JIMAR Joint Institute for Marine and Atmospheric Research



# JIMAR

# **Annual Report for Fiscal Year 2013**

For Cooperative Agreement NA11NMF4320128

Mark A. Merrifield, PhD Director

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#### Introduction

The Joint Institute of Marine and Atmospheric Research (JIMAR) is a cooperative enterprise between the National Oceanic and Atmospheric Administration (NOAA) and the University of Hawaii (UH). The scope of these efforts spans the U.S.-affiliated Pacific Islands as well as the broader Pacific and Indian Ocean basins. JIMAR brings together research scientists from NOAA line offices, UH, and the global community to conduct research in the broad interests of NOAA. NOAA line offices collaborating in the JIMAR program include the National Marine Fisheries Service (primarily the Pacific Islands Fisheries Science Center) and NOAA Research Laboratories (primarily the Pacific Marine Environmental Laboratory [PMEL], Atlantic Oceanic and Meteorological Laboratory [AOML], Earth System Research Laboratory [ESRL], National Weather Service [NWS], National Environmental Satellite and Data Information Service [NESDIS], and National Ocean Service [NOS]). JIMAR also promotes student development, outreach, and supports special training programs. JIMAR intends to be the lead agent for all NOAA research in the Indo-Pacific region and maintain standards of accomplishment expected of the School of Ocean and Earth Science and Technology (SOEST) at the UH. Included in this report are projects under award number NA11NMF4320128.



Mark Merrifield, Director

Our mission and vision statements are as follows.

Mission: JIMAR's mission is to conduct research that is necessary for understanding and predicting changes in the Indo-Pacific region, for conserving and managing coastal and marine resources in island environments, notably the Hawaiian Islands and the U.S.-affiliated Pacific Islands, and for meeting the Nation's economic, social, and environmental needs in these regions.

Vision: JIMAR's vision is to support NOAA's concept of Resilient Ecosystems Communities and Economies while recognizing the special challenges and opportunities that the Pacific Islands face in achieving a sustainable and prosperous future in changing global and regional economies.

JIMAR research covers eight themes, all aligned with the NOAA strategic plan and the University's Indo-Pacific mission. The themes are: (1) ecosystem forecasting; (2) ecosystem monitoring; (3) ecosystem-based management; (4) protection and restoration of resources; (5) equatorial oceanography; (6) climate research and impacts; (7) tropical meteorology; and (8) tsunamis and other long-period ocean waves.

JIMAR researchers continued to excel during FY 2013, particularly in the areas of collaboration with the NOAA Pacific Islands Fisheries Science Center (PIFSC). JIMAR has used internal funds to invest in stronger ties between NOAA and University of Hawaii researchers by supporting graduate and undergraduate research assistantships, by bringing in new viewpoints and expertise through the support of postdoctoral researchers and visiting scientists, and by providing seed funds to help grow collaborative research opportunities in the major theme areas. This annual report provides an overview of JIMAR research achievements during FY 2013. Here are a few highlights.

- JIMAR Research Analyst Dr. Melanie Abecassis was lead author on a paper submitted to PLOS ONE that
  examined habitat preferences for juvenile loggerhead turtles in the North Pacific using tracking data obtained
  from tagged animals. A habitat-based model was developed to predict areas of highest probability of turtle
  presence in the North Pacific. This information is relevant to fishers and environmental managers for potential
  bycatch reduction strategies. Dr. Jeffrey Polovina, PIFSC Ecosystems and Oceanography Division Chief and
  Senior JIMAR Fellow, and JIMAR Marine Turtle Research Specialist Denise Parker were co-authors on the
  paper.
- JIMAR Senior Fisheries Economics Specialist Dr. Hing Ling Chan was lead author on a NOAA Technical Memorandum that examined the extent to which limits imposed on a fishery to protect endangered species may cause changes in external fleet activities that eventually will have adverse effects on the very species intended for protection. In the case for the Hawaii shallow-set longline swordfishery, the 'spillover effect' of regulation causes increased foreign fishing of swordfish outside of U.S. management jurisdiction, which

results in increased numbers of adverse interactions with endangered marine turtles. As a result of this type of research, in late 2012 NMFS increased the number of permitted incidental interactions with leatherback and loggerhead turtles within the Hawaii shallow-set longline fishery.

- As part of the PIFSC Marine Turtle Research Program (MTRP), JIMAR Biological Research Associate Irene Nurzia-Humburg led a 28-day field camp on East Island, French Frigate Shoals in the Northwestern Hawaiian Islands. This island is a major nesting site for Hawaiian green sea turtles and 2012 marked the 40th consecutive year for MTRP nesting data collection on the island. This remarkable field program was started in 1973 by the current MTRP federal sponsor, Dr. George Balazs. During this year, a total of 402 nesting turtles were encountered and documented.
- In March and April of 2013, Dr. Bernardo Vargas-Angel, JIMAR Coral Ecologist, led a team of researchers from the PIFSC Coral Reef Ecosystems Division to conduct benthic surveys on coral demographics, diversity, colony densities, and coral condition at 36 sites along the north shore of Kauai. These surveys are aimed to augment local efforts to gain understanding of spatial distribution and potential ecological and environmental linkages of a rapid tissue loss coral disease outbreak initially documented in August 2012. Preliminary findings corroborate the occurrence of disease hotspots at each of the survey sites as well as the unique nature of the outbreak.
- The Pacific Islands Ocean Observing System (PacIOOS) served information and data to over 100,000 unique individuals, totaling 5.8 million web visits from the website (http://pacioos.org). Operational wind, wave, and current modeling products were expanded beyond the Hawaii region, serving operational ocean and atmospheric forecasts for the Mariana Archipelago, Philippine Sea, Samoan Archipelago, and the Central South Pacific Ocean. PacIOOS technicians expanded in-situ real-time data platforms during FY 2013, growing the PacIOOS buoy/instrument fleet to over 30 deployed assets.
- JIMAR and Pelagic Fisheries Research Program (PFRP) supported graduate student Anela Choy and her advisor in the Oceanography department, Dr. Jeffrey Drazen, completed a study detailing the surprisingly high ingestion rates of anthropogenic debris, primarily plastics, by large Hawaiian pelagic fishes. This work highlights the importance of understanding the impacts of marine debris in subsurface waters. Their work appeared in the journal Marine Ecology Progress Series.
- The PIFSC Young Scientist Opportunity (PYSO) is a collaborative summer intern program between PIFSC and JIMAR that offers qualified participants professional scientific research experience and training under the mentorship with selected researchers of the PIFSC. PYSO provides participants the opportunity to acquire specific skills needed to pursue their professional goals and an in-depth perspective on how NOAA Fisheries and JIMAR serve the community. For the 2013 summer JIMAR is supporting sponsorship of four PYSO participants.
- Other outreach events that JIMAR provided funding support during FY 2013 are the SOEST Aloha Bowl, February 23, 2013 (the regional competition for the National Ocean Science Bowl), and the 38th Albert L. Tester Symposium, April 17-19, 2013.

The Director of JIMAR is a regular member of the University of Hawaii faculty and is appointed through joint decisions by leaders of the University and NOAA Research. The Director reports to an Administrative Board composed of University and NOAA officials. As both NOAA Research and University research ventures have grown, both agencies have delegated more responsibilities to the field. The Director of NOAA Research has delegated most decision-making authority to the Director of PMEL. The President of the University has delegated his responsibilities as Chair of the Administrative Board to the Chancellor of the Manoa campus. The Director manages day-to-day operations through the administrative staff (fully-supported by the Cooperative Agreement and returned indirect cost funds), Program Managers (Pelagic Fisheries Research Program [PFRP]), and faculty PI/Directors (University of Hawaii Sea Level Center [UHSLC]). A Council, elected among the Fellows, advises the Director on major expenditures on visiting scientists and the selection of new and renewed Fellows. The list of current Fellows and Council members are provided. The appointments of all current Fellows were renewed so that all appointments are synchronized. Owing to the long-distance nature of the NOAA/JIMAR relationship, no single meeting of all Fellows is possible. Business of both the Fellows and the Council are done via e-mail and by visits of the Director to NOAA facilities and professional meetings.

JIMAR Senior Fellows from NOAA are Dr. Steven Bograd (PFEL), Dr. Richard Brill (NMFS), Dr. Richard Feely (PMEL), Dr. Ed Harrison (PMEL), Dr. Gregory Johnson (PMEL), Dr. William Kessler (PMEL), Dr. Frank Marks, Jr. (AOML), Dr. Michael McPhaden (PMEL), Dr. Dennis Moore (PMEL), Dr. Jeffrey Polovina (PIFSC),

Dr. Samuel Pooley (PIFSC), Dr. Mark Powell (AOML), and Dr. Frank Schwing (PFEL).

JIMAR Senior Fellows from the University of Hawaii are Dr. Gary Barnes, Dr. Steven Businger, Dr. Eric DeCarlo, Dr. Eric Firing, Dr. Charles Fletcher, III, Dr. Kim Holland, Dr. Roger Lukas, Dr. Douglas Luther, Dr. Julian McCreary, Dr. Mark Merrifield, Dr. Thomas Schroeder, Dr. John Sibert, and Dr. Bin Wang. Visiting Senior Fellows are Dr. Gerald Meehl, Dr. Jagadish Shukla, and Dr. Akimasa Sumi.

JIMAR Council Members from NOAA are Dr. Michael McPhaden, Dr. Dennis Moore, and Dr. Jeffrey Polovina.

JIMAR Council Members from the University of Hawaii are Dr. Eric Firing, Dr. Julian McCreary, Dr. Thomas Schroeder, and Dr. Bin Wang.

Task I activities are related to the management of the cooperative institute (CI), as well as general education and outreach activities. This task also includes support of postdoctoral and visiting scientists conducting activities within the research themes of the CI that are approved by the CI Director, in consultation with NOAA, and are relevant to NOAA and the CI's mission goals.



#### Distribution of JIMAR's Task I NOAA Funding by Activity



# **Distribution of NOAA Funding by Task**

## **Accomplishments for Fiscal Year 2013**

### **Ecosystem Forecasting**

Research under this theme leads to improved forecasting of the frequency and magnitude of ecosystem processes within the Pacific Islands region. JIMAR facilitates research in development of open source fisheries ecosystems modeling tools (Auto-Differentiation Model Builder) and marine population dynamics and fisheries stock assessment models.

#### **ADMB Open Source Project**

#### P.I: John R. Sibert

NOAA Office (of the primary technical contact): National Marine Fisheries Service/Pacific Islands Fisheries Science Center

#### NOAA Sponsor: Samuel G. Pooley

#### NOAA Goal(s):

- Resilient Coastal Communities and Economies
- NOAA Enterprise-wide Capabilities: Science and Technology Enterprise; Engagement Enterprise; Organization and Administration Enterprise

#### **Purpose of the Project**

The general purpose of the ADMB Open Source Project is to maintain and improve the ADModel Builder software package as free, open-source software. ADMB is currently used by all NOAA Fishery Science Centers to create stock assessment tools. The long term goal is to enable the long term support of this software through an active and committed group of user/developers located in laboratories and universities around the nation and around the world. Specific objectives are to improve the ease of use, increase capabilities, and to enlarge the community of ADMB users and developers.

#### Progress during FY 2013

Major and minor software releases were distributed in FY 2013. These releases included new features (PRIORS\_SECTION, user-contributed functions, matrix exponential support), improvements to usability (simplification of source code build process, simplification of linking user applications, simplification of installation, and support for new compilers (Linux 32/64 bit: GNU C++ 4.7 and Intel C++ 13; MacOS: XCode 4.6; Windows: Microsoft Visual C++ 2012).

ADMB training courses are an essential part of the project and help grow the user base. These courses help existing ADMB users with learning new features and improving their models. The courses are also useful for core team developers to see firsthand any difficulties the end users are having with the software and get feedback from the participants. Below is a partial list of past courses and instructors:

- ICES 2012: AD Model Builder Workshop, Norway. Instructors: Anders Nielsen, Hans Skaug, and Mark Maunder.
- AD Model Builder and Stock Assessment Course, 18-22 February 2013, ICES HQ, Copenhagen, Denmark. Instructors: Anders Nielsen and Arni Magnusson.
- Tutorial on developing ADMB Libraries. Presented at the Center for the Advancement of Population Assessment Methodology Workshop on Modeling Selectivity in Fish Stock Assessments (CAPAM Workshop). March 11-14, 2013, La Jolla, CA. Instructors: Steve Martell, Athol Whitten, and Mathew Supernaw.
- AD Model Builder Workshop, March 2013, Dept. of Psychology, University of Copenhagen. Instructors: Jeppe Høy Christensen, Carsten Nielsen, and Anders Nielsen.
- AD Model Builder Workshop, May 2013, University of British Columbia. Instructor: Robert Ahrens. ADMB developers' workshops are very important to the project. International group of users and developers collaborate to offer suggestions, to work on resolving current issues and to discuss potential new features. These

workshops help ensure a broad base of codependency for developing and maintaining open-source computer code into the future. Workshops were held in March 2012 in Honolulu and June 2013 in Seattle. Developer Workshop reports are available on the ADMB Project website at http://www.admb-project.org/developers/ workshop

The ADMB Project website is the primary point of contact for new and existing ADMB users. Improvement of the website has been a continuing activity. During 2013, the ADMB Project website was reorganized, cleaned up and updated. The number of pages available in the tabs menu was reduced to improve navigation by merging related pages. Additional examples to illustrate the ADMB capabilities were added to the website and allowed to fall under multiple categories. Examples from the ADMB and ADMB-re manual, the NCEAS project website and the otter-research website were moved to the ADMB project website. Users are now allowed to view the collection of all available examples and categorization was added to examples. A number of outdated and deprecated pages, such as those describing installs of deprecated compilers and ADMB versions, were removed or moved to storage. Material from past ADMB courses was collated and reorganized in the website to provide easy access to new users. Other changes included updating the list of ADMB related publications and reorganizing them by first author. When available, a short description of how ADMB benefited each work has been added. Links to electronic copies of publications were added when publicly available.

Implementation of concurrency to exploit the features of multi-core computer processors is an on-going priority for the ADMB Project and has proved difficult to implement. The "AD" in ADMB refers to the use of automatic differentiation to achieve fast, accurate and stable numerical function minimization. The primary source of the difficulty in implementing concurrency is the inherent difficulty in supporting the extensive data structures required for automatic differentiation. Some recent progress has been achieved using thread-specific data structures supported by some of the newer compilers.

The following is a partial list of publications reporting research dependent on the ADMB software:

- Cope, J., 2013. Implementing a statistical catch-at-age model (Stock Synthesis) as a tool for deriving overfishing limits in data-limited situations. Fisheries Research, 142:3-14.
- Lynch, P.D., K.W. Shertzer, and R.J. Latour, 2012. Performance of methods used to estimate indices of abundance for highly migratory species. Fisheries Research, 125-126: 27-39.
- MacCall, A. D., 2013. Use of the delta method to evaluate the precision of assessments that fix parameter values. Fisheries Research. 142:56-60.
- Maunder, M.N., and A.E. Punt, 2013. A review of integrated analysis in fisheries stock assessment. Fisheries Research, 142:61-74.
- Methot, R.D. Jr., and C.R. Wetzel, 2013. Stock synthesis: A biological and statistical framework for fish stock assessment and fishery management. Fisheries Research, 142: 86-99.
- Molton, K.J., T.O. Brenden, and J.R. Bence, 2012. Control rule performance for intermixing lake whitefish populations in the 1836 Treaty waters of the Great Lakes: a simulation-based evaluation. Journal of Great Lakes Research, 38:686-698.
- Punt, A.E. and M.N. Maunder, 2013. Stock Synthesis: Advancing stock assessment application and research through the use of a general stock assessment computer program. Fisheries Research, 142:1-2.
- Sibert, J., I. Senina, P. Lehodey, and J. Hampton, 2012. Shifting from marine reserves to maritime zoning for conservation of Pacific bigeye tuna (Thunnus obesus). PNAS, 109(44):18221-18225.
- Stewart, I. J., A.C. Hicks, I.G. Taylor, J.T. Thorson, C. Wetzel, and S. Kupschus, 2013. A comparison of stock
  assessment uncertainty estimates using maximum likelihood and Bayesian methods implemented with the same
  model framework. Fisheries Research, 142:37-46.
- Taylor, I.G. and R.D. Methot Jr., 2013. Hiding or dead? A computationally efficient model of selective fisheries mortality. Fisheries Research, 142:75-85.
- Taylor, I.G., V. Gertseva, R. D. Methot Jr., an M. N. Maunder, 2013. A stock-recruitment relationship based on pre-recruit survival, illustrated with application to spiny dogfish shark. Fisheries Research, 142:15-21.
- Wayte, S.E., 2013. Management implications of including a climate-induced recruitment shift in the stock assessment for jackass morwong (Nemadactylus macropterus) in south-eastern Australia. Fisheries Research, 142:47-55.
- Whitten, A.R., N.L. Klaer, G.N. Tuck, and R.W. Day, 2012. Accounting for cohort-specific variable growth in fisheries stock assessments: A case study from south-eastern Australia. Fisheries Research, 142:27-36.

#### **Ecosystem Monitoring**

Observing systems and data management are integral to this theme. Significant efforts are undertaken in JIMAR to monitor and assess reef ecosystems, fisheries habitat and stocks, endangered marine animals, and threats to marine ecosystems. JIMAR contributes to the NMFS effort to continually monitor catch data from the fisheries industry across the Pacific Islands.

#### **Bio-Sampling**

PI: Mark A. Merrifield [JIMAR Project Lead: Meagan Sundberg]

NOAA Office (of the primary technical contact): National Marine Fisheries Service/Pacific Islands Fisheries Science Center

NOAA Sponsor: Samuel G. Pooley, Robert Humphreys

#### NOAA Goal(s)

· Healthy Oceans

#### **Purpose of the Project**

This JIMAR project monitors and conducts research on ecosystems that involve marine species and resources of concern to the Pacific Islands Region. The project activities enable scientists to provide scientific advice to those charged with management of the resources as mandated by legislation (e.g., Reauthorized Magnuson Stevens Act, Marine Mammals Protection Act, Endangered Species Act, etc.). The primary objective of the Life History (LH) Program bio-sampling project is to conduct fundamental biological and ecological research on federally managed species to provide new or improved estimates of species life history parameters (length-atage growth curves, longevity, size at median maturity, spawning season, length-weight relations) to improve and support the biological data needs of ongoing and future stock assessments of fishery resources.



Figure 1. Gonadal Somatic Index (GSI) (mean ± standard deviation for male, female, and unknown gender specimens of onaga (Etelis coruscans) sampled in Guam from August 2009-March 2013.

#### Progress during FY 2013

To fulfill the primary objective of the LH program, the project continues to conduct biological studies aimed at improving knowledge of LH parameters (e.g., age and growth, reproduction, etc.) utilizing specimens collected in the central, south, and western Pacific regions. To this end, a fisheries bio-sampling specialist continues to: 1) identify species and collect length-weight data from bottomfish species available at the United Fishing Agency fish auction; 2) participate in bottomfish sampling operations around the Main Hawaiian Islands; 3) process any incoming Deep-7 bottomfish for hard parts and tissue; and 4) conduct seasonal sampling of the deep-seven bottomfish reproductive organs (gonads) onsite at the auction and off-island in Maui. Collected specimens continue to be appropriately labeled, preserved, and archived; associated specimen data is organized, analyzed, and managed in an efficient manner in Oracle, Excel, or Access. Additional project activities include: 1) statistical analysis of gonadal somatic indices (GSI) by month, length, and sex to examine GSI trends for targeted bio-sampled fish species in Guam, Saipan, and American Samoa in order to estimate spawning periods,



*Figure 2. Bottomfish processing of a lehi* (Aphareus rutilans) *aboard the NOAA Ship Oscar Elton Sette.* 

initial size at maturity, and sampling gaps; 2) statistical analysis of comparisons between lengths measured along the body contour versus linear distance; 3) responsibility for data management, metadata documentation, and proper archiving of all data generated from bio-sampling based life history research studies; and 4) creating graphic data displays (histograms and scatterplots) from various bio-sampling databases (Hawaii bottomfish, UFA fish auction, and Western Pacific) for reports, presentations, updates, and meetings.

A draft administrative report summarizing the bio-sampling activities of the Commercial Fisheries Bio-Sampling project in the Western Pacific Regions of Guam, Saipan, and American Samoa will be submitted for review by the end of FY 2013. A manuscript describing the distribution of cryptic *Lampris* spp. has not been completed due to higher-priority biosampling tasks. This year's at-sea research efforts will take the bio-sampling project to Johnston Atoll to obtain samples of otoliths, gonads, and tissues from adult snapper/grouper species for future life history and DNA-based population connectivity studies, the latter in collaboration with HIMB researchers.

# Climate Change and Ecosystem Variability in the North Pacific Ocean and the Dynamics of Marine Resource Populations

#### P.I.: Mark A. Merrifield

NOAA Office (of the primary technical contact): National Marine Fisheries Service/Southwest Fisheries Science Center

NOAA Sponsor: Franklin B. Schwing, Steven J. Bograd

#### NOAA Goal(s)

· Healthy Oceans

#### **Purpose of the Project**

The project's purpose is to: 1) describe the characteristic modes of variability in the North Pacific Ocean over interannual to decadal time scales, from analysis of historical data and numerical ocean model output, and to conduct research related to the application of in situ and satellite remote sensing data products for marine fisheries and other ocean users requirements; and 2) to conduct research and provide satellite data in support of the emerging west coast regional associations (RAs) of the Integrated Ocean Observing System (IOOS). These

research efforts are being undertaken to: a) improve understanding of marine environmental variability and its impacts on living marine resources; b) develop improved living marine resource assessment models; and c) apply satellite remote sensing technology to improve the management of economically and ecologically important marine resources.

The project's affiliation with JIMAR only covered the period from July 1–September 30, 2012.

#### Progress during FY 2013

NOAA-PFEL JIMAR scientists made progress on several fronts during the first quarter of FY 2013, resulting in 4 published manuscripts, with several others currently undergoing peer review. Highlights are presented below.

Oceanographic variability and climate change impacts on top predator habitat in the North Pacific. Studies of the physical dynamics of the California Current continued, using both in situ observations and models. Analyses on the oceanographic effects on top predator habitat also continued, with work focusing on: a) developing a near-real-time tool to estimate the probability of encountering cetaceans in the southern California Current; b) estimating the effects of the DWH oil spill on bluefin tuna spawning habitat in the Gulf of Mexico; and c) developing climate projections of climate-driven multi-species habitat changes in the North Pacific. The latter project resulted in a high-profile manuscript in Nature Climate Change that described the broad scale distribution and predicted habitat shifts using species-habitat relationships and output from the GFDL Earth System Model. Hazen et al (2013) identified a large northward shift in top predator biodiversity predicted by the models, and showed that some species were at risk from losing habitat while others gained habitat in future projections.

Remote sensing studies of marine ecosystems. In addition to continuing maintenance of CoastWatch infrastructure and data services in conjunction with ERD personnel, Foley added new data products, published in peer-reviewed journals, presented invited talks at meetings and participated in events intended to extend the scope of the project's outreach and education efforts. Improvements to the base infrastructure included accommodations for changes in NESDIS data delivery mechanisms. Data product improvements included continued work on an operational, satellite-based, Harmful Algal Bloom detection and monitoring product. Additionally, Foley participated in several outreach and education activities.

#### **Ecosystem Modeling**

P.I.: Mark A. Merrifield [JIMAR Project Lead: Melanie Abecassis]

NOAA Office (of the primary technical contact): National Marine Fisheries Service/Pacific Islands Fisheries Science Center

NOAA Sponsor: Samuel G. Pooley, Jeffrey J. Polovina

#### NOAA Goal(s)

· Healthy Oceans

#### **Purpose of the Project**

The purpose of this project is to further understanding of the habitat preferences of loggerhead turtles and swordfish in order to evaluate potential bycatch reduction strategies based on minimizing the occurrence of longline fishing targeting swordfish in turtle habitat hot spots. This study focuses on analyzing turtle tracks collected by satellite tags and adapting turtle and swordfish habitat within the SEAPODYM model.

A more general objective is to study habitat preferences for various animals and the factors that drive those preferences and understand ecosystem changes using fishery data.

#### Progress during FY 2013

Over 200 turtle tracks were analyzed to characterize juvenile loggerheads habitat and swimming capabilities in the North Pacific. Findings were used to parameterize a Eulerian habitat and movement model called SEAPODYM to predict areas of higher use and produce an index of habitat suitability in the entire North Pacific Ocean (Fig. 1). This study has been peer-reviewed and submitted to the journal PlosONE. At the time of writing this report, the authors are waiting on approval upon re-submission of the revised manuscript.



(above) Figure 1. Modeled loggerhead turtle habitat index simulated for a release of 29 tagged turtles in May 2005. The habitat index (color scale, between 0 and 1) is overlaid with portions of tracks (black segments). From top to bottom: Jun. 13, 2005; Sep. 18, 2005; Dec. 17, 2005; Mar. 16, 2006.

(below) Figure 2. Annual observer CPUE (#fish per 1000 hooks) for fish (A) > 15 kg, (B) < 15 kg, and (C) percent catch of fish > 15 kg in the Hawaii and American Samoa longline fisheries. Solid line: October-March Hawaii-based shallow-set fishery, dashed line: annual Hawaii-based deep-set fishery, dash-dotted line: annual American Samoa deep-set fishery.



A formal agreement was reached with the SPC in Noumea to obtain an exhaustive fishing dataset for non-US longline fleets in the Pacific Ocean to revise the adaptation of the SEAPODYM model to swordfish that was undertaken in 2011. The study had hit roadblocks due to the unavailability of data for some fisheries, which severely limited the project's ability to reach satisfying model parameter estimates.

A research cruise onboard the NOAA Ship Oscar Elton Sette was conducted June 12–26 that focused on the Kona IEA region off Hawai'i Island. Oceanographic and active and passive acoustic data were collected to characterize the area's vertical structure and assess the presence of cetaceans and their prey.

In order to examine subtropical ecosystem indicators, a JIMAR scientist (Aimee Hoover) analyzed the species composition time series of observer catch and effort data within the fishing grounds of American Samoa and Hawaii. Each fishery was divided into species groupings of large species (>15 kg) and small species (<15 kg) to understand the impact large predator reduction may have on the ecosystem structure. The changes in catch per unit effort (CPUE) of various species allow for predictions on catch rate, target species abundance, and overall trophic structure throughout these areas. The overall CPUE of large species has declined in all fisheries, while the CPUE of small species has increased (Fig. 2). Further analysis is being conducted to better understand these changes.

#### **Ecosystems Observations Research Program**

P.I.: Mark A. Merrifield [JIMAR Project Lead: Jeffrey Hare]

NOAA Office (of the primary technical contact): National Marine Fisheries Service/Pacific Islands Fisheries Science Center

NOAA Sponsor: Samuel G. Pooley, Michael Seki

#### NOAA Goal(s)

· Healthy Oceans

#### **Purpose of the Project**

This JIMAR project monitors and conducts research on ecosystems that involve marine species and resources of concern to the Pacific Islands Region. The project activities enable scientists to provide advice to those charged with management of the resources as mandated by legislation (e.g., Reauthorized Magnuson Stevens Act, Marine Mammals Protection Act, Endangered Species Act, etc.). Current activities include: 1) analysis and facilitation of Geographic Information System (GIS) databases of fisheries and habitats; 2) data management of fisheries and ocean observations; 3) support to advance public awareness of marine ecosystems and observations; and 4) field support for bottomfish research.

