

JIMAR

Joint Institute for Marine and Atmospheric Research



JIMAR

Annual Report for Fiscal Year 2014

For Cooperative Agreement NA11NMF4320128

Mark A. Merrifield, PhD
Director

Joint Institute for Marine and Atmospheric Research
University of Hawai'i at Manoa
1000 Pope Road, MSB 312
Honolulu, HI 96822 USA
<http://www.soest.hawaii.edu/jimar>





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Performance Period July 1, 2013–June 30, 2014

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Introduction

The Joint Institute for 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 with JIMAR include the National Marine Fisheries Service (primarily the Pacific Islands Fisheries Science Center) and NOAA Research Laboratories (primarily the Pacific Marine Environmental Laboratory [PMEL], Earth System Research Laboratory [ESRL], National Weather Service [NWS], National Environmental Satellite and Data Information Service [NESDIS], and the 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 maintains standards of accomplishments 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 challenging 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 waves.

JIMAR researchers continued to excel during FY 2014, 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 2014. Here are a few highlights:

- Modern stock assessment models utilize a wide variety of data types such as measures of catch, relative abundance, and age or size composition of the catch. However, inappropriate data weightings or mis-specified fishing selectivity process can cause undue influence on the stock abundance estimate. JIMAR Senior Fishery Specialist, Hui-Hua Lee led an effort to produce a diagnostic method for evaluating the relative importance of the input parameters and to make recommendations for improving stock assessment techniques. The result is the *Fisheries Research* journal article "Use of likelihood profiling over a global scaling parameter to structure the population dynamics model: An example using blue marlin in the Pacific Ocean" by H.H. Lee, K.R. Piner, R.D. Methot, and M.N. Maunder (158:138-146, doi:10.1016/j.fisheries.2013.12.017).
- Since 2011, JIMAR scientists have endeavored to characterize the general ecology, distribution, and threats to coral species petitioned for protection under the Endangered Species Act (ESA). Some in the scientific community raised concerns that listing corals under ESA could result in burdensome processes to continue research and monitoring efforts. JIMAR Coral Ecological Researcher, Mariska Weijerman, and JIMAR Marine

Ecosystems Research Coordinator, Matt Dunlap, were part of a team of researchers who examined the ESA process for data-deficient species and investigated the consequences on research for recently listed corals. The result is a Current Opinion in *Environmental Sustainability* journal article “Endangered Species Act listing: Three case studies of data deficiencies and consequences of ESA ‘threatened’ listing on research output” by M. Weijerman, C. Birkeland, G.A. Piniak, M.W. Miller, C.M. Eakin, P. McElhany, M.J. Dunlap, M. Patterson, and R.E. Brainard (7:15-21, doi: 10.1016/j.cosust.2013.11.026). They found that journal publications did not decrease for recently listed coral species, suggesting that important research for threatened species can continue despite apparent bureaucratic obstacles.

- JIMAR Field Research Supervisor, Jessie Lopez, led an effort to study geographic variation in the levels of persistent organic pollutants (POPs) in the serum of Hawaiian monk seals from the main Hawaiian Islands. This resulted in the *Endangered Species Research* journal paper “Geographic variation of persistent organic pollutants in Hawaiian monk seals (*Monachus schauinslandi*) in the main Hawaiian Islands” by J. Lopez, K.D. Hyrenbach, C. Littnan, and G.M. Ylitalo (24:249-262, doi:10.3354/esr00602). They discovered that seals with similar ranges were shown to have similar POP levels, but seals with home ranges around the island of O’ahu had significantly higher summed polychlorinated biphenyls and polybrominated diphenyl ethers than seals around the islands of Kaua’i and Moloka’i. There are differences in the land use characteristics adjacent to seals’ home ranges (Oahu has a high percentage of urban land use; Moloka’i has a high percentage rural and agricultural land use). This work is unique, as the integration of serum POP levels and seal home ranges revealed geographic patterns that help assess the risk to seals at both the individual and population level. The integrated approach of this study can also be applicable to other marine wildlife exposed to local and non-point pollutants.
- JIMAR Ecosystem Researcher, Melanie Abecassis, and JIMAR Marine Turtle Research Specialist, Denise Parker, were members of a team researching habitat preferences for juvenile loggerhead turtles in the North Pacific. They developed a *PLOS ONE* journal paper entitled “A model of loggerhead sea turtle (*Caretta caretta*) habitat and movement in the oceanic North Pacific” by M. Abecassis, I. Senina, P. Lehodey, P. Gaspar, D. Parker, and G. Balazs (8(9), e73274, doi:10.1371/journal.pone.0073274). Tracking data from two multi-year long tagging programs using satellite transmitters deployed on wild and captive-reared turtles were utilized in this study. Among other findings, the team discovered that larger turtles dive deeper than the mixed layer and subsequently target warmer surface waters. Water temperature and swimming speed were used to parameterize a habitat-based Eulerian model to predict areas of highest probability of presence in the North Pacific. The model-generated habitat index generally matches the tag tracks closely, capturing the north-south turtle migration. The model failed to replicate observed east-west movements, suggesting temperature and foraging are not the only factors driving large-scale loggerhead movements. This work uniquely simulates loggerhead tracks with a model that incorporates habitat to drive movements, not just swimming capabilities and advection by currents. Having a full picture of turtle movements in the central Pacific could potentially lead to better bycatch management.
- The management of ecological processes is a developing field that requires reliable indicators that can be monitored over time. Herbivory is a key ecological process on coral reefs, and pooling herbivorous fishes into functional groups based on their feeding mode is increasingly used as it may quantify herbivory in ways that indicate resilience. JIMAR Reef Fish Researcher Adel Heenan was the lead author on the *PLOS ONE* paper “Monitoring herbivorous fishes as indicators of coral reef resilience in American Samoa” by A. Heenan and I. Williams (8:11, e79604, doi:10.1371/journal.pone.0079604). They evaluated whether the biomass estimates of the herbivore functional groups are good predictors of reef benthic assemblages, using data from island groups in American Samoa. They assembled a candidate set of linear and nonlinear models to identify the relations between benthic cover and total herbivore and non-herbivore biomass and the biomass of the aforementioned functional groups. For each benthic substrate type, the biomass of specific groups of herbivorous fishes were important explanatory variables in predicting benthic cover, whereas biomass of all fishes combined generally was not. The findings emphasize the link between herbivorous fishes and the benthic community and demonstrate support for the use of functional groups of herbivores as indicators for resilience-based monitoring.
- Patterns of regional sea level rise and variability in the Pacific continue to be a research focus of the University of Hawaii Sea Level Center. The importance of trade wind variations was reinforced in a recent study by JIMAR Researcher Phil Thompson, who demonstrated the impact of remote tropical wind forcing versus local winds in establishing weak sea-level rise rates along the Pacific coast of North America over the past two

decades (see *Journal of Climate* 27, 4733-4751, “Wind-driven coastal sea level variability in the Northeast Pacific”).

- Strong westerly wind bursts early in 2014 led to sizeable zonal shifts in ocean heat and sea level. Statistical predictions of seasonal sea level anomalies such as these for island nations in the tropical Pacific have been extended by JIMAR Researcher Rashed Chowdhury (An improved Sea Level Forecasting Scheme for Hazards Management in the U.S.-Affiliated Pacific Islands, *Journal of Climatology*), as part of the suite of ENSO products offered by the Pacific ENSO Applications Climate Center (PEAC).
- Marine debris is an ongoing concern for Pacific Island communities and ecosystems. In particular, the pristine Papahānaumokuākea Marine National Monument in the Northwestern Hawaiian Islands is highly susceptible to floating debris accumulation. A recent study by JIMAR Researcher Alyssa Agustin has examined a multiyear time series of debris accumulation at Tern Island and documented debris deposition patterns in space and time that may lead to a better understanding of wind and current patterns that favor periods of enhanced accumulation at Tern.
- The Pacific Islands Ocean Observing System (PacIOOS) served information and data to over 255,000 unique individuals, totaling 1.5 million web pages views on the pacioos.org website and a total of 1TB of data transferred. Operational modeling products (wave, atmospheric, and ocean) and inundation (high sea-level and wave run-up) forecasts were expanded to serve the Mariana Archipelago, Samoan Archipelago, and the Marianas Islands. PacIOOS technicians expanded in-situ real-time data platforms during FY 2014, growing the PacIOOS buoy/instrument fleet to over 30 deployed assets. PacIOOS also released a mobile web version and app of Voyager data portal, pacioos.org/voyager/mobile.
- The Second JIMAR/PIFSC Symposium “Climate and Change” was held November 13, 2013 at the Hawaii Imin Conference Center, University of Hawaii at Manoa campus. Presentations by JIMAR researchers and invited guest speakers covered an array of topics addressing global climate change and its effects on ocean ecosystems. With over 200 people in attendance throughout the event the symposium successfully showcased JIMAR and PIFSC research accomplishments and developed new avenues of research collaboration between UH, NOAA, and the broader scientific community.
- Other outreach events that JIMAR provided funding support during FY 2014 are the 39th Albert L. Tester Symposium (March 12-14, 2014, University of Hawaii at Manoa) and the PIFSC Young Scientist Opportunity (PYSO) 2014 summer intern program. The PYSO is a collaborative program between PIFSC and JIMAR that offers qualified participants professional scientific research experience and training under the mentorship of selected researchers of the PIFSC.

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 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).

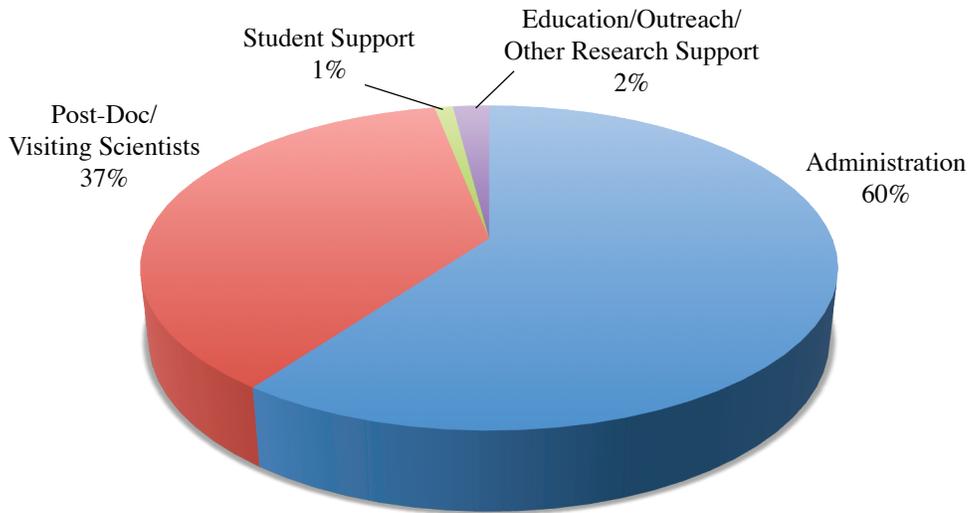
JIMAR Senior Fellows from the University of Hawaii are Dr. Gary Barnes, Dr. Steven Businger, Dr. Eric DeCarlo, Dr. Eric Firing, Dr. Charles Fletcher, III, Dr. Kim Holland, Dr. Roger Lukas, Dr. Douglas Luther, Dr. Julian McCreary, Dr. Mark Merrifield, Dr. Thomas Schroeder, Dr. John Sibert, and Dr. Bin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

