web-based mapping system is to serve as a repository and dissemination tool for geospatial data collected within the Marine Monuments. The mapping project responds to a need identified in the draft 2014 MTMNM Ecosystem Implementation Plan (currently in PIFSC editorial review) that called for the development of GIS products to include layers of habitat (including microhabitat distribution and utilization), fish and coral species and human usages.

CNMI Staff Trained in Methods for Determining Fish Maturity

During 9-10 December 2014, PIFSC scientist Dr. Edward DeMartini of the Fisheries Research and Monitoring Division conducted a two-day workshop on the histological staging of fish gonads in collaboration with the CNMI Division of Fish and Wildlife (DFW) and Micronesian Environmental Services (MES). Staging of gonads in the laboratory provides information on reproductive maturity of the fish which can lead to greater understanding of the relationship between fish size and maturity, seasonality of spawning and other quantities of interest. Results contribute to improved stock assessment and a more solid scientific foundation for fishery management. Personnel from DFW and MES successfully

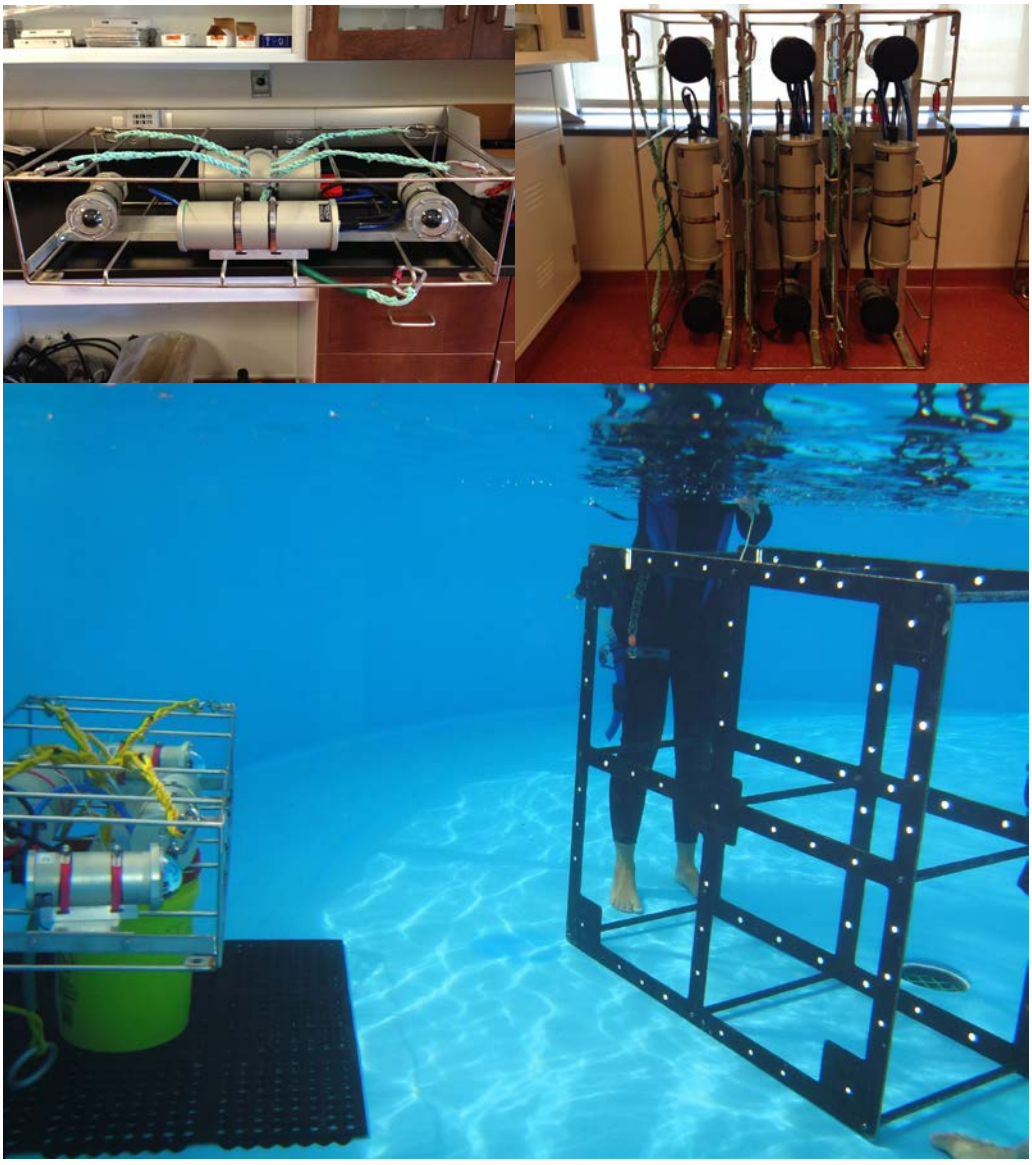
completed the training and are now prepared to stage fish gonads collected from the CNMI biosampling program and the 2014 Insular Fisheries expedition by the NOAA Ship *Oscar Elton Sette* (OES-14-04).