*Fishery and Habitat Spatial Data Analysis*. This work continuously supports fishery and ecosystem research and management within the Western and Central Pacific Ocean (WCPO) region. The objective of this project is to provide JIMAR support to scientists and resource managers at the Pacific Islands Fisheries Science Center (PIFSC) and in the WCPO region in development, maintenance and administration of geo-spatial databases, spatial data servers and services, and of web-based applications. Support is also provided in spatial data analysis, spatial data statistics, and ArcGIS technical support for fishery and ecosystem research and monitoring programs. This project will effectively improve communication and technology sharing procedures and contribute towards effective stewardship and collaborations between JIMAR and PIFSC in marine fisheries and ecosystem resource management in the Pacific Islands.

Scientific Information Services for Ecosystems Monitoring and Research. Monitoring, analysis, and modeling of marine ecosystems in the Pacific Islands Region require access to a broad array of information collected by research vessels and U.S.-flagged fishing vessels across the region. This JIMAR effort provides continuing technical support to researchers and collaborators at the Pacific Islands Fisheries Science Center (PIFSC) who require access to NMFS-managed federal fisheries statistics, fisheries research and oceanographic survey data, and other information housed in PIFSC Oracle enterprise databases.

*Pacific Islands Fisheries Science Outreach and Education Program.* The objective of this effort is to plan, develop, and implement effective communications products for JIMAR and the NOAA PIFSC. To carry out the project, the JIMAR staff work with the NOAA Pacific Islands Regional Office (PIRO) Communications Team.

This project directly supports JIMAR's objective to assist in efforts to conserve and preserve environmental resources through outreach and education. Additionally, the project provides resources for summer student internships with JIMAR in various divisions of PIFSC.

Field Support for Bottomfish Research. Bottomfish research is one of the cornerstones of the fisheries assessment effort conducted at PIFSC, and JIMAR plays a key role in these research effort with several collaborative projects focused on bottomfish (see reports on the Main Hawaiian Islands Deep 7 Bottomfish Fast Track Project; Bio-Sampling; Human Dimensions of Fishing and Marine Ecosystems in the Western Pacific; and the Stock Assessment Research Program). This effort provides an integrative approach to maintain coordination of JIMAR's approaches to bottomfish research, particularly for JIMAR's participation in numerous PIFSC field campaigns, providing logistics and travel support.

#### Progress during FY 2013

*Fishery and Habitat Spatial Data Analysis*. The following activities were done to support fishery and ecosystem research and management within the WCPO region.

- Continue to maintain, update, and administer the ArcGIS map services, web-based applications, and back-end enterprise geo-database for the spatial information repository displaying, accessing and distribution;
- Support the project of Near-Shore Aquaculture Site Selection with web-based map services and applications for the Main Hawaiian Islands;
- Improve the Essential Fish Habitats (EFH) / Habitat Areas of Particular Concern (HAPC) geo-databases for bottomfish, crustaceans, reef fish, and precious corals in the WCPO region;
- Support the spatial analysis of the Hawaiian longline fleets' swordfish fishing effort in collaboration with the PIFSC Socioeconomics group;
- Support the 2012 Annual Fisheries Statistics and Data Report of the U.S. Longline Fisheries to international fishery management organizations, including the Western and Central Pacific Fisheries Commission (WCPFC), International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean (ISC), and the Inter-American Tropical Tuna Commission (IATTC);
- Support the Pacific Islands Data Management Stewardship Community (DMSC) with the development of the Data Documentation Implementation Plan (DDIP).

Scientific Information Services for Ecosystems Monitoring and Research. Nathan Chan, JIMAR Scientific Information Specialist, provided technical support to PIFSC and JIMAR staff on various aspects of data services, including management of quality controls and timely data entry of Hawaii longline fishery daily logbook data into the PIFSC Oracle enterprise database. An estimated 19,000 longline logsheets have been entered during the project year. Chan provided support in maintaining the Fisheries Data Catalog and Discovery Metadata catalog, both of which run on the Drupal CMS (Content Management System). While co-development of these catalogs was completed in FY 2012, the web-based resources were made available to PIFSC and JIMAR users in January 2013 when the new PIFSC Intranet was released. The Fisheries Data Catalog is a web-based listing of PIFSC fisheries and research data holdings that include summaries of essential metadata and related literature such as code lists, forms and logsheets, and field specifications. The Discovery Metadata catalog is a more current and comprehensive web-based listing of discovery metadata of all datasets inventoried and maintained by the PIFSC. The data collections support fisheries and ecosystem research by PIFSC staff and JIMAR scientists affiliated with PIFSC. In addition, Chan attended the Drupalcon 2013 in Portland, OR, to learn about developments in Drupal that may be used to improve access to and user experience of the catalog sites.

*Pacific Islands Fisheries Science Outreach and Education Program.* During the project year, the program produced communications, outreach and education materials that JIMAR and/or local NOAA divisions and programs staff displayed or distributed directly to the public, partners or stakeholders at community events and other venues. The program supports all divisions and programs within PIFSC to create a consistent outward facing message and image. Participation in outreach and education events informs and engages the public and stakeholders on PIFSC efforts to understand marine resource pressures. The communications materials produced provide information to the public, partners, collaborators and stakeholders that communicate NOAA'S mission in easy to understand language and in a visually appealing format. The project was slowed by the loss of key JIMAR staff in the middle of the year, but among the products during the project year are as follows.

- Posters, signage and displays for NOAA Fisheries Honolulu Service Center opening ceremony
- Hawaii Charter Fishing Cost-Earnings Survey 2012 brochure

- New Pacific Islands Fisheries Science Center brochures
- · Website revisions and improvements

In addition, this project provides support for the summer 2013 engagement of four undergraduate students to participate in PIFSC research projects: 1) Video Database for Mesophotic Corals; 2) Socioeconomics of Non-Commercial Fishing; 3) Vocalizations of Hawaiian False Killer Whales; and 4) Analysis of Data from Remote Underwater Video Surveys. The PIFSC Young Scientist Opportunity (PYSO) is jointly coordinated by PIFSC and JIMAR and offers highly qualified students the opportunity for professional research experience with a mentoring scientist. This unique program provides students with hands-on experience while building relationships with professionals in their field.

*Field Support for Bottomfish Research*. JIMAR staff participated in the public comment hearings in Hawaii and American Samoa for the proposed Endangered Species Act listing of 66 coral species. Among many other benefits, healthy coral reef ecosystems provide critical habitat for bottomfish, and JIMAR was entrusted with responsibilities to engage with the Pacific region stakeholder on this important NOAA decision.

Instrument repair and calibration was conducted for bottomfish cruise application during the project year, and further field engagement included facilitation of cruise participation of faculty and students in the UH-SOEST (School of Ocean and Earth Science and Technology) Department of Oceanography and the Hawaii Institute for Marine Biology (HIMB).

As part of JIMAR's ecosystem observations in the Central Pacific, the project supported the collection of water samples on cruises aboard the NOAA Ship Oscar Elton Sette along the Kona coastline off the island of Hawaii. These water samples were subsequently processed to identify specific chloro-pigments as indicators to identify phytoplankton species composition. This analysis was conducted using high-performance liquid chromatography (HPLC) at the SOEST Department of Oceanography. The results will be used to identify the phytoplankton species composition, and future time series will reveal potential changes in phytoplankton species composition in the Central North Pacific.

#### **Fisheries Monitoring and Support**

#### P.I.: Mark A. Merrifield [JIMAR Project Lead: Walter Machado]

#### NOAA Office (of the primary technical contact): National Marine Fisheries Service/Pacific Islands Fisheries Science Center

#### NOAA Sponsor: Samuel G. Pooley, Kurt Kawamoto

#### NOAA Goal(s)

· Healthy Oceans

#### **Purpose of the Project**

This JIMAR project works to provide PIFSC with timely and accurate Fishery Management Plan (FMP) logbook data and other fishery information for use in research and management. The main focus of the work is the daily monitoring of Hawaii's pelagic longline fleet, which is presently, and increasingly subject to international management at the species level. The project provides PIFSC and the fishing industry a contact point for feedback and information exchange with fishery scientists and managers.

#### Progress during FY 2013

The JIMAR Fisheries Specialist continues to provide timely high level support to fishery monitoring activities by providing high quality fisheries data to JIMAR and NMFS. The daily



fisheries data to JIMAR and NMFS. The daily Figure 1. Capt. Mo Kwang received an ocean temperature map.



Figure 2. JIMAR Fisheries Specialist Walter Machado picking up longline logbooks at United Fishing Agency.

burden of quality control and processing logbook data have increased due to fast tracking procedures which were implemented to monitor Hawaii's big eye tuna (BET) landings. This information is used in forecasting landings sufficient to predict possible closure of the Hawaii longline BET fishery if/when the WCPFC and IATTC annual quota is predicted to be reached. The fast track monitoring was expanded to include yellowfin tuna in 2012 due to stock concerns. These additional monitoring requirements increase the daily workload and are compiled weekly or as necessary as the quota gets taken. Additional quality control procedures and cross checks of relevant data bases have been implemented as needed to continually improve the results and timeliness of the product. As an example, a matching program comparing the longline logbook tuna counts to sales records at the United Fishing Agency auction was developed and is now used to improve the quality of the data. The general Hawaii longline fleet wide quarterly reports are completed 45 days after the end of the quarter.

A photo database of Hawaii's pelagic longline fishing fleet has been developed to document and monitor permitted vessels in the fleet, and this album is continually updated throughout the year. The logbook scanning project has successfully archived

20 years of the Hawaii longline logbooks with two more years of logbooks yet to be scanned.

#### Investigation of Ecological Constraints for Bumphead Parrotfish

#### P.I.: Mark A. Merrifield [JIMAR Project Lead: Meagan Sundberg]

# NOAA Office (of the primary technical contact): National Marine Fisheries Service/Pacific Islands Fisheries Science Center

NOAA Sponsor: Samuel G. Pooley, Robert Humphreys

#### NOAA Goal(s)

· Healthy Oceans

#### **Purpose of the Project**

The principal activity under this JIMAR project is to conduct an abundance survey of juvenile bumphead parrotfish in the interior lagoon at Wake Island. Some locations are devoid of young fish, yet these same areas may maintain large numbers of adult fish, and this anomaly has yet to be investigated at Wake Island. To comprehensively survey the lagoon for juvenile bumphead parrotfish presence, researchers will employ standardized transect and photoquadrant techniques using SCUBA and snorkeling gear to characterize the abundance of juvenile bumphead parrotfish and provide a quantitative description of their nursery habitat.

#### Progress during FY 2013

Because of multiple delays and setbacks, including the lack of funds for federal collaborating participants, the project was not conducted as intended during the reporting year. Most of the logistics for travel to and from Wake including booking US Air Force transport, determining what resources are available on island, billeting, and obtaining military clearance have been completed. In addition to the bumphead parrotfish, other target species to survey have been identified, the team has been chosen and assigned research objectives, and the appropriate diving and snorkeling certifications have been obtained. If there are no further delays, the research survey is currently scheduled to occur June 12th-June 28th 2013.



Figure 1. Aerial image of Wake Island; photo taken from commons.wikimedia.org.



Figure 2. Photograph of a juvenile bumphead parrotfish; photo taken from fishbase.org taken by John E. Randall.

#### Main Hawaiian Islands Deep 7 Bottomfish Fast Track Project

P.I.: Mark A. Merrifield [JIMAR Project Lead: Jessica Miller]

NOAA Office (of the primary technical contact): National Marine Fisheries Service/Pacific Islands Fisheries Science Center

NOAA Sponsor: Samuel G. Pooley, Kimberly Lowe

NOAA Goal(s)

· Healthy Oceans

#### **Purpose of the Project**

The Main Hawaiian Islands (MHI) Deep 7 Bottomfish Fast Track Project is an ongoing JIMAR project that began September 2007. The Annual Catch Target (ACT) was implemented by NOAA Fisheries in the State of Hawaii to manage the "Deep 7" bottomfish species caught near the main Hawaiian Islands. The "Deep 7" complex is comprised of six eteline snappers and an endemic grouper, known locally as onaga (*Etelis coruscans*), ehu

(Etelis carbunculus), opakapaka (Pristipomoides filamentosus), kalekale (Pristipomoides sieboldii), gindai (Pristipomoides zonatus), lehi (Aphareus rutilans) and hapu'upu'u (Hyporthodus quernus). Hawaii State law requires commercial fishers to submit their monthly fishing reports 10 days after the following month in which marine life was taken. Department of Land and Natural Resources-Division of Aquatic Resources (DLNR-DAR) implemented a new law on September 1, 2011 requiring commercial fishermen who catch Deep 7 species to submit trip reports within 5 days of their trip end date. JIMAR staff work in collaboration with DLNR-DAR to fast-track Deep 7 bottomfish fishing and dealer data in order to successfully monitor the fishery. The fishing year for the Deep 7 Bottomfish fishery opens on September 1, and closes when the total landings are predicted to reach the ACT or on August 31, whichever occurs first. Near real-time monitoring is needed to close the fishery when the ACT is near attainment, so data collection and processing must be fast-tracked to provide timely and accurate landing information to assist in the monitoring and management of this fishery.



Figure 1. JIMAR employee, Eric Yokomori entering fishing data in the Online Fishing Report system.

#### Progress during FY 2013

The project continued to successfully manage the MHI Deep 7 bottomfish fishery. JIMAR staff met this objective through accurate and timely data entry. In order to facilitate timely submittal, monthly reminder letters were mailed to Deep 7 dealers. Fishers who submitted late trip reports received citations for violating the state law requiring fishers to submit their Deep 7 Bottomfish trip reports within five days of their trip end date. As of May 7, 2013, of the 2,453 Deep 7 trip reports submitted, 80% were received on time. The compliance rate improved; last year at the close of the season, 75% of trip reports were submitted on time. JIMAR staff entered commercial fishing and dealer data within two days of receiving the report and a second staff member proofed the entered data. JIMAR staff generally followed up with fishers and dealers within three days to correct any



Figure 2. This graph shows the accumulation of the Annual Catch Target (ACT) and the Annual Catch Limit (ACL) for the 2012-2013 MHI Deep 7 Bottomfish Fishing year as of May 9, 2013.

questionable or incorrect data that was submitted online or through mail. Using a computer program, fisheries data was error checked on a daily basis and weekly updates were sent to fishery managers beginning in September 2012. Reports containing discrepancies between fish and dealer reports were created monthly and rectified by contacting fishers and dealers for corrections. Bottomfish newsletters were mailed to active Deep 7 bottomfishers in October 2012 and March 2013 to update them on the progress of the fishery. The Deep 7 bottomfish fishery opened on September 1, 2012 with an ACT of 325,000 pounds and an Annual Catch Limit (ACL) of 346,000 pounds. As of May 7, 2013, 204,653 pounds of Deep 7 Bottomfish landings have been reported, 63 percent of the ACT. Based on the weekly updates JIMAR staff sends fishery managers, it is predicted that the ACT will not be met before the fishery closes on August 31, 2013. However if there is a significant change in the landings and the fishery managers decide to close the fishery, JIMAR staff will mail notices to Deep 7 fishers and dealers notifying them of the fishery's impending closure. If the landings continue at the current rate, the fishery will remain open until August 31, 2013 and reopen on September 1, 2013 with an ACT and ACL that will be determined at the Western Pacific Regional Fishery Management Council (Council) meeting in June 2013. This may be the second time since the bottom fish fishery has been managed using a catch limit that the limit was not reached before the closing date. On May 11, 2012, 62.1% of the ACT had been reported landed, the landings are being reported at a similar rate this year which could be for the same reasons it remained open last year. Fishers have stated that the weather has not been conducive to bottomfish fishing and the ACT is the same that it was last year, which is 22% larger than the catch limits set in the 2009-2010 and 2010-2011 fishing.

#### **Ocean Remote Sensing**

#### P.I.: Mark A. Merrifield [JIMAR Project Lead: Lucas Moxey]

#### NOAA Office (of the primary technical contact): National Marine Fisheries Service/Pacific Islands Fisheries Science Center

#### NOAA Sponsor: Samuel G. Pooley, Jeffrey J. Polovina

#### NOAA Goal(s)

- · Healthy Oceans
- NOAA Enterprise-wide Capabilities: Science and Technology Enterprise; Engagement Enterprise; Organization and Administration Enterprise

#### Purpose of the Project

The NOAA OceanWatch—Central Pacific node supplies near-real time, remotely sensed oceanographic and environmental data for the entire Pacific-based communities, including resource managers, researchers, educators and the general public, and JIMAR staff play a key role in this work. The satellite-derived products include ocean surface temperature, ocean color, ocean surface topography, ocean surface wind fields, environmental indicators (Empirical Orthogonal Functions–EOFs), and high-resolution (1.1 km) thermal infrared High Resolution Picture Transmission (HRPT) imagery from the NOAA AVHRR satellites. The HRPT data is collected daily by the AVHRR receiving station located in Ewa Beach, Oahu (Hawaii).

#### Progress during FY 2013

During FY 2013, the Ocean Remote Sensing (ORS) project completed all the objectives it had established during FY 2012, and also completed additional relevant projects. ORS supported users from Hawaii, the Pacific-rim and from around the globe by providing satellite remotely-sensed data and products. In an effort to accommodate for the addition of new products, the OceanWatch website has been updated, including the updating of the entire dataset holdings descriptions. Further updates and improvements were also conducted on the Live Access Server (LAS) and THREDDS data servers in order to enable greater connectivity and data access customizations for PacIOOS/HiOOS. During FY 2013, JIMAR staff in ORS incorporated new datasets that included global NOAA GOES-POES Sea-Surface Temperature, NOAA VIIRS Ocean Color, NASA VIIRS Ocean Color, NASA Aquarius Sea-Surface Salinity (Version 2), and the AVISO Merged Sea-Surface Height and Geostrophic Currents. Additionally, ORS also conducted updates in the SeaWiFS Ocean Color Climatology, Aqua Ocean Color Climatology, and Pathfinder v5 Sea-Surface Temperature Climatology. During this time, ORS also



(above) Figure 1. Example of the NASA Aquarius Sea-Surface Salinity (Version 2) product available via the OceanWatch website.

(below) Figure 2. Example of the newly operational NOAA GOES-POES Sea-Surface Temperature product.



Sea-Surface Temperature (degrees Celsius)



Figure 3. View of the NOAA OceanWatch–DataMatcher application developed to support PIFSC researchers.

implemented various data reprocessing efforts for the Cross-Calibrated Multi-Platform Ocean Surface Wind, NASA Moderate Resolution Imaging Spectroradiometer (MODIS) Ocean Color, AVISO Sea-Surface Height, and AVISO Merged Sea-Surface Height datasets.

As part of a collaborative effort with PIFSC Coral Reef Ecosystem Division (CRED), ORS also provided customized satellite remote sensing processing scripts, while also generating customized datasets to support users that included the NOAA PIFSC Marine Mapper–Aquaculture Site Selection Tool, NOAA Climate Service–Pacific Islands Region, Marine Research Foundation, NOAA Pacific Islands Regional Office, and the Indian National Institute of Oceanography (NIO). During this period, ORS also developed three NOAA PIFSC in-house applications–the "NOAA OceanWatch–Data Matcher Tool", "NOAA OceanWatch Data Explorer (1D)", and the "NOAA OceanWatch Data Explorer (2D)"–in order to support the needs of researchers within PIFSC. These applications were developed using advanced Perl-CGI, Google Earth Mapping, and javascript code to interface directly with the entire oceanographic satellite remote sensing archive available at the OceanWatch THREDDS server. Additionally, ORS also partnered with the Western Pacific Regional Fishery Management Council for developing and leading a teacher workshop on water quality monitoring in concert with the WPRFMC 158th meeting in American Samoa.

#### Seasonal Fluctuations in Pacific Island Marine Debris Deposition

#### P.I.: Mark A. Merrifield

#### NOAA Office (of the primary technical contact): National Ocean Service, Coastal Services Center

#### NOAA Sponsor: Carey Morishige

#### NOAA Goal(s)

- · Healthy Oceans
- · Resilient Coastal Communities and Economies

#### **Purpose of the Project**

Time series of Hawaii marine debris deposition has been compared to estimates of winds, waves, sea level, and currents over event, seasonal, and interannual time scales to determine if potential connections exist between environmental forcing and debris deposition rates. The debris data were collected from Tern Island, with samples available on a bi-weekly basis from 1990 through 2006. Regional wind forcing is specified using scatterometer and buoy winds, as well as atmospheric reanalysis products. The wave field is estimated using nearby NDBC buoys as well as WaveWatch III model hindcasts. Ocean currents are specified using available regional circulation model hindcasts. Statistical analyses are augmented by a particle-tracking component based on regional ocean

circulation models. The expected outcome will be a report that defines the significant statistical relationships between environmental forcing and debris deposition, and/or a discussion of deposition probabilities based on particle tracking experiments. The report is intended to provide guidelines, and best practices for improved forecasting of debris depositions in Hawaii, and other applicable locations.

#### **Progress during FY 2013**

Correlation analyses of wave, wind, and current time series have been performed with the Tern Island deposition time series. A significant correlation has not been detected, suggesting that vector winds, wind speed and direction, wave height, wave period, and vector surface currents, current speed and direction are



Figure 1. Backward trajectory of debris from Tern Island in winter of 2003 using QuikSCAT data and the Surface Currents from Diagnostic Model (SCUD) (Maximenko and Hafner, 2010). The computation was made every two days. Colors run from purple to blue to green to orange to red (regular color spectrum) to indicate time of deposition.

not skillful indicators of debris accumulation. The seasonality of debris deposition has been examined with winter months showing lower values on average than other seasons. A Monte Carlo simulation has been undertaken to determine if the decrease is statistically significant, and it appears to be marginally significant. Interannual and longer period fluctuations in debris were not significantly correlated with the SOI or PDO index.

Based on analyses developed by Jim Potemra, it was found that some of the large debris events at Tern Island correlate with meridional changes in the location of Ekman transport convergence. Ekman convergence, as estimated by the line of zero zonally-averaged meridional Ekman transport, typically occurs between 26°N to 30°N. The analysis shows during certain times, this line shifts south to near the latitude of Tern Island, and this is sometimes coincident with large marine debris deposition events (Figure 1). The relationship is not one-to-one, suggesting that additional factors may come into play, such as the time history of near convergent flow near Tern prior to large deposition events, and the combination of other forcing factors (e.g., wave, winds, tides) with convergent flow patterns. Particle drift maps have been constructed from the Surface Currents from Diagnostic Model (SCUD) (Maximenko and Hafner, 2010). This backward trajectory is helpful because it indicates where

particles came from six months earlier that ended up at Tern Island. The computation was made every two days of the specified year. In the 2003 case study, the marine debris comes from many directions. For large deposition events during this period the debris appears to originate from the northwest. This suggests that when the Ekman convergence line has moved south and is near Tern Island in the winter, the debris comes from the northwest direction. The results of this study to date have been conducted by Ms. Alyssa Agustin as part of her Global Environmental Science senior thesis at the University of Hawaii.

#### Sustaining Healthy Coastal Ecosystems

P.I.: Mark A. Merrifield [JIMAR Project Leads: Annette DesRochers, Jamison Gove, Kyle Koyanagi, Megan Moews, John Rooney, Bernardo Vargas-Angel, Jill Zamzow]

NOAA Office (of the primary technical contact): National Marine Fisheries Service/Pacific Islands Fisheries Science Center

NOAA Sponsor: Samuel G. Pooley, Russell Brainard

#### NOAA Goal(s)

· Healthy Oceans

#### **Purpose of the Project**

The JIMAR Sustaining Healthy Coastal Ecosystems project mission is to provide sound science to enable informed and effective implementation of ecosystem-based management and conservation strategies for coral reef ecosystems of the U.S.-affiliated Pacific Islands Region. To accomplish this mission, project scientists lead and participate in a multi-partner integrated, interdisciplinary program of ecosystem assessment and long-term monitoring, benthic habitat mapping, and applied research on the coral reef ecosystems of 40 primary islands and atolls in the Hawaiian Archipelago, the Mariana Archipelago (Guam and the Commonwealth of the Northern Mariana Islands), American Samoa, and the Pacific Remote Island Areas (PRIA). This work supports NOAA and other agencies in meeting mandates of the Coral Reef Conservation Act of 2000 and various executive orders issued to ensure conservation and protection of the nation's coral reef ecosystems.

#### Progress during FY 2013

*Coral Reef Fish Research to Support Ecosystem-Based Management.* The Coral Reef Fish Research Team met all established objectives for FY 2013, including but not limited to: 1) successful completion of SE-12-07, a main Hawaiian Islands reef fish survey and baited remote underwater video cruise; 2) metadata records for the Kahekili herbivore fisheries management area on Maui and 2-page informational summary of results to date at Kahekili; 3) fulfillment of over a hundred data analysis requests from the Hawaii Division of Aquatic Resources and other interested parties; 4) a series of two page, R-script-generated data products detailing fish survey results for the main Hawaiian islands as well as the Pacific Remote Island Areas and American Samoa; 5) publication of a 22 page technical report with results from 133 fish surveys inside and outside of marine protected areas around the island of Guam; 6) submission of a manuscript on herbivorous fishes in American Samoa to the openaccess journal PLOS ONE; 7) a fish survey mission to Timor Leste; 8) continued size-estimation and species identification training for the NOAA Pacific Islands Fisheries Science Center (PIFSC) Coral Reef Ecosystem Division (CRED) and partner divers; and 9) continued training of CRED team members as advanced coxswains and towed divers.

Benthic Research to Support Ecosystem-Based Management. In a continuation of decade-long monitoring of coral reef ecosystem health in the U.S. Pacific Islands, interdisciplinary Pacific Reef Assessment and Monitoring Program (RAMP) cruises are conducted around the Main Hawaiian Islands. Scientists from NOAA Coral Reef Ecosystem Division (CRED), JIMAR, and partner agencies conduct integrated assessments and monitoring of fish, corals, algae, and invertebrates and collect a variety of oceanographic and water-quality observations. Over the period August 1-23, 2012, JIMAR scientists were involved in the fifth RAMP cruise around the Main Hawaiian Islands onboard the Hi'ialakai and visited the islands of Hawaii, Maui, Lanai, Molokai, Kauai, and Niihau. JIMAR scientists closely examined the reefs around these islands to document any ecological changes since the prior expedition in 2010. JIMAR scientists will also be involved in a modified RAMP cruise taking place



(above) Figure 1. A large school of Yellowfin Goatfish (Mulloides vanicolensis) and Blue-striped Snapper (Lutjanus kasmira) swims across a SPC transect during SE1207. Photo by Paula Ayotte.

(below) Figure 2. NOAA diver Marie Ferguson collects benthic imagery data during a fish survey dive off Maui as part of Oscar Elton Sette cruise SE-12-07. Photo courtesy of Darla White, Department of Land and Natural Resources.



September 3-19, 2013, onboard the Hi'ialakai and traveling to French Frigate Shoals, Lisianski Island, and Pearl and Hermes Reef. This cruise will be dedicated to implementing the NCRMP sampling methodologies: climate related discrete water samples, Subsurface Temperature Recorders (STRs), Autonomous Reef Monitoring Structures (ARMS), Calcification Accretion Units (CAUs), and Bioerosion Monitoring Units (BMUs). This year marks the implementation of the National Coral Reef Monitoring Plan (NCRMP) which addresses a few changes to some protocols, including the inception of a stratified random approach for benthic coral surveys, as well as the selection of permanent sentinel sites within which oceanographic instrumentation and biological deployments will be affixed for long term monitoring of water thermal structure, biodiversity, and carbonate accretion, deposition, bioerosion, and benthic composition. Results from the 2013 cruises to the Main and Northwestern Hawaiian Islands will be summarized in their respective cruise reports.