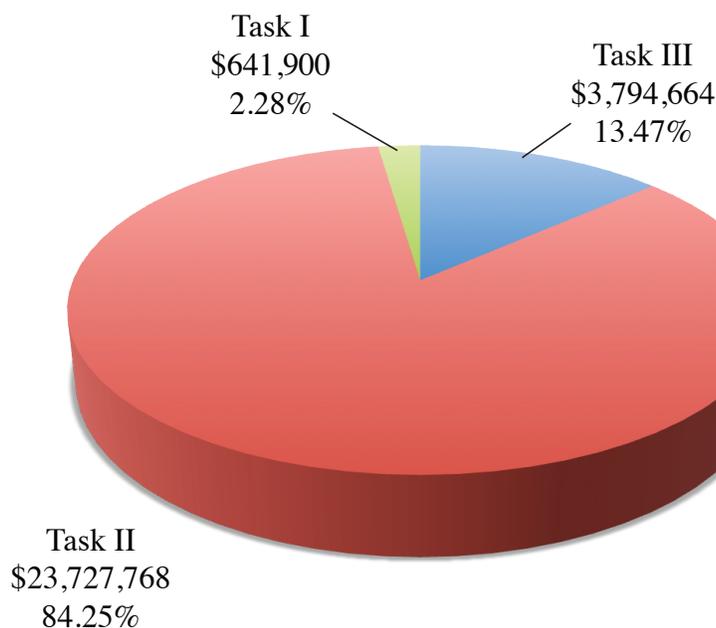
JIMAR Council Members from the University of Hawaii are Dr. Eric Firing, Dr. Julian McCreary, Dr. Thomas Schroeder, and Dr. Bin Wang.

Task I is the base program of JIMAR. It provides research support for the visiting scientist and postdoctoral programs, and the administrative support for the Institute. The University of Hawaii contributes to this task by bearing all indirect costs, and by paying the salary of the Director. Funding percentages by activity are exhibited in the following chart.

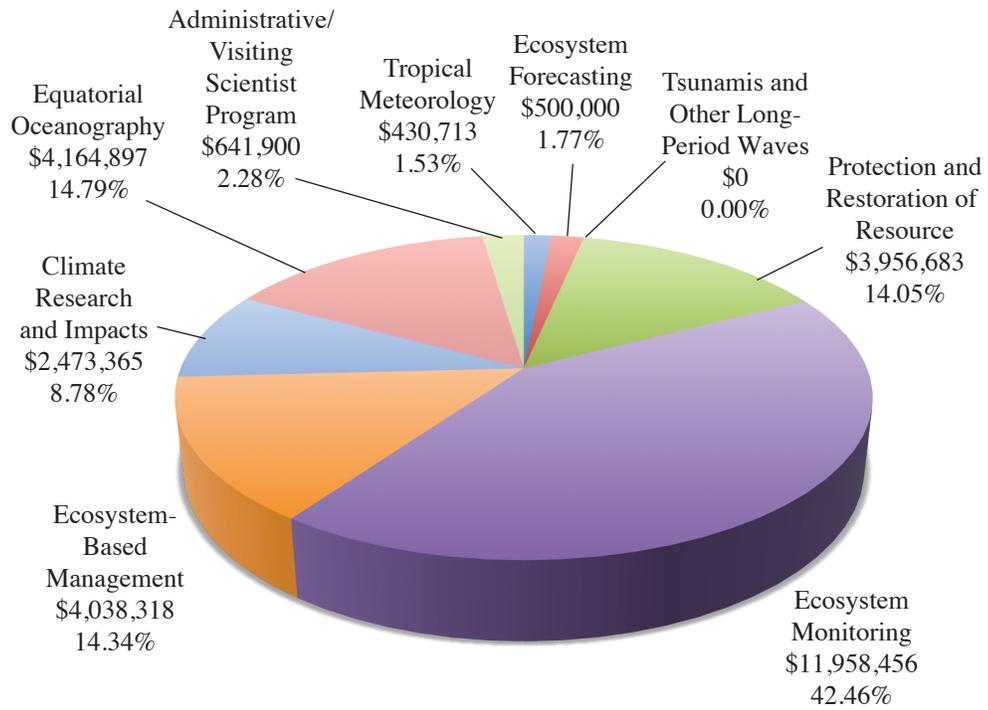
Distribution of JIMAR's Task I NOAA Funding by Activity



Distribution of NOAA Funding by Task (FY 2012-2014)



**Distribution of NOAA Funding by Theme
(FY 2012-2014)**



Accomplishments for Fiscal Year 2014

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. Specifically, the project aims to: 1) improve and maintain software installation and manuals for end users; 2) improve software quality and more fully apply the ADMB coding standard; 3) enhance the software with new features to improve run time efficiency and model development; 4) improve long-term maintainability of the source code; and 5) upgrade previous generation C++ coding standards to modern C++ coding standards. The project maintains a long-term goal to support the ADMB software through an active and committed group of users and developers located in laboratories and universities around the USA and the world.

Progress during FY 2014

Project Infrastructure. ADMB project infrastructure includes services that enable collaboration among the many users and developers. The project continues to explore and evaluate new tools to help users and developers build better software. In the last twelve months the following features have been added or expanded.

Documentation for users. Activities accomplished include the following: 1) released revised AUTODIF, ADMB, and ADMB-RE Manuals. Extensive revision, correction and updates to the manuals were undertaken to incorporate the latest features, correct typographical errors, and integrate into the automated build process. These updated manuals now ship with the latest binaries; 2) added training videos, presentations, reference cards, beginners guides, and FAQs to the project website (see <http://www.admb-project.org/documentation>); 3) substantially increased the example applications illustrating methods on the website (e.g., eighty-six categorized examples given at tinyurl.com/mdf7fum); and 4) enhanced documentation of the MCMC options within ADMB that will become an appendix to the standard user documentation.

Documentation for developers. Activities accomplished include the following: 1) wrote documentation for key aspects of the function minimizer routine; 2) simplified functions for debugging; and 3) provided fundamental concepts of how ADMB works. Highlighted features are provided in the Autodif manual (tinyurl.com/qysrn2h) and have been published in a now award-winning peer-reviewed journal article.

Webserver. The website was reorganized so that end users can easily find information. Application Program Interface using Doxygen documentation of the source code.

Software releases. ADMB releases are a high priority for the project. Each year, the Core Team delivers major and/or minor releases. Major releases include new features. All releases have improvements and fixes

to the documentation, installation and source code. The following is a list of releases with key changes and descriptions:

- Improved the GNU Make build files to compile libraries quicker using simultaneous option
- Improved model linking by using a single core library (libadmb) instead of multiple separated libraries (libado, libadmod, libdf1b2 and libadt)
- Improved admb scripts so they can call directly without the need to set system variables ADMB_HOME and PATH
- Reverted ludcmp, beta and gamma functions back to stable and faster ADMB-9 algorithms
- Added support for more compilers: Linux 32/64 bit-GNU C++ 4.7/4.8 and Intel C++ 13 MacOS-XCode 4.6 Windows-Microsoft Visual C++ 2012

Internet Presence. The ADMB Project website is the primary point of contact for new and existing ADMB users. Improvement of the website has been a continuous activity. During 2013-2014, the ADMB Project website was reorganized, cleaned up and updated.

Education and Outreach. Outreach is an essential component of an open-source software project. ADMB Project outreach activities include training courses, developer workshops and World Wide Web presence.

Training courses. ADMB courses are an essential part of the project that helps grow the user base by introducing the software to new users. These courses help existing ADMB users with learning new features and improving their models. They are also useful for core team developers to see firsthand any difficulties end users are having with the software and get instant feedback from the participants. Recent courses were held as follows:

- 2013 July: Introduction to AD Model Builder, University of British Columbia Fisheries Centre. Instructors: Aaron Greenburg and Catarina Wor
- 2013 November: Stock assessment course (Advanced), 18–22 November 2013, Copenhagen, Denmark. Instructors: Jan Jaap Poos and Richard Hillary
- 2014 February: Use of classes and template functions in ADMB programs, University of Washington School of Fisheries and Aquatic Sciences. Instructor: Steven Martell
- 2014 June: AD Model Builder Workshop at the International Statistical Ecology Conference, Montpellier, France. Instructors: Mark Maunder, Hans Skaug, and Anders Nielson

Academic and professional user base. A number of academic institutions now incorporate AD Model Builder as part of their curriculums and graduate programs. Although not a comprehensive list, the following institutions now make regular use of ADMB: University of Washington School of Fisheries, University of British Columbia, University of Florida, Virginia Institute of Marine Sciences, Simon Fraser University, Scripps Institution of Oceanography, University of Victoria, University of Maryland Center for Environmental Sciences, North Carolina State University, University of Hawaii, University of Wisconsin Madison, Michigan State University, University of Auckland, University of Cape Town, Cornell University, and University of Rhode Island. A more comprehensive list is available at User-base.

Developers' Workshops. ADMB Developers' Workshops are very important to the project. An international group of users and developers collaborate together to offer suggestions, fix issues and to discuss potential new features. These workshops help ensure a broad base of code dependency for developing and maintaining open-source computer code into the future. A report is written for each workshop, including a full description of meeting accomplishments, participant lists and priorities. A workshop was held in September 8-11 2013 in Reykjavik, Iceland. The workshop report, along with earlier developer workshop reports, is available online, <http://www.admb-project.org/developers/workshop>.

A list of journal papers, formal publications, scientific reports, stock assessment documents, theses, and dissertations that have benefited from ADMB is available at the project website at <http://www.admb-project.org/community/bibliography>. It is difficult to capture all papers benefitting from ADMB as its use is so prevalent but the following is a selection of notable papers published in the primary scientific literature in 2013-14:

- Forrest, R.E., M.K. McAllister, S.J. Martell, and C.J. Walters, 2013. Modelling the effects of density-dependent mortality in juvenile red snapper caught as bycatch in Gulf of Mexico shrimp fisheries: Implications for management. *Fisheries Research*, 146, 102-120.
- Barbeaux, S.J., J.K. Horne, and J.N. Ianelli, 2014. A novel approach for estimating location and scale specific fishing exploitation rates of eastern Bering Sea walleye pollock (*Theragra chalcogramma*). *Fisheries Research*, 153, 69-82.
- Berg, C.W., A. Nielsen, and K. Kristensen, 2014. Evaluation of alternative age-based methods for estimating relative abundance from survey data in relation to assessment models. *Fisheries Research*, 151, 91-99.