PIFSC biologist Ed DeMartini provided training on histological staging of fish gonads to staff of the CNMI Division of Fish and Wildlife and Micronesian Environmental Services. Application of the training to gonad samples collected in the CNMI biosampling program will improve the scientific basis of stock assessment and fishery management in the region.

New Optical Technology Acquired for 2015 Fishery-Independent Surveys of Hawaii Bottomfish and Reef Fish

A key research goal of PIFSC is to develop, test and implement fishery-independent sampling methods to assess the abundance of Hawaii bottomfish and reef fish. To this end, several research expeditions have been completed to test and calibrate alternative methods that employ optical or acoustic technologies. In preparation for the 2015 expedition, the PIFSC Advanced Sampling Technologies Program has assembled, water-tested, and calibrated 3

Modular Optical Underwater Survey Systems (MOUSS). The MOUSS is considered an upgrade of the stereo-camera system used in previous surveys, the Bottom Camera Bait Station (BotCam). The MOUSS uses high definition digital cameras and a sophisticated computer control system, and has a removable camera base bar that allows for a variety of stereo-camera applications. With its compact and light weight design, MOUSS units can be deployed from smaller survey platforms such as cooperative fishing vessels which further increases sampling capabilities.



The new MOUSS camera systems were assembled in the laboratory, then water-tested and calibrated in shoreside tanks in preparation for upcoming field deployment.

PUBLICATIONS

Articles in Peer-Reviewed Journals

Bograd, S. J., E. L. Hazen, E. A. Howell, and A. B. Hollowed.

2014. The fate of fisheries oceanography. Introduction to the Special Issue. Fish. Oceanogr. DOI: 10.5670/oceanog.2014.83.

Brodziak, J., M. Mangel, and C.-L. Sun.

2014. Stock recruitment resilience of North Pacific striped marlin based on reproductive ecology. Fish. Res. DOI: 10.1016/j.fishres.2014.08.008.

Chang, Y.-J., J. Brodziak, J. O'Malley, H.-H. Lee, G. DiNardo, and C.-L. Sun.

2014. Model selection and multi-model inference for Bayesian surplus production models: A case study for Pacific blue and striped marlin. Fish. Res. DOI: 10.1016/j.fishres.2014.08.023.

DeCarlo, T. M., A. L. Cohen, H. C. Barkley, Q. Cobban, C. Young, K. E. Shamberger, R. E. Brainard, and Y. Golbuu.

2015. Coral macrobioerosion is accelerated by ocean acidification and nutrients. Geology. DOI: 10.1130/G36147.1.

Dutton, P. H., M. P. Jensen, K. Frutchey, A. Frey, E. LaCasella, G. H. Balazs, J. Cruce, A. Tagarino, R. Farman, and M. Tatarata.

2014. Genetic stock structure of green turtle (Chelonia mydas) nesting populations across the Pacific Islands. BioOne. DOI: 10.2984/68.4.1.

Howell, E. A., A. Hoover, S. R. Benson, H. Bailey, J. J. Polovina, J. A. Seminoff, and P. H. Dutton.

2015. Enhancing the TurtleWatch product for leatherback sea turtles, a dynamic habitat model for ecosystem-based management. Fish. Oceanogr. DOI: 10.1111/fog.12092.

Jouffray, J.-B., M. Nyström, A. V. Norström, > D. Williams, L. M. Wedding, J. N. Kittinger, and G. J. Williams.

2014. Identifying multiple coral reef regimes and their drivers across the Hawaiian archipelago. Phil. Trans. R. Soc. B. DOI: 10.1098/rstb.2013.0268.

Lee, H.-H., K. R. Piner, R. D. Methot Jr., and M. N. Maunder.

2014. Use of likelihood profiling over a global scaling parameter to structure the population dynamics model: An example using blue marlin in the Pacific Ocean. Fish. Res. DOI: 10.1016/j.fishres.2013.12.017.

Lehodey, P. A. Conchon, I. Senina, R. Domokos, B. Calmettes, J. Jouanno, O. Hernandez, and R. Kloser.

2015. Optimization of a micronekton model with acoustic data. ICES J. Mar. Sci. DOI: 10.1093/icesjms/fsu233.

Oleson, E. M., A. Širović, A. R. Bayless, and J. A. Hildebrand.

2014. Synchronous seasonal change in fin whale song in the North Pacific. PLoS One. DOI: 10.1371/journal.pone.0115678.

Richmond, L., D. Kotowicz, and J. Hospital.