JIMAR scientists conducted focused benthic surveys in areas of special interest around the island of Tutuila, American Samoa. Surveys for coral demographics, diversity, colony densities, and coral condition were conducted in March– April 2013 at nearly 40 sites in Faga'alu Bay. These surveys were part of a larger project lead by NOAA-CRCP scientists aimed at providing a baseline valuation of coral demographics



Figure 3. Chip Young taking a coral core from a large mounding coral at Kingman Atoll, May 2012.

performance measures that explicate the status and trends of the coral communities of the Bay in a spatially comprehensive manner, as it related to reducing Land-Based Sources of Pollution (LBSP) threats, namely siltation and sedimentation stress in Faga'alu, American Samoa. The coral reef in this area is severely affected by high levels of terrigenous runoff and sedimentation resulting from prolonged, deficient land use practices within the boundaries of the adjacent watershed. By conducting these surveys JIMAR coral scientists are providing critical, baseline information to local and federal managers to evaluate the effectiveness of reef-to-ridge management practices aimed at reducing land-based sources of pollution in Faga'alu Bay.

JIMAR scientists conducted 7 days of diving from April 30–May 6, 2013 and completed a total of 36 coral demographic and disease surveys along Kauai Island's north shore: at Waipa Hanalei (16 sites); Back door Hanalei (9 sites); Wainiha Bay (5 sites); and Anini (6 sites). These surveys were aimed at augmenting the efforts already undertaken by local agencies to gain a better understanding of the spatial distribution and potential ecological and environmental linkages of a rapid tissue loss coral disease outbreak initially documented in August 2012 affecting corals along the north shore of Kauai. Preliminary findings corroborate the occurrence of disease hotspots within each of the reef systems surveyed as well as the unique nature of this event.

Oceanographic Research to Support Ecosystem-Based Management. The Oceanography Team's objective is to provide high quality oceanographic data to support scientific research and information relevant to stakeholders, managers and colleagues to help better understand changes in coral reef ecosystem health owing to climate change, land based sources of pollution, over fishing and other reef ecosystem stressors.

During FY 2013 the Oceanography Team initiated implementation of NOAA's National Coral Reef Monitoring Program, climate (NCRMP-climate). The NCRMP philosophy is to collect a standard suite of oceanographic and ecological information throughout each of NOAA's jurisdictions in the Pacific in order to assess coral reef ecosystem and environmental change related to future changes in global climate, including ocean acidification.

The Oceanography Team helped to develop the oceanographic component of NCRMP-climate and the suite of parameters measured, which include; temperature, calcification rates measured by CAUs, carbonate chemistry measured by water sampling, and cryptic biodiversity measured by the ARMS. These instruments and samples will be standardized between the Pacific and Atlantic sections, to give comparable results. During FY 2013, the Oceanography Team has begun implementation of the NCRMP-climate suite in American Samoa and many of the Pacific Remote Island Areas (PRIA) including Johnston, Jarvis, Palmyra, Kingman, Howland and Baker.

In the past year, the Oceanography Team deployed instrumentation and collected water samples in Timor Leste. This marks the beginning of longterm monitoring of climate change and ocean acidification in this region.

In July 2012, Jamison Gove, Charles Young and Oliver Vetter represented JIMAR/CRED at the International Coral Reef Symposium (ICRS) in Cairns, Australia. They each presented scientific results and ongoing scientific projects that support the mission of JIMAR/CRED.

In April 2013 a combined benthic and oceanography mission to American Samoa was successfully completed. This marked the end of the yearlong oceanographic field component and the start of the data analysis portion of this project, funded by CRCP. The oceanographic instrumentation was recovered and data is currently being analyzed to work on improving the understanding of circulation patterns and sedimentation within Faga'alu Bay.

Ultimately, this information will help make decisions related to the health and preservation of Faga'alu's coral reef ecosystem.

Lastly, as part of the Coral Triangle Atlas project, the Oceanography Team computed climatologies and time series metrics for key oceanographic parameters within the Coral Triangle region. In addition, Jamison Gove attended a workshop in Penang, Malaysia, May 14-17, 2013 where he presented JIMAR/CRED's contributions to the Coral Triangle Atlas.

Information Services to Support Ecosystem-Based Management. In FY 2013, the JIMAR Information Services Team supported the efforts and activities not only for the CRED, but also for several local, regional, national, and international programs by providing technical expertise in the areas of data management, geographic information systems, graphic design, and outreach and education, and by developing several products and publications.

The team's contributions to the CRED and other programs are largely focused on addressing at least one if not several of the key data management functions. To improve planning for data

(right) Figure 5. Fish market at Kendari, Indonesia. Photo by Megan Moews.



Figure 4. Oliver Vetter removing a lead anchor that held a sea surface temperature buoy at Ta'u, American Samoa 2012.



management the team: 1) prepared a data management plan for the CRED's oceanography team; 2) worked with the PIFSC Data Management Steering Committee to develop and conduct a Data Management Human Resource Assessment for the PIFSC and drafted a PIFSC Data Management Policy and corresponding User Guide; 3) worked with American Samoa's DMWR to develop a 3-year project to plan for and support the DMWR's data management needs, and continued to seek funding opportunities for said project; and 4) developed a foundation for a spatial framework to support fisheries management in Indonesia, which has led to a new project to assess the data management needs of several directorates within the Ministry of Marine Affairs and Fisheries in Indonesia.



Figure 6. A fisherman's livelihood in Timor Leste. Often, fish such as those seen here are actually purchased frozen from Indonesia, then displayed and sold in this manner. Photo by Rusty Brainard, 2012.

To support data collection the team: 1) finalized the deliverables for the CRCP-funded project to support the GCMP's Data Management Initiative, including a web-based database application that was developed for the GCMP's coral demographic, reef fish, and macroinvertebrate datasets; 2) initiated implementation of the new system within Guam; and 3) developed and implemented a new web-based data entry application for the marine debris team in time for the 2013 debris mission and also provided a data manager to support that mission. The team assisted in the data management preparations for several other field missions as well including: 1) benthic demographic surveys in Faga'alu, American Samoa; 2) fish surveys in the Main Hawaiian Islands; 3) coral health surveys in Maui, and later in Kauai; and 4) several CTI missions, including Kimbe Bay, Timor Leste, and the Philippines. Preparations for the upcoming RAMP cruises to the Hawaiian Archipelago were also underway, including data manager training for the team's new data management specialist.

The team was also involved in numerous data processing activities this past year. For all of the aforementioned missions that took place in FY 2013, the data were processed, quality controlled, and migrated to the CRED's enterprise database. Several other datasets from prior missions were also processed, most notably from the FY 2012 RAMP cruises to the PRIA, American Samoa, and the NWHI.

With regard to data documentation, the team: 1) generated metadata records for most of the datasets collected during the FY 2012 and FY 2013 missions and submitted those records to CoRIS; 2) developed new metadata templates for the CRED; and 3) continued to implement the Pacific Islands Region Data Documentation Implementation Plan. Collaboration with the CRED, PIFSC, and CoRIS continued in support of both those efforts.

To increase data access and dissemination the team: 1) continued development of the CRED's online data tool, Reef Box, but the application has not been released to the public because the application has not yet received security clearance from NOAA for the application; 2) developed a web application built around the WoRMS web service to enable the biological teams to maintain species lists; 3) responded to numerous requests for data; and 4) continued to develop concepts to add a geospatial component to Reef Box, but as of yet none of the concepts have been implemented because of competing projects for the Coral Triangle, World View 2, and Marine Debris.

Finally, in support of data analysis and integration, the team: 1) continued development of the Atlantis ecosystem model for Guam and was recently awarded funding for 3 years from the CRCP to support the effort; 2) worked with the oceanography team to develop and publish oceanographic parameters for the Coral Triangle Atlas; 3) developed products for Timor Leste and areas in the Pacific Islands Region from World View 2 satellite imagery including derived pseudo-bathymetry and hard-soft habit layers; and 4) initiated collaborations with the CRCP to plan for the integration of data collected for the National Coral Reef Monitoring Program.



Figure 7. Nearshore bathymetry for Ni'ihau from WorldView-2 satellite imagery, with a digital elevation model from the U.S. Geological Survey in the background. Only a handful of the almost 50 islands and atolls areas within the region have high resolution bathymetry covering nearshore depths. These data are critical for spatial planning and management of marine resources. JIMAR scientists have adapted existing methods to derive bathymetry from WorldView-2 imagery to provide a low-cost interim solution.

The Information Services team also contributed to several outreach and education activities including: 1) a workshop in Guam about the Guam Atlantis Ecosystem Model organized and led by the team's Coral Ecology Researcher; 2) developing a flyer, "Large Fishes in American Samoa", in partnership with PIRO; 3) planning for a series of events to be held later in 2013 for the CRCP-funded "Reef Smart Hawaii" project; 4) finalizing the revamp of the CRED's website; and 5) creating a variety of products and materials for several Coral Triangle-related efforts.



(above) Figure 8. A survey of coral reef ecosystems in the Manu'a Islands revealed that coral species diversity remains high, even at a depth of 79 m, on a mesophotic reef off the island of Ofu in American Samoa. The bright red dots are from scaling lasers spaced 10 cm apart.

(below) Figure 9. Midway Atoll: Marine Debris Team standing next to nearly 14 metric tons that was removed during the 2013 marine debris survey and removal operations.





Figure 10. Midway Atoll—JIMAR Diver working on removing derelict fishing gear found during 2013 marine debris survey and removal operations.

Finally, the team was involved in several publications for the CRED in FY 2013 including: 1) a NOAA Tech Memo, Depth Derivation Using Multispectral World View 2 Satellite Imagery, not yet published, written by the team's Geographic Information Specialist; 2) creation of a booklet, Restoring Coral Reefs: removing marine debris in the Northwestern Hawaiian Islands; and 3) the team's Coral Reef Research was first author on an article that was published in PlosOne on three Hawaiian coral reef Ecopath models.

*The Coral Triangle Initiative*. The purpose of the project is to build capacity in the Coral Triangle (CT) region toward implementation of an Ecosystem Approach to Fisheries Management (EAFM) for improved management and sustainability of fisheries, food security, livelihoods, economic growth, and biodiversity. To this end, the overall goal is to build capacity in science and management through trainings, workshops, pilot efforts and field instrument deployments and sampling.

The project provided administrative support for all CT activities. This includes travel and meeting coordination, and coordination of field and training efforts along with curricula development and integration. For program development, the team worked with Coral Triangle partners, including governmental officials, researchers, educational institutions and non-governmental organizations, toward development/implementation of fisheries management planning frameworks and EAFM in particular. The team assisted the 6 Coral Triangle Initiative (CTI; Indonesia, Malaysia, Papua New Guinea, Philippines, Solomon Islands, Timor-Leste) countries to establish and sign off on EAFM frameworks and is working with Indonesia to develop a fisheries management planning process framework for the country. The project developed and integrated curricula and guidelines to socialize EAFM throughout the Coral Triangle. Capacity building took place through provision of technical support, training and guidance to Coral Triangle partners in moving toward EAFM. In addition to more focused trainings, EAFM trainings for leaders took place in Indonesia, Philippines, Timor Leste, Philippines, and later in the year Papua New Guinea and the Solomon Islands. Training of Trainers for EAFM was scheduled for Malaysia and Indonesia in June and September.

Field deployments took place in the Philippines, Timor Leste and later Indonesia with the deployment of an array of instruments for monitoring and assessment of ocean acidification. Stratified random fish surveys and satellite imagery are also being collected in Timor Leste. In addition, climatology information was made available to the Coral Triangle Atlas for use by the 6 countries in the region.

Benthic Habitat Mapping Research to Support Ecosystem-Based Management. Coastal and marine spatial planning, and any resource management activity that includes a spatial component, requires data on where the resources are located in order to be both effective and efficient at achieving desired outcomes. This project will address high priority needs for spatial data with which to manage coral reef ecosystems in the Pacific Islands region, in accordance with the NOAA Coral Reef Conservation Program (CRCP) report "CRCP Mapping



Figure 11. Midway Atoll—Marine Debris Team pulling derelict fishing gear into small boat during 2013 marine debris survey and removal operations.

Achievements and Unmet Needs" and other CRCP documents. This project will continue the collection, processing, and dissemination of acoustic and optical benthic habitat mapping data products in the region to fill needs for spatial data. Primary focuses of the project in FY 2013 included filling gaps in existing maps to make seamless benthic habitat map layers that extend from the shoreline to the outer edge of coral reef ecosystems, and improving understanding of the range, extent and location of coral reef resources.

A wide variety of project outcomes, deliverables and measures, distributed across the Pacific Islands Region, were proposed by the project for FY 2013 and all have been completed. These milestones include conducting autonomous underwater vehicle dives in American Samoa and Hawaii as part of a series of cruises to compare different fisheries independent methods for collecting data to support fish stock assessments. Multibeam echosounder and camera sled surveys were completed in the vicinity of Pelekane Bay on the island of Hawaii. The multibeam survey is part of decade-long effort that will provide complete datasets of high resolution bathymetry of all coral reef ecosystems in the region. In addition to Pelekane Bay, camera sled surveys were conducted around the Manu'a Islands in American Samoa. The goal in both surveys was to characterize and map coral reef ecosystem benthic communities and substrates in the deeper  $\sim 50\%$  of these ecosystems, also known as mesophotic coral ecosystems, where very little data have been previously collected. A manuscript was submitted for internal review that discussed data from previous years of surveying on mesophotic coral ecosystems in the Mariana Archipelago. In addition to bathymetry, the project produces maps of hard (rock, rubble, etc.) versus soft (sand/ mud) substrates, which are biologically important data often used to stratify sampling for ecological monitoring. Nearshore bathymetry data were derived from WorldView-2 satellite imagery for the island of Ni'ihau, and the same imagery were used to develop a method for deriving hard/soft data. Acoustically derived hard/soft data were also produced for Ni'ihau as well, providing coverage for almost the entire coral reef ecosystem there. Hard/soft maps were produced for the Manu'a Islands.

*Marine Debris Research, Removal, and Logistics Support.* Continuing annual efforts that began in 1996 to identify and remove marine debris from the Papahanaumokuakea Marine National Monument in the Northwestern Hawaiian Islands (NWHI), JIMAR staff in the PIFSC Coral Reef Ecosystem Division (CRED) successfully completed a marine debris survey and removal operation in the spring of 2013 (March 28–April 18). The project

also completed a 21 day shore-based operation at Midway Atoll conducting in-water and shoreline survey and removals operations. This year's efforts surveyed over 3 km<sup>2</sup> and removed nearly 14 metric tons of derelict fishing gear and plastics from the shallow coral reef and shoreline environments of Midway Atoll. As part of the 2013 mission, the CRED Marine Debris Team conducted extensive surveys on Midway Atoll looking for debris related to the 2011 Japan tsunami event. A few items suspected of being related to the event were reported to the NOAA Marine Debris Program. A 23.5 foot derelict vessel found on the shoreline of Midway's Eastern Island was confirmed to be lost during the 2011 Japan Tsunami event. Other items found during this year's marine debris survey are still awaiting confirmation. In addition to the normal marine debris operations other project accomplishments include: 1) completed 3 NOAA Marine Debris Program shoreline standing stock surveys; 2) opportunistically collected data for a Midway Atoll pilot accumulation rate study, and 3) tested benthic injury assessment data protocols for potential future proposals and projects. The Marine Debris Project continued to receive local, national, and international recognition with the removal of nearly 769 metric tons of marine debris from the NWHI since 1996. This year's effort became the most viewed blog post in PIFSC history within a 24 hour period. In addition to the 2013 NWHI marine debris effort, JIMAR staff also completed a rapid response marine debris removal effort on Oahu and participated in four outreach and education events. One event of particular interest was the Japan Environmental Action Network (JEAN) workshop with the Japan Ministry of the Environment, and Japan and United States government agencies. NGO's participating in this workshop discussed Japan Tsunami Marine Debris.

#### Western Pacific Fisheries Information Network (WPacFIN)

#### P.I.: Mark A. Merrifield [JIMAR Project Lead: Diosdado Gonzales]

NOAA Office (of the primary technical contact): National Marine Fisheries Service/Pacific Islands Fisheries Science Center

#### NOAA Sponsor: Samuel G. Pooley, Kimberly Lowe

#### NOAA Goal(s)

· Healthy Oceans

#### **Purpose of the Project**

The objective of this JIMAR project is to ensure that the best available fisheries monitoring data can be provided by the NOAA Pacific Islands Fisheries Science Center's (PIFSC), Western Pacific Fisheries Information Network (WPacFIN), for research and sustainable management of fisheries in the Pacific Islands Region. This is achieved through computer programming and software development, database design and management, and other information technology support to fisheries agencies participating in the WPacFIN. This technical support enables PIFSC and WPacFIN agency partners to produce timely reports and summaries of the best available fisheries data from each island area. WPacFIN partner agencies include the American Samoa Department of Marine and Wildlife Resources (DMWR); the Hawaii Division of Aquatic Resources (DAR), Department of Land & Natural Resources; the Guam Division of Aquatic and Wildlife Resources (DAWR), Department of Agriculture; the Guam Bureau of Statistics and Plans (BSP); and the Commonwealth of the Northern Mariana Islands (CNMI) Division of Fish and Wildlife (DFW). In addition to extensive involvement with these partner agencies, the project also provides services in support of vendor monitoring programs, providing mutual benefit to dealers and WPacFIN partners in support of developing improved landings value information. JIMAR staff and federal NOAA staff work cooperatively with island agencies, contractors, fishermen and fish dealers to provide the best available monitoring data for the island areas of Guam, CNMI, Hawaii and American Samoa.

#### Progress during FY 2013

WPacFIN staff is assisting in the development of a new database design that will better support WPacFIN agency partners in the island areas and NOAA-PIFSC data access and management needs. The new data structure is based on a MySQL database system deployed in the island areas, with MySQL and C# programming for data summary and user interfaces. The MySQL data system is mirrored to a NOAA Oracle database, also developed in WPacFIN Central. WPacFIN Central is staffed primarily (70-80%) via JIMAR.


(above) Figure 1. Dios Gonzales in American Samoa working on the American Samoa Data Creel Survey Data System. (below) Figure 2. Bin Wei in American Samoa working on the American Samoa Bio-Sampling Data System.



One module of the new database is designed to improve integration of American Samoa (AS) Commercial Fisheries Bio-Sampling (CFBS) data with the AS Shore-based Creel Survey data. The integration of these datasets makes it possible to improve taxonomic accuracy of estimated expanded catch estimates. These reports are used by the Western Pacific Regional Fishery Management Council ("Council") and they contribute to national and local fisheries publications, such as the NOAA annual document and online publication "Fisheries of the United States" (FUS).

The Council Fisheries Ecosystem Plan (FEP) reports include the Pelagics, Bottomfish and Coral Reef Ecosystem Plan Team reports for each island agency. FEP reports were completed in 2012-2013, but the Council continually recommends revisions in the reporting modules so there are more revisions in progress for 2014.

The migration of existing databases to MySQL and Oracle is not fully complete due to network hardware and software issues that must be resolved by PIFSC Information Technology Support (ITS) program, WPacFIN and other parties. The programs to migrate the databases to MySQL and Oracle databases are mostly complete, but testing has been delayed by the current network issues.

The project met the report deadline for FUS (April 15th) and Fishery Statistics of the Western Pacific (FSWP, August 31st) reports. These reports are compiled by WPacFIN staff using a combination of Visual FoxPro programs and MySQL stored procedures, with a C# programming interface for calling MySQL stored procedures. The FSWP document was completed for calendar year 2010, and FUS was completed for 2011 and preliminary 2012 data.

The project also completed the metadata and technical documentation for WPacFIN-developed software based in Visual FoxPro.

WPacFIN staff made numerous updates to HDAR's Fisherman Reporting System (FRS) and Dealer Reporting System (DRS), to comply with new HDAR requirements. Updates were also made to other WPacFIN developed software, including the American Samoa, CNMI and Guam Data Systems.

## **Ecosystem-Based Management**

Research under this theme focuses on facilitating an ecosystem approach to management in the Pacific Islands region. JIMAR research interests include investigations of the human dimensions of fisheries management, studies of the economic impacts from changes in fisheries, assessments of pelagic and insular fisheries stocks, and extensive public outreach and education efforts.

## **Economics of Fisheries Initiative**

## P.I.: Mark A. Merrifield [JIMAR Project Lead: Hing Ling Chan]

NOAA Office (of the primary technical contact): National Marine Fisheries Service/Pacific Islands Fisheries Science Center

## NOAA Sponsor: Samuel G. Pooley, Minling Pan

## NOAA Goal(s)

· Resilient Coastal Communities and Economies

#### **Purpose of the Project**

The purpose of this project is to conduct economic assessment of commercial and recreational fisheries and of the seafood market in the Pacific Islands Region.

## Progress during FY 2013

The project has been successful in continuing data collection and monitoring activities in the Hawaii longline fishery, American Samoa longline fishery, and the Guam and CNMI small-boat fisheries. The databases continue to be updated with additional observations.

An internal report was generated for the Scientific and Statistical Committee to summarize the economic performance indicators for these fisheries. For the purpose of training, data collection, and data quality control,

JIMAR employees traveled to American Samoa in September 2012 and to Guam and CNMI in February 2013. Two brochures are in progress: one for the Hawaii longline trip expenditures and another one for the spillover effect of environmental regulation for sea turtle interaction with Hawaii longline swordfish fishery.

Two sub-projects including cost-earnings for Hawaii longline fleet and economic returns to social networks of fishermen in Hawaii longline fishery are in data collection phase. In addition, a database was developed to present 'Tier I' economic performance measures for three main fisheries in the Pacific Islands Area. This database is in the standardized format that is consistent with the national report system.

## Human Dimensions of Fishing and Marine Ecosystems in the Western Pacific

## P.I.: Mark A. Merrifield [JIMAR Project Lead: Dawn Kotowicz]

NOAA Office (of the primary technical contact): National Marine Fisheries Service/Pacific Islands Fisheries Science Center

## NOAA Sponsor: Samuel G. Pooley, Stewart Allen, Sarah Malloy

## NOAA Goal(s)

· Resilient Coastal Communities and Economies

#### **Purpose of the Project**

The need for information on the human dimensions of marine ecosystems is becoming more important not only in assessing the effects of management on individuals, households, and communities, but in identifying possible management alternatives and accompanying social, cultural, and economic objectives. Establishment of new Marine National Monuments (MNMs) near Guam, the Commonwealth of the Northern Mariana Islands (CNMI), and the Pacific Remote Island Areas (PRIAs) raises a number of sociocultural issues relevant to management of the MNMs. Required annual catch limits for managed marine species present another critical need for social research to study the social, economic, and cultural implications of allocation of catch for consideration of management concerns. Researchers assist PIFSC in coordinating with local populations and collecting relevant information to describe the sociocultural considerations to managers as they develop management priorities and plans.

#### Progress during FY 2013

The Human Dimensions of Fishing and Marine Ecosystems in the Western Pacific project is comprised of several sub-projects described below.

Hawaii Resident Users' Knowledge, Attitudes, and Perceptions (KAP) of Coral Reefs in the Two Hawaii Priority Sites. This project involves the administration of a survey at Hawaii's coral reef priority site in South Kohala, Hawaii. The survey's purpose is to identify resident resource users' knowledge, attitudes, and perceptions (KAPs) regarding coral reef and watershed conditions and to measure participants' support of a variety of potential management strategies to protect resources at the two priority sites. JIMAR researchers designed the survey and managed its administration. The survey was conducted in South Kohala by a contractor between November 2012 and April 2013. JIMAR researchers analyzed the survey data and will present preliminary results at the upcoming Hawaii Conservation Conference in July 2013. A draft report has been written and shared with project partners, requesting feedback. When the feedback is received and addressed, the final report and findings will be presented in South Kohala to key stakeholders, project partners, and interested community members. A brochure of survey findings will also be available to interested parties, and results will be available on PIFSC's website.

Updates of the Guam and American Samoa Fishing Community Profiles. JIMAR staff in the Human Dimensions Research Program used both primary and secondary research methods to develop the profile updates. Secondary research activities consisted of compiling existing information including demographic information from the U.S. Census and reports from the governments of Guam and American Samoa. JIMAR researchers also collected and summarized other relevant information such as results from social research in both areas, and fisheries management changes proposed by the Council and the local governments. Primary data collection included phone calls, emails and in-person semi-structured interviews with the project's network of colleagues and partners familiar with Guam and American Samoa. The updates to each profile are under internal Science Center review. They will be published as companions and supplements to the original profiles. A brochure will also be produced describing key findings. These products will be available on the PIRSC website.

American Samoa. During their visit to American Samoa in September 2012, JIMAR researchers collected information on the topics identified for long-term monitoring in American Samoa as a fishing community (Levine and Allen 2009). JIMAR researchers spoke with several members of the fishing community to identify recent changes or events that have affected the fishing community and could warrant further examination. Researchers met with several Department of Marine and Wildlife Resources (DMWR) employees (including then Director Ray Tulafono and biologist Dr. Domingo Ochavillo) about the local creel survey, bio-sampling community-based fisheries management and programs. Additionally, DMWR staff organized a meeting to give the fishermen a chance to share ideas and concerns with the JIMAR researchers.

The topics covered in the update include the impact of the tsunami in 2009, opinions toward federal fishery annual catch limits (ACLs), the current status of cannery operations and perceptions regarding the establishment of Rose Atoll Marine National Monument and the expansion of Fagatele Bay National Marine Sanctuary.

Other stakeholders interviewed include: Fono Representatives and members of the Office of Samoan Affairs; NOAA and Council staff, including Michael Marsik, Fatima Sauafea-Lea'u, and Fini Aitaoto; American Samoa Community College Samoan Studies Institute; longline fishing vessel owners; and members from the Pago Pago Game Fishing Association.

*Guam.* JIMAR researchers reported on the indicators identified in Guam as a Fishing Community, where Allen and Bartram (2008) identified several



Figure 1. Honolulu Harbor (top) and Kahina Pohaku Fishpond in East Molokai (bottom). The communities of Honolulu and East Molokai, two of the communities that have been chosen for the initial stage of ground truthing, represent a contrasting set of socioeconomic and fishery characteristics. Honolulu is an urban area well known for its longline fisheries that target tuna and swordfish, whereas East Molokai is a more rural community with a primarily subsistence-based fishery.

indicators that are important to monitor over time as a means to update interested parties about the ways in which Guam has changed as a fishing community since the profile was published. In 2013, JIMAR researchers reported on these indicators: 1) fishermen's access to shoreline resources; 2) status of fishermen's cooperatives and organization; 3) fishermen and marine protected areas; 4) progress toward community-based management; 5) status and effects of military buildup; 6) role of and recovery from natural hazards; 7) socioeconomic conditions; 8) trends; and 9) fishing conflicts.

Colleagues and partners that were consulted to help identify topics to be updated and current trends in fishing and fisheries include: Manny Duenas of the Guam Fishermen's Cooperative; Jason Biggs a professor at the University of Guam; Laura Biggs of Sea Grant; Judy Amesbury of Micronesian Archaeological Research Services and other stakeholders. Additionally, they solicited information about new and developing topics of interest to Guam residents that are connected to fishing.

Utilizing Recreational and Commercial Fishermen's Knowledge and Perspectives in Assessing Annual Catch Limits in the Pacific Islands Region. In the Western Pacific Region, the setting of annual catch limits (ACLs) for managed species was difficult for many reasons. Fishermen had very limited knowledge of the procedures used or how the final limits were set, and there were no systematic opportunities for fishermen's involvement in the technical process. This project consists of two opportunities to more constructively involve fishermen in the

revising of stock assessments and ACLs. For the first, JIMAR researchers are working with the Waialua Boat Club on Oahu to involve non-commercial marine license holders in the recording of their catch and effort data for each fishing trip. Working in cooperation with the Waialua Boat Club, JIMAR researchers developed and implemented a survey to assess the extent of each member's catch, describe their motivations for each fishing trip, and document how they distribute their catch (percent given away, percent kept for personal use, etc.). The survey entails members complete a short survey after each fishing trip. The effort began in July and is ongoing for one year. This information will assist in estimating the non-commercial marine license holder catch of species for the upcoming stock assessment (such as the Main Hawaiian Islands Deep 7 bottomfish complex).