- Goethel, D. R., C.M. Legault, and S.X. Cadrin, 2014. Demonstration of a spatially explicit, tag-integrated stock assessment model with application to three interconnected stocks of yellowtail flounder off of New England. *ICES Journal of Marine Science: Journal du Conseil*, fsu014.
- Hulson, P.J.F., and D.H. Hanselman, 2014. Tradeoffs between bias, robustness, and common sense when choosing selectivity forms. *Fisheries Research*.
- Kotwicki, S., J.N. Ianelli, and A.E. Punt, 2014. Correcting density-dependent effects in abundance estimates from bottom-trawl surveys. *ICES Journal of Marine Science: Journal du Conseil*, fst208.
- Lee, H.H., K.R. Piner, R.D. Methot Jr., and M.N. Maunder, 2014. Use of likelihood profiling over a global scaling parameter to structure the population dynamics model: An example using blue marlin in the Pacific Ocean. *Fisheries Research*.
- Lo, N.C., and B.E. Fissel, 2014. Stock Assessment through egg production methods in the US. *Biology and Ecology of Sardines and Anchovies*, 308.
- O’Dea, E.B., K.M. Pepin, B.A. Lopman, and C.O. Wilke, 2014. Fitting outbreak models to data from many small norovirus outbreaks. *Epidemics*.
- Plagányi, É.E., A.E. Punt, R. Hillary, E.B. Morello, O. Thébaud, T. Hutton, and P.C. Rothlisberg, 2014. Multispecies fisheries management and conservation: tactical applications using models of intermediate complexity. *Fish and Fisheries*, 15(1), 1-22.
- Sharma, R., A. Langley, M. Herrera, J. Geehan, and S.Y. Hyun, 2014. Investigating the influence of length–frequency data on the stock assessment of Indian Ocean bigeye tuna. *Fisheries Research*.
- Thorson, J.T., 2014. Standardizing compositional data for stock assessment. *ICES Journal of Marine Science: Journal du Conseil*.
- Thorson, J.T., A.C. Hicks, and R.D. Methot, 2014. Random effect estimation of time-varying factors in Stock Synthesis. *ICES Journal of Marine Science: Journal du Conseil*.
- Tsehaye, I., M.L. Jones, J.R. Bence, T.O. Brenden, C.P. Madenjian, and D.M. Warner, 2014. A multispecies statistical age-structured model to assess predator-prey balance: application to an intensively managed Lake Michigan pelagic fish community. *Canadian Journal of Fisheries and Aquatic Sciences*.

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 and the JIMAR Bio-sampling project is to conduct fundamental biological and ecological research on federally managed species, provide new or improved estimates of life history parameters (length-at-

age growth curves, longevity, size at median maturity, spawning season, length-weight relations), and improve and support the biological data needs of ongoing and future stock assessments of fishery resources.

Progress during FY 2014

To fulfill the primary objective of the LH program, the project continues to conduct biological studies aimed at improving knowledge of life history parameters (e.g., age and growth, size at maturity, and longevity) utilizing specimens collected in the central, south, and western Pacific regions. To this end, the project’s Fisheries Bio-sampling Specialist continues to: 1) identify species and collect length-weight data from bottomfish species at the United Fishing Agency (UFA) fish auction; 2) participate in bottomfish sampling operations around the Main Hawaiian Islands and Pacific Remote 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. Any associated specimen data is organized, analyzed, and managed in an efficient manner using appropriate databases.

Additional project activities include: 1) statistical analysis of fork length frequencies and median length of targeted fish species sampled in Hawaii, Guam, Saipan, and American Samoa to determine length distributions and sampling gaps; 2) utilizing R- statistical software in addition to Excel to analyze fisheries data in a variety of ways; 3) formulating efficient code to examine and produce graphical representations of available data; 4) spatial analysis using ArcMap software of bottomfish catch locations for fish caught during past and current sampling operations; 5) management of the project database, metadata documentation, and data archival related to bio-sampling activities; and 6) examination of histological slides of opakapaka gonadal tissue to verify sex and identify maturation stage.

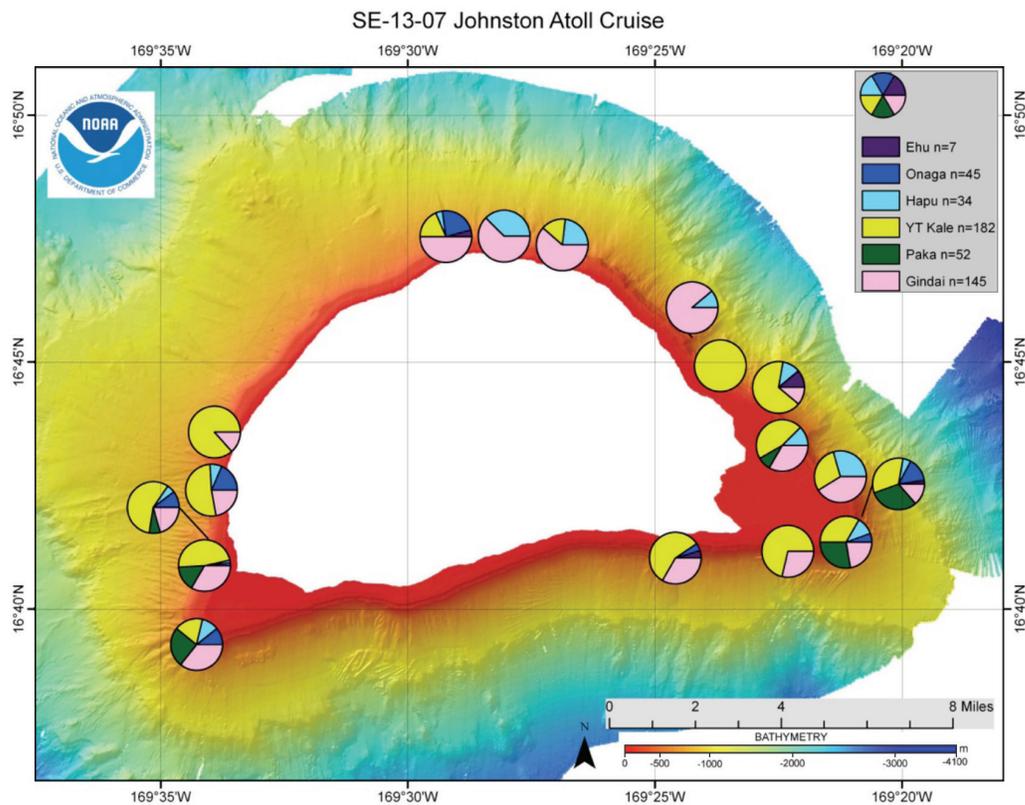


Figure 1. Spatial analysis of bottomfish caught during the SE-13-07 research project at Johnston Atoll; the pie charts display the number of fish caught at each sampling site.

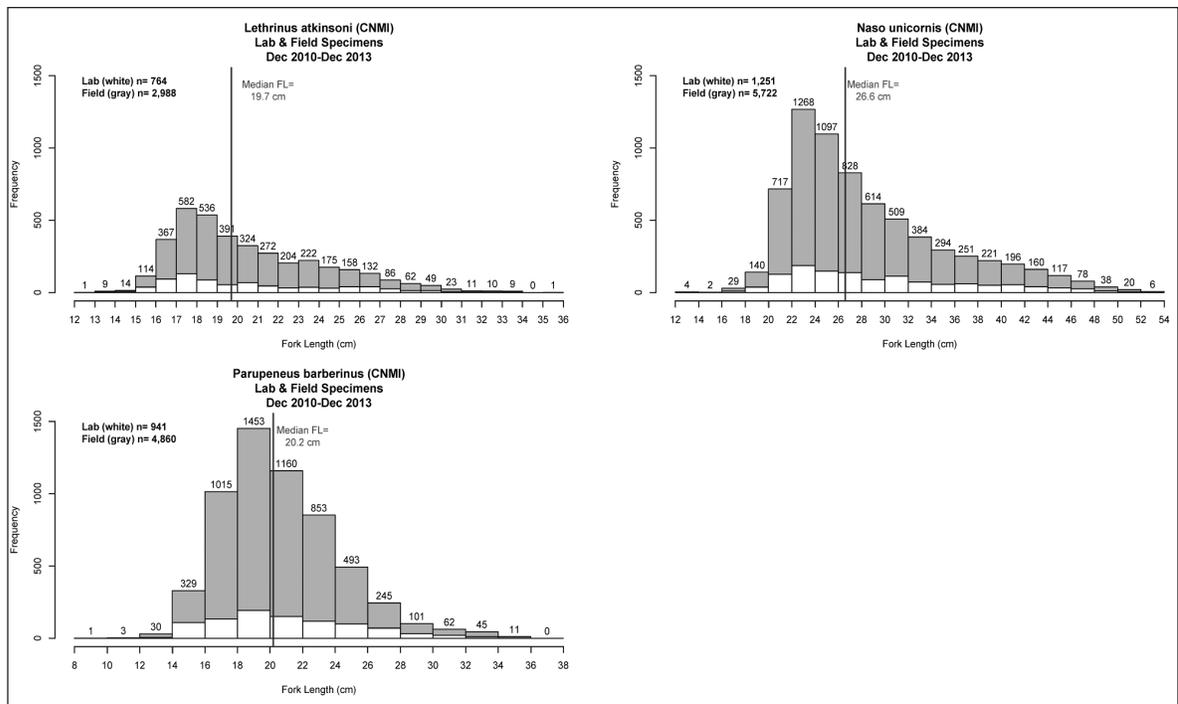


Figure 2. Cumulative fork length frequency histogram of species targeted for biosampling in CNMI. The number of fish with additional specimens extracted (otoliths and/or gonads) is shown in white (Lab specimens) and the number of specimens sampled in the Field (length-weight data only) is shown in gray; median fork length for each species is displayed.

A draft administrative report summarizing the bio-sampling activities of the Commercial Fisheries Bio-Sampling program in the Western Pacific regions of Guam, Saipan, and American Samoa has been submitted for review. A comparison between lengths measured along the body contour versus linear distance for five of the seven Deep 7 bottomfish species has been completed, but the results have not yet been summarized in a formal report because two species lack sufficient measurements to make an accurate comparison. An updated Administrative Report for the UFA auction sampling of bottomfishes has not been completed due to higher-priority bio-sampling tasks. This year's at-sea research efforts will take the bio-sampling project to the Mariana Islands to obtain samples of otoliths, gonads, and tissues from adult and juvenile bottomfish and reef fish species for future life history and DNA-based population connectivity studies, the latter in collaboration with Hawaii Institute of Marine Biology (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.

Progress during FY 2014

In closing out this project, funds were used to support Dr. Hazen's trip to the FATE (Fisheries and the Environment) meeting to present his FATE funded research on "Using movement models, foraging events, and environmental data to identify bluefin tuna hotspots in the California current." Dr. Hazen and colleagues are working to develop a manuscript on this topic.

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

This JIMAR project investigates loggerhead turtle habitat preferences to evaluate potential strategies for reducing loggerhead turtle takes in the Hawaii-based shallow longline fishery by modeling turtle and swordfish habitats with the SEAPODYM model. The second component of this project uses previously-acquired tag data from three species of cetaceans and collected in-situ oceanographic and acoustic data to build habitat models. Finally, longline logbook and observer datasets are analyzed to study the ecosystem structure and develop ecosystem indicators in the North and South Pacific.

Progress during FY 2014

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). After two rounds of revisions, the manuscript was published in September 2013 in PLOS ONE (Abecassis et al. 2013).

As part of the PIFSC Kona IEA project, two research cruises were conducted onboard the R/V Falkor (from Schmidt Ocean Institute) and the NOAA Ship Oscar Elton Sette in February and March 2014 off the Kona Coast of the Island of Hawai'i to collect acoustic, trawling and oceanographic data used as input into cetacean habitat models. Project staff participated in data collection along with NOAA and UH colleagues. A project-supported University of Hawaii (UH) graduate student analyzed the acoustic data. Fifty-seven cetacean tracks provided by the Cascadia Research Collective were analyzed to compute cetacean density maps, and generalized additive models were built to characterize the relationships between cetacean presence, micronekton presence and oceanographic variables. This analysis has been finalized and the manuscript is in progress.