2015. Monitoring socioeconomic impacts of Hawai'i's 2010 bigeye tuna closure: complexities of local management in a global fishery. Ocean Coast Manag. DOI: 10.1016/j.ocecoaman.2015.01.015.

Van Houtan, K. S., J. M. Halley, and W. Marks.

2015. Terrestrial basking sea turtles are responding to spatio-temporal sea surface temperature patterns. Biol. Lett. DOI: 10.1098/rsbl.2014.0744.

VanHoutan, K. S., S. K. Harvrove, and G. H. Balazs.

2014. Modeling sea turtle maturity age from partial life history records. BioOne. DOI: 10.2984/68.4.2.

Walsh, W. A., and J. Brodziak.

2014. Billfish CPUE standardization in the Hawaii longline fishery: Model selection and multimodel inference. Fish. Res. DOI: 10.1016/fishres.2014.07.015.

Work, T. M., J. Dagenais, G. H. Balazs, N. Schettle, and M. Ackermann.

2014. Dynamics of virus shedding and in situ confirmation of chelonid herpesvirus 5 in Hawaiian green turtles with fibropapillomatosis. Vet. Pathol. DOI: 10.1177/0300985814560236.

Technical Memoranda

Brodziak, J., A. Yau, J. O.'Malley, A. Andrews, R. Humphreys, E. DeMartini, M. Pan, M. Parke, and E. Fletcher.

2014. Stock assessment update for the main Hawaiian Islands Deep7 bottomfish complex through 2013 with projected annual catch limits through 2016. U.S. Dep. Commer., NOAA Tech Memo., NOAA-TM-NMFS-PIFSC-42, 61 p.

Weijerman, M., I. Kaplan, E. Fulton, B. Gordon, S. Grafeld, and R. Brainard.

2014. Design and parameterization of a coral reef ecosystem model for Guam. U.S. Dep. Commer., NOAA Tech. Memo., NOAA-TM-NMFS-PIFSC-42, 115 p. + Appendices.

Special Publications

PIFSC. 2014. Reefs for the future: Resilience of coral reefs in the main Hawaiian Islands. NOAA Fisheries Science Center, PIFSC Special Publication, SP-15-001, 2p.

Administrative Reports

Hospital J., and C. Beavers.

2014. Hawaii Retail Seafood Markets: Observations from Honolulu (2007-2011). Pacific Islands Fish. Sci. Cent. Natl. Mar. Fish. Serv., NOAA Honolulu, HI, 96818-5007. Pacific Islands Fish. Sci. Cent. Admin. Rep. H-15-01, 32 p.

Parrish, F. A, D. Wagner, D. Jayewardene, C. Kelly, J. DeMello, and E. Breuer.

2014. NOAA Deep-sea coral and Sponge Research and Management Priorities Workshop for the Pacific Islands Region, Honolulu, Hawaii, April 22-23, 2014. Pacific Islands Fish. Sci. Cent. Natl. Mar. Fish. Serv., NOAA Honolulu, HI, 96818-5007. Pacific Islands Fish. Sci. Cent. Admin. Rep. H-14-03, 16 p.

Data Reports

Lopez, J., T. Wurth, and C. Littnan

2014. Report on Hawaiian Monk Seal Survey on Ni'ihau Island, 2014. Pacific Islands Fish. Sci. Cent. Natl. Mar. Fish. Serv., NOAA Honolulu, HI, 96818-5007. Pacific Islands Fish. Sci. Cent. Data Report DR-14-017, 8 p.

PIFSC

2014. PIFSC Report on the Logbook Program for the American Samoa Longline Fishery January–March 2014. Pacific Islands Fish. Sci. Cent. Natl. Mar. Fish. Serv., NOAA Honolulu, HI, 96818-5007. Pacific Islands Fish. Sci. Cent. Data Report DR-14-014, 13 p.

PIFSC

2014. The Hawaii-based Longline Logbook Summary Report January-December 2013. Pacific Islands Fish. Sci. Cent. Natl. Mar. Fish. Serv., NOAA Honolulu, HI, 96818-5007. Pacific Islands Fish. Sci. Cent. Data Report DR-14-016, 14 p.

Presentation Abstracts

Francke, D. S. Alessi, and S. Brunson.

2015. Sea turtle stranding trends in the Hawaiian Islands. Hawaii Conservation Conference, August 3-6, 2015, University of Hawaii at Hilo, Hilo, Hawaii.

Hagemann, M., G. H. Balazs, I. Nurzia Humburg, and T. Lopez.

2014. Skeletons in our closet: sea turtle specimens in the Bernice Pauahi Bishop Museum in Hawaii. 35th International Sea Turtle Symposium, Dalaman, Turkey, April 2015.