The second project involves documenting Saipan fishermen's local ecological knowledge regarding important coral reef fishery species in order to help refine the ACLs set for CNMI. The coral reef fishery in CNMI is especially data-poor in that little is known regarding the biological life history, overall level of abundance, the overall catch of several species. JIMAR researchers conducted semistructured interviews with fishermen and other long-term residents regarding these topics for coral reef fishery species. JIMAR researchers will compile the information and present



Figure 2. A participant in the Traditional Fishing project shows JIMAR researchers the fish freezer at his home in Saipan, CNMI.

their findings in a workshop format to those who were interviewed. Through the workshop, researchers hope to collaboratively refine the findings and provide the general context of the coral reef fishery, currently and historically over the past several decades.

Validation of National Social Indicators in Hawaii Fishing Communities. JIMAR researchers are participating in a national initiative to create a set of standardized social indicators for fisheries communities. Social indicators are being developed as a statistical tool useful in gauging the relative vulnerability of different communities to fishery changes and impacts, making it possible to compare communities within and across regions with respect to potential social and economic fisheries-related impacts. JIMAR researchers have integrated U.S. Census and American Community Survey data with fisheries data to create these indicators for Hawaii and, to the extent possible, for American Samoa, Guam, and CNMI. Five sub-island communities in Hawaii (defined at the census county division level) that represent a broad range of socioeconomic and fishing conditions were chosen to validate the indicators—Honolulu, Waianae, Kailua-Kona, Hilo and East Molokai. Researchers interviewed fishermen representing different fishing sectors and other knowledgeable community representatives in these communities to collect qualitative data for validating the accuracy of the social indicators. JIMAR researchers also coordinated with other regions to integrate the social indicators into a national database. A draft report has been produced describing the statistical analysis of the region's social indicators. A second report describing the validation process will be drafted following the completion of the second year of groundtruthing in five more selected communities in Hawaii.

Research in Marine National Monuments of CNMI and Guam, American Samoa and the Pacific Remote Islands Areas (PRIAs). JIMAR researchers continued work on the traditional fishing work in the Islands Unit of the Marianas Trench Marine National Monument (MTMNM). A brochure about this research work was produced and distributed to study participants and the interested public. Additionally, a video and multiple sound recordings were produced and will be distributed to partners for display in several outlets to increase public awareness of the use of the Islands Unit prior to its declaration as part of the MTMNM. The final report in the form of an Administrative Report is in final review. JIMAR researchers produced a data report of results from the phone survey of Guam and CNMI residents regarding management preferences for the MTMNM. They presented the results of both of these research projects in CNMI at a fishermen's workshop and a workshop for planning research in the MTMNM. During these presentations, they solicited comments from the public and managers to apply towards further research.

Funds from the Rose Atoll and PRIAs projects were directed to the Marianas Trench Marine National Monument-related projects. JIMAR researchers participated in planning activities for research to be conducted in the Monument in the upcoming 5 years. Project development for this work is currently underway but includes further research regarding fish dispensation patterns and tracking the effectiveness of outreach efforts to residents of the CNMI and Guam.

## Pacific Islands Region Observer Program Initiative

## P.I.: Mark A. Merrifield [JIMAR Project Lead: John Peschon]

# NOAA Office (of the primary technical contact): National Marine Fisheries Service/Pacific Islands Regional Office

## NOAA Sponsor: Michael Tosatto, John Kelly

## NOAA Goal(s)

Healthy Oceans

## **Purpose of the Project**

The Pacific Islands Regional Observer Program (PIROP) is required by a fishery management plan developed by the Western Pacific Regional Fishery Management Council and approved by the National Marine Fisheries Service with the authority of the Magnuson-Stevens Fishery Conservation and Management Act, the Endangered Species Act and the Marine Mammal Protection Act. The observer program provides high quality data on protected



Figure 1. Cheree Smith with graduating observer training class in Majuro, Marshall Islands.



Figure 2. John Peschon with graduating observer class in Kiribati.

species interactions (sea turtles, marine mammals, and seabirds), catch composition, fishing effort, and selected fisheries research projects from commercial longline vessels based in Hawaii and American Samoa. The data are collected at sea by fisheries observers. The primary responsibility for PIROP debriefers is to train observers and ensure the quality and integrity of observer data through the debriefing process.

## Progress during FY 2013

Over the reporting period (July 2012–May 2013), 315 observer trips were debriefed. Program staff led instruction sessions and developed a training module for one observer training classes in Honolulu. A high retention of observers in the Hawaii and American Samoa longline fisheries obviated the need for additional training classes. The program provided support to developing fisheries in the Pacific Islands by training new observers and observer trainers in the Republic of the Marshall Islands, Fiji, Republic of Vanuatu and the Federated States of Micronesia. The program worked with the Forum Fisheries Agency (FFA) and the Secretariat of the Pacific Communities (SPC) in cooperation to develop and enhance at-sea fisheries monitoring programs and aid in the development of observer databases. The program developed a Marine mammal identification training module for observers to refresh their identification of these animals.

## Pacific Islands Region Outreach and Education Program

P.I.: Mark A. Merrifield [JIMAR Project Lead: Gary Karr]

NOAA Office (of the primary technical contact): National Marine Fisheries Service/Pacific Islands Fisheries Science Center

NOAA Sponsor: Samuel G. Pooley, Wende Goo

NOAA Goal(s)

Healthy Oceans

## **Purpose of the Project**

The objectives of this project are to plan, develop, and implement effective communications, outreach and education programs as a partnership between JIMAR and the NOAA Fisheries Service Pacific Islands Region (PIR)–including both the Pacific Islands Regional Office (PIRO) and the Pacific Islands Fisheries Science Center

(PIFSC). To carry out the project, a Communications Team comprised of JIMAR employees serves as a resource, advisor and point of contact for outreach and education activities for JIMAR and NOAA Fisheries PIR staff, in the divisions and programs of both offices. This project directly supports the JIMAR theme of achieving a sustainable balance between the forces of coastal development, conservation and preservation goals by performing outreach and education.

## Progress during FY 2013

Proposed objectives for the fiscal year were accomplished including events participation, materials produced and staff recruitment. During the fiscal year a new staff member joined the JIMAR Communications Team as an Outreach and Education Coordinator. The Outreach and Education Coordinator began work in April of the fiscal year and assumed the duties related to this position including planning, scheduling, carrying out and developing outreach and education materials for upcoming events.

During FY 2013, the program produced communications, outreach and education materials that JIMAR and/ or NOAA Fisheries PIR divisions and programs staff displayed or distributed directly to the public, partners or stakeholders at community events and other venues. The program supports all the divisions and programs within both PIRO and PIFSC creating a consistent outward facing message and image. Participation in outreach and education events informed and engaged the public and stakeholders concerning PIRO and PIFSC efforts to manage, conserve and recover the marine resources under its jurisdiction. The communications materials produced provide information to the public, partners, collaborators and stakeholders that communicate NOAA'S mission to the public and other audiences in easy to understand language and a visually appealing format.

The events in which the program participated ranged from an elementary class size to over 20,000 at the Hawaii Fishing and Seafood Festival. Communications Team staff coordinated and implemented participation as well as designed and produced displays and informational materials for outreach events and activities throughout the year. Events staffed or supported during FY 2012 include the following.

- NOAA Fisheries Honolulu Service Center at Pier 38-opening ceremony
- Hawaii Conservation Conference
- Fisheries in Your Neighborhood at Kahala Mall
- · Fisheries in Your Neighborhood at Windward Mall
- 7th Annual Hawai'i Fishing & Seafood Festival at Pier 38 Fishing Village
- WPFMC Fishers Forum-Tuna, Tuna, Tuna
- Career fairs for Washington, Wheeler, and Niu Valley Middle Schools
- Welcome Back Whales event at Turtle Bay Resort
- Hokulani Elementary School Science Night
- Hawaii Fish and Dive Expo
- Science Alive! at Bishop Museum
- Hawaii Ocean Expo
- Punahou School Sustainability Fair
- · Seven Earth Day events around Oahu and one on Molokai
- Pacific Islands Region 10th Anniversary
- Career Day for Mililani Elementary
- North Shore Ocean Fest at Turtle Bay Resort—A World Ocean's Day Celebration Materials and displays produced include the following.
- Monthly Employee Brown Bag Seminar series advertisements
- Posters, signage, and displays for NOAA Fisheries Honolulu Service Center opening ceremony
- Hawaii Charter Fishing Cost-Earnings Survey 2012 brochure
- Aku Boat Photo Display activity
- Banners, posters, and displays for Fisheries in Your Neighborhood, Hawaii Fishing and Seafood Festival, Hawaii Fish and Dive Expo, Science Alive! at Bishop Museum, Hawaii Ocean Expo and North Shore Ocean Fest events
- Marine Science 101 interactive educational activity materials
- New Pacific Islands Regional Office brochure
- · Graphics, text revision, design, and layout for Hawaiian monk seal brochure and banner
- Graphics, text, design, and layout for Marine Wildlife Viewing Guidelines brochure



Figure 1. NOAA Fisheries Pacific Islands Region outreach and education booths at the Hawaii Ocean Expo 2013. The two-day event attracted an estimated 5,000 attendees who learned about NOAA Fisheries and its mission.



Figure 2. Program staff help interpret and transform complex scientific data, results and concepts into an array of products that are easily understood, visually appealing and compelling. Public understanding and support are key elements to the continued success of JIMAR and NOAA Fisheries Pacific Islands Region.

- PIFSC Quarterly Report Bulletins design and layout
- Federal Programs Office Annual Report graphics, proofing, design, and layout
- PIFSC twitter account development and maintenance
- PIFSC blog account development and maintenance
- PIRO website revisions (e.g., Federal Register Notices, proposed and final rules, page content edits and updates, new pages, etc.)
- PowerPoint presentations for career days
- Various video presentations for PIRO visitors lobby monitor
- NOAA Fisheries Interactive Touch Screen Kiosk Project content development and site determination
- Graphics, design, layout and content for posters, FAQ sheets, PowerPoint presentations, and handouts for distribution to congressional contacts and the general at public hearings held throughout the US Pacific Islands concerning the corals proposed listing
- Produced posters, banners, and web page for NOAA Fisheries Pacific Islands Region (PIRO and PIFSC) 10 Year Anniversary recognition events
- Essential Fish Habitat fact sheet
- Oscar Elton Sette fisheries research in the Marianas spring 2014 flyer
- Spinner Dolphin sign at Kealakekua Bay (revised and updated) in collaboration with State of Hawaii DAR
- Marianas Trench Marine National Monument and Marianas Archipelago Ecosystem Science Implementation Workshop 2013 flyer
- PIR Species of Concern FY 2012 Year-End Report branding and posting
- Marianas Trench Marine National Monument and Marianas Archipelago Ecosystem Science Implementation Workshop 2013 flyer

## Pacific Islands Region Sustainable Fisheries Initiative

## P.I.: Mark A. Merrifield [JIMAR Project Lead: Christopher Hawkins]

# NOAA Office (of the primary technical contact): National Marine Fisheries Service/Pacific Islands Regional Office

## NOAA Sponsor: Michael Tosatto, Robert Harman

## NOAA Goal(s)

· Healthy Oceans

## **Purpose of the Project**

The project has two components: 1) to collect, compile and analyze social science data supporting regional federal fisheries policy-making per the Fishery Conservation and Management Act (FCMA), the National Environmental Policy Act (NEPA), and other federal statutes (social science); and 2) to further communication with stakeholders in the Region–including fishermen, the general public, non-government organizations and government agencies (outreach). In addition, JIMAR staff assists Sustainable Fisheries Division (SFD) staff with various NOAA fisheries initiatives in the Region, as appropriate.

## Progress during FY 2013

Social Component. The JIMAR/SFD Social Scientist accomplished the following.

• Developed a template, based on regulatory requirements, to ensure that the required FCMA National Standard 8 information and analysis elements described in regulation are included in fishery ecosystem plans and amendments. This template was used to examine potential social impacts to fishery participants and communities so that the Western Pacific Regional Fishery Management Council (Council) and NOAA Fisheries were able to make better-informed policy choices and the documents more fully met required national standards for fishery policy-making. The template was shared with national colleagues.

• Mentored a NOAA Hollings Scholar undergraduate intern during the reporting period. This internship resulted in an internal document of contemporary social and economic portraits of non-commercial fisheries in the Region.

• Managed a large mail survey of Hawaii registered boaters regarding boat-based fishing topics. This project

addressed Goals 2 and 3 of the Regional Saltwater Recreational Action Agenda (Improve Recreational Catch, Effort, and Status Data; Improve Social and Economic Data on Recreational Fisheries).

• Managed a consulting contract regarding the flow of non-commercially caught fish through selected communities on the Big Island.

 Served as 2012 co-lead for the new allregion NMFS/Fisheries Management Council Social Science Policy Group.

• Served as Division lead for the Oceanic Libra Corporation's Western Pacific Community Development Program request to the Council and NMFS.

· Along with the Pacific Islands Fisheries Science Center, initiated the development of a Social Science Research Working Group, to include the Council and other key partners.

Outreach *Component*. The Sustainable Fisheries Outreach and Education the 2013 Hawaii Fishing and Diving Expo. Specialist accomplished the following.



JIMAR The JIMAR Social Scientist assists a young boy with a fishing activity at

- Designed and produced the final report for the August 2012 Recreational Fishing Summit.
- Designed and produced the 2011 Annual Seabird Report.
- Completed multiple updates to the SFD website.
- Developed web updates that include new web pages for the Recreational Fisheries and Seafood Programs.

· Collaborated with the JIMAR Communications Team to design a full-range of materials for the corals Endangered Species Act proposed listing activities and the PIR 10 Year Anniversary celebration.

## Pelagic Fisheries Research Program

## P.I.: Kevin C. Weng

NOAA Office (of the primary technical contact): National Marine Fisheries Service/Pacific Islands **Fisheries Science Center** 

## NOAA Sponsor: Samuel G. Pooley

## NOAA Goal(s)

· Healthy Oceans

## Purpose of the Project

Manage the activities of the PFRP, solicit and implement new research proposals, and promote science-based management of fisheries for highly migratory fisheries in the western Pacific Ocean.

## Progress during FY 2013

- Request for Proposals. No RFP was issued during 2013 because the funding was reduced such that the PFRP had no funds available.
- *Multi-year projects*. The PFRP had no remaining multi-year projects to fund.
- International collaboration in research on pelagic fisheries. The PFRP continues to support the ADMB Project, an international effort to ensure that the AD Model Builder software will be maintained in the future. (This software is used in over 200 fisheries management agencies for statistical modelling and assessment of fish population around the world; see http://admb-project.org/.)



CLIOTOP science implementation structure from Hobday, A. J., Young, J. W., Abe, O., Costa, D. P., Cowen, R. K., Evans, K., Gasalla, M. A., Kloser, R., Maury, O., and Weng, K. C., 2013, Climate impacts and oceanic top predators: Moving from impacts to adaptation in oceanic systems, Rev. Fish Biol. Fish., doi:10.1007/s11160-013-9311-0.

Postdoctoral scholar, Martin Pedersen (Denmark) collaborated with the PI to produce a paper on analytical methods for studies of spatial ecology in fishes. The manuscript was accepted for publication in "Methods in Ecology and Evolution".

PFRP program manager. The PFRP program manager made presentations at the following conferences.

1) "Habitat of a globally distributed deep water shark, *Hexanchus griseus*, in Hawaii". Presented at the International Society for Ichthyology and Herpetology/American Elasmobranch Society, 8 August 2012, Vancouver, Canada.

2) "Movements of Bottomfish Determined with Acoustic Tracking". Presented at the Western Pacific Regional Fishery Management Council bottomfish workshop, 24 October 2012, Honolulu, HI.

3) "Pelagic Fisheries Research Program". Presented at the CMORE Career Workshop, 5 November 2012, Honolulu, HI.

4) "Pilot Study: Movements of Bottomfish Determined with Acoustic Tracking". Presented at the PIFSC Bottomfish Workshop, 25 February 2013, Honolulu, HI. The PI also presented work by Dr. Ana Vaz on larval dispersal and recruitment, because Dr. Vaz was unable to attend, and the PI was familiar with her work.

5) "Vertical habitat use of nektonic animals in relation to oxygen". Presented at the Climate Impacts on Oceanic Top Predators (CLIOTOP) Symposium, 11 February 2013, Noumea, New Caledonia. The PI was a co-organizer of this conference and also serves as the co-chair of the CLIOTOP Steering Committee.

6) "Climate Impacts on Oceanic Top Predators (CLIOTOP)–Progress and alignment with IMBER". To be presented at the upcoming Integrated Marine Biogeochemistry and Ecosystem Research (IMBER) SSC Meeting, 17 June 2013. Las Palmas, Spain.

The PFRP, in collaboration with the Large Pelagics Research Center at the University of Massachusetts, maintains a website to serve and support the use of geolocation tools for the scientific community. http://code.google.com/p/geolocation.

## Stock Assessment Research Program

## P.I.: Mark A. Merrifield [JIMAR Project Lead: Hui-Hua Lee]

## NOAA Office (of the primary technical contact): National Marine Fisheries Service/Pacific Islands Fisheries Science Center

## NOAA Sponsor: Samuel G. Pooley, Gerard Dinardo

## NOAA Goal(s)

· Healthy Oceans

## Purpose of the Project

The goals of this JIMAR program are to: 1) assess the status of pelagic species in the Pacific Ocean: 2) assess the status of insular resources in the Pacific Islands Region (PIR), including the Hawaiian Archipelago and U.S. Territories; and 3) assess the impacts of fishing on these various stocks. PIFSC and JIMAR staff primarily conduct collaborative assessments of pelagic fish stocks in the Pacific Ocean along with scientists from Japan, Taiwan, Korea, China, Mexico, the Inter-American Tropical Tuna Commission (IATTC), and the Secretariat of the Pacific Community (SPC). The assessments are conducted under the auspices of the International Scientific Committee for Tuna and Tuna-like species in the North Pacific Ocean (ISC). Priority is given to marlins, swordfish and oceanic sharks species (blue, oceanic whitetip, silky, mako and thresher sharks) in the Pacific Ocean. Researchers in this project also investigate bottomfish and crustaceans in the PIR. The primary objective of these investigations is to provide quantitative information that meets defined standards of scientific rigor and satisfies management requirements for sustainable exploitation of these resources.



Figure 1. Deployment of an Autonomous Underwater Vehicle (AUV) used for fisheries-independent surveys. A typical use by JIMAR researchers is recording fish sightings using a stereo-video camera system.



Figure 2. Stock assessment results with striped marlin Kajikia audax in the western and central North Pacific Ocean (WCNPO). This work was conducted under ISC auspices, with Dr. H.-H Lee of JIMAR as the lead analyst. The first and second graphs are annual landings by country and by gear type, respectively, reported by ISC member countries from 1952 through 2010. The Other category in (a) includes catches reported to the WCPFC by the Philippines, Indonesia, China, Vanuatu, Contains Federated States of Micronesia, and Belize. The Other category in (b) refers to miscellaneous gears including bait, net, trap, coastal fisheries and WCPFC catch. (c) Kobe plot depicting the relationship between relative fishing mortality and relative spawning biomass in the WCNPO from 1975 through 2010.

## Progress during FY 2013

JIMAR researchers within the PIFSC Stock Assessment Program completed several tasks with reef fishes and pelagic fishes in FY 2013. Progress for the two types of fishes is described separately below.

A stock assessment for the highly migratory pelagic striped marlin Kajikia audax was completed with Dr. H.-H. Lee as the lead analyst. This assessment was favorably reviewed by three scientists from the Center for Independent Experts (CIE) in January 2013. JIMAR researchers are also participating in ongoing Pacific blue marlin and North Pacific blue shark stock assessments that should be completed in FY 2013 or early FY 2014.

Analytical and statistical work on reef fishes included: 1) assessment of key species of Hawaiian reef fishes using a length-based approach; 2) development of computer programs applicable to sampling methodology calibration and life history parameter analyses; and 3) optimization of a fish sampling design for the Main Hawaiian Islands. Additional work included: 1) participation in a two-week cruise around the Main Hawaiian Islands to conduct underwater visual surveys of reef fishes; 2) participation a two-week workshop on stock assessment in data-poor situations that was held in Jakarta and Lombok, Indonesia; and 3) organization of a two-day workshop on length-based mortality estimation. Attendees at the latter meeting included members of the Local Planning Teams for Hawaii, American Samoa, Guam, and the Commonwealth of the Northern Marianas, respectively.

## Protection and Restoration of Resources

This theme seeks to develop tools and approaches for protection and restoration of living marine resources, habitats, and ecosystems in the Pacific Islands region. JIMAR scientists work to protect, restore, and educate the public on endangered species of marine turtles, Hawaiian monk seals, and cetaceans. JIMAR works to protect and restore pelagic and insular fisheries through stock assessments, fisheries monitoring, and fisheries information exchange. JIMAR also conducts research and mitigation efforts on marine debris around the Pacific Islands.

## **Cetacean Research Program**

## P.I.: Mark A. Merrifield [JIMAR Project Lead: Marie Hill]

NOAA Office (of the primary technical contact): National Marine Fisheries Service/Pacific Islands Fisheries Science Center

NOAA Sponsor: Samuel G. Pooley, Erin Oleson

## NOAA Goal(s)

· Healthy Oceans

## **Purpose of the Project**

The JIMAR Cetacean Research Program (CRP) is charged with assessing the status of cetacean stocks within the U.S. Exclusive Economic Zone (EEZ) waters of the Pacific Islands region (PIR), which encompasses the EEZ around the entire Hawaiian archipelago, Johnston Atoll, Kingman Reef and Palmyra Atoll, Baker and Howland Islands, Jarvis Island, American Samoa, Wake Island, Guam, and the Commonwealth of the Northern Mariana Islands. At least 34 cetacean stocks occur in the Hawaiian EEZ alone, and many more exist in the other PIR EEZs, though most are largely unstudied. Assessment of cetacean stocks includes conducting inventories of species within each PIR EEZ, followed by evaluation of the structure of the stocks within each EEZ, the population status of each stock, and evaluation and mitigation of human impacts on cetacean stocks.

## Progress during FY 2013

During May-June 2013 the CRP is conducting a large vessel survey within the Papahānaumokuākea Marine National Monument boundary. The Papahānaumokuākea Associated Cetacean Ecology Survey (PACES) goals include the collection of both visual and acoustic data on all cetacean species encountered, as well as, biopsy sampling when possible. One of the primary target species is the false killer whale (*Pseudorca crassidens*). The CRP will attempt to deploy satellite tags, collect individual photo-identifications, and biopsy samples from the Northwestern Hawaiian Islands stock of false killer whales in order to determine if their habitat usage overlaps with those of the insular (endangered) or offshore stocks within the Hawaii EEZ.



Pilot whale within the photo-identification catalog from the Marianas

The CRP JIMAR Project Lead returns to Guam, Saipan, Tinian, and Rota in mid-June in order to conduct small boat surveys for the photo-identification and biopsy sampling of cetaceans within the surrounding waters. During Fiscal Year 2013, JIMAR staff created photo-identification catalogs for short-finned pilot whales (*Globicephala macrorhynchus*), bottlenose dolphins (*Tursiops truncatus*), and spinner dolphins (*Stenella longirostris*) using photos taken within the Marianas (2010-2012).

The CRP Longline High-frequency Acoustic Recording Packages (HARP) project continues to acoustically monitor the Hawaii-based longline fishery to gain a better understanding of false killer whale (*Pseudorca crassidens*) interactions with fishing gear. Through collaboration among scientists, fishermen and engineers, great developments have been made to the overall instrument design and deployment scheme. A total of 7 fishing trips have been acoustically monitored over the past year, with an average of 12 sets per trip. Five of those trips involved single instrument deployments, while a fishing vessel was chartered through support from the Hawaii Longline Association for the other two trips in order to deploy multiple recorders on each set in areas with high depredation risk. Preliminary analysis of the acoustic data obtained has identified probable *Pseudorca* whistles on some of the sets, both with and without depredation.

The CRP continues to maintain High-Frequency Acoustic Recording Packages (HARPs) for long-term continuous recording of cetacean occurrence off the Kona coast of the Island of Hawai'i, Kaua'i, Pearl and Hermes Reef in the Northwestern Hawaiian Islands, Wake Island, Tinian and Saipan. Results of these monitoring efforts will provide detailed accounts of the seasonal and diel behavior of cetaceans in these locations.

## Hawaiian Monk Seal Research Program

#### P.I.: Mark A. Merrifield [JIMAR Project Lead: Lizabeth Kashinsky]

## NOAA Office (of the primary technical contact): National Marine Fisheries Service/Pacific Islands Fisheries Science Center

#### NOAA Sponsor: Samuel G. Pooley, Charles Littnan

#### NOAA Goal(s)

· Healthy Oceans

## **Purpose of the Project**

The JIMAR Hawaiian Monk Seal Research Program (HMSRP) conducts research on the Hawaiian monk seal (HMS), the most endangered marine mammal occurring entirely within U.S. jurisdiction. There are approximately 1,200 individuals remaining and the population is declining. The program conducts studies designed to promote sound conservation and management of the species by characterizing natural and anthropogenic factors that may impede population recovery. Research focuses on connections between population biology, foraging ecology,



(above) Figure 1. Hawaiian monk seal at rest at Pearl and Hermes Reef, photo by Jon Brack.

(below) Figure 2. Identifying individual Hawaiian monk seals at Pearl and Hermes Reef, photo by Jon Brack.



individual health, and environmental/oceanographic parameters in the North Pacific. The program develops, tests, and implements tools to assist in recovering the species

#### **Progress during FY 2013**

Activities undertaken by the JIMAR HMSRP included population monitoring and assessment, survival enhancement, foraging ecology characterization, health and disease evaluation, and behavioral research. Field camps were deployed to the Northwestern Hawaiian Islands from June 4-July 3, 2012. JIMAR staff reviewed and revised protocols, trained field personnel in data and specimen collection techniques, and provided logistical support for the camps. JIMAR field personnel collected survey and life history data and specimens, removed marine debris from beaches, tagged seals for long-term identification, disentangled seals, reunited mother-pup pairs, and documented and mitigated mortality caused by males exhibiting aggressive behaviors towards other seals. JIMAR staff also collected specimens and survey and life history data in the main Hawaiian Islands (MHI), responded to and coordinated responses to HMS strandings in the MHI, and participated in necropsies and rehabilitation efforts, including capture of debilitated seals. The foraging ecology program continued analysis of MHI seal scat for dietary studies. The program also deployed telemetry equipment, including Crittercams to record high-definition video of HMS foraging behavior. Program staff gained technical skills and the ability to expand and enhance monk seal population assessment efforts through collaboration with a visiting scientist who trained staff to operate a new remote camera system. The health and disease program collected biomedical samples for disease surveys in the MHI in conjunction with telemetry deployments and from stranded animals. Samples were sent to various laboratories for analysis. The program also managed the disposition of a large number of biomedical samples accumulated during population assessment activities and MHI epidemiological sampling, continued an ongoing reorganization project to better manage the samples, and maintained a live animal care life support system.