The UH-Ocean Glider, an autonomous underwater vehicle owned and operated by the UH School of Ocean and Earth Science and Technology (SOEST) was deployed in early December 2013 and recovered on January 2, 2014. The glider made 135 dives collecting in-situ oceanographic data and acoustic recordings of cetaceans along the Kona Coast. Once the species in the dataset are identified by NOAA partners, this information will be used to validate the cetacean habitat models.

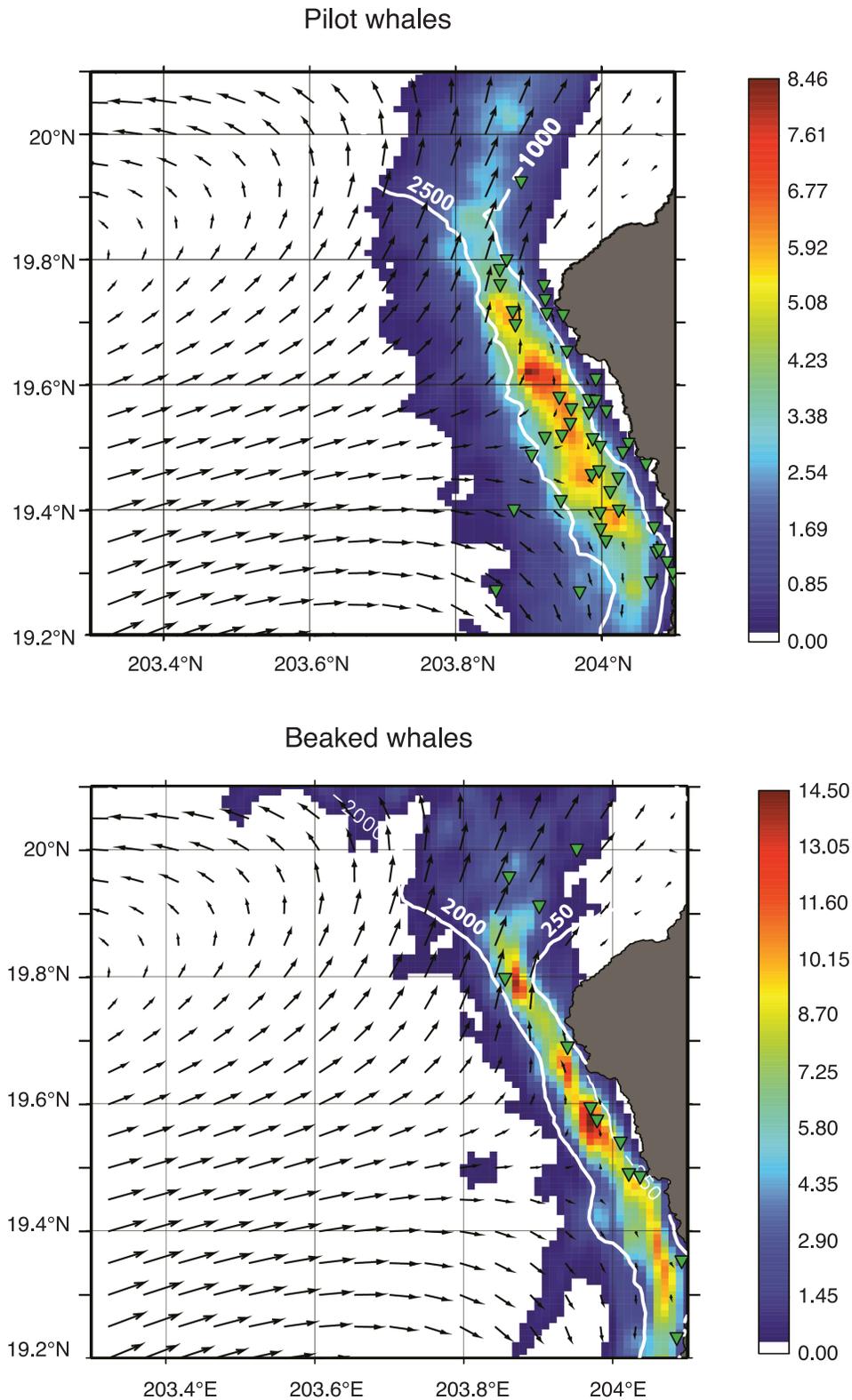


Figure 1. Observed pilot whales (top) and beaked whales (bottom) kernel density from tag data (color scale) overlaid with bathymetry contours (white lines) and surface current direction (black arrows). Size of the arrow is proportional to current strength). Tag deployment locations are represented with green triangles.

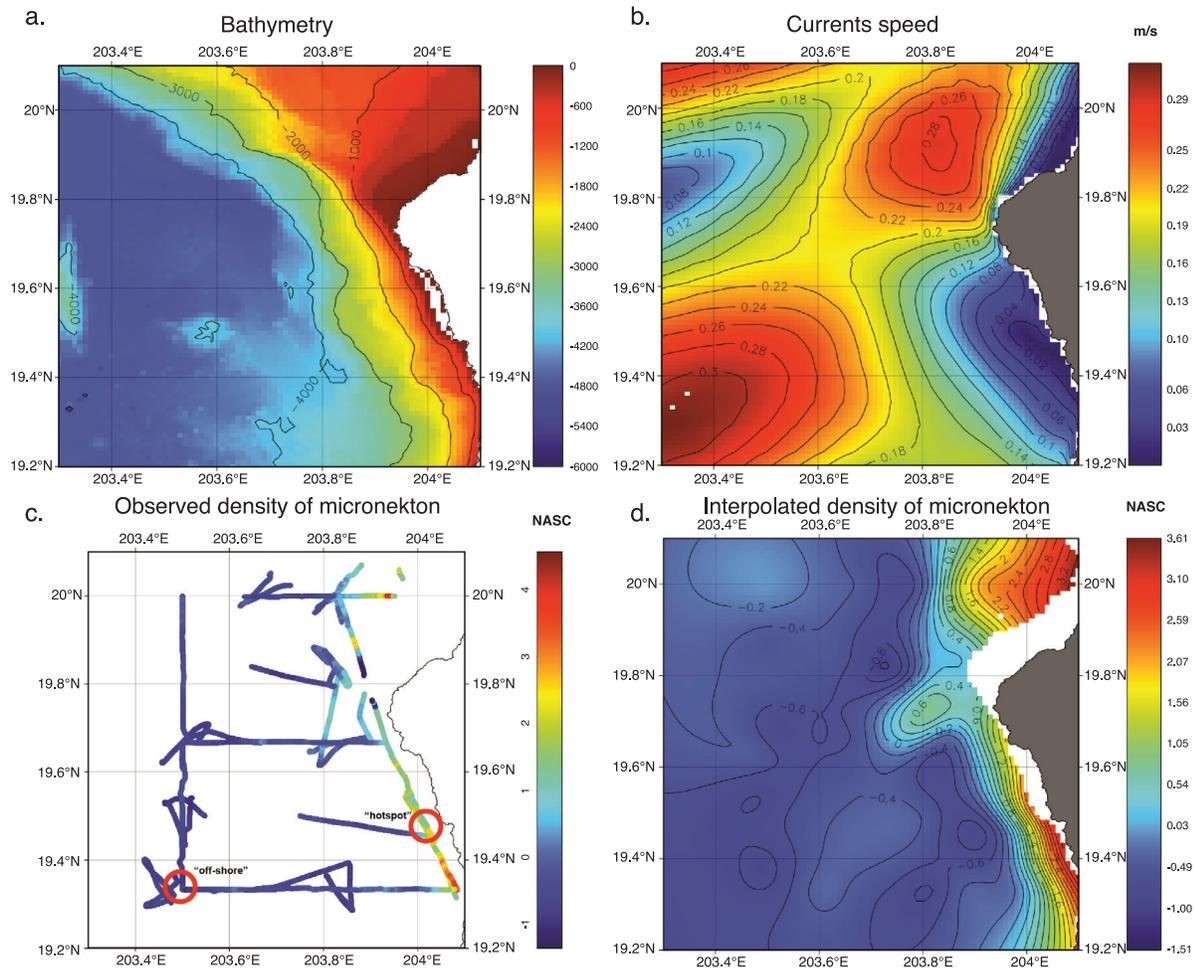


Figure 2. Kona coast oceanography: Bathymetry (a), Currents speed (b, m/s). Observed density of micronekton (70kHz, night-time, 375-665m) along 2011 & 2013 cruise transects (c), and corresponding interpolated density of micronekton of the study area (d).

A formal agreement was reached in 2012 with the Secretariat of the Pacific Community (SPC) in Noumea, New Caledonia, to obtain an exhaustive fishing dataset for non-US longline fleets in the Pacific Ocean in order to revise the adaptation of the SEAPODYM model for swordfish that was undertaken in 2011 (Abecassis et al 2011). The study had stalled due to the unavailability of data from some fisheries, which severely limited the ability to reach satisfying model parameter estimates. However, data from the Inter-American Tropical Tuna Commission (I-ATTC) were still missing from the available dataset. In April 2014, the JIMAR Project Lead met with partners, and commitments to provide a complete dataset were made. This fishing dataset will allow for a robust habitat parameterization of the SEAPODYM model for swordfish.

In May 2014 JIMAR researchers were scheduled to participate in a research cruise to the Marianas Islands, however, the cruise was canceled due to mechanical issues with NOAA Ship Oscar Elton Sette.

Finally, longline data were used to revise an ecosystem indicator, the TurtleWatch index, which aims to reduce bycatch of leatherback turtles in the shallow set longline fishery, and satellite data were used to study the variability and structure of the North Pacific Subtropical Frontal Zone. Results from both studies have been submitted to scientific journals.

Ecosystems Observations Research Program

P.I.: Mark A. Merrifield [JIMAR Project Leads: Jeff Anderson, Nate Chan, Bryan Dieter, Aaron Moriwake, John Rooney, Kat Uno, Haiying Wang]

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

The purpose of this project is to monitor and conduct research on ecosystems that involve marine species and resources of concern to the Pacific Islands Region. 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) advancing public awareness of marine ecosystems and observations; 4) providing field support of advanced technologies for bottomfish research; and 5) facilitation of deep-sea coral and sponge research.