Hospital, J.

2014. Bottoms up: demand for Hawaii bottomfish revisited. Hanauma Bay Outreach Seminar Series, Honolulu, HI, January 11, 2015.

Hospital, J.

2015. Hawaii retail seafood markets: observations from Honolulu (2007-2011). Hawaii Conservation Conference, August 3-6, 2015, University of Hawaii at Hilo, Hilo, Hawaii.

Kalberg, K., and M. Pan.

2014. 2012 Economic cost-earnings of pelagic longline fishing in Hawaii. The 116th Scientific and Statistical Committee Meeting, June 17-19, 2014, Honolulu, Hawaii.

Nadon, M. J. Ault, S. Smith, I. Williams, G. DiNardo.

2015. Assessment of data-poor Hawaiian coral reef fish populations using life history parameters obtained through a stepwise Monte Carlo simulation approach. Hawaii Conservation Conference, August 3-6, 2015, University of Hawaii at Hilo, Hilo, Hawaii.

Pan, M.

2015. Methods and challenges to collecting real-time economic data for commercial fisheries in the Pacific Islands Region. North American Association of Fisheries Economists, 2015 Biennial Forum, may 20-22, Ketchikan, Alaska.

Pan, M. and H. Chan.

2015. A study of the economic and social characteristics of the small-boat fishery in Hawaii. Hawaii Conservation Conference: August 3-6, 2015, University of Hawaii at Hilo, Hilo, Hawaii.

Parker, D., L. Fu, H.-X. Gu, T.-H. Li, W. Liu, R. Lo, M. Murphy, Y. Wang, Z.-R. Xia, F. Yeh, B. Yeh, T. Work, J. Wang, S. Brunson, C. Fong, C. Ng, J. Seminoff, and G. Balazs.

2014. China-USA 2014 Workshop in Hawaii: moving forward into the future with trust and friendship to advance sea turtle research and conservation. 35th International Sea Turtle Symposium, Dalaman, Turkey, April 2015.

Manuscripts Approved by Science Director to be Submitted for Publication

Chan, H., and M. Pan.

2014. Spillover effects of environmental regulation for sea turtle protection in the Hawaii longline swordfish fishery. Marine Resource Economics.

Fisher, R., R. A. O'Leary, S. Low-Choy, K. Mengersen, R. E. Brainard, and J. Caley.

2014. Species richness on coral reefs and the pursuit of convergent global estimates. Nature.

Kolinski, S. P., J. Cruce, D. M. Parker, K. P. Frutchey, G. H. Balazs, and R. Clarke.

2014. Migrations and conservation implications of post-nesting green turtles from Gielop Island, Ulithi Atoll, Federated States of Micronesia. Micronesica.

McBride, R., J. O'Malley, T. Gerard, and B. Barnett.

2014. Conference review: 5th International Otolith Symposium. Fisheries.

Mcleod, E., B. Szuster, J. Hinkel, E. L. Tompkins, N. Marshall, T. Downing, S. Wongbusarakam, A. Patwardhan, M. Hamza, C. Anderson, S. Bharwani, L. Hansen, and P. Rubinoff.

2014. Identification and prioritization of determinants of adaptive capacity of tropical island communities. Conservation Letters.

Mcleod E., S. Margles, S. Wongbusarakum, M. Gombos, A. Daze, A. Otzelberger, A. Hammill, V. Agostini, D. Cot, M. Wiggins.

2014. Community-based climate vulnerability and adaptation tools: A review of tools and their applications. Coast Management.

Misa, W. F. X. E, B. L. Richards, G. T. DiNardo, C. D. Kelley, V. N. Moriwake, and J. C. Drazen.

2014. Evaluating soak time and measurement methodology for stereo-video surveys of commercially important bottomfish in the main Hawaiian Islands. Journal of Experimental Marine Biology and Ecology.

Montambault, J. R., S. Wongbusarakum, P. Houk, T. Leberer, E. Joseph, W. Andrew, F. Castro, B. Nevitt, Y. Golbuu, N. Oldiais, C. R. Groves, and W. Kostka.

2014. Adaptive management's positive deviance: conservation monitoring that crosses the knowledge-action boundary in Micronesia. Conservation Biology.

Vroom, P., and J. L. Harris.

2014. Blooms of invasive species on a near-pristine reef test ecosystem resilience. Nature.

Williams, I., J. Baum, A. Heenan, K. Hanson, M. Nadon, and R. Brainard.

2014. Human, oceanographic and habitat drivers of central and western Pacific coral reef fish assemblages. PLoS ONE.

Wongbusarakum, S., M. Gombos, B. Parker, C. Courtney, S. Atkinson, and W. Koska.

2014. The LEAP Tool: Enhancing community-based planning for a changing climate. Coastal Management.