Shark predation monitoring and mitigation to prevent monk seal pup mortality and fishing for predatory Galapagos sharks in nearshore areas of pupping sites occurred at French Frigate Shoals (FFS). Field staff translocated weaned pups from areas of higher to lower predation risk within the atoll and two pups were translocated from FFS to Laysan. Field staff at Laysan, Lisianski, and Kure Atoll applied a topical anthelminthic to young seals and collected associated data to determine the efficacy of treating parasite infections. JIMAR staff coauthored manuscripts on large scale HMS movements and impacts of nearshore fisheries on MHI seals and prepared a manuscript on MHI seal biocontaminant loads incorporating spatial distribution data. Staff also improved a data interface allowing for greater efficiency and improved ability to analyze data, and participated in directed studies of main Hawaiian Island (MHI) seal behavioral observations for anthropogenic interactions. JIMAR staff served as part of the HMS critical habitat review team for designation of critical habitat in the MHI and participated in outreach activities

## Marine Turtle Research Program (MTRP)

## P.I.: Mark A. Merrifield [JIMAR Project Lead: Devon Francke]

## NOAA Office (of the primary technical contact): National Marine Fisheries Service/Pacific Islands Fisheries Science Center

NOAA Sponsor: Samuel G. Pooley, George Balazs

## NOAA Goal(s)

· Healthy Oceans

## **Purpose of the Project**

This project includes ten discrete elements: 1) research to reduce or mitigate high-seas and coastal fishery bycatch of sea turtles; 2) research on the general biology, life history and ecology of sea turtles in coastal marine habitats and on nesting beaches; 3) monitoring of sea turtle population trends for stock assessments; 4) simulation modeling of long term sea turtle datasets to better understand population dynamics; 5) health assessments and disease investigations with focus on sea turtle fibropapilloma tumor disease; 6) administration of a sea turtle stranding and salvage network for research and live turtle rehabilitation; 7) training, capacity building and sea turtle information exchange with other Pacific islands; 8) educational outreach to the public focused on sea turtle research results; 9) maintenance of efficient and secure computerized storage, management, and retrieval of sea turtle research data; and 10) training of observers training in the collection of sea turtle data aboard commercial longline fishing vessels.

## Progress during FY 2013

In the FY 2012 annual report, MTRP identified the following goals for FY 2013: 1) continue research of the pelagic ecology and movements of sea turtles to develop management strategies to reduce bycatch; 2) continue captive care and rehabilitation of captive-reared and stranded turtles; 3) conduct necropsies on stranded turtles and collect and



Figure 1. MTRP JIMAR Marine Turtle Research Specialist Irene Nurzia-Humburg presenting a commemorative plaque to Meg Duhr-Schultz, FWS Refuge Manager on Tern Island, FFS, on June 19, 2012 in celebration of 40 years of sea turtle nesting research and partnership.

manage biological samples; 4) conduct longline observer training; 5) participate in field captures of marine turtles in the main Hawaiian Islands; 6) collect nesting data at FFS in the NWHI; and 7) hire and train a new JIMAR

MTRP Stranding Associate. The project's progress toward these goals is discussed below.

• JIMAR Marine Turtle Specialist, Denise Parker, manages a Pacific-wide satellite-tracking database, prepares maps, analyzes satellite-tracking data, and provides data for publication in peer-reviewed journals. Data has been managed and maps were produced for 94 turtles from seven projects throughout the Pacific during FY 2013.

• JIMAR Employees Wendy Marks (July 2012 to February 2013), Devon Francke, and Irene Nurzia-Humburg (December 2012 to present) along with NMFS MTRP staff and the public, rescued, rehabilitated, and released 34 stranded sea turtles. Two of these turtles required extended rehabilitation at the NMFS Kewalo Research Facility. Daily care of these two turtles involved feeding, cleaning tanks, administering medications, assisting the veterinarian and conducting external visual exams.

• NOAA built a new life support system for turtle rehabilitation and research at the DKIRC at Ford Island. Wendy Marks was one of the designated individuals to go through the intensive training to learn how to operate this highly specialized and technical system. When NOAA moves to the DKIRC in early 2014, marine turtle rehabilitation and captive care will be monitored and maintained at this new facility.

• JIMAR employees Wendy Marks, Devon Francke, and Irene Nurzia-Humburg along with NMFS MTRP staff conducted 120 necropsies on stranded marine turtles during FY 2013. Salvaged carcasses were examined externally



Figure 2. MTRP JIMAR Marine Turtle Biological Stranding Associate Devon Francke validating nesting record data collected at French Frigate Shoals and entered into the Oracle Turtle Database Processing System (OTDPS). During FY 2013, Devon validated more than 11,000 records. Data validation and entry into OTDPS are two major aspects of Devon's work with JIMAR and the MTRP.

and a gross necropsy was performed to ascertain a cause of stranding. Biological samples such as skin for genetic analysis, food items for diet analysis and tumor tissue for disease studies were collected and managed by JIMAR MTRP stranding associates.

• JIMAR MTRP employees, along with NMFS MTRP staff, did not conduct longline observer training sessions in FY 2013; no training sessions were scheduled by PIRO during the current fiscal year.

• JIMAR MTRP employees, Wendy Marks and Devon Francke, participated in field captures of juvenile and subadult green turtles on July 10-12, 2012 at the Kailua Bay study sites. Devon Francke also participated in field captures on May 1, 2013 at Punaluu Black Sand Beach on Hawaii Island. Juvenile green turtles were captured by hand/snorkel or by scoop net and then tagged, measured, weighed, examined and released.

• JIMAR MTRP Biological Research Associate, Irene Nurzia-Humburg led a 28 day field camp at East Island, French Frigate Shoals, a major nesting site for Hawaiian green turtles. This was the 40th consecutive year of nesting data collection at this site and Irene's 6th year. A total of 402 nesters were encountered and comprehensively cataloged during monitoring period. Upon safe return to Honolulu, a post-season analysis of information collected during the 2012 nesting season was completed including: 1) thorough proofing of the data; 2) finalizing the yearly findings report; 3) updating the Standard Operating Procedures manual; 4) downloading and archiving photos; 5) downloading GPS and temperature logger data; and 6) creating maps and graphs from the data.

• Recruitment and interviews were conducted to select a new JIMAR MTRP Stranding Associate that will be hired prior to the end of FY 2013. This position will assist in stranding response, necropsies, and database entry and validation, alongside other day-to-day duties. A final selection for the position is close at hand.

• JIMAR Associate Wendy Marks completed online classes at San Juan College toward obtaining an Associate Degree in Veterinary Technology and national certification. JIMAR assisted toward this goal with tuition reimbursement.

• In December, 2012, Wendy Marks gave a presentation at the Sea Turtle Rehabilitation Workshop, hosted by the Turtle Hospital at Marathon Island in the Florida Keys. The information Wendy obtained at these talks will lead to improved methods of treatment.

• Denise Parker peer-reviewed manuscripts submitted for publication to the journals of Herpetologica and Herpetological Conservation and Biology.

• Devon Francke completed a year-long project developing graphs that summarized weekly stranding cases from 2012 to contrast with weekly cases during 2011. The report indicated a 20.4% decrease in overall strandings from 2011 to 2012.

• Irene Nurzia-Humburg prepared and submitted to the FWS the inaugural annual report that describes the Marine Turtle Research Program and Marine Turtle Assessment Program activities for the calendar year 2012 involving terrestrial relevant research aspects of sea turtles in Hawaii and elsewhere in the Pacific Rim. She also completed the Papahanaumokuakea Marine National Monument Annual Action Plan Evaluation for the calendar year 2012.

## Protected Resources Environmental Compliance Initiative (PRECI)

## P.I.: Mark A. Merrifield [JIMAR Project Lead: Karen Frutchey]

# NOAA Office (of the primary technical contact): National Marine Fisheries Service/Pacific Islands Regional Office

NOAA Sponsor: Michael Tosatto, Alecia Van Atta

## NOAA Goal(s)

• Healthy Oceans

## **Purpose of the Project**

This JIMAR project works to develop and implement strategies to further recover marine species protected under the Endangered Species Act (ESA) and /or the Marine Mammal Protection Act (MMPA), including conduct of Section 7 consultations under the ESA. The project assists in the analysis and procedural requirements to manage federal fisheries in compliance with the ESA and the MMPA, and develops and delivers outreach and education campaigns for the public concerning protected resources issues.

#### Progress during FY 2013

The objectives established for this period included: 1) sea turtle conservation, management and fisheries related mitigation activities within the PRECI; 2) assist in outreach and education missions by managing and developing outreach programs, materials and activities; and 3) creating partnerships with other federal and state agencies and non-profit organizations.

The JIMAR Protected Resources Division (PRD) International Turtle Conservation and Management Liaison, Karen Frutchey, presented a summary of turtle research to date on behalf of Honu Cook Islands at the 33rd Annual Symposium on Sea Turtle Biology and Conservation. To maintain disaster response preparedness, the JIMAR Project Lead continued training on hazardous materials and on working within the Incident Command System. Continuing as liaison between international marine turtle conservation project principal investigators and PIRO, project staff served as technical monitors for international marine turtle projects in Vietnam, New Caledonia, Federated States of Micronesia (FSM), the Republic of the Marshall Islands, Cook Islands, Solomon Islands and French Polynesia. Liaison support was also provided to territorial projects in Guam, the Commonwealth of the Northern Marianas Islands (CNMI) and American Samoa. Technical support for a marine turtle genetic sampling project was provided in collaboration with the NOAA Southwest Fisheries Science Center (SWFSC) scientists to characterize western Pacific green turtle nesting stocks. To progress this research, staff assisted countries and territories with sample organization, Convention on International Trade of Endangered Species (CITES) compliance and served in a supporting role in analysis of green turtle skin samples. As part of this genetics project, JIMAR assisted the governments of Guam, American Samoa, FSM and CNMI. The JIMAR Project Lead also reviewed sample datasets from several regional partners before samples were shipped to and incorporated in the SWFSC archive. The JIMAR Project Lead has also contributed to a draft publication on green turtle stock structure in the western and central Pacific Ocean. Furthermore, reviews were conducted on NOAA documents including marine turtle grant applications, grant progress reports, marine turtle and marine mammal research permit applications, the five year status review for the hawksbill sea turtle and the global status review of the green turtle.

The JIMAR PRD Sea Turtle Biologist, Kim Maison, served as technical monitor for three grant funded projects including Hawaii Island hawksbill monitoring, Maui hawksbill monitoring, and conservation and research on sea turtles at Palmyra Atoll. In addition, she is currently leading PRD's response to a petition to list eight species of Pomacentrid reef fish under the ESA. She updated research and analysis on the effectiveness of global efforts to reduce greenhouse gas emissions as a contribution to the Supplemental Information Report associated with the proposed listing of 66 coral species. Using GIS software JIMAR staff completed numerous mapping projects including false killer whale bycatch locations, preferred haul out locations for use in Hawaiian monk seal critical habitat designation, distinct population segments of scalloped hammerhead sharks, and various maps depicting action areas and the extent of impacts (mainly acoustic) on protected species and habitats for ESA Section 7 consultations. Staff reviewed six project progress reports, one conservation and research plan, and completed seven informal Section 7 consultations. Kim serves as the lead on analysis of permitted research activities within the Papahanaumokuakea Marine National Monument and their potential impacts on sea turtles, monk seals, and cetaceans via ESA Section 7 consultations. The JIMAR Biologist continued to maintain the Sea Turtle Reference database for PRD and served as a supporting team member on Section 7 consultations, providing technical assistance to the regulatory team on numerous projects and consultations. In particular, language in agency documents must be periodically updated to incorporate the impacts of climate change into analyses. Staff attended two professional conferences (in Hawaii and Baltimore). She co-planned and convened an annual Hawaii Hawksbill Recovery Group Meeting with PIFSC and FWS colleagues. As the Climate Change Point of Contact for all of PIRO, PRECI JIMAR staff continues to provide information and guidance on incorporating the effects of climate change into management analyses and identifying gaps in climate science where information would be useful for marine resource management. Project staff also represent PIRO by serving on two steering committees and one working group for regional climate change organizations.

JIMAR PRD Outreach and Education Specialist, Jen Metz, continued to provide assistance and guidance with the various outreach and education efforts for PRD. Jen worked closely with the PRD Assistant Hawaiian Monk Seal Coordinator on outreach efforts aimed at promoting awareness and conservation of the Hawaiian monk seal. These efforts include the development of outreach materials targeting both local residents and visitors to Hawaii referencing the "Good Neighbors: How to Share Hawaii's Beaches with Endangered Monk Seals" animated video produced in the previous fiscal year. JIMAR Outreach staff presented Hawaiian monk seal-focused outreach and education programs throughout the year and hosted several Earth Day-themed outreach booths at military installations such as Marine Corps Base Hawaii, Fort Shafter and Schofield Barracks. Project staff also contributed to the development of visitor industry staff training about the Hawaiian monk seal for the Ko'Olina area. Staff continued to work closely with the PIRO PRD Sea Turtle Team Lead on the "Fishing Around Sea Turtle" outreach program, promoting and distributing new posters and stickers to the local fishing community. The project Outreach Specialist continues to collaborate with Hawai'i Pacific University (HPU) professor Kristi West; Hawaiian Islands Humpback Whale National Marine Sanctuary (HIHWNMS) Education Coordinator Patty Miller; and the PIRO Marine Mammal Response Coordinator on the "Marine Mammals, Ocean Health and You" web-based marine mammal stranding and response-themed curriculum for 7th-9th grades. Eleven draft lessons have been completed and JIMAR staff conducted the first teacher workshop on O'ahu. JIMAR project staff assisted the Dolphin SMART coordinator with tour industry trainings and developing a project plan and needs assessment for increasing awareness about spinner dolphins in Guam and American Samoa. Jen also developed a research project proposal and began conducting research for her online graduate degree program in Environmental Education and Interpretation from the University of Wisconsin Stevens Point. The research proposal is a needs assessment for improving education and outreach about Hawaiian monk seals within the visitor community in Hawaii. She continues to conduct interviews with key informants—a focus group of visitor industry participants is scheduled for late June 2013—with an estimated research project completion of early fall 2013. Finally, JIMAR project staff continue to manage web content for PRD; serve as the PIRO representative for the Hawai'i Watchable Wildlife Committee; as an Advisory Board Member for the National Association for Interpretation, Pacific Islands Chapter; and as the lead for the PIRO Green Team.

## Sea Turtle Bycatch Mitigation Research

## P.I.: Mark A. Merrifield [JIMAR Project Lead: John Wang]

## NOAA Office (of the primary technical contact): National Marine Fisheries Service/Pacific Islands Fisheries Science Center

## NOAA Sponsor: Samuel G. Pooley, Keith Bigelow

## NOAA Goal(s)

· Healthy Oceans

## **Purpose of the Project**

Fisheries bycatch has been implicated in the population declines of numerous marine megafauna species. As a result, reducing bycatch of protected species, such as sea turtles, sharks, marine mammals and sea birds, is a priority for the fishing industry, fisheries managers, and conservationists. Project researchers propose to improve the overall selectivity of fishing gear, develop bycatch mitigation strategies for sea turtle species, and examine the habitat use of sea turtle species to better understand how different fisheries impact these sea turtle populations. To accomplish this, the project plans to conduct studies examining various bycatch reduction technologies (BRTs). In particular, researchers will examine the use of visual cues to improve the selectivity of gillnets and coordinate with Japanese scientists on the development of turtle escape devices in their coastal pound nets to better understand the energetics and habitat use of sea turtles.

Figure 1. Veronica Barragan, a high school student from San Diego, working with a Mexican commercial fisherman hauling nets during experiments to test potential sea turtle BRT.





Figure 2. A gillnet with green LED lightsticks being deployed in Pacific waters off Baja California. Experiments with illuminating gillnets indicate that this method may reduce loggerhead sea turtle interactions during night time sets.

## Progress during FY 2013

Experiments aimed at reducing the bycatch of turtles in coastal gillnet fisheries using UV lights to illuminate nets found that illuminated nets had a 40% decrease in green sea turtle capture rates. When tested in commercial gillnet fisheries based in Bahia de los Angeles, Baja California Norte, the UV illuminated nets did not have an effect on the overall target catch rates or overall catch value. Analysis of the catch composition found that the experimental nets showed a 45% increase in California halibut, the primary target species, and a 30% decrease in overall elasmobranch bycatch, with a 55% decrease in scalloped hammerhead bycatch. Experiments in a small scale gillnet fisheries based in Peru showed that green LED illuminated nets reduce green sea turtle bycatch by 43%. In addition, preliminary experiments conducted on the Mexican INAPESCA's research vessel, R/V UNICAP XVI, found that illuminated gillnets reduced Pacific loggerhead sea turtle bycatch by 57% during night-time sets.

Despite reduced funding that prevented the project's ability to conduct another Japanese pound-net and sea turtle bycatch workshop, the project was able to bring a Japanese collaborator to the US to work on analyzing and writing up previous years data. Two manuscripts were completed and are currently being reviewed by coauthors in preparation for submission to journals.

Research work to understand the energetic and habitat use of pelagic sea turtles included the analysis of over 200 samples of sea nettles (*C. fuscescens*), purple stripe (*C. colorata*), egg-yolk (*Phacellophora camtshatica*), and moon jellies (Aurelia sp.) from the leatherback conservation area (central California) to determine their energy density (via bomb calorimetry analysis) and trophic status (compound specific nitrogen stable isotope analysis of amino acids; CSIA-AA). Variation in energy densities was estimated using a hierarchical model. The energy density was highest for *C. fuscescens* ( $0.16 \pm 0.02$  kJ g-1 WM) and lowest for Aurelia sp. ( $0.08 \pm 0.02$  kJ g-1 WM). There was also variation in the body parts of the jellies with the stomach, manubrium, and gonads having the highest energy density and the bell the lowest. Adult leatherbacks, with maintenance costs of 2.2 x 104 kJ day-1, would need to consume 100 to 275 kg of sea jellies per day depending on prey items or 25% to 68% of their body mass in sea jellies daily to meet maintenance costs. These results provide a better understanding of leatherback biology, energetics, and trophic status, and further strengthen the project's knowledge of the ecosystem roles of leatherbacks in the Pacific Ocean.

## **Equatorial Oceanography**

Research under this theme is associated with the collection and analysis of physical, biological, and chemical observations across the equatorial regions of the Pacific Ocean to yield important information on large-scale ocean dynamics and variability. JIMAR hosts the University of Hawaii Sea Level Center (UHSLC) which maintains a coordinated network of tide gauge stations and provides sea level data for the oceanographic and climate communities. JIMAR is also home for the Pacific Islands Ocean Observing System (PacIOOS) which is one of 11 regional centers coordinating oceanographic observational data.

## The University of Hawaii Sea Level Center

## P.I.: Mark A. Merrifield

NOAA Office (of the primary technical contact): Climate Program Office

NOAA Sponsor: David Legler

## NOAA Goal(s)

- Climate Adaptation and Mitigation
- · Resilient Coastal Communities and Economies

## **Purpose of the Project**

The purpose of the University of Hawaii Sea Level Center (UHSLC) is to ensure that tide gauge data from around the world are collected, quality assessed, and archived for climate and oceanographic research. In addition, the center seeks to implement a global tide gauge observing system as defined by the Intergovernmental Oceanographic Commission Global Sea Level Observing System (GLOSS) and the Global Climate Observing System (GCOS). The center focuses on high frequency measurements that are available in near-real time as a complement to the Permanent Service for Mean Sea Level (PSMSL), which is the primary archive for delayed mode monthly-averaged sea level time series. In collaboration with NODC, the UHSLC maintains the Joint Archive for Sea Level (JASL), a research quality dataset for high frequency tide gauge observations. The UHSLC acquires tide gauge data from ~ 450 stations maintained by 65 international agencies, and the UHSLC collaborates directly with international partners to maintain 75 high profile stations that are important for the global observing system. The UHSLC collaborates with the Pacific GPS Facility to install and maintain continuous GPS capabilities for the assessment of ground motion at ~10 GCOS/GLOSS tide gauge stations. The UHSLC is an active participant in the operational and scientific oversight of GLOSS through the GLOSS Group of Experts. UHSLC datasets are used in conjunction with operational numerical models, for the calibration of satellite altimeter data, the production of oceanographic products, and research on interannual to decadal climate fluctuations and short-term extreme events. UHSLC station data also are made available via satellite to the Pacific Tsunami Warning Center, the West Coast/Alaska Tsunami Warning Center, and international centers for tsunami monitoring. Over the years the UHSLC has participated in international scientific programs including NORPAX, TOGA, WOCE, GODAE, CLIVAR, and the TOPEX/POSEIDON and Jason Science Working Teams.

#### Progress during FY 2013

UHSLC analysts continue to maintain the Fast Delivery Database, the primary source for quality assessed, near-real time sea level data available to the research community, and the JASL database of research quality, delayed mode, high frequency tide gauge data. Project objectives for data management were accomplished during FY 2013 in that the core function of each database was maintained, and both databases were expanded to take on new station installations as they become available. In terms of station maintenance, the main objective was to conduct 6 field trips and service 15 stations during FY 2012. Seven field trips were conducted and 15 stations were serviced. The project planned continuous GPS upgrades at 2 stations, Penrhyn and Fortaleza, but visits to those stations have been delayed due to logistical concerns. The project plans to conduct the visits and install the stations in the upcoming year.

A sea level metric was developed to assess the effectiveness of the global tide gauge network to measure global mean sea level (GMSL), independent of the satellite measurements. The project's estimate of GMSL (Figure 1) is calculated by averaging the first differences of monthly tide gauge sea levels from the combined UHSLC



Figure 1. GMSL from the integrated average of first differences from tide gauges (blue) and a 1-sigma error bar (gray shading), an annual reconstruction of GMSL from Church and White (2011), and GMSL from Aviso.



Figure 2. The standard deviation of monthly differences between GMSL from Aviso and GMSL from the tide gauges over the altimeter period. For each month in the time series, only locations with data during the month were allowed to contribute to the GMSL calculation from tide gauges.

Fast-delivery and Research Quality datasets with land motion corrections based on model estimates of global isostatic adjustment (GIA). Project analysts then perform a simple average over the gridded first difference series and integrate forward in time to obtain an estimate of GMSL variability. The monthly time series is then smoothed with a convolution low-pass filter giving an approximate temporal resolution of 3 months. The simple estimate of GMSL is entirely independent of satellite measurements, but it agrees well with GMSL calculated from the multimission Aviso gridded sea surface height product and the most widely cited reconstruction of annual GMSL using EOFs from altimetry (Church and White, 2011). The sea level metric is specified as the 1-sigma error about the calculation of GMSL from tide gauges. The error is shown as a symmetric gray error bar about the GMSL curve in Figure 1 and as an individual time series in Figure 2. The 1-sigma error is estimated by calculating the standard deviation of the differences between GMSL from Aviso and GMSL from tide gauges during the altimeter period for each monthly configuration of the tide gauge network since 1960. This estimate of the uncertainty includes instrumental error, error in the GIA model, error due to unaccounted for land motion,

and spatial sampling error. The error calculation based on the availability of gauges from 1960-present shows a clear downward trend with a sharp decrease in the 1980s and slight increase in recent years. This reduction in error over the last 50 years is the result of decreasing spatial sampling error as the tide gauge density increased in previously undersampled regions. There are only minor recent changes in the network, thus the reason for the recent increase in error is unclear. A more detailed analysis of the network and the sea level time series will be necessary to assess the cause of the recent increase in error.

UHSLC research efforts have been focused on multidecadal sea level variability and extreme sea level events and climate variations. Multidecadal sea level variability in the Northeast Pacific has been deconstructed in terms of trade wind and mid-latitude wind forcing (Thompson and Merrifield, 2013, submitted to J. Climate). A similar analysis is now underway for the Northwest Pacific. Seasonal predictions of sea level extremes are being analyzed for the tropical Pacific, as long-term extreme probabilities based on a GEV analysis. A deconstruction of sea level annual maxima has been completed based on the global tide gauge network. That paper is in press at the Journal of Geophysical Research, Oceans. The project took part in the BAMS State of the Climate report, describing global and regional sea level change during 2012.

## **Climate Research and Impacts**

Oceanic and atmospheric processes drive global and regional climate, and climate change and impacts are associated with changes in these processes as well. Under this theme, JIMAR collaborates in research efforts with the International Pacific Research Center (IPRC) in SOEST, and hosts the Pacific ENSO (El Nino Southern Oscillation) Applications Center (PEAC).

# Enhancement of Data and Research Activities for Climate Studies at the International Pacific Research Center (IPRC)

## P.I.: Kevin P. Hamilton

NOAA Office (of the primary technical contact): National Environmental Satellite, Data, and Information Service/National Climate Data Center

## **NOAA Sponsor: Howard Diamond**

## NOAA Goal(s)

- Weather-Ready Nation
- Climate Adaptation and Mitigation
- · Resilient Coastal Communities and Economies

## **Purpose of the Project**

This project enhances activities at the Asia-Pacific Data-Research Center (APDRC) as well as climate research within the International Pacific Research Center (IPRC) at the University of Hawaii. The project's overall goals are: (i) to meet critical regional needs for ocean, climate and ecosystem information; (ii) to enhance activities in support of the Global Earth Observation System of Systems (GEOSS) and the NOAA Pacific Climate Information System (PaCIS); (iii) to provide infrastructure in support of follow-on activities to the Global Ocean Data Assimilation Experiment (GODAE); and (iv) to conduct research to enhance understanding of climate variability and change in the Asia-Pacific region. The vision of the APDRC is to link data management and preparation activities to research activities within a single center, and to provide one-stop shopping of climate data and products to local researchers and collaborators, the national climate research community, and the public. The APDRC is organized around three main goals: providing integrated data server and management systems for climate data and products; developing and serving new climate-related products for research and applications users; and conducting climate research in support of the IPRC and NOAA research goals.

## Progress during FY 2013

There are two main components to this activity: Data Management (DM) and Data Server Systems (DSS). The DM group identifies important datasets from each of three sub-disciplines: oceanographic data, atmospheric

data and air-sea flux data. Moreover, the group ensures that on-line data is up-to-date, well documented, and to a certain extent, quality controlled. Members in the activities also compile research results that have evaluated the data products in some way. Finally, the group also makes recommendations on how to make the data more useful to clients—the value-added component. An additional activity included under data management is user interface development. The user-interface activity focuses on providing an interface between users and the data archives, including maintaining the APDRC web presence. The group ensures that the web pages are user-friendly and up-to-date and also handles specific, specialized data requests (e.g., email requests) by notifying the appropriate activity within the data management group. Finally, this group fosters co-operation with data serving groups outside the APDRC by providing links to their sites.

The DSS component then ensures the data and products are properly served to the community via the APDRC system. A software-server manager, in collaboration with the IPRC computing facility, maintains all the software programs that comprise the APDRC data server systems. The group installs and upgrades all the server software, ensuring that programs are up-to-date, and makes sure that the APDRC web links are active and accurate. The group also oversees the day-to-day operation of the server machines and provides all upgrades to these machines. The server management group keeps up-to-date on new advances in technology, including both hardware and software, by attending meetings and workshops and through dialogue with other groups to provide future direction and recommendations for the APDRC computing infrastructure. The group also teams with the IPRC Parallel Computing Facility (PCF) to provide technical support to users.

The APDRC maintains a wide suite of data transport and discovery servers, including OPeNDAP-based THREDDS DODS Server (TDS), GrADS DODS Server (GDS) and dapper; a Live Access Server (LAS); and Dchart. These servers continue to be maintained, and there were no dramatic changes to these services in the past year.

The APDRC data archives increased in size mainly due to a large acquisition of OFES output, daily downloads of high-resolution, global ocean model output from the Navy operational model (HYCOM). In addition, the APDRC staff has been instrumental in assembling coupled climate model output from CMIP-5 runs for local research activities. Daily downloads of various operational models continue. One these is output from a regional atmospheric model (run at UHM) that is used by a wide variety of users, and the APDRC now has a long archive. In all, the APDRC has archived about 200 TB of data (a 50% increase from last year): 44% of this is CMIP-5 output (87.7 TB); 36% output from the Earth Simulator (OFES/AFES; 71.7 TB); model output from various sources occupy about 9% (18.4 TB); the remaining 11% covers all other data sets.

All tasks and projects were completed on time and within budget.