Progress during FY 2014

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

- Continued maintenance, updating, and administration of ArcGIS map services, web-based applications, and back-end enterprise geo-database for the spatial information repository for display, access and distribution of spatial data;

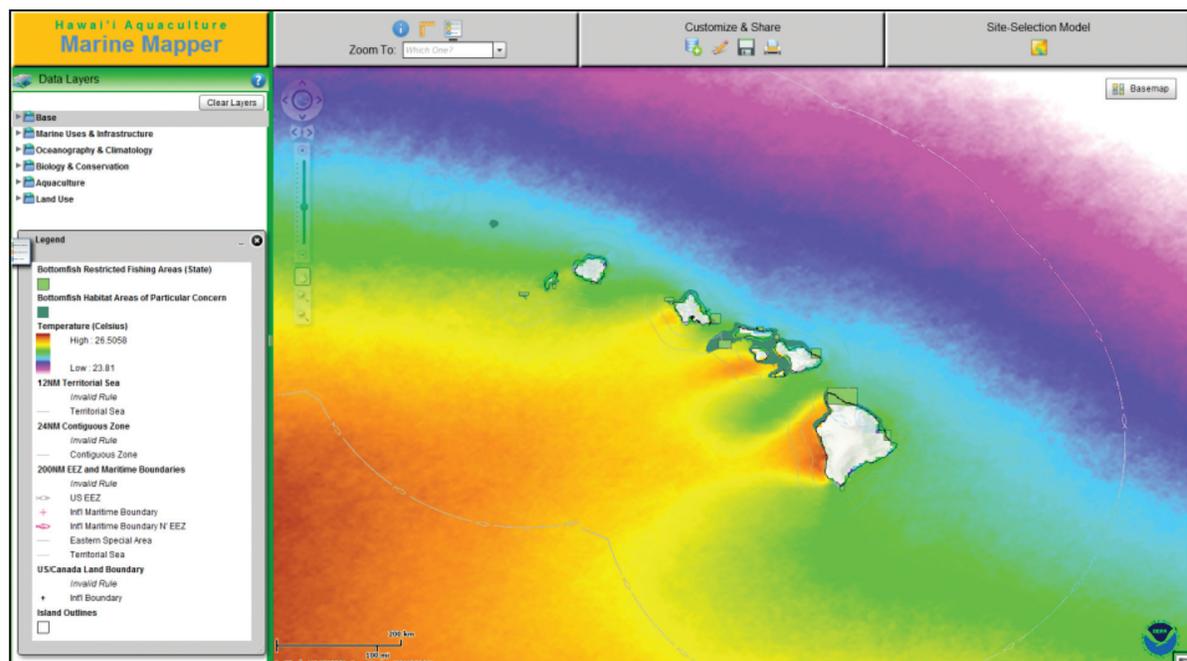


Figure 1. The Hawaii Aquaculture Marine Mapper GUI showing a selection of raster and vector datasets that are made available via the web mapping applications.

- Supported the Near-Shore Aquaculture Site Selection project with web-based map services and applications for the Main Hawaiian Islands, American Samoa, Commonwealth of Northern Marianas Islands (CNMI) and Guam;
- Supported the 2013 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);
- Supported the Protected Species Division with maintenance and assessment of their turtle database;
- Supported the Pacific Islands Data Management Stewardship Community (DMSC) with the development of the Data Documentation Implementation Plan (DDIP), User Guide, and Priority Process;
- Helped ensure that metadata standards were followed for new projects.

Scientific Information Services for Ecosystems Monitoring and Research. The 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 19,300 longline log sheets will be entered for the project year. Project staff also worked with Fishery Monitoring Branch (FMB) staff on data entry procedures of American Samoa longline fishery logbook data, which FMB will start receiving during the next project year. The Specialist also provided support in maintaining the Fisheries Data Catalog and Discovery Metadata catalog, both of which run on the Drupal CMS (Content Management System). 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, log sheets 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. These data collections support fisheries and ecosystem research by PIFSC staff and JIMAR scientists affiliated with PIFSC.



Figure 2. Fish research system at the SWS facility. Also, tanks are used to calibrate underwater stereo video cameras.

Pacific Islands Fisheries Science Outreach and Education Program. During FY 2014, 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 following is a selected listing of outreach and education products and services provided by staff during FY 2014.

- New PIFSC brochures
- Website revisions and improvements
- Created visually appealing Powerpoint presentations for staff use
- Layout of survey and other related promotional materials for the 2014 Hawaii Small Boat Survey
- Layout of materials for the 2014 PIFSC External Review
- Produced materials for educational children's activities/games for various events during FY 2014
- Assisted in producing materials for the 2014 NOAA Pacific Islands Fisheries Science Camp
- Layout of PIFSC related fact sheets
- Layout and production of fact sheets and other promotional materials for the 2014 CNMI and Guam council meetings
- Designed a sticker for the Barbless Circle Hook program

In addition, project staff provided support for the summer 2014 engagement of four undergraduate students to participate in PIFSC research projects: 1) Net Calcium Carbonate Deposition Rates (with the PIFSC Coral Reef Ecosystems Division); 2) Supply Chain Risk Management of Wholesale Fish Buying in Response to a Fishery Closure (with the PIFSC Human Dimensions Program); 3) Deepwater Bottomfish Acoustical and Optic Comparison (with the PIFSC Ecosystems and Oceanography Division), and 4) Energy Flow through Biological



Figure 3. Recovering green sea turtle in a tank at the SWS on Ford Island.

Systems (with the PIFSC Turtle Research Program). 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. At the end of the summer, a seminar is conducted by the participating students to demonstrate the results and successes from each project.

Field Support for Bottomfish Research. During the year, two JIMAR Insular Fisheries Research Specialists participated in the collecting, processing and analysis of fishery-independent data for insular stocks in the PIR in collaboration with the University of Hawaii's Department of Oceanography. Their analysis centered on processing and interpreting baited bottomfish video camera data (BotCam) collected during several Pacific region research cruises in order to determine bottomfish species from those data. This research work leads to standardized estimates of abundance to characterize absolute fish numbers by species.

Over the project year, the JIMAR project staff delivered video annotation data collected during the following PIFSC research cruises:

- SE-11-07
- SE-12-08
- SE-13-02
- SE-13-06

Over 450 videos surveys were conducted during those research cruises. Annotating BotCam video from the above-mentioned research cruises required close collaboration with PIFSC project leads to standardize the analysis method and maximize the utility of the resulting data while balancing scheduled delivery time frames. These video annotation data enhanced the development of standardized estimates of abundance to include in PIFSC Fisheries Biology and Stock Assessment Branch (FBSAB) reports on bottomfish stock assessment. These annotation data also provided the basis for other fisheries research.

Another key deliverable was to consolidate property management and ensure the operational readiness of existing advanced technology assets [e.g., the SeaBED AUV jointly-operated between PIFSC and Northwest Fisheries Science Center (NWFSC); and the DeepOcean Engineering Phantom ROV] as well as the next generation stationary camera survey system, and 10 Modular Underwater Stereoscopic System (MOUSS), which were delivered to PIFSC for use in future coordinated bottomfish surveys. JIMAR staff participated in the following PIFSC research cruises operating the identified advanced technology assets:

- SE-14-01 JIMAR staff operated the DeepOcean Engineering Phantom ROV that supported PIFSC Integrated Ecosystem Assessment (IEA) research priorities off the Kona coast of the Big Island of Hawaii. The JIMAR team successfully conducted 5 prolonged missions with the ROV, setting depth (> 500 m) and duration records for the PIFSC use of this device. These operational records continue to demonstrate the viability of this device for appropriate future research activities.
- SE-14-02 JIMAR staff, in collaboration with PIFSC and Northwest Fisheries Science Center (NWFSC) personnel operated the SeaBED AUV in a continuation of calibration efforts among other bottomfish survey methods.

During FY 2014, a JIMAR Ocean Engineer was hired to manage the project. The Ocean Engineer serves as the overall lead for the Insular Fisheries Research video analysts as well as for the advanced technology survey portion of the coordinated bottomfish survey effort. The group also coordinated activities within the new PIFSC Marine Instrumentation Lab at the Inouye Regional Center (IRC).

The project's Advanced Technology Program Team supported numerous JIMAR and PIFSC outreach activities, including the Hawaii Ocean Expo, UH-SOEST Open House, and NOAA Pacific Fisheries Science Camp.

Deep-Sea Coral and Sponge Research and Management. In 2009, NOAA received funding to implement field research efforts as part of the Deep Sea Coral Research and Technology Program (DSCRTP). To maximize this opportunity and to meet the requirements of the DSCRTP, JIMAR partnered with PIFSC and conducted a Pacific regional workshop to determine and evaluate exploration and research priorities.

On April 22-23, 2014, scientists and resource managers met in Honolulu for the Deep-Sea Coral and Sponge Research and Management Priorities Workshop to identify critical information needs for deep-sea coral and sponge ecosystems in the Pacific Islands Region. The goal of the workshop was to develop a three-year exploration and research priorities plan. Workshop participants represented a broad range of stakeholders including representatives from the Federal government, the Western Pacific Regional Fishery Management Council (WPRFMC), and academia.

Workshop accomplishments included:

- Identified a core list of critical information needs related to locating, surveying and modeling deep-sea corals.
- Determined current knowledge on deep-sea coral biology and ecology, and where possible, used that knowledge to outline management for human impacts on deep-sea coral ecosystems.
- Identified data sets that exist for analysis to refine subsequent field operations.
- Identified initial research activities and geographical targets for meeting the Pacific Islands scientific and management needs.

The information from the workshop will be used as a guiding framework to improve our knowledge, conservation and management of deep-sea coral and sponge ecosystems in the U.S. Pacific. Workshop recommendations for future work in the US Pacific included:

- Identify the environmental factors that affect distribution of deep-sea corals and sponges.
- Characterize the biogeographic patterns at the basin scale.
- Document the resilience of deep coral assemblages after disturbance.
- Determine new insights to be derived from existing data sets.
- Determine the vertical distribution of coral and sponge assemblages on the steep pinnacle features of the Pacific plate.

Aquaculture Siting Resources. Over the past year the JIMAR GIS Data and Web Services Specialist developed and managed the geospatial databases, GIS data/geoprocessing services and web mapping applications supporting aquaculture site selection in the Pacific Islands. In FY 2012, the original aquaculture site selection web mapping application was completed for the Main Hawaiian Islands. In FY 2013 applications were developed and completed for two additional regions: Guam/Commonwealth of the Northern Mariana Islands and American Samoa. These applications make accessible a myriad of data sets relevant to nearshore and open ocean infrastructure development. In addition to providing a publically accessible web map interface, the applications also provide a user-friendly analytical tool for generating the aquaculture site selection maps based on user selected environmental and cultural variables. This GIS-formatted information, which includes political, socio-economic, biological, geological, oceanographic, human use, and legal information, is now available for decision-makers, regulators, researchers, entrepreneurs, and general public inquiries. The website products include graphical and tabular data, images, and synthesized information, and provide a screening-level mapper and decision support tool to assist managers in evaluating applications for off-shore aquaculture siting around the Pacific Islands. The web mapping applications are available at the following websites:

- Main Hawaiian Islands: <http://www.pifsc.noaa.gov/marinemapper/MHI/>
- Guam/CNMI: <http://www.pifsc.noaa.gov/marinemapper/GCNMI/>
- American Samoa: <http://www.pifsc.noaa.gov/marinemapper/AMSAM/>



Figure 4. The SeaBED AUV, operated by JIMAR scientists in the PIFSC Science Operations Team in collaboration with the NOAA's Northwest Fisheries Science Center, being launched for a survey. SeaBED effectively samples across a wide range of habitat types at depths of 20 to 2,000 meters, autonomously following the sea floor at a close, fixed height collecting high-resolution imagery. JIMAR, PIFSC, and NWFS scientists are focused on developing this tool as part of an integrated, multi-gear, fishery-independent survey that will provide information on fish assemblages and their associated habitat across their full range, including in complex benthic environments and within marine protected areas that cannot be sampled by trawl surveys or other extractive methods.



Figure 5. Opakapaka (Pristipomoides filamentosus), Lehi (Aphareus rutilans) and blueline triggerfish (Xanthichthys caeruleolineatus) recorded during typical stereo-video deployment in the Main Hawaiian Islands. Imagery collected from stereo-video systems (e.g., BotCam, MOUSS, SeaBED AUV, ROV) are analyzed by JIMAR scientists in the PIFSC Science Operations Team. Fish identifications, counts, and lengths are generated during the video annotation process for use by the PIFSC Stock Assessment Program. By recording fish in their habitat, video sampling offers a non-extractive alternative to traditional fisheries surveys.

Aquaculture Systems Management. During FY 2014, JIMAR staff developed a maintenance schedule for equipment (water pumps, sand filters, fractionators, UV sterilizers, level sensors, actuators, etc.) used in the Seawater Systems (SWS) at the NOAA Inouye Regional Center (IRC) on Ford Island. A few modifications and new system operational protocols were developed for the monk seal, fish, turtle, and multi-purpose systems. A weekly exercise program, which includes the Supervisory Control and Data Acquisition (SCADA) system, was implemented to prepare the four unique systems in the event that tanks are needed for incoming animals. Staff also assisted in the development of a standard operating procedure (SOP) for housing sea turtles at SWS on Ford Island. During this period, JIMAR staff provided facility support for two recovering monk seals, four injured green sea turtles, and provided tanks to calibrate underwater stereo video camera for fish size measurements at the new IRC SWS.

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 towards the goal of maintaining a healthy ocean, which provides for a resilient and economically sound community. The main focus of the work is the daily monitoring of Hawaii's pelagic longline fleet that 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 2014

The JIMAR Fisheries Specialist continues to provide timely high-level support to fishery monitoring activities by providing high quality fisheries data to NMFS, PIFSC, and other JIMAR projects. The daily responsibility of quality control and processing logbook data has increased due to fast-tracking procedures, which were implemented to monitor Hawaii's bigeye tuna (BET) landings. This information is used in forecasting landings sufficient to predict possible closure of the Hawaii longline BET fishery if/when the Western and Central Pacific Fisheries Commission (WCPFC) and Inter-American Tropical Tuna Commission (IATTC) annual quota is predicted to be reached. The fast track monitoring was expanded to include striped marlin due to stock concerns. The additional monitoring requirement increases the daily workload and data are compiled weekly or as necessary as the quota gets taken. Additional quality control procedures and cross checks of relevant databases 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 data quality. The general Hawaii longline fleet-wide quarterly reports are completed 45 days after the end of the quarter. The logbook scanning and archiving project is ongoing.

A photo database of Hawaii's pelagic longline fishing fleet has been continually updated throughout the year and is used to document the fleet on an ongoing basis.



Figure 1. Collecting longline logs from Capt. Faagalo Muaina at Pier 38.

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 was to conduct an abundance survey of juvenile bumphead parrotfish (*Bolbometopon muricatum*) in the interior lagoon at Wake Island. Some geographical locations are devoid of young *B. muricatum*, yet these same areas maintain large numbers of adult fish; this anomaly had yet to be investigated at Wake Island. Among the U.S. jurisdictions where bumphead parrotfish are found, Wake Island represents the highest density of adults in U.S. waters. The survey results were intended to confirm or reject bumphead parrotfish presence in the lagoon, provide a better understanding of the dynamics of settlement and recruitment of this species, and provide a quantitative description of their nursery habitat.

Progress during FY 2014

In collaboration with the United States Air Force (USAF), Wake Island Command, Wake Island Base Operations, and Chugach Federal Solutions, Inc., a four-member team conducted a 12-day survey of the lagoon at Wake Island from June 12th– June 26th, 2013. Each morning, the crew snorkeled a predetermined region, covering the largest area possible. Thirteen snorkel surveys were conducted; 6 in waters around Peale Island and 7 in waters around Wake Island. During each survey a handheld GPS unit was towed behind a designated snorkeler. Water samples were systematically collected from two sites; temperature and salinity measurements were also obtained. Fin clips from reef fishes, pieces of coral, and invertebrate appendages were opportunistically collected.

No juvenile bumphead parrotfish were found during the 13 snorkel surveys on Wake and only 5 adult bumphead parrotfish were spotted the entire trip making it difficult to identify and characterize ideal juvenile bumphead parrotfish habitat. The scarcity of adults was expected considering they usually frequent deeper water, however the lack of juveniles was surprising. Because of its remoteness, it was hypothesized Wake Island was primarily self-seeding. However it is too premature to conclude juvenile bumphead parrotfish are completely devoid from the lagoon and surrounding waters because much of the lagoon habitat and all of Wilkes Island has yet to be explored.

Scientific Name	Common Name	Type of Tissue Collected	Number Collected
<i>Pocillopora damicornis</i>	Lace Coral	Nubbin 3 cm ²	1
<i>Acropora cytherea</i>	Table Coral	Nubbin 3 cm ³	8
<i>Acropora sp.</i>	Table Coral	Nubbin 3 cm ⁴	31
<i>Linckia mulitfora</i>	Spotted Sea Star	Arm Segment	80
<i>Panulirus penicillatus</i>	Tufted Spiny Lobster	Antenna	16
<i>Echinometra mathaei</i>	Oblong Urchin	Spine	62
<i>Holothuria atra</i>	Black Sea Cucumber	Skin	65
<i>Centropyge flavissima</i>	Lemonpeel Angelfish	Fin Clip	8
<i>Mulloidichthys flavolineatus</i>	Yellow Line Goatfish	Fin Clip	44

Figure 1. Number of specimens collected from each species during the Wake Island bumphead parrotfish survey; all specimens were collected by the UH team member.

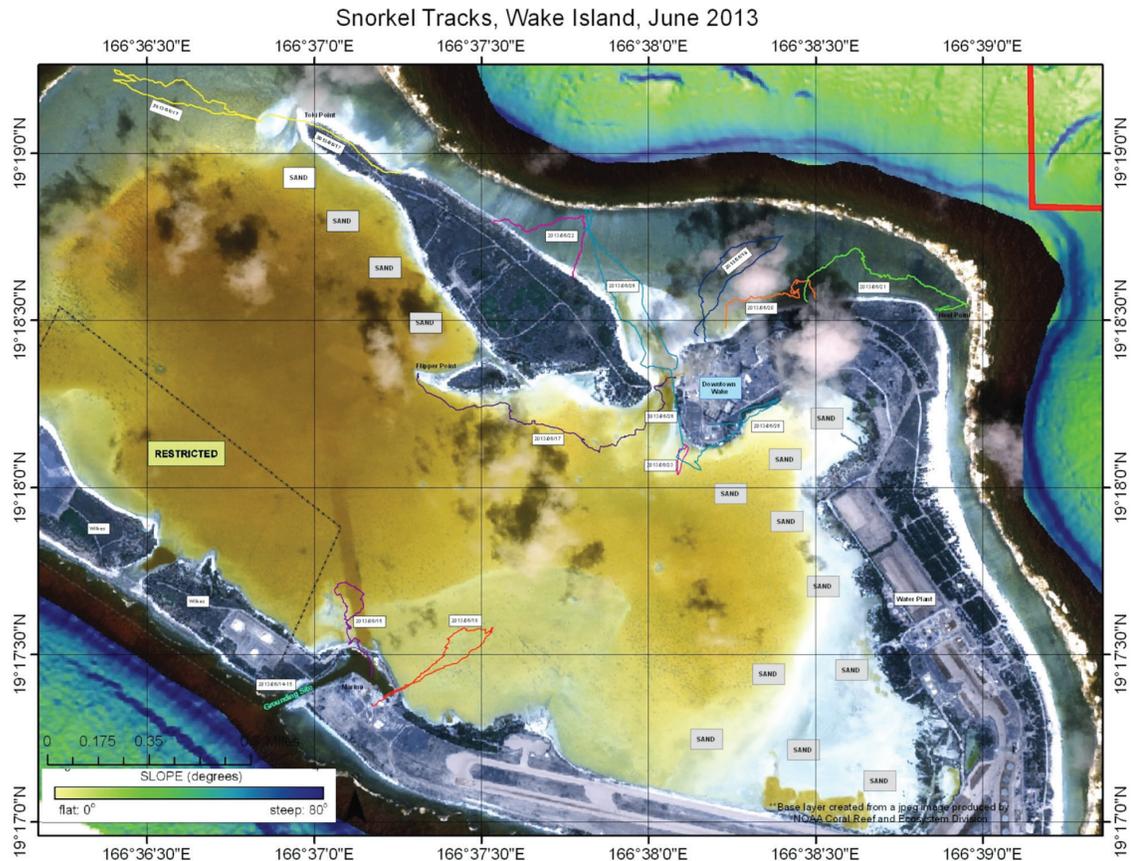


Figure 2. Chart of Wake Island snorkeling tracks; 13 surveys were conducted—4 around Peale Island (two were not tracked using a GPS unit), five around Wake near Downtown, and two near the marina on the southern “arm” of Wake Island.

Prior to departure, a variety of factors prevented the team from conducting the envisioned survey. Much of the lagoon and back-reef was inaccessible during their stay, the lead scientist of the project was unable to participate, visibility within the lagoon was extremely limited, and arranging for travel to Wake Island was far more challenging than expected.

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 in September 2007. The Annual Catch Limit (ACL) system was implemented by NOAA Fisheries in the State of Hawaii to manage sustainable harvest of 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 Revised Statutes require commercial fishers to submit their monthly fishing reports within 10 days following the month in which marine life was taken. The Department of Land and Natural Resources-Division of Aquatic Resources (DLNR-DAR) implemented a new Administrative Rule 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 annually on September 1st, and closes either when the total landings are predicted to reach the ACL, or on August 31st (whichever occurs first). Near real-time monitoring is needed to close the fishery before the ACL is reached, without exceeding this limit, so data collection and processing must be fast-tracked to provide timely and accurate landings information to assist in the monitoring and management of this fishery.

Progress during FY 2014

The project continued to successfully fast track data for the MHI Deep 7 bottomfish fishery. JIMAR staff met this objective through accurate and timely data entry, quality control cross checking between fishermen and dealer reported data, and outreach to both reporting parties to resolve discrepancies. In order to facilitate timely submittal, monthly reminder letters were mailed to Deep 7 dealers. Fishers who submitted late trip reports received citations from DLNR-DAR 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 June 22, 2014, 2,863 Deep 7 trip reports were submitted for the 2013-2014 fishing year and 9% were issued violations for late submissions. The compliance rate improved, last year at the close of the season, 11% of trip reports were issued violations due to late submissions. JIMAR staff entered commercial fishing and dealer data within two days of receiving the report and a second staff member proofed the data that were entered. JIMAR staff generally follows up with fishers and dealers within three days to correct any questionable or incorrect data submitted online or through mail.

Using a computer program written by the Pacific Fisheries Science Center (PIFSC) Western Pacific Fisheries Information Network (WPacFIN), fisheries data were error checked on a daily basis and weekly updates were sent to fishery managers beginning in September 2013. Reports containing discrepancies between fisher and dealer reports were created monthly and rectified by contacting fishers and dealers for corrections. As part of the project's outreach efforts, bottomfish newsletters were mailed to active Deep 7 bottomfishers in November 2014 to update them on the progress of the fishery.