# Mechanisms of Atmospheric Mercury in Transport and Transformation in the Remote Pacific Marine Free Troposphere Measured in Hawaii

## P.I.: Mark A. Merrifield

## NOAA Office (of the primary technical contact): Earth System Research Laboratory/Mauna Loa Observatory

NOAA Sponsor: Winston Luke [Darryl T. Kuniyuki]

#### NOAA Goal(s)

· Weather-Ready Nation

#### **Purpose of the Project**

*Primary Task.* Collection of atmospheric mercury speciation data. The project collects and analyzes semicontinuous high altitude (11,400 feet) measurements of Hg0, RGM, and HgP at the Mauna Loa Observatory (MLO), Hawaii. The objectives of this task will be to accumulate a long-term record of ambient Hg0, RGM, and HgP chemistry to: (i) support atmospheric mercury chemistry research; (ii) establish a baseline mercury measurement station; and (iii) investigate the long range transport of mercury from South East Asia across the Pacific. In addition to this primary task, other data are measured and collected which may elucidate the transport and transformation mechanisms of atmospheric mercury. This includes measurements of atmospheric aerosols, ozone, sulfur dioxide, elemental carbon, and meteorological variables. All of the data will be organized and archived in a database. Some data and theories will be placed on the MLO website and other types of media for outreach purposes

## Progress during FY 2013

Activity was centered on enhancing measurement capabilities at MLO, to expand the list of ancillary trace species measured at the site as an aid to data interpretation, and on conducting additional tests and measurements to characterize and assess the origins and magnitudes of observed mercury measurement artifacts at MLO. In September 2012 extensive testing was performed on the Tekran speciation system at MLO. The results of these tests provided conclusive evidence for the presence of Hg0-HgP measurement artifacts in the inlet glassware of the commercial system.

In February 2013 the measurement suite at MLO was enhanced by the installation of a commercial detector for the continuous measurement of carbon monoxide (CO) at the site. In addition, a second Tekran 2537a analyzer was installed at MLO to provide dedicated measurements of Hg0 to compare with equivalent data reported by the existing speciation system, thus identifying periods of artifact formation and measurement error. Finally, a second speciation system was installed at the Smithsonian Institution's Sub Millimeter Array (SMA) facility near the summit of Mauna Kea, some 40 km NNE of the MLO site.



Figure 1. Tekran mercury measurement system at MLO. Note the addition of a second Tekran analyzer (top) for the dedicated measurement of elemental mercury (HgO).

Comparing data collected simultaneously at the two sites allowed for the ready identification of measurement errors in the detectors, and lent insight into the origins and magnitude of these errors.



Figure 2. Tekran speciation measurement system deployed at the Smithsonian Submillimeter Array (SMA) facility on Mauna Kea from February 13-March 13, 2013.

## **Pacific ENSO Applications Climate Center**

## P.I.: Mark A. Merrifield

## NOAA Office (of the primary technical contact): National Weather Service/Pacific Region Office

## **NOAA Sponsor: Jeffrey LaDouce**

## NOAA Goal(s)

- · Weather-Ready Nation
- Climate Adaptation and Mitigation
- · Resilient Coastal Communities and Economies

#### **Purpose of the Project**

The purpose of the project is to conduct research and develop information products specific to the US-Affiliated Pacific Islands (USAPI) on El Nino–Southern Oscillation (ENSO) climate cycle and latest long-term forecasts of ENSO conditions, and its historical impacts on rainfall, sea level variability and change, and tropical cyclone, in support of planning and management activities in such climate-sensitive sectors as water resource management, fisheries, agriculture, civil defense, public utilities, coastal zone management, and other important economic and environmental sectors in the USAPI region.

## Progress during FY 2013

Since 2005, an operational sea level forecasting scheme (3 to 5-months in advance) for the U.S.-Affiliated Pacific Islands (USAPI) has been instrumental (http://www.prh.noaa.gov/peac/sea-level.php) in the Pacific ENSO Applications Climate Center (PEAC). The El Niño-Southern Oscillation (ENSO) climate cycle and the sea-surface temperatures (SSTs) in the tropical Pacific Ocean are taken as the primary factors in modulating these forecasts on seasonal time scales. The current SST-based Canonical Correlations Analyses (CCA) hindcast forecasts have been found to be skillful; however, the skill gradually decreases as the lead-time increases, and it is less skillful after 2-3 season (i.e., 6 to 9 months). Currently, PEAC disseminates these 3 to 5 months forecasts; however, the increasing demand for longer lead-time forecasts (e.g., 6-12 months) has primarily motivated us to re-visit the forecasting scheme at PEAC. While re-visiting the current forecasting scheme for improvement, the recent trend of enhanced trade winds west of the dateline is hypothesized to be an important factor for modulating sea level variability on month-to-seasonal time-scales.



Average of 4-seasons (i.e., JFM, AMJ, JAS, and OND) forecasts skills for all USAPI stations at 0 to 3 seasons lead time. Note that forecasts at 0-season lead time meaning that the 'sea-level' of target season (e.g., JFM) is simulated based on SST-U, SST, and U of the previous season (e.g., OND) (also see Tables 3, 4, and 5). Similarly, 1, 2, 3-season lead time means sea level forecasts based on SST-U, SST, or U of previous JAS, AMJ, and JFM season. Also note that similar analyses were done with seasons AMJ, JAS, and OND and the average values of 4-seasons are shown in the figure.

Findings revealed that the combined SST and zonal wind (U)-based forecasts are more skillful than the SST or wind based forecasts alone. It is particularly more efficient on longer time scales for most of the stations. The improvements of these forecasts will enable the capability of our clients in the USAPI region to develop a more efficient long-term response plan for hazard management.

## **PMEL-UH Ocean Carbon Project**

#### P.I.: Matthew J. Church

## NOAA Office (of the primary technical contact): Pacific Marine Environmental Laboratory

**NOAA Sponsor: Christopher Sabine** 

#### NOAA Goal(s)

· Healthy Oceans

## **Purpose of the Project**

The primary mission of this project is to evaluate the variability in air-sea CO2 fluxes by conducting high resolution time-series measurements of atmospheric boundary layer and surface ocean CO2 partial pressure (pCO2). The Moored Autonomous pCO2 (MAPCO2) system collects CO2 data from surface seawater and marine boundary air every three hours for up to a year at a time before they need servicing. Daily summary files of the measurements are transmitted back to PMEL where the data are examined and plots of the results are posted to the web in near-real time.

## Progress during FY 2013

The project provided salary support for Dan Sadler who oversaw maintenance of instrumentation used for high resolution, remote measurements of atmospheric and surface ocean CO2 partial pressure (pCO2). In particular, Sadler oversaw installation and testing of shipboard CO2 systems used on NOAA TAO cruises, and installation of a pCO2 system on the WHOTS mooring. The WHOTS mooring is a joint collaborative effort between Woods Hole Oceanographic Institution (WHOI) and the University of Hawaii with support for the mooring deriving from the National Science Foundation and NOAA. Sadler maintains, calibrates, and installs pCO2 sensors for this mooring, in addition to various shipboard sensors that are used for carbon cycling work along the TAO array in the equatorial Pacific Ocean.

## Profiling CTD Float Array Implementation and Ocean Climate Research

## P.I.: Mark A. Merrifield

#### NOAA Office (of the primary technical contact): Pacific Marine Environmental Laboratory

NOAA Sponsor: Gregory C. Johnson

## NOAA Goal(s)

• Climate Adaptation and Mitigation

#### **Purpose of the Project**

JIMAR works with U.S. and International Argo Project partners, especially NOAA/PMEL, on two aspects of the Argo Program. The first component involves float testing, deployment, and data/engineering evaluation. The second component involves climate research using data from Argo floats and other sources.

## Progress during FY 2013

E. Steffen and the PMEL float lab took delivery of 76 Argo floats this year. Dr. Steffen diagnosed and coordinated repairs of problems discovered with the floats and worked with the manufacturer to resolve problems including warranty replacements. She continued work on retooling of lab equipment and vessel storage racks



Figure 1. Upper Ocean (0–700 dbar) Ocean Heat Content Anomaly [109 J m-2] for 2012 relative to 1993-2012 estimated using in situ (mostly from Argo in recent years) temperature data and satellite altimeter sea surface height data (in colors, with red being warm and blue cold).

to accommodate the new type of float being used, as well as working with data managers at the laboratory, national, and international levels to accommodate these new floats. She arranged for float deployments and notified the national and international databases. She traveled to load floats on various ships and train deployers. Stated goals were met.

J. Lyman produced and analyzed (with JIMAR Senior Fellow Dr. Gregory Johnson) yearly maps of global upper ocean heat content from 1993 through 2012 (Fig. 1) combining in situ thermal data and satellite altimetry data, as well as yearly maps of sea surface salinity from 2005 through 2012. They continued working on estimating uncertainties in and improving estimates of global ocean heat content anomalies and their trends. This year Dr. Lyman was co-author on four journal articles. Stated goals were met.



Figure 2. Locations (filled circles) of Argo floats prepared by JIMAR float research analyst E. Steffen as of 21 May 2013. Grey indicates floats that have not reported for the last 20 days or more, colors more recently reporting floats.

## Seasonal Forecasts and Extreme Event Projections for Pacific Island Sea Level

## P.I.: Mark A. Merrifield

#### NOAA Office (of the primary technical contact): National Climate Data Center

## NOAA Sponsor: John Marra

## NOAA Goal(s)

- · Weather-Ready Nation
- Resilient Coastal Communities and Economies

#### **Purpose of the Project**

The main objective is to assess various statistical analyses of tide gauge datasets to improve the skill in predicting monthly to seasonal water level deviations from means and extremes in the Pacific Island region. Generalized Extreme Value (GEV) analysis will be used to generate probabilistic extreme water level scenario products. The importance of El Nino Southern Oscillation (ENSO) related sea level variability in the region will be exploited to try and improve seasonal sea level forecasts based on various ENSO projections and products.

## Progress during FY 2013

The first phase of sea level station-based extreme water level scenario products have been completed for 39 Joint Archive for Sea Level (JASL) tide gauge stations in the Pacific Basin that contain at least 30 years of data. Products were generated using a non-stationary Peaks over Threshold (POT) analysis that incorporated a linear trend in the location parameter. The resulting deliverables include return level estimations that are projected from future sea-level rise scenarios provided by USGCRP National Climatic Assessment (NCA). These products are currently in the process of being made available through the web. The second phase of creating extreme water level scenario products is currently in development. In this phase, a GEV analysis is being conducted to determine if various factors (e.g., annual and semi-annual cycles, astronomical forcing, climate variability, long-term trends) influence the behavior of extreme water levels. Given the research effort needed to understand the statistics of still water sea level extremes, we have not included an assessment of wave-driven water level changes to date.

Forecasts for seasonal deviations from mean sea levels are, at present, based on a CCA (Canonical Correlation Analysis) statistical model derived from a 30-year record of sea-surface temperature (SST) anomalies in a region of the Pacific bounded by -35 to 35 N and 100 to 300 E. Projections for the US Affiliated Pacific Islands, located in the tropics west of 180 E, are consistent with variations in the ENSO signal and the assessed cross-validation skill is rated as very good. Forecasts for Honolulu and Hilo, however, are only weakly correlated with ENSO and rated fair, at best. The project is exploring a range of methodologies and forcing fields in an effort to improve forecasts for six sites on the main Hawaiian Islands and six other sites in the subtropical North Pacific, namely French Frigate Shoals, Midway, Johnston Atoll, Wake, Chichijima and Naha. The initial approach has relied on a multivariate regression of tide gauge records on the leading Empirical Orthogonal Functions (EOFs) of the forcing field, either SST or the two components of wind-stress over a given region and time span. The results are compatible with those obtained from the CCA model and the methodology allows for easier interpretation of relationships and significance. The tests run to date have been based on 30-year and 20-year data sets covering the geographic region of the CCA model and a more limited North Pacific region. Supplementary tests are also being done to determine the most effective number of EOF modes to use in the regressions, and how best to prepare the tide gauge data, i.e., whether or not to remove the perigean and nodal tidal cycles, seasonal cycles and/or long term trends. Preliminary results indicate that seasonal sea level variability correlates slightly more strongly and significantly with wind-stress than with SST. However wind-stress forecasting skill, as determined by crossvalidation, is weaker than that of SST and is less regular as a function of lag and season.

## **Tropical Meteorology**

SOEST is uniquely qualified for geophysical research in tropical regimes, and the Department of Meteorology provides world-class research in the areas covered under this theme. In addition to facilitating IPRC and Department of Meteorology research, JIMAR hosts NOAA National Weather Service fellowship programs in the SOEST academic departments.

## Improved Automation and Performance of VORTRAC Intensity Guidance

PI: Michael M. Bell

## NOAA Office (of the primary technical contact): Office of Oceanic and Atmospheric Research

NOAA Sponsor: Chris Landsea

## NOAA Goal(s)

- Weather-Ready Nation
- · Resilient Coastal Communities and Economies

## Purpose of the Project

The purpose of this project is to improve guidance for tropical cyclone (TC) intensity change near landfall. The project improves the capability of the VORTRAC software (Vortex Objective Radar Tracking and Circulation) to automatically diagnose central surface pressure and its tendency from radar-derived wind fields at the National Hurricane Center (NHC) when a TC center is within the Doppler range of a coastal WSR-88D radar.



Figure 1. Screenshot of VORTRAC radar display during landfall of Tropical Storm Andrea (2013). Radar reflectivity, current central pressure, radius of maximum wind, storm location, and other diagnostics are prominently displayed for National Hurricane Center forecasters in real-time.



Figure 2. Screenshot of VORTRAC pressure display during landfall of Tropical Storm Andrea (2013). Time series graph of pressure and radius of maximum wind and other diagnostics are prominently displayed for National Hurricane Center forecasters in real-time.

## Progress during FY 2013

VORTRAC is a software package with a graphical display that provides intensity guidance during TC landfalls. VORTRAC uses a series of algorithms to deduce the central pressure and radius of maximum wind of a landfalling TC in near real time from WSR-88D Level II radar data and environmental reference pressure data from nearby coastal weather stations. Almost all aspects of the VORTRAC operation have now been automated, and take advantage of operational data streams. Improved software performance and radar algorithms have also been implemented in FY 2013. Updated software was installed at NHC at the beginning of the 2013 hurricane season, and tested successfully during the landfall of Tropical Storm Andrea. Additional operational guidance will be provided to Hurricane Specialists throughout the 2013 hurricane season during TC landfalls along the U.S coast.

## National Weather Service Pacific Region Fellowship Program

## P.I.: Mark A. Merrifield

## NOAA Office (of the primary technical contact): National Weather Service/Pacific Region Office

## NOAA Sponsor: Jeffrey LaDouce

## NOAA Goal(s)

• Weather-Ready Nation

## **Purpose of the Project**

As part of the memorandum of understanding between the University and the National Weather Service (NWS), the NWS supports graduate students in SOEST academic units.

## Progress during FY 2013

During FY 2013, the NWS Fellowship Program provided ongoing educational support to the Geology and Geophysics, Oceanography, and Meteorology departments. The NWS Fellowship funds were used to: 1) support scholarships for students to attend a mainland summer field camp; 2) provide stipends for an undergraduate field course held in Nevada as part of GG course 305; 3) support the preparation of educational materials for Mineralogy and Petrology courses; 4) provide salaries for lecturers and teaching assistantships in Geology and Geophysics and Oceanography; and 5) support a graduate research assistantship for Carl Barnes in the Meteorology department that has led to the completion of his graduate thesis entitled "Eyewall rainfall patterns from aircraft lower fuselage radar images".

## Tropical Pacific Testbed (TPT) for GOES-R Application Development

## P.I.: Steven Businger

# NOAA Office (of the primary technical contact): National Environmental Satellite Data and Information Service

## **NOAA Sponsor: Steven Goodman**

## NOAA Goal(s)

- Weather-Ready Nation
- Climate Adaptation and Mitigation

## **Purpose of the Project**

The Tropical Pacific Testbed (TPT) for GOES-R application development is being pursued for several reasons. The proving ground will improve forecaster skills and tools, resulting in more accurate and timely forecasts and warnings. The TPT will help educate developers in tropical cyclone-, heavy rainfall-, and aviation related operations and constraints. Additionally, the TPT will educate forecasters in the latest tropical cyclone, heavy rainfall, and aviation research. Lastly, the TPT will support the production of tropical cyclone-, heavy rainfall-, and aviation- weather products, using Interactive Calibration of Four Dimensions (IC4D), Advanced Weather Interactive Processing System (AWIPS), AWIPS-II, and Automated Tropical Cyclone Forecasting (ATCF) System, as appropriate.

## Progress during FY 2013

The project is on schedule to meet its goals. A list of accomplishments is as follows.

- Facilitation of GOES-R product installation at Pacific Region Headquarters.
- Final installation of X/L Band antenna and network setup.
- Lightning Algorithm modification and development.
- Installation of products into AWIPS.
- Completion of Pseudo reflectivity lightning product.
- Development of web page to serve polar orbiting satellite imagery (Fig. 1). Collaborators during this year include the following.
- Roy Huff-Satellite liaison
- · Jordan Gerth-General AWIPS and GOES-R network support
- Liam Gumley–X/L band network support and data product installation
- Eric Lau-Facilitation of AWIPS II/training and PRH product integration
- Wayne Feltz-General satellite training at UW Madison and project facilitation and oversight
- Mark DeMaria and Hiro Gosden-AWIPS I localization
- John Porter-development of aerosol algorithm (Fig. 2)

MKWC		Current Conditions           Temp         4.6 C           RH         31 %           Wind         ENE 36 mph           Road         Open
Home	Tropical Pacific Proving Ground for GOES-R Application Development (In Develo	opment)
MK Forecast Trends Statistics	Select Category: Atmosphere   Ocean   Land Select Variable: Areosol Optical Depth   Cloud Top Pressure   Cloud Top Temperature   Precipitable Water   True Colo	or
Current Conditions Seeing Web Carns Road Conditions NWS Bulletins	True Color Latest Image First Pass Time Tue Jun 04 2013 1219 HST Second Pass Tue Jun 04 2013 1036 HST Time	
Satellite Geostationary Polar Orbiter	Terra	
Radar	First Pass Time Mon Jun 03 2013 1439 HS	
LAPS Models GFS WRF	Aqua Mon Jun 03 2013 1439 HS	
Archive		- T
Links		
Symposium on Seeing	Useful Links	
Glossary	Aqua and Terra Orbit Tracks	_
Feedback		
Disclaimer		2
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Figure 1. Screen capture of MKWC web page serving polar orbiting satellite imagery.



Figure 2. Image of aerosol optical depth for March 18, 2013, derived from MODIS and surface wind data.



Figure 3 X/L Band Antenna Dish installed at Hawaii Community College. The X/L Band Antenna downlink is operational.
### **Tsunamis and Other Long-Period Ocean Waves**

JIMAR efforts in tsunami detection include development of monitoring systems for the Indian Ocean. Further collaboration in this theme is affected through interactions with the UHSLC.

### The University of Hawaii Sea Level Center–Tsunami Research

P.I.: Mark A. Merrifield

### NOAA Office (of the primary technical contact): NOAA Tsunami Program

**NOAA Sponsor: Michael Angove** 

### NOAA Goal(s)

Resilient Coastal Communities and Economies

### Purpose of the Project

The UHSLC has installed, and is currently maintaining, 9 water level stations in the Caribbean Sea and 10 water level stations in the Pacific Ocean in support of regional tsunami warning and sea level monitoring. The Caribbean portion of the project is in collaboration with Dr. Victor Huerfano, the Director of the Puerto Rico Seismic Network (PRSN). UHSLC oversees the operation of the stations and provides training for a PRSN technician on Caribbean station maintenance activities. The UHSLC has also provided ongoing technical support, and data processing and quality assessment services. The Pacific portion of the project is primarily focused on the maintenance of tsunami water level stations previously maintained by the Pacific Tsunami Warning Center (PTWC). UHSLC is working with PTWC and the West Coast and Alaska Tsunami Warning Center (WCATWC) on network priorities and station selection. UHSLC involvement ensures that the water level stations will comply with global sea level observing system requirements for oceanographic and climate research.



### **Progress during FY 2013**

visited by UHSLC technicians (Legaspi, Tern Island, Callao, Matarani, Atico), met

For the Pacific Ocean, the five stations The tide gauge installation at Callao, Peru is part of the Pacific Tsunami Warning System.

expectations. This included a visit to the three stations in Peru, and the final installation of the Atico station with the help of the Peruvian host agency. The Atico communication system was designed to support the Peruvian host agency; however, the file protocol is difficult to work with via GTS and the project intends to upgrade the data collection platform and transmitter during the next site visit. With the Atico station online, the project has completed all tsunami station upgrades in the Pacific. An overdue visit to Tern Island was completed with the assistance of U.S. Fish and Wildlife. Considerable storm damage occurred since the last maintenance visit and the UHSLC technician was able to fortify the existing station while also helping USFW with general infrastructure improvements on the island. Although Soccoro Island is no longer formally included in the list of Pacific stations, the project has been in contact with CICESE in Mexico and will try to assist them with spare parts as they attempt to bring this station back into operation. In addition to technician visits, project staff was able to make repairs remotely at five stations with the assistance of local operators.

For the Caribbean, UHSLC and PRSN were able to visit eight stations during FY 2013 (El Porvenir, Santa Marta, San Andres, Punta Cana, Puerto Plata, Curacao, Dominica, and Grenada), exceeding the expectation of five station visits. The Santa Marta station was damaged by large storm waves shortly after the visit and the project is in the process of implementing a more fortified design for that exposed station. Curacao has similar siting issues, and UHSLC technicians will either fortify that site or move the site during a future visit.

## **JIMAR Publications**

Author(s) Names	Publication Date	Title	Published In (Journal Name, volume and page number)	Type of Publication	Citation No. or hyperlink	Project Title
Abecassis, M.	11/27/12	Analysis of logger- head turtles tracks in the North Pacific to parameterize a feeding habitat and movement model	PFRP Principal Investigators Meeting: Honolulu, HI. November 26- 27, 2012	Presentation	http://www. soest.hawaii.edu/ PFRP/nov12mtg/ nov12mtg.htm	Pelagic Fisheries Research Program
Asher J., J. Maragos, J.C. Kenyon, B. Vargas-Ángel, and E. Cocagna	4/1/12	Range extensions for several spe- cies of Acropora in the Hawaiian Archipelago and the Papahānaumo- kuākea Marine Na- tional Monument	Bull. Mar. Sci., 88, 337–338	Journal Article	http://www.rsmas. miami.edu/bms/	Sustaining Healthy Coastal Ecosystems
Baker, J. D., T. C. Johanos, T.Wurth, and C. Littnan	4/25/13	Body growth in Hawaiian monk seals	Mar. Mammal Sci. (published online 25 April 2013)	Journal Article	http://onlineli- brary.wiley.com/ doi/10.1111/ mms.12035/ab- stract	Hawaiian Monk Seal Research Program
Barnes-Mauthe, M.	11/27/12	Information sharing networks and ethnic homoph- ily in Hawaii's longline fishery	PFRP Principal Investigators Meeting: Honolulu, HI. November 26- 27, 2012	Presentation	http://www. soest.hawaii.edu/ PFRP/nov12mtg/ nov12mtg.htm	Pelagic Fisheries Research Program
Blyth-Skyrme, V.	10/3/12	Benthic habitat map- ping of coral reef ecosystems	Coastal and Marine Spatial Planning Workshop, organized by Pacific Islands Regional Office	Presentation		Sustaining Healthy Coastal Ecosystems
Blyth-Skyrme, V., J. Rooney, F. Parrish, and R. Boland	4/1/13	Mesophotic coral ecosystems — potential candidates as essential fish habitat and habitat areas of particular concern	National Marine Fisheries Service Science Center Administrative Report, H-13-02	Report	ftp.soest.hawaii. edu/pibhmc/ website/webdocs/ documentation/ PIFSC_Admin_ Rep_13-02.pdf	Sustaining Healthy Coastal Ecosystems
Brainard R., C. Young, C. Braun, M. Timmers, B. Vargas- Angel, R. Feely, A. Cohen, N. Price, J. Smith, and D. Gledhill	7/15/12	Monitoring ecologi- cal impacts of ocean acidification on Pacific reefs	Proc. 12th International Coral Reef Symposium, 9-13 July 2012, Cairns, QLD, Australia	Conference Proceedings	http://www. icrs2012.com/Pro- ceedings.htm	Sustaining Healthy Coastal Ecosystems
Brodziak, J., J. O'Malley, A.J. Yau, and Y.J. Chang	5/28/13	Application of a Bayesian produc- tion model to assess Pacific blue marlin (Makaira nigricans) in 2013	ISC Billfish Working Group: Shimizu, Japan. May 20-28, 2013. ISC/13/ BILLWG-2/09	Workshop Proceedings	http://isc.ac.affrc. go.jp/work- ing_groups/billfish. html	Stock As- sessment Research Program

Cahoon, M., C. Littnan, K. Longenecker, and J. Carpenter	4/23/13	Dietary comparison of two Hawaiian monk seal popula- tions: the role of diet as a driver of divergent population trends	Endanger. Species Res., 20, 137-146	Journal Article	doi:10.3354/ esr00491; http:// www.int-res.com/ abstracts/esr/v20/ n2/p137-146/	Hawaiian Monk Seal Research Program
Cha, DH., and Y. Wang	3/1/13	A dynamical initial- ization scheme for real-time forecasts of tropical cyclones using the WRF model	Mon. Wea. Rev., 141, 964-986	Journal Article	doi:10.1175/2011 MWR3584.1	Enhance- ment of Data and Research Activities for Climate Studies at the Interna- tional Pacif- ic Research Center
Chang, Y.J., C.L. Sun, Y. Chen, S.Z. Yeh, G. DiNardo, and N.J. Su	1/8/13	Modeling impacts of environmental varia- tion on the habitat suitability of sword- fish, <i>Xiphias gladius</i> , in the equatorial Atlantic Ocean	ICES J. Mar. Sci.	Journal article	doi:10.1093/ icesjms/fss190	Stock As- sessment Research Program
Chang, Y.J., J. Brodziak, H.H. Lee, G. DiNardo, and C.L. Sun	1/23/13	A Bayesian hierar- chical meta-analysis of blue marlin ( <i>Makaira nigricans</i> ) growth in the Pacific Ocean	ISC Billfish Working Group: Honolulu, Hawaii. January 16-23, 2013. ISC/13/ BILLWG-1/02	Workshop Proceedings	http://isc.ac.affrc. go.jp/work- ing_groups/billfish. html	Stock As- sessment Research Program
Chang, Y.J., J. Brodziak, H.H. Lee, G. DiNardo, and C.L. Sun	5/28/13	Model selection un- certainty and multi- model inference in the generalized fish- ery production mod- eling: simulation study of the Pacific blue marlin stock	ISC Billfish Working Group: Shimizu, Japan. May 20-28, 2013. ISC/13/ BILLWG-2/09	Workshop Proceedings	http://isc.ac.affrc. go.jp/work- ing_groups/billfish. html	Stock Assessment Research Program
Chowdhury M. R.	2013	The Variability of ENSO and Predict- ability of Seasonal Flooding: Pacific Islands and Bangla- desh	In: Floods- From Risk to Opportunity, Ali Chavoshian and Kuniyoshi Takeuchi (eds.), IAHS Publ. 357, 166-173	Journal Article		Pacific ENSO Applica- tions Cli- mate Center
Choy, C.A.	11/27/12	Updated insights into the trophic ecology of large mesopelagic fishes from the central North Pacific using stomach content and fatty acid biomarker analyses	PFRP Principal Investigators Meeting: Honolulu, HI. November 26- 27, 2012	Presentation	http://www. soest.hawaii.edu/ PFRP/nov12mtg/ nov12mtg.htm	Pelagic Fisheries Research Program
Cohen, A., R. Brainard, C. Young, N. Cantin, R. Feely, K. Shamberger, E. McLeod, and D. McCorkle	7/15/12	Nutrient modulation of the coral calcifi- cation response to a natural gradient in ocean acidification	Proc. 12th International Coral Reef Symposium, 9-13 July 2012, Cairns, QLD, Australia	Conference Proceedings	http://www. icrs2012.com/Pro- ceedings.htm	Sustaining Healthy Coastal Ecosystems