The 2012-2013 MHI Deep 7 bottomfish fishery remained opened for the full year, closing on August 31, 2013. As of June 22, 2014, 456 fishers reported landing 73% of the Annual Catch Target (ACT) and 69% of the 2012-2013 annual catch limit (ACL). The 2013-2014 Deep 7 bottomfish fishery opened on September 1, 2013. An ACT and an ACL were used to manage the MHI Deep 7 bottomfish during the 2011-2012 and the 2012-2013 fishing years. In June 2013, the Western Pacific Regional Fishery Management Council recommended managing the 2013-2014 fishing year with an ACL of 346,000 pounds, the same as during the past two years. This ACL was posted in the Federal Register by NOAA Fisheries in September 2013. The ACT, used to manage the fishery over the last two years, is no longer necessary. The ACT was a buffer to prevent exceeding the ACL and was used because there was management uncertainty. This uncertainty has been eliminated due to the trip report requirement and the high compliance rate, supported largely by fast track monitoring and outreach.

As of June 22, 2014, 284,294 pounds of Deep 7 Bottomfish landings have been reported, which represents 82% of the 2013-2014 ACL. Based on the amount of catch in weekly updates JIMAR staff sends to fishery managers and scientists at the PIFSC, it is predicted that the ACL will not be met before the fishery closes on August 31, 2013. The landings rate was significantly higher during the current fishing year, than in the past two years.

There was some concern earlier in the year that the fishery might close before August 31, 2014. PIFSC scientists began making projections on the date the ACL will be reached for the current fishing year in February 2014. The landings increased at a faster rate, when compared with the previous year. In early April 2014 it was projected that the fishery could reach the ACL by the end of August. In May, the rate of landings began slowing down and the catch is no longer projected to meet the ACL before the fishery closes. However if there is a significant change in the rate of landing and fishery managers decide to close the fishery this year, JIMAR project staff will mail advance notices to Deep 7 fishers and dealers to prepare them for an impending closure.

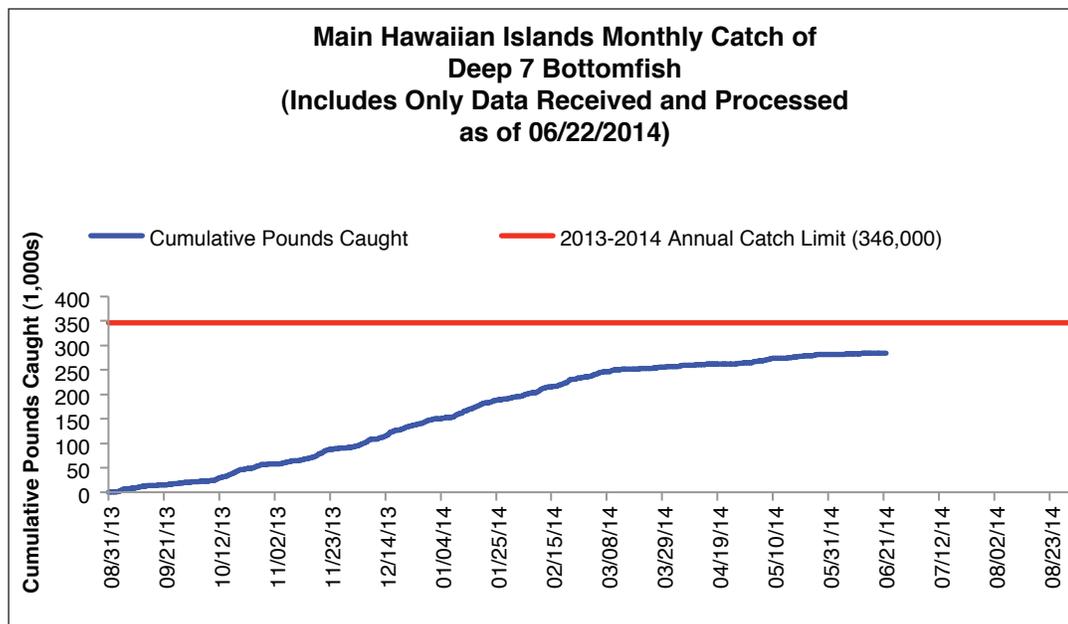


Figure 1. This graph shows the accumulation rate for the ACL during the 2013-2014 MHI Deep 7 bottomfish fishing year (effective date June 22, 2014).

If the landings continue at the current rate, the fishery will remain open until August 31, 2014, but will reopen on September 1, 2014, with an ACL that will be determined at the Council meeting in June 2014. This may be the third time because the bottomfish fishery has been managed using a catch limit that this limit was not reached before the closing date. During the 2012-2013 fishing year, 69% of the ACL was reached. With more than two months left of the fishing year, 82% of the ACL has been reached for the 2013-2014 fishing year. Data shows that the average individual weight (pounds per fish) increased during the 2013-2014 fishing year. Despite the higher rate of landings this year, the fishery may still be able to stay open, because the ACL is now 27% higher than it was during the 2009-2010 and 2010-2011 fishing years.

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

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 (Advanced Very High Resolution Radiometer) satellites. The HRPT data is collected daily by the AVHRR receiving station located in Ewa Beach, Oahu (Hawaii).

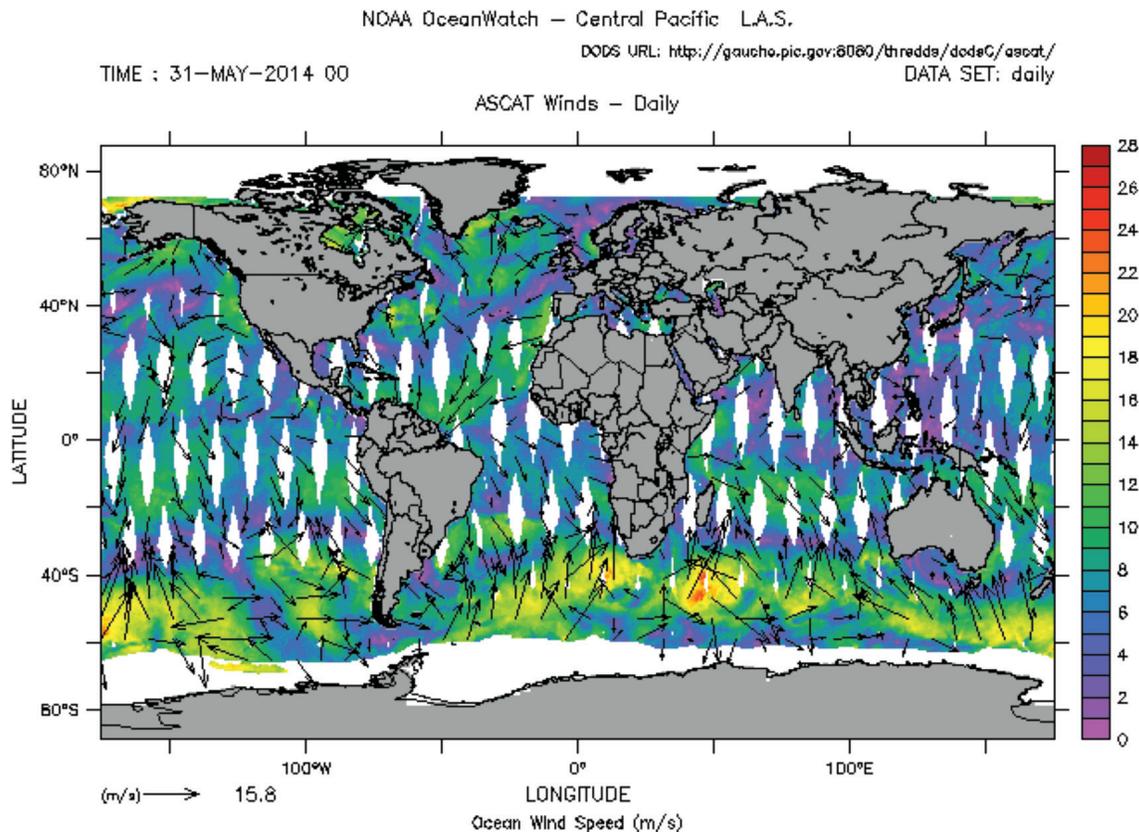


Figure 1. Example of the newly operational 1-day ASCAT wind speed product.

Progress during FY 2014

During FY 2014, the Ocean Remote Sensing (ORS) project completed all the objectives it had established during FY 2013, 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 the addition of new products, the OceanWatch web site has been updated, including the updating of the entire dataset holdings descriptions. Other updates and improvements were also conducted on the Live Access Server (LAS) and THREDDS (Thematic Real-Time Environmental Distributed Data Services) data servers in order to enable greater connectivity and data access customizations for PacIOOS/HiOOS (Pacific Islands Ocean Observing System/Hawaii Ocean Observing System). During FY 2014, JIMAR staff in ORS incorporated new datasets that included the 1-day ASCAT (Advanced SCATterometer) wind data (Figure 1) and the re-processing of the entire AVISO (Archiving, Validation, and Interpretation of Satellite Oceanographic Data) sea-surface height datasets (“two-satellite” and “multi-satellite” mission products) (Figure 2). Project staff implemented a full NASA VIIRS (Visible Infrared Imaging Radiometer Suite) mission reprocessing, as well as a 2012 NASA Aqua Ocean Color data reprocessing in concert with the reprocessing conducted by NASA GSFC (Goddard Space Flight Center). Additionally, ORS conducted updates in the Aqua Ocean Color Climatology in support of PacIOOS data needs. ORS also discontinued a variety of obsolete data products from its data inventory, including the superseded AVISO sea surface height data, and the regional GOES (Geostationary Operational Environment Satellite) monthly and weekly data. ORS also prepared the software infrastructure necessary for readily processing the new NOAA ACSP0 (Advanced Clear Sky Processor for Oceans) sea surface temperature (SST) dataset, in support of NOAA oceanographic cruise research efforts. Other technical efforts included the detailed analysis and comparisons of various SST datasets from GOES, GOES-POES (Geostationary Operational Environment Satellite/Polar Operational Environment Satellite), AVHRR-GAC (Advanced Very High Resolution Radiometer- Global Area Coverage) and ocean color (NOAA VIIRS, NASA Aqua Ocean Color) datasets for evaluation & quality assurance/quality control (QA/QC) purposes.