Comfort, C.	11/27/12	Connectivity in deep water sharks and implications for bycatch	PFRP Principal Investigators Meeting: Honolulu, HI. November 26- 27, 2012	Presentation	http://www. soest.hawaii.edu/ PFRP/nov12mtg/ nov12mtg.htm	Pelagic Fisheries Research Program
Croll, D., K. Newton, K. Weng, F. Galvan-Magna, and J. O'Sullivan	2012	Long-distance mi- gration of a pelagic manta ray: behavior, habitat use and movement of the spine-tailed devil ray in the Eastern Pacific Ocean	Mar. Ecol. Progr. Ser., 465, 193-200	Journal Article	doi:10.3354/ meps09900	Pelagic Fisheries Research Program
Del Raye, G.	11/27/12	Climate impacts on physiological perfor- mance of fishes	PFRP Principal Investigators Meeting: Honolulu, HI. November 26- 27, 2012	Presentation	http://www. soest.hawaii.edu/ PFRP/nov12mtg/ nov12mtg.htm	Pelagic Fisheries Research Program
Domokos, R.	11/27/12	Detecting and identi- fying fish and forage with acoustics	PFRP Principal Investigators Meeting: Honolulu, HI. November 26- 27, 2012	Presentation	http://www. soest.hawaii.edu/ PFRP/nov12mtg/ nov12mtg.htm	Pelagic Fisheries Research Program
Donovan, M., I. Williams, J. Dierking, and A. Friedlander	7/9/12	Multi-scale demo- graphic trends in an introduced Hawaiian reef fish	Proc. 12th International Coral Reef Symposium, 9-13 July 2012, Cairns, QLD, Australia	Conference Proceedings	http://www. icrs2012.com/Pro- ceedings.htm	Sustaining Healthy Coastal Ecosystems
Donovan, M.K., A.M. Friedlander, E.E. DeMartini, M.J. Donahue, and I.D. Williams	12/13/12	Demographic pat- terns in the peacock grouper (Cephalo- pholis argus), an introduced Hawaiian reef fish	Environ. Biol. Fishes, doi: 10.1007/s10641- 012-0095-1	Journal Article	http://link. springer.com/ article/10.1007/ s10641-012-0095- 1/fulltext.html	Sustaining Healthy Coastal Ecosystems
Fiedler, P.C., R. Mendelssohn, D.M. Palacios, and S.J. Bograd	2013	Pycnocline varia- tions in the eastern tropical and North Pacific, 1958-2008	J. Climate	Journal Article	doi:10.1175/JCLI- D-11-00728.1	Climate Change and Ecosystem Variability in the North Pacific Ocean and the Dy- namics of Marine Resource Populations
Godin, A.C., T. Wimmer, J.H. Wang, and B. Worm	3/1/13	No effect from rare- earth metal deterrent on shark bycatch in a commercial pe- lagic longline trial	Fisheries Res., 143, 131-135	Journal Article	http://www. sciencedirect. com/science/jour- nal/01657836/143	Sea Turtle Bycatch Mitigation Research
Gove J.M., G.J. Williams, M.A. McManus, S.F. Heron, S.A. Sandin, O.J. Vetter, and D.G. Foley	2/1/13	Quantifying clima- tological ranges and anomalies for Pacific coral reef ecosys- tems	PLoS ONE, 8, 4, e61974	Journal Article	doi:10.1371/jour- nal.pone.0061974	Sustaining Healthy Coastal Ecosystems

Gove J.M., G.J. Williams, M.A. McManus, S.F. Heron, S.A. Sandin, O.J. Vetter, and D.G. Foley	7/15/12	Quantifying clima- tological ranges and anomalies for Pacific coral reef ecosys- tems	Proc. 12th International Coral Reef Symposium, 9-13 July 2012, Cairns, QLD, Australia	Conference Proceedings	http://www. icrs2012.com/Pro- ceedings.htm	Sustaining Healthy Coastal Ecosystems
Grace-McCaskey, C.A.	3/20/13	Fishermen, politics, and participation: An ethnographic examination of com- mercial fisheries management in St. Croix, U.S. Virgin Islands	Society for Applied Anthropology Conference: Denver, CO. March 19-23, 2013	Presentation		Human Dimensions of Fishing and Marine Ecosystems in the West- ern Pacific
Gray, A.	11/27/12	Fine scale move- ments of a mesope- lagic fish at Cross Seamount	PFRP Principal Investigators Meeting: Honolulu, HI. November 26- 27, 2012	Presentation	http://www. soest.hawaii.edu/ PFRP/nov12mtg/ nov12mtg.htm	Pelagic Fisheries Research Program
Hannides, C., and J. Drazen	11/27/12	Examining pelagic food webs using multiple chemical tracers	PFRP Principal Investigators Meeting: Honolulu, HI. November 26- 27, 2012	Presentation	http://www. soest.hawaii.edu/ PFRP/nov12mtg/ nov12mtg.htm	Pelagic Fisheries Research Program
Hobday, A. J., J.W. Young, O. Abe, D.P. Costa, R.K. Cowen, K. Evans, M.A. Gasalla, R. Kloser, O. Maury, and K.C. Weng	2013	Climate Impacts and Oceanic Top Preda- tors: Moving from impacts to adapta- tion in oceanic systems.	Rev. Fish Biol. Fish., doi:10.1007/ s11160-013-9311- 0, published online 03 May 2013	Journal Article	doi:10.1007/ s11160-013-9311-0	Pelagic Fisheries Research Program
Hoeke, R.H., C.D. Storlazzi, and P.V. Ridd	5/1/13	Drivers of circula- tion in a fringing coral reef embay- ment: a wave-flow coupled numerical modeling study of Hanalei Bay, Hawai'i	Cont. Shelf Res., 58, 79-95	Journal Article	http://www. sciencedirect. com/science/ article/ pii/S0278434 313000654	Sustaining Healthy Coastal Ecosystems
Hutchinson, M., J. H. Wang, Y. Swimmer, K. Holland, S. Kohin, H. Dewar, J. Wraith, R. Vetter, C. Heberer, and J. Martinez	11/1/12	The effects of a lan- thanide metal alloy on shark catch rates	Fish. Res., 131- 133, 45-51	Journal Article	http://www. sciencedirect.com/ science/journal/ 01657836 /131-133	Sea Turtle Bycatch Mitigation Research
Jensen, O., and T. Branch	11/27/12	Global meta- analysis of tuna and billfish stocks	PFRP Principal Investigators Meeting: Honolulu, HI. November 26- 27, 2012	Presentation	http://www. soest.hawaii.edu/ PFRP/nov12mtg/ nov12mtg.htm	Pelagic Fisheries Research Program
Johnson, G. C., and J. M. Lyman	2012	Global oceans: Sea surface salinity [in "State of the Climate in 2011"]	Bull. Am. Met. Soc., 93, 7, special supplement, p. S68-S69, S72	Journal Article	http://dx.doi.org/10 .1175/2012BAMSS tateoftheClimate.1	Profiling CTD Float Array Imple- mentation and Ocean Climate Research

Johnson, G. C., J. M. Lyman, J. K. Willis, S. Levitus, T. Boyer, J. Antonov, and S. A. Good	2012	Global oceans: Ocean heat con- tent [in: State of the Climate in 2011"]	Bull. Am. Met. Soc., 93, 7, special supplement, p. S62-S65	Journal Article	http://dx.doi.org/10 .1175/2012BAMSS tateoftheClimate.1	Profiling CTD Float Array Imple- mentation and Ocean Climate Research
Jones T.T., B.L. Bostrom, M.D. Hastings, K.S. Van Houtan, D. Pauly, et al.	10/5/12	Resource require- ments of the Pacific leatherback turtle population	PLoS ONE, 7, 10, e45447, doi:10.1371/ journal. pone.0045447	Journal Article	http://www. plosone. org/article/ info%3Adoi% 2F10.1371% 2Fjournal. pone.0045447	Sea Turtle Bycatch Mitigation Research
Kawatani, Y. , and K. Hamilton	5/24/13	Weakened strato- spheric quasibienni- al oscillation driven by increased tropical mean upwelling	Nature, 497, 478- 481	Journal Article	doi:10.1038/na- ture12140	Enhance- ment of Data and Research Activities for Climate Studies at the Interna- tional Pacif- ic Research Center
Kelly, E., R. Sparks, I. Williams, and J. Smith	7/9/12	Herbivore enhance- ment as a tool for reef restoration	Proc. 12th International Coral Reef Symposium, 9-13 July 2012, Cairns, QLD, Australia	Conference Proceedings	http://www. icrs2012.com/Pro- ceedings.htm	Sustaining Healthy Coastal Ecosystems
Kenyon J., J. Maragos, and P. Vroom	7/13/12	Monitoring supports establishment of Pa- cific Islands Marine National Monument	Proc. 12th International Coral Reef Symposium, 9-13 July 2012, Cairns, QLD, Australia	Conference Proceedings	www.reefbase.org/ resource_center/ publication/icrs. aspx?icrs=ICRS11	Sustaining Healthy Coastal Ecosystems
Kopf, R.K.	11/27/12	Age and growth of striped marlin, Kajikia audax, in the Hawaii-based longline fishery	PFRP Principal Investigators Meeting: Honolulu, HI. November 26- 27, 2012	Presentation	http://www. soest.hawaii.edu/ PFRP/nov12mtg/ nov12mtg.htm	Pelagic Fisheries Research Program
Kotowicz, D.M.	2/17/13	Shifting perceptions of resilience in the wake of the Indian Ocean Tsunami	American Association for the Advancement of Science Annual Meeting: Boston, MA. Feb 14-18, 2013	Presentation	http://aaas.confex. com/aaas/2013/ webprogram/Pa- per8509.html	Human Dimensions of Fishing and Marine Ecosystems in the West- ern Pacific
Lagerloef, G., F. Wentz, S. Yueh, H-Y. Kao, G. C. Johnson, and J. M. Lyman	2012	Global oceans: Ocean heat con- tent [in: State of the Climate in 2011"]	Bull. Am. Met. Soc., 93, 7, special supplement, p. S70-S71	Journal Article	http://dx.doi.org/10 .1175/2012BAMSS tateoftheClimate.1	Profiling CTD Float Array Imple- mentation and Ocean Climate Research

Lee, H.H. and K.R. Piner	12/6/12	Future projections of the western and central North Pacific striped marlin stock	9 <sup>th</sup> Regular Session of the Western and Central Pacific Fisheries Commission. WCPFC9-2012- IP-18	Workshop Proceedings	http://www. wcpfc.int/doc/ SC9-WCPFC9-11/ Future-Projections- Western-and- Central-North- Pacific-Striped- Marlin-Stock- %28WCPFC9-	Stock As- sessment Research Program
Lee, H.H. and K.R. Piner	5/28/13	Use of likelihood profiling over a global scaling pa- rameter to structure the population dynamics model: an example using blue marlin in the Pacific Ocean	ISC Billfish Working Group: Shimizu, Japan. May 20-28, 2013. ISC/13/ BILLWG-2/05	Workshop Proceedings	http://isc.ac.affrc. go.jp/work- ing_groups/billfish. html	Stock As- sessment Research Program
Lee, H.H. and Y.J. Chang	5/23/13	Age-structured natural mortality for Pacific blue marlin based on meta-anal- ysis and an ad hoc mortality model	ISC Billfish Working Group: Honolulu, Hawaii. January 16-23, 2013. ISC/13/ BILLWG-1/07	Workshop Proceedings	http://isc.ac.affrc. go.jp/work- ing_groups/billfish. html	Stock As- sessment Research Program
Lee, H.H., K.R. Piner, R. Humphreys, and J. Brodziak	1/10/13	Stock assessment of striped marlin in the western and central North Pacific Ocean	Pacific Islands Fisheries Science Center Internal Report IR-12-035	Report	http://www.pifsc. noaa.gov/do/peer_ reviews/striped_ marlin_stock_as- sessment_2013_01. php	Stock As- sessment Research Program
Lee, H.H., K.R. Piner, Y.J. Chang, D. Tagami, and I. Taylor	1/23/13	Preliminary blue marlin stock assess- ment in the Pacific Ocean	ISC Billfish Working Group: Shimizu, Japan. May 20-28, 2013. ISC/13/ BILLWG-2/04	Workshop Proceedings	http://isc.ac.affrc. go.jp/work- ing_groups/billfish. html	Stock As- sessment Research Program
Lee, JY., B. Wang, M.C. Wheeler, X. Fu, D.E. Waliser, and IS. Kang	1/15/13	Real-time multi- variate indices for the boreal summer intraseasonal oscil- lation over the Asian summer monsoon region	Clim. Dyn., 40, 493-509	Journal Article	doi:10.1007/ s00382-012-1544-4	Enhance- ment of Data and Research Activities for Climate Studies at the Interna- tional Pacif- ic Research Center
Lee, WC., M. Bell, and P. Harasti	3/6/13	Joint Hurricane Testbed Progress Report	Interdepartmental Hurricane Conference	Presentation	http://www.nhc. noaa.gov/jht/ ihc_13/s5a-03-lee. pdf	Improved Automation and Perfor- mance of VORTRAC Intensity Guidance

Leslie, H.M., E. Goldman, K.L. McLeod, L. Sievanen, H. Balasubramanian, R. Cudney-Bueno, A. Feuerstein, N. Knowlton, K. Lee, R. Pollnac, and J.F. Samhouri	5/21/13	How good science and stories go hand- in-hand	Conserv. Biol.	Journal Article	doi:10.1111/ cobi.12080	Human Dimensions of Fishing and Marine Ecosystems in the West- ern Pacific
Looney, E.	3/13/13	Researchers con- tinue study of pollu- tion effects on coral health off West Maui	NOAA Pacific Islands Fisheries Science Center Blog		http://pifscblog. wordpress. com/2013/03/13/ pollution-coral- maui/	Sustaining Healthy Coastal Ecosystems
Lopez, J.	4/15/13	Persistent organic pollutants in the Hawaiian monk seal from the Main Ha- waiian Islands	B.E.A.C.H. Earth Month lecture series, Honolulu, HI, April, 2013	Presentation		Hawaiian Monk Seal Research Program
Lopez, J., C. Littnan, D. Hyrenbach, and G.M. Ylitalo	4/24/13	Persistent organic pollutants in the Hawaiian monk seal from the Main Ha- waiian Islands	44th Annual Conference of the International Association of Aquatic Animal Medicine: Sausalito, CA. April 20-26, 2013	Presentation		Hawaiian Monk Seal Research Program
McDole, T., J. Nulton, K.L. Barott, B. Felts, C. Hand, M. Hatay, H. Lee, M.O. Nadon, B. Nosrat, P. Salamon, B. Bailey, S.A. Sandin, B. Vargas- Angel, M. Youle, B.J. Zgliczynski, R.E. Brainard, and F. Rohwer	9/7/12	Assessing coral reefs on a Pacific-wide scale using the mi- crobialization score	PLoS ONE, 7, 9, e43233	Journal article	doi:10.1371/jour- nal.pone.0043233	Stock As- sessment Research Program
Merrifield, M. A., A. S. Genz, C. P. Kontoes, and J. J. Marra	in press	Annual maximum water levels from tide gauges: Con- tributing factors and geographic patterns	J. Geophys. Res.	Journal Article		The Uni- versity of Hawaii Sea Level Center
Nadon, M., J. Ault, I. Williams, and S. Smith	7/9/12	Incorporating visual surveys into popula- tion assessments of Hawaiian reef fishes	Proc. 12th International Coral Reef Symposium, 9-13 July 2012, Cairns, QLD, Australia	Conference Proceedings	http://www. icrs2012.com/Pro- ceedings.htm	Sustaining Healthy Coastal Ecosystems
Nadon, M.O., J.K. Baum, I.D. Williams, J.M. McPherson, B.J. Zgliczynski, B.L. Richards, R.E. Schroeder, and R.E. Brainard	4/26/12	Re-creating missing population baselines for Pacific reef sharks	Conserv. Biol., 26, 3, 493-503	Journal article	doi:10.1111/j.1523- 1739.2012.01835.x	Stock As- sessment Research Program

Nicol, S.	11/27/12	Integrating electron- ic and conventional tagging data into modern stock assess- ment models	PFRP Principal Investigators Meeting: Honolulu, HI. November 26- 27, 2012	Presentation	http://www. soest.hawaii.edu/ PFRP/nov12mtg/ nov12mtg.htm	Pelagic Fisheries Research Program
Nicol, S.	11/27/12	TUMAS: user friendly stock as- sessment tool for managers and del- egates	PFRP Principal Investigators Meeting: Honolulu, HI. November 26- 27, 2012	Presentation	http://www. soest.hawaii.edu/ PFRP/nov12mtg/ nov12mtg.htm	Pelagic Fisheries Research Program
Norstrom, A.V., J.N. Kittinger, M. Nystrom, and I.D. Williams	7/9/12	Mapping spatial resilience of Hawai- ian coral reefs	Proc. 12th International Coral Reef Symposium, 9-13 July 2012, Cairns, QLD, Australia	Conference Proceedings	http://www. icrs2012.com/Pro- ceedings.htm	Sustaining Healthy Coastal Ecosystems
O'Malley, J.M. and W.A. Walsh	4/1/2013	Annual and long- term movement patterns of spiny lobster, <i>Panulirus</i> <i>marginatus</i> , and slipper lobster, <i>Scyl-</i> <i>larides squammosus</i> , in the Northwestern Hawaiian Islands	Bull. Mar. Sci., 89, 2, 529-549	Journal article	http://www.rsmas. miami.edu/bms/	Stock As- sessment Research Program
Pedersen, M.	11/27/12	Analysis and inter- pretation of acoustic array data	PFRP Principal Investigators Meeting: Honolulu, HI. November 26- 27, 2012	Presentation	http://www. soest.hawaii.edu/ PFRP/nov12mtg/ nov12mtg.htm	Pelagic Fisheries Research Program
Pedersen, M., and K. Weng	Accepted	Estimating individu- al animal movement from observation networks	Methods Ecol. Evol.	Journal Article		Pelagic Fisheries Research Program
Piner, K.R., H.H. Lee, A. Kimoto, I.G. Taylor, M. Kanaiwa, and CL. Sun	2/25/13	Population dynam- ics and status of striped marlin ( <i>Ka- jikia audax</i> ) in the western and central northern Pacific Ocean	Mar. Freshwater Res., 64, 108-118	Journal article	http://dx.doi. org/10/1071/ MF12302	Stock As- sessment Research Program
Polovina, J.	11/27/12	A top-down, size- based, ecosystem response to fishing in the subtropical Pacific pelagic eco- system: observations and theory	PFRP Principal Investigators Meeting: Honolulu, HI. November 26- 27, 2012	Presentation	http://www. soest.hawaii.edu/ PFRP/nov12mtg/ nov12mtg.htm	Pelagic Fisheries Research Program
Pomeroy, R., R. Brainard, N. Armada, A. Heenan, M. Moews, and J. Shackeroff	7/9/12	Incorporating climate change into ecosystem ap- proaches to fisheries management	Proc. 12th International Coral Reef Symposium, 9-13 July 2012, Cairns, QLD, Australia	Conference Proceedings	http://www. icrs2012.com/Pro- ceedings.htm	Sustaining Healthy Coastal Ecosystems
Рорр, В.	11/27/12	Stable isotopic com- positions of mercury indicate depth of forage in North Pa- cific pelagic preda- tory fishes and their prey from Hawaii	PFRP Principal Investigators Meeting: Honolulu, HI. November 26- 27, 2012	Presentation	http://www. soest.hawaii.edu/ PFRP/nov12mtg/ nov12mtg.htm	Pelagic Fisheries Research Program

Richards, B., I. Williams, O. Vetter, and G. Williams	7/9/12	Where the wild things are: large- bodied coral reef fishes	Proc. 12th International Coral Reef Symposium, 9-13 July 2012, Cairns, QLD, Australia	Conference Proceedings	http://www. icrs2012.com/Pro- ceedings.htm	Sustaining Healthy Coastal Ecosystems
Richards, B.L., I.D. Williams, O.J. Vetter, and G.J. Williams	7/1/12	Environmental fac- tors affecting large- bodied coral reef fish assemblages in the Mariana Archi- pelago	PLoS ONE, 7, 2, e31374.	Journal Article	doi:10.1371/jour- nal.pone.0031374	Sustaining Healthy Coastal Ecosystems
Rooney, J.	4/5/13	Beach erosion and mesophotic coral reefs in Hawaii	Presentation to the First Grade classes at Island Pacific Academy, Kapolei HI	Presentation		Sustaining Healthy Coastal Ecosystems
Rooney, J., F. Parrish, and R. Boland	9/13/12	Mesophotic coral ecosystems of the Au'au Channel and Pacific Islands Region	Presentation made to Pacific Islands Regional Office, Habitat Conservation and Protected Species Divisions	Presentation		Sustaining Healthy Coastal Ecosystems
Rooney, J., J. Taylor, and B. Richards	2/22/13	Development of the SeaBED AUV as a tool for bottomfish surveying	Deep Slope Bottomfish Research Coordination Workshop	Presentation		Sustaining Healthy Coastal Ecosystems
Rooney, J., M. Ferguson, and J. Taylor	10/30/12	Method and plans for camera sled sur- veying of mesophot- ic coral ecosystem benthic and demer- sal communities in the Manu'a Islands	Presentation made to local resource managers and stakeholders in Pago Pago, American Samoa	Presentation		Sustaining Healthy Coastal Ecosystems
Rooney, J., M. Ferguson, J. Taylor, and T. Letalie	11/14/12	Preliminary results from camera sled surveying of meso- photic coral eco- system benthic and demersal communi- ties in the Manu'a Islands	Presentation made to local resource managers and stakeholders in Pago Pago, American Samoa	Presentation		Sustaining Healthy Coastal Ecosystems
Rooney, J., S. Lindfield, and V. Blyth-Skyrme	7/10/12	Mesophotic coral ecosystems of the Mariana Archi- pelago	Proc. 12th International Coral Reef Symposium, 9-13 July 2012, Cairns, QLD, Australia	Conference Proceedings	http://www. icrs2012.com/Pro- ceedings.htm	Sustaining Healthy Coastal Ecosystems
Scholey, V.	11/27/12	Ocean acidification impacts on tropical tuna populations	PFRP Principal Investigators Meeting: Honolulu, HI. November 26- 27, 2012	Presentation	http://www. soest.hawaii.edu/ PFRP/nov12mtg/ nov12mtg.htm	Pelagic Fisheries Research Program
Schroeder, T. A., M.R. Chowdhury, M.A. Lander, C.C. Guard, C. Felkley, and D. Gifford	2012	The role of the Pa- cific ENSO Applica- tions Center in re- ducing vulnerability to climate hazards	Bull. Am. Met. Soc., 93, 7, 1003- 1015	Journal Article	http://journals. ametsoc.org/toc/ bams/93/7	Pacific ENSO Ap- plications Climate Center

Senina, I.	11/27/12	Integrating conven- tional and electronic tagging data into the Spatial Ecosystem and Population Model SEAPODYM	PFRP Principal Investigators Meeting: Honolulu, HI. November 26- 27, 2012	Presentation	http://www. soest.hawaii.edu/ PFRP/nov12mtg/ nov12mtg.htm	Pelagic Fisheries Research Program
Sievanen, L.	2/17/13	Adapting to climate variability in the Gulf of California, Mexico	American Association for the Advancement of Science Annual Meeting: Boston, MA. Feb 14-18, 2013	Presentation	http://aaas.confex. com/aaas/2013/ webprogram/Pa- per8515.html	Human Dimensions of Fishing and Marine Ecosystems in the West- ern Pacific
Stewart J.S., E.L. Hazen, D.G. Foley, S.J. Bograd, and W.F. Gilly	2012	Modeling marine predator migration during range expan- sion: Humboldt squid (Dosidicus gigas) in the Califor- nia Current System	Mar. Ecol. Progr. Ser., 471, 135-150	Journal Article		Climate Change and Ecosystem Variability in the North Pacific Ocean and the Dy- namics of Marine Resource Populations
Su, N.J., C.L. Sun, A.E. Punt, S. Z. Yeh, W.C. Chiang, Y.J. Chang, and H.Y. Chang	1/8/13	An ensemble analy- sis to predict future habitats of striped marlin ( <i>Kajikia</i> <i>audax</i> ) in the North Pacific Ocean	ICES J. Mar. Sci.	Journal Article	doi:10.1093/ icesjms/fss191	Stock As- sessment Research Program
Su, N.J., C.L. Sun, A.E. Punt, S.Z. Yeh, W.C. Chiang, YJ. Chang, and H.Y. Chang	1/23/13	Effects of sexual dimorphism on pop- ulation parameters and exploitation ratios of blue marlin ( <i>Makaira nigricans</i> ) in the northwest Pacific Ocean	Aquat. Living Resour., 26, 1, 19-24	Journal Article	doi:10.1051/ alr/2012039	Stock As- sessment Research Program
Sun, CL., NJ. Su, SZ. Yeh, and Y.J. Chang	1/23/13	Sex-specific growth parameters and natural mortality rates for blue marlin (Makaira nigricans) in the northwest Pacific Ocean	ISC Billfish Working Group: Honolulu, Hawaii. January 16-23, 2013. ISC/13/ BILLWG-1/10	Workshop Proceedings	http://isc.ac.affrc. go.jp/work- ing_groups/billfish. html	Stock As- sessment Research Program
Thomas, L. R., G. DiNardo, H.H. Lee, K.R. Piner, and S.E. Kahng	5/25/13	Factors influencing the distribution of Kona crabs <i>Ranina</i> <i>Ranina</i> (Brachyura: Raninidae) in the main Hawaiian Islands	J. Crustacean Biol.	Journal Article	doi:10.1163/ 1937249X- 00002171	Stock As- sessment Research Program
Thys, T., J. Whitney, A. Hearn, K. Weng, C. Peñaherrera, L. Jawad, J. Alfaro- Shigueto, J.C. Mangel, and S.A. Karl	In press	First record of the southern ocean sun- fish, Mola ramsayi, in the Galápagos Marine Reserve	Mar. Biodiver. Records	Journal Article		Pelagic Fisheries Research Program

Timm, O. Elison, M. Takahashi, T.W. Giambelluca, and H.F. Diaz	5/23/13	On the relation between large-scale circulation pattern and heavy rain events over the Hawaiian Islands: Recent trends and future changes	J. Geophys. Res., 118	Journal Article	doi:10.1002/ jgrd.50314	Enhance- ment of Data and Research Activities for Climate Studies at the Interna- tional Pacif- ic Research Center
Timmers M., C. Bird, D. Skillings, P. Smouse, and R. Toonen	2/17/12	There's no place like home: Crown of thorns outbreaks in the central Pacific are regionally de- rived and indepen- dent events	PLoS ONE, 7, 2, e31159	Journal Article	doi:10.1371/jour- nal.pone.0031159	Sustaining Healthy Coastal Ecosystems
Vargas-Angel, B.	4/7/13	Comprehensive assessment and de- velopment of coral demographic per- formance measures for Faga'alu Bay, American Samoa	Presentation made to the Faga'alu Watershed Community Committee	Presentation		Sustaining Healthy Coastal Ecosystems
Vargas-Angel, B.	4/17/13	CRED benthic re- search - Hawaii	Presentation made to the Hawaii Division of Aquatic Resources	Presentation		Sustaining Healthy Coastal Ecosystems
Vargas-Angel, B.	3/1/13	Study reveals dif- ferences in coral development within Faga`alu Bay, Amer- ican Samoa	NOAA Pacific Islands Fisheries Science Center Blog		http://pifscblog. wordpress. com/2013/03/01/ coral-development- fagaalu/	Sustaining Healthy Coastal Ecosystems
Vargas-Angel, B.	10/25/12	New data on benthic cover at Guam now available	NOAA Pacific Islands Fisheries Science Center Blog		http://pifscblog. wordpress. com/2012/10/25/ data-benthic-cover- guam/	Sustaining Healthy Coastal Ecosystems
Vargas-Angel, B.	4/9/13	Researchers contin- ue studies of effects of water circulation and sedimentation on benthic com- munities at Faga'alu Bay, American Samoa	NOAA Pacific Islands Fisheries Science Center Blog		http://pifscblog. wordpress. com/2013/04/09/ benthic-fagaalu- bay/	Sustaining Healthy Coastal Ecosystems
Vargas-Angel, B.	5/10/13	Researchers com- plete surveys of coral disease off the north shore of Kaua`i	NOAA Pacific Islands Fisheries Science Center Blog		http://pifscblog. wordpress. com/2013/05/10/ disease-surveys- kauai/	Sustaining Healthy Coastal Ecosystems
Vaz, A., and K. Richards	11/27/12	Early life stage dis- persal of yellowfin tuna	PFRP Principal Investigators Meeting: Honolulu, HI. November 26- 27, 2012	Presentation	http://www. soest.hawaii.edu/ PFRP/nov12mtg/ nov12mtg.htm	Pelagic Fisheries Research Program