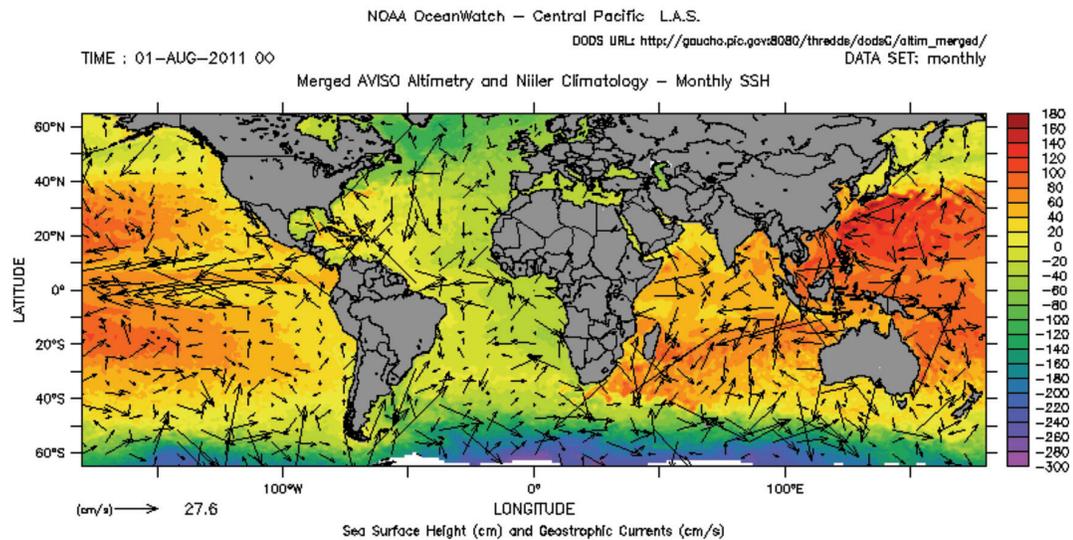


Figure 2. Example of the new AVISO monthly sea-surface height product available via the OceanWatch web site.

As part of its commitment towards collaborative and project support efforts with regional partners, ORS developed customized real-time data products for multiple partners and agencies, including NOAA PaCIS (Pacific Climate Information System), Univ. of Hawaii/PacIOOS, NOAA PIFSC–Kona IEA (Integrated Ecosystem Assessment) Initiative, and the NOAA Science-On-a-Sphere (SOS) programs. Also, as part of its collaboration and outreach efforts, ORS served on the review board of the 2014 Marine Education and Training Grant program led by NOAA PIRO, and participated in the 2014 NOAA B-WET (Bay Watershed Education and Training) program led by NOAA PSC (Pacific Services Center). Other outreach collaboration activities included the development and instruction of a 4-day water resources educator workshop with the Western Pacific Regional Fishery Management Council (WPRFMC).

Pacific Islands Territorial Science Initiative

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
- Resilient Coastal Communities and Economies

Purpose of the Project

This JIMAR project seeks to improve the volume and quality control of catch data from the fisheries of the Pacific Island Territories of Guam, American Samoa and the Commonwealth of the Northern Mariana Islands. Lack of data collection and quality control in the US Pacific Territories has resulted in a paucity of fisheries information to guide management actions mandated by the Magnuson-Stevens Act and other federal law. The small size of the territorial governments with modest budgets, relatively low commercial value of the diverse and small-scale fisheries, and limited physical presence of NMFS in the Pacific Territories, have all contributed to inadequate data collection programs. Thus, there is a need to improve the data volume from the territories and a need for quality control of that data to conduct accurate stock assessments, especially the monitoring and validation of commercial and recreational landings. The improved data will be deposited into the Western Pacific Fisheries Information Network (WPacFIN), which is a centralized database supporting fisheries management

across the Pacific Islands Region. The project will collaborate with several JIMAR projects and PIFSC programs to establish better communications with the management agencies in the Territories, develop protocols for fisheries sampling, and develop tools for appropriate data analyses.

Progress during FY 2014

This project was initiated late in the reporting period, and current efforts are focused on recruitment of professional scientific staff that will successfully collaborate with federal scientists and managers to fully develop the project. PIFSC has long-standing relationships with the US Pacific Territories and maintains primary responsibility for fisheries research engagement there. Experience in working with the territories indicates that frequent visits and face-to-face meetings with Territorial government fisheries management staff are critical to inform the necessary data management and analysis conducted within PIFSC by federal and JIMAR staff.

Seasonal Fluctuations in Pacific Island Marine Debris Deposition

P.I.: Mark A. Merrifield

NOAA Office (of the primary technical contact): National Ocean Service, Marine Debris Program

NOAA Sponsor: Courtney Arthur

NOAA Goal(s)

- Healthy Oceans
- Resilient Coastal Communities and Economies

Purpose of the Project

Time series of marine debris deposition have been collected from Tern Island in the Northwestern Hawaiian Islands (NWHI) with samples available on a bi-weekly basis from 1990 through 2006. The dataset includes deposition data for floating as well as saturated debris. Various oceanographic and meteorological datasets have been gathered to determine if relationships exist between physical forcing factors and marine debris deposition at Tern Island, and further whether these relationships can be used in a predictive framework.

Progress during FY 2014

The marine debris deposition on Tern Island reveals that temporal variability in floating debris features a prominent spectral peak at 3 cycles per year (cpy). A similar peak is not found in submerged debris deposition. Significant energy in the 3-cpy frequency band is found in regional atmospheric pressure, wind stress, and surface wave spectra. General NOAA Operational Modeling Environment (GNOME) simulations suggest that the major source of floating debris for the NWHI is the great Pacific Garbage Patch located to the northeast of the islands. Debris from the patch reaches the NWHI following prevailing wind patterns, with ocean currents having a weaker effect on transport rates. Wind shifts in the garbage patch region include energetic motions at 3 cpy. Model simulations are underway to test whether these wind changes at the patch source region cause the release of high debris clusters, which show up as debris events downstream at Tern Island.

Sustaining Healthy Coastal Ecosystems

P.I.: Mark A. Merrifield [JIMAR Project Leads: Troy Kanemura, Mark Manuel, Megan Moews, John Rooney, Bernardo Vargas-Angel, Chip Young, 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
- Resilient Coastal Communities and Economies

Purpose of the Project

The JIMAR Sustaining Healthy Coastal Ecosystems project mission provides 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 2014

Coral Reef Fish Research. The Coral Reef Fish Research Team met all established objectives for FY 2014, including but not limited to: 1) successful completion of the Marianas Reef Assessment and Monitoring Program Rapid Ecological Assessment and towed diver fish surveys; 2) conducted Oahu south shore, Guam and Northwestern Hawaiian islands baited remote underwater video operations; 3) established metadata records for the Kahekili herbivore fisheries management area on Maui; 4) fulfillment of over a hundred data analysis



Figure 1. Biodiversity in the Coral Triangle, Ambon, Indonesia. 2014. Photo by Megan Moews.



Figure 2. District, provincial, national, NGO, and university fisheries management forum stakeholders come together in Palu, Indonesia for EAFM socialization led by Rusty Brainard of NOAA PIFSC CRED and Megan Moews RCUH JIMAR/NOAA PIFSC CRED and fisheries management planning covering 4 of Indonesia's 11 large fisheries management areas. 2014. Photo courtesy Rusty Brainard.

requests from the Hawaii Division of Aquatic Resources and other interested parties; 5) produced a series of two page, R-script-generated data products detailing fish survey results for the main Hawaiian islands, northern and southern Marianas, and the Pacific Remote Island Areas; 6) publication of a 112-page technical report with results from annual monitoring of the main Hawaiian islands, American Samoa, and the Pacific Remote Island Areas; 7) publication of a paper on herbivorous fishes in American Samoa in the open-access journal PLOS ONE; 8) preparation of a course in Essential Ecosystems Approaches to Fisheries Management and related course materials; 9) provided support for the pilot course in Malaysia and the first official course in Bangkok; 10) supervised a technical working group researching innovations to promote sustainable fisheries in Asia; 11) generation of site-level wave exposure and human population data for use in analyses; 12) facilitation of a workshop on planning and fisheries management in the Solomon Islands; 13) continued size-estimation and species identification training for the NOAA PIFSC Coral Reef Ecosystem Division (CRED) and partner divers; and 14) continued training of CRED team members as advanced coxswains, fast rescue boat coxswains, and towed divers.

Fish team members made research presentations at the 2014 Ocean Sciences Conference, a Hawaii Division of Aquatic Resources seminar, and at the University of Hawaii Marine Biology Graduate Program seminar series. Two abstracts were submitted to and accepted by the 2014 Hawaii Conservation Conference.

Benthic Research. In continuation of the decade-long monitoring of coral reef ecosystem health in the U.S. Pacific Islands, two interdisciplinary Pacific Reef Assessment and Monitoring Program (RAMP) cruises were conducted in 2013-14 aboard the NOAA Ship Hi'ialakai. Scientists from the NOAA Coral Reef Ecosystem Division (CRED), JIMAR, and partner agencies conducted integrated assessments and monitoring of fish, corals, algae, and invertebrates and collected a variety of oceanographic and water-quality observations. Between August 1-23, 2013, 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. Surveys around the island of Oahu were undertaken mostly from shore-based operations occurring between Oct. 18 and Nov. 6, 2013. Additionally, between March 5 and May 7, 2014, JIMAR scientists were involved in the sixth Marianas Archipelago Reef Assessment Monitoring Program (MARAMP) cruise aboard the Hi'ialakai, visiting Wake Atoll and the islands of Guam, Rota, Aguijan Tinian, Saipan, Sarigan, Pagan, Asuncion, Asuncion, Farallon de Pajaros, Maug, Agrihan, Alamagan, as well as Zealandia Bank and Supply Reef. JIMAR scientists examined the reefs around these islands to document any ecological changes since the prior expeditions in 2011.



Figure 3. Food security, livelihoods and long-term sustainability for families are priorities in terms of improved fisheries management in the Coral Triangle and Southeast Asia region. Palu, Indonesia, 2014. Photo by Rusty Brainard.

JIMAR scientists were also involved in a modified RAMP cruise September 3–19, 2013, onboard the Hi‘ialakai and traveled to French Frigate Shoals, Lisianski Island, and Pearl and Hermes Reef. This cruise was dedicated to implementing the National Coral Reef Monitoring Plan (NCRMP) climate related sampling methodologies: discrete water samples; Subsurface Temperature Recorders (STRs); Autonomous Reef Monitoring Structures (ARMS); Calcification Accretion Units (CAUs); and Bioerosion Monitoring Units (BMUs). 2013 marked the implementation of the NCRMP which incorporated changes to some survey protocols, including the inception of a stratified random site selection approach for benthic coral surveys, as well as the selection of permanent sentinel sites within which oceanographic instrumentation and biological deployments were affixed for long term monitoring of water thermal structure, biodiversity, carbonate accretion, deposition, bioerosion, and benthic composition. Results from the 2013 and 2014 cruises to the Main and Northwestern Hawaiian Islands, and Wake and the Mariana Islands are summarized in respective cruise reports.

JIMAR scientists also conducted focused benthic surveys in areas of special interest along the Ka‘anapali coast of Maui Island. Surveys for coral demographics, diversity, colony densities, and coral condition were conducted between June 23–July 3, 2014 at replicate transects off the Mahinahina, Honokowai, and Wahikuli drainages. These surveys are part of a larger project lead by JIMAR and CRED scientists in partnership with the State of Hawaii Division of Aquatic Resources, the U.S. Geological Survey, the West Maui Reef-2-Ridge Initiative, and the U.S. Coral Reef Taskforce Watershed Initiative. The surveys are aimed at providing a baseline assessment for coral demographics to evaluate the effectiveness of watershed restorative management practices intended to reduce Land-Based Sources of Pollution (LBSP) threats, namely siltation and sedimentation stress. Management practices that address LBSP pollution control on lands that drain into the ocean along the Honokowai-Wahikuli watershed are considered high priority because the adjacent shallow coral reefs have been severely impacted by decades of inadequate runoff control, causing severe dieback and reduced live