Vetter, O.J., and J.M. Gove	7/15/12	Wave stress on coral reef ecosystems	Proc. 12th International Coral Reef Symposium, 9-13 July 2012, Cairns, QLD, Australia	Conference Proceedings	http://www. icrs2012.com/Pro- ceedings.htm	Sustaining Healthy Coastal Ecosystems
Walsh, W.A.	1/23/13	A catch history for blue marlin <i>Makaira</i> <i>nigricans</i> in Hawai- ian waters: 1948- 2011	ISC Billfish Working Group: Honolulu, Hawaii. January 16-23, 2013. ISC/13/ BILLWG-1/14	Workshop Proceedings	http://isc.ac.affrc. go.jp/work- ing_groups/billfish. html	Stock As- sessment Research Program
Walsh, W.A.	11/27/12	Analyses of catch data for blue and striped marlins (Is- tiophoridae)	PFRP Principal Investigators Meeting: Honolulu, HI. November 26- 27, 2012	Presentation	http://www. soest.hawaii.edu/ PFRP/nov12mtg/ nov12mtg.htm	Pelagic Fisheries Research Program
Walsh, W.A. and S.L.H. Teo	1/23/13	Catch statistics, length data and standardized CPUE for blue sharks Pri- onace glauca taken by longline fisheries based in Hawaii and California	ISC Shark Working Group: La Jolla CA. January 7-14, 2013. ISC/13/ SHARKWG-1/05	Workshop Proceedings	http://isc.ac.affrc. go.jp/work- ing_groups/billfish. html	Stock As- sessment Research Program
Walsh, W.A., Y.J. Chang, and H.H. Lee	1/23/13	Catch statistics, size composition and CPUE standardiza- tions for blue marlin <i>Makaira nigricans</i> in the Hawaii-based pelagic longline fish- ery in 1995-2011	ISC Billfish Working Group. Honolulu, Hawaii. January 16-23, 2013. ISC/13/ BILLWG-1/13	Workshop Proceedings	http://isc.ac.affrc. go.jp/work- ing_groups/billfish. html	Stock As- sessment Research Program
Wang, J.H., P. Alvarez, J. Barkan, V. Barragan, G. Crisostomo, K.C. Dam, A. Figueroa, S. Fisler, M. Santos, and Y. Swimmer	5/9/13	Effects of UV il- lumination on by- catch in small-scale commercial gillnet fisheries	Proc. 64th Tuna Conference: Lake Arrowhead, CA. May 20-23, 2013	Conference Proceedings	http://www.tu- naconference.org/ Proceedings.htm	Sea Turtle Bycatch Mitigation Research
Wang, J.H., S. Fisler, J. Barkan, and Y. Swimmer	2/1/13	UV illumination of gillnets reduces sea turtle and shark bycatch	Proc. 33rd Annual Symposium on Sea Turtle Biology and Conservation: Baltimore, MD. February 5-8, 2013	Conference Proceedings	http://www.sea- turtlesociety.org/ symposium/pro- ceedings.shtml	Sea Turtle Bycatch Mitigation Research
Weijerman, M., F. Parrish, and E. Fulton	5/30/12	Comparison of coral reef ecosystems along a fishing pres- sure gradient	PLoS ONE, 8, 5, e63797	Journal Article	doi:10.1371/jour- nal.pone.0063797	Sustaining Healthy Coastal Ecosystems
Welch, D.	11/27/12	Optimal design & operation of the POST Array - Mak- ing ocean measure- ments cost-Effective and policy relevant	PFRP Principal Investigators Meeting: Honolulu, HI. November 26- 27, 2012	Presentation	http://www. soest.hawaii.edu/ PFRP/nov12mtg/ nov12mtg.htm	Pelagic Fisheries Research Program
Weng K., and R. Honebrink	2013	Occurrence of White sharks (Carcharodon carcharias) in Ha- waiian waters	J. Mar. Biol.	Journal Article	http://dx.doi.org/ 10.1155/2013/ 598745	Pelagic Fisheries Research Program

Weng K., J. O'Sullivan, C. Lowe, C. Winkler, M. Blasius, K. Loke-Smith, T. Sippel, J. Ezcurra, S. Jorgensen, and M. Murray	2012	Back to the wild: release of juvenile white sharks from the Monterey Bay Aquarium	In Domeier, M.L. (ed). Global Perspectives on the Biology and Life History of the Great White Shark. CRC Press, Boca Raton, FL	Journal Article		Pelagic Fisheries Research Program
Weng, K., and J. Muir	11/27/12	Residency of bigeye tuna at Cross Sea- mount	PFRP Principal Investigators Meeting: Honolulu, HI. November 26- 27, 2012	Presentation	http://www. soest.hawaii.edu/ PFRP/nov12mtg/ nov12mtg.htm	Pelagic Fisheries Research Program
Williams G.J., J.E. Smith, E.J. Conklin, J.M. Gove, E. Sala, and S.A Sandin	6/1/13	Benthic communi- ties at two remote Pacific coral reefs: Effects of reef habi- tat, depth, and wave energy gradients on spatial patterns	PeerJ, 1, e81	Journal Article	doi:10.7717/ peerj.81	Sustaining Healthy Coastal Ecosystems
Williams, G., J. Asher, R. Brainard, J. Ehses, T. Jones, I. Williams, and S. Sandin	7/9/12	Coral reef resilience across US-affiliated islands in the Pacific Ocean	Proc. 12th International Coral Reef Symposium, 9-13 July 2012, Cairns, QLD, Australia	Conference Proceedings	http://www. icrs2012.com/Pro- ceedings.htm	Sustaining Healthy Coastal Ecosystems
Williams, I., J. Zamzow, K. Lino, M. Ferguson, and E. Donham	8/1/12	Status of coral reef fish assemblages and benthic condi- tion around Guam: A report based on underwater visual surveys in Guam and the Mariana Archipelago, April- June 2011	NOAA Technical Memorandum NMFS-PIFSC-33	Report	http://www.pifsc. noaa.gov/library/ pubs/tech/NOAA_ Tech_Memo_PIF- SC_33.pdf	Sustaining Healthy Coastal Ecosystems
Williams, I.D., et al	2/28/13	Pacific Reef Assess- ment and Monitor- ing Program Fish Monitoring Brief: main Hawaiian Is- lands 2012	PIFSC Data Report DR-13-006	Report	http://www.pifsc. noaa.gov/library/ pubs/DR-13-006. pdf	Sustaining Healthy Coastal Ecosystems
Williams, I.D., et al	4/10/13	Pacific Reef Assess- ment and Monitor- ing Program Fish Monitoring Brief: Pacific Remote Is- land Areas 2012	PIFSC Data Report DR-13-007	Report	http://www.pifsc. noaa.gov/library/ pubs/DR-13-007. pdf	Sustaining Healthy Coastal Ecosystems
Williams, I.D., et al	4/10/13	Pacific Reef Assess- ment and Monitor- ing Program Fish Monitoring Brief: American Samoa 2012	PIFSC Data Report DR-13-008	Report	http://www.pifsc. noaa.gov/library/ pubs/DR-13-008. pdf	Sustaining Healthy Coastal Ecosystems
Young, J.	11/27/12	Trophic understand- ing of tunas in the southwest Pacific	PFRP Principal Investigators Meeting: Honolulu, HI. November 26- 27, 2012	Presentation	http://www. soest.hawaii.edu/ PFRP/nov12mtg/ nov12mtg.htm	Pelagic Fisheries Research Program

Zglczynski, B.J., I.D. Williams, R.E. Schroeder, M.O. Nadon, B.L.	2/6/13	The IUCN Red List of Threatened Spe- cies: an assessment of coral reef fishes	Coral Reefs	Journal Article	http://www.pifsc. noaa.gov/library/ pubs/Zgliczynski_ etal_CR_2013.pdf	Sustaining Healthy Coastal Ecosystems
Richards, and S.A. Sandin		in the US Pacific Islands				
Zhang, SJ., T. Li, X. Ge, M. Peng, and N. Pan	4/1/12	A 3DVAR-based dynamical initial- ization scheme for tropical cyclone predictions	Wea. Forecast., 27, 473-483	Journal Article	doi:10.1175/WAF- D-11-00014.1	Enhance- ment of Data and Research Activities for Climate Studies at the Interna- tional Pacif- ic Research Center

# Appendix I List of Acronyms

ACL	Annual Catch Limit
ACT	Annual Catch Target
ADMB	Automatic Differentiation Model Builder
AFES	Atmospheric Model for the Earth Simulator
APDRC	Asia-Pacific Data Research Center
ARL	Air Resources Laboratories
ARMS	Autonomous Reef Monitoring Structure
AS	American Samoa
ATCF	Automated Tropical Cyclone Forecasting
AUV	Autonomous Underwater Vehicle
AVHRR	Advanced Very High Resolution Radiometer
AVISO	Archiving Validation and Interpretation of Satellite Oceanographic Data
AWIPS	Advanced Weather Interactive Processing System
BAMS	Bulletin of the American Meteorological Society
BET	Bigeye Tuna
BMU	Bioerosion Monitoring Unit
BRT	Biological Review Team
BSP	Guam Bureau of Statistics and Plans (BSP)
CALIPSO	Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations
CAPAM	Center for the Advancement of Population Assessment Methodology
CAU	Calcification Acidification Units
CCA	Canonical Correlation Analysis
CFBS	Commercial Fisheries Biosampling
CI	Cooperative Institute
CICESE	Centro de Investigacion Científica y de Educacion Superior de Ensenada
CIE	Center for Independent Experts
CITES	Convention on International Trade of Endangered Species
CLIOTOP	Climate Impacts on Top Predators
CLIVAR	Climate Variability and Predictability Research Program
CMIP	Coupled Model Inter-comparison Project
CMORE	Center for Microbial Oceanography: Research and Education
CMS	Content Management System
CNES	Centre National d'Etudes Spatiales
CNMI	Commonwealth of the Northern Mariana Islands
CO <sub>2</sub>	Carbon Dioxide
CoRIS	Coral Reef Information System

CPUE	Catch Per Unit Effort
CRCP	Coral Reef Conservation Program
CRED	Coral Reef Ecosystem Division
CRP	Cetacean Research Program
CSIA-AA	Compound Specific Nitrogen Stable Isotope Analysis of Amino Acids
СТ	Coral Triangle
CTD	Conductivity-Temperature-Depth
CTI	Coral Triangle Initiative
DAR	Division of Aquatic Resources
DAWR	Division of Aquatic and Wildlife Resources (Guam)
DDIP	Data Documentation Implementation Plan
DFW	Division of Fish and Wildlife (CNMI)
DKIRC	Daniel K. Inouye Regional Center
DLNR	Department of Land and Natural Resources
DMSC	Data Management Stewardship Community
DMWR	Department of Marine and Wildlife Resources (American Samoa)
DODS	Distributed Ocean Data System
Dolphin SMART	Stay Move Always Refrain Teach
DRS	Dealer Reporting System
DWH	Deep Water Horizon
EAFM	Ecosystem Approach to Fisheries Management
ECV	Essential Climate Variable
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
ENSO	El Niño Southern Oscillation
EOF	Empirical Orthogonal Function
EORP	Ecosystems Observations Research Program
ERD	Environmental Research Division
ESA	Endangered Species Act
ESRL	Earth Systems Research Laboratory
FCMA	Fishery Conservation and Management Act
FEP	Fisheries Ecosystem Plan
FFA	Forum Fisheries Agency
FFS	French Frigate Shoals
FMP	Fishery Management Plan
FRS	Fisherman Reporting System
FSM	Federated States of Micronesia
FSWP	Fishery Statistics of the Western Pacific
FUS	Fisheries of the United States

FWS	Fish and Wildlife Service
FY	Fiscal Year
GCMP	Guam Coastal Management Program
GCOS	Global Climate Observing System
GDS	GrADS DODS Server
GEOSS	Global Earth Observation System of Systems
GEV	Generalized Extreme Value
GFDL	Geophysical Fluid Dynamics Laboratory
GIA	Global Isostatic Adjustment
GIS	Geographic Information System
GLOSS	Global Sea Level Observing System
GMSL	Global Mean Sea Level
GODAE	Global Ocean Data Assimilation Experiment
GOES	Geostationary Operational Environmental Satellite
GPS	Global Positioning System
GrADS	Grid Analysis and Display System
GSI	Gonadal Somatic Indices
GTS	Global Telecommunications System
HAPC	Habitat Areas of Particular Concern
HARP	High-frequency Acoustic Recording Package
HDAR	Hawaii Division of Aquatic Resources
Hg	Mercury
$Hg^0$	Elemental Mercury
Hg <sup>P</sup>	Particulate Mercury
HI	Hawaii
HIC	Hawaii Information Consortium
HIHWNMS	Hawaiian Islands Humpback Whale National Marine Sanctuary
HIMB	Hawaii Institute of Marine Biology
HiOOS	Hawaii Ocean Observing System
HMS	Hawaiian Monk Seal
HMSRP	Hawaiian Monk Seal Research Program
HPLC	High-Performance Liquid Chromatography
HPU	Hawaii Pacific University
HQ	Headquarters
HRPT	High Resolution Picture Transmission
НҮСОМ	Hybrid Coordinate Ocean Model
IATTC	Inter-American Tropical Tuna Commission
IC-4D	Interactive Calibration of Four Dimensions
ICES	International Council for the Exploration of the Sea

ICRS	International Coral Reef Symposium
IEA	Integrated Ecosystem Assessment
IFOMC	International Fisheries Observer and Monitoring Conference
IMBER	Integrated Marine Biogeochemistry and Ecosystem Research
INAPESCA	Instituto Nacional de Pesca (Mexican National Fisheries Institute)
IOOS	Integrated Ocean Observing System
IPRC	International Pacific Research Center
ISC	International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean
ITS	Information Technology Support
JAMSTEC	Japan Agency for Marine-Earth Science and Technology
JASL	Joint Archive for Sea Level
JEAN	Japan Environmental Action Network
JIMAR	Joint Institute for Marine and Atmospheric Sciences
KAPs	Knowledge, Attitudes and Perceptions
LAS	Live Access Server
LBSP	Land-Based Sources of Pollution
LED	Light-Emitting Diode
LH	Life History
MAPCO <sub>2</sub>	Moored Autonomous pCO <sub>2</sub> System
MARAMP	Marianas Archipelago Reef Assessment Monitoring Program
MCBH	Marine Corps Base Hawaii
MHI	Main Hawaiian Islands
MLO	Mauna Loa Observatory
MMPA	Marine Mammal Protection Act
MNM	Marine National Monuments
MODIS	Moderate Resolution Imaging Spectroradiometer
MTMNM	Marianas Trench Marine National Monument
MTRP	Marine Turtle Research Program
NASA	National Aeronautics and Space Administration
NCA	National Climatic Assessment
NCRMP	National Coral Reef Monitoring Program
NDBC	National Data Buoy Center
NEDIS	National Environmental Data and Information Service
NEPA	National Environmental Policy Act
NHC	National Hurricane Center
NIO	National Institute of Oceanography (India)
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration

NODC	National Oceanographic Data Center
NORPAX	North Pacific Experiment
NOS	National Ocean Service
NSF	National Science Foundation
NWHI	Northwestern Hawaiian Islands
NWS	National Weather Service
OFES	Ocean model For Earth Simulator
OPeNDAP	Open-source Project for a Network Data Access Protocol
ORE	Outreach and Education Program
ORS	Ocean Remote Sensing
OTDPS	Oracle Turtle Data Processing System
PACES	Papahānaumokuākea Associated Cetacean Ecology Survey
PacIOOS	Pacific Islands Ocean Observing System
PaCIS	Pacific Climate Information System
PDO	Pacific Decadal Oscillation
PEAC	Pacific ENSO Applications Climate Center
PFEL	Pacific Fisheries Environmental Laboratory
PFRP	Pelagic Fisheries Research Program
PICCC	Pacific Islands Climate Change Cooperative
PIFSC	Pacific Islands Fisheries Science Center
PIR	Pacific Islands Region
PIRO	Pacific Islands Regional Office
PIROP	Pacific Islands Regional Observer Program
PMEL	Pacific Marine Environmental Laboratory
POES	Polar Orbiting Environmental Satellite
РОТ	Peaks over Threshold
PRC	Pacific Regional Center
PRECI	Protected Resources Environmental Compliance Initiative
PRH	Pacific Region Headquarters
PRIAs	Pacific Remote Island Areas
PRSN	Puerto Rico Seismic Network
PSMSL	Permanent Service for Mean Sea Level
PTWC	Pacific Tsunami Warning Center
PYSO	PIFSC Young Scientist Opportunity
QuikSCAT	Quick Scatterometer
RA	Regional Associations
RAMP	Reef Assessment and Monitoring Program
RCUH	Research Corporation of the University of Hawaii
RFP	Request for Proposals

RGM	Reactive Gaseous Mercury
SCUBA	Self-Contained Underwater Breathing Apparatus
SCUD	Surface Currents from Diagnostic Model
SEAPODYM	Spatial Ecosystem and Population Dynamics Model
SeaWiFS	Sea-viewing Wide Field of view Sensor
SFD	Sustainable Fisheries Division
SIS	Scientific Information Services
SMA	Sub Millimeter Array
SOEST	School of Ocean and Earth Science and Technology
SOI	Southern Oscillation Index
SPC	Secretariat of the Pacific Community
SSC	Scientific and Statistical Committee
SST	Sea Surface Temperature
STR	Subsurface Temperature Recorder
SWFSC	Southwest Fisheries Science Center
TAO	Tropical Ocean Atmosphere
TB	Terrabyte
TC	Tropical Cyclone
TDS	THREDDS-DODS Server
THREDDS	Thematic Real-time Environmental Distributed Data Services
TOGA	Tropical Ocean Circulation Experiment
TPT	Tropical Pacific Testbed
UFA	United Fishing Agency
UH	University of Hawaii
UHM	University of Hawaii at Manoa
UHSLC	University of Hawaii Sea Level Center
USAPI	U.S. Affiliated Pacific Islands
USGCRP	United States Global Change Research Program
UV	Ultraviolet
UW-Madison	University of Wisconsin-Madison
VIIRS	Visible Infrared Imaging Radiometer Suite
VORTRAC	Vortex Objective Radar Tracking and Circulation
WCATWC	West Coast and Alaska Tsunami Warning Center
WCNPO	Western and Central North Pacific Ocean
WCPFC	Western and Central Pacific Fisheries Commission
WCPO	Western and Central Pacific Ocean
WHOI	Woods Hole Oceanographic Institution
WHOTS	WHOI Hawaii Ocean Time-series Station
WOCE	World Ocean Circulation Experiment

WoRMS	World Register of Marine Species
WPacFIN	Western Pacific Fisheries Information Network
WPRFMC	Western Pacific Regional Fishery Management Council
WSR-88D	Weather Surveillance Radar-1988 Doppler

# Appendix II Visiting Scientists

Date	Name/Affiliation	Purpose of Visit
10/31/12 - 11/14/12	Tee Jay Letalie Fish Aggregation Devise Supervisor Department of Marine and Wildlife in American Samoa America Samoa	Participate in mapping mission of the Manu'a Island in American Samoa.
11/09/12 – 11/17/12	Michel Dreyfus Research Biologist Centro Regional de Inv Pesquera Ensenada, Mexico	Collaborate on analysis of fishery statistics and abundance indices for Pacific Bluefin Tuna captured in North Pacific long line and purse seine fisheries.
11/22/12 – 12/01/12	Vernon Scholey Laboratory Director Inter-American Tropical Tuna Commission Achotines Lab Las Tablas, Los Santos, Republic of Panama	Present research done on PFRP project Ocean Acidification Impacts on Tropical Tuna Population at the annual PFRP Principal Investigators Meeting. Collaborate research with Kevin Weng and his students.
11/24/12 – 11/27/12	David Welch President Kintama Research Services Nanaimo, BC, Canada	Present his experiences on marine animal tracking and methodology with particular reference to the utility of marine animal tracking data to fishery management and stock assessment at the annual PFRP Principal Investigators Meeting. Collaborated research with Kevin Weng and his students.
11/25/12 – 11/27/12	Ana Vaz Post-Doctoral Researcher University of Miami Miami, FL	Present results on the PFRP project "Early Life State Dispersal of Yellowfin Tuna ( <i>Thunnus Albacares</i> ) in the Central North Pacific" at the annual PERP Principal Investigators Meeting.
11/26/12 – 11/30/12	Leila Sievanen Post-Doctoral Research Associate Brown University Providence, RI	Present work on indicators of vulnerability in fishing communities in Mexico. Consult PIFSC and JIMAR on our vulnerability of fishing communities' projects and CAMEO project.

12/08/12 - 12/15/12	Melisa Menendez Garcia Researcher University of Cantabria Orena, Cantabria, Spain	Collaborative research on extreme seal level events.
12/04/12 – 12/05/12	Richard Carbone Science Advisor Earth Observing Laboratory	Discuss collaborative research on Western Pacific warm pool SST structure and occurrence of deep moist atmospheric convection/rainfall and extension of this research to the Indian Ocean associated with DYNAMO research.
2/18/13 - 2/27/13	Alexey Altukhov Research Biologist Russian Academy of Science Petropavolvsk-Kamchatsky, Russia	Collaborate and share technical and filed skills with JIMAR and PIFSC staff on using remote camera system.
3/14/13 - 3/14/13	Isaac Ginis Professor University of Rhode Island Narragansett, RI	Gave a seminar titled "Cumulative effect of tropical cyclone on the ocean: A numerical modeling study".
4/22/13 - 4/26/13	Brett Taylor PhD Student James Cook University, Australia QLD 4811, Australia	Present his research on the parrotfish life history, discuss similar on-going life history research on parrotfish species, and evaluate methodologies in the determination of age, growth curves, size and age at 50% reproductive maturity.

### Appendix III Workshops and Meetings Hosted by JIMAR

### PFRP Principal Investigators Meeting November 26-27, 2012 Pacific Room, Imin Conference Center, UH-Manoa

Melanie Abecassis	Pie
Michele Barnes-Mauthe	Ke
Anela Choy	Ma
Christina Comfort	Sir
Gen Del Raye	Во
Reka Domokos	Ca
Jeffrey Drazen	Ma
Andrew Gray	Jef
Cecelia Hannides	Br
Bob Humphreys	Ke
Olaf Jensen	Da
Yanli Jia	Ve

erre Kleiber eller Kopf lartha Maciasz mon Nicol ob Olson assie Pardee lartin Pedersen off Polovina rian Popp elvin Richards ana Sackett ern Scholey Michael Seki Inna Senina John Sibert Tom Swenarton Ana Vaz Bill Walsh David Welch Kevin Weng Jock Young Johnoel Ancheta Dodie Lau

### Symposium on the Life and Legacy of Dr. Klaus Wyrtki April 8-9, 2013 Asia Room, Imin International Conference Center, UH-Manoa

Alyssa Agustin Assaf Azouri Janet Becker Pat Caldwell Glenn Carter Alma Castillo Megumi Chikamoto Matt Church Eric DeCarlo Thomas Decloedt Fred Duennebier **Bill Emery** Eric Firing Pierre Flament Malte Heinemann Bruce Howe Julia Hummon Jerard Jardin Dongchull Jeon Yanli Jia Christina Karamperidou David Karl Tom Kilpatrick June-Yi Lee Oyvind Lundesgaard Doug Luther Lorenz Magaard

Nikolai Maximenko Jay McCreary Mark Merrifield Gary Mitchum Brent Miyamoto Dennis Moore Pete Mouginis-Mark Mike Mottl Ted Murphy Shikiko Nakahara Jim O'Brien Kelly Pearson **Brian Popp** Jim Potemra Steve Poulos Brian Powell Bo Qiu Bryan Rahter Charina Lyn Repollo Renate Ryan Sharon Sakamoto Fernando Santiago-Mandujano Niklas Schneider Sharon Schneider Tom Schroeder Undine Schwarz Alexander Shor

Saulo Soares Joao Souza Gisela Speidel Sam Stevenson Malte Stuecker Daisuke Takagi Phil Thompson Axel Timmermann Les Uhrich Li-Chiao Wang Judith Wells Matthew Widlansky Oliver Wyrtki Toshi Yamagata

# Appendix IV JIMAR Personnel

Category	Number	Unknown	High School	Associates	Bachelors	Masters	Ph.D.
Research Scientist	18	0	0	0	0	0	18
Visiting Scientist	0	0	0	0	0	0	0
Postdoctoral Fellow	2	0	0	0	0	0	2
Research Support Staff	122	0	7	6	70	38	1
Administrative	11	0	0	0	8	2	1
Undergraduate Students	22	0	22	0	0	0	0
Graduate Students	10	0	0	0	5	5	0
Received less than 50% NOAA support	0	0	0	0	0	0	0
Total	185	0	29	6	83	45	22
Located at Lab (include name of lab)	2 - PMEL 9 - PIRO 123 - PIFSC 3 - ESRL						
Obtained NOAA employment within the last year	2						
Postdoctoral Fellows and Students from Subgrantees	Postdocs: 0 Students: 0						

## Information as of June 30, 2013

### **Appendix V Awards**

### **Sharon DeCarlo**

• Nominee for 2012 RCUH Outstanding Employee of the Year

### Jessica Guillermo

• 2012 NOAA PIRO Team Member of the Year

### **Adel Heenan**

• 2012 NOAA PIFSC Team Member of the Year

### Kolter Kalberg

• Nominee for 2012 RCUH Outstanding Employee of the Year

#### **Kevin Lino**

• Nominee for 2012 RCUH Outstanding Employee of the Year

### Irene Nurzia-Humburg

• French Frigate Shoals Research Contribution Award

### Nicole Wakazuru-Yoza

• 2012 NOAA PIFSC Team Member of the Year

# Appendix VI Graduates

### Carl Barnes, MS

"Eyewall rainfall patterns from aircraft lower fuselage radar images"

### Mark Manuel, MS

"Investigating survival, movement and spillover of juvenile yellow tang (Zebrasoma flavescens) from a marine protected area in west Hawai'i"

## Appendix VII Publication Summary

The table below shows the total count of publications for the reporting period categorized by JIMAR Lead Author, NOAA Lead Author, or Other Lead Author and whether it was peer-reviewed or non-peer reviewed.

		FY13
Peer-Reviewed	JIMAR Lead Author	16
	NOAA Lead Author	7
	Other Lead Author	18
Non-Peer-Reviewed	JIMAR Lead Author	41
	NOAA Lead Author	12
	Other Lead Author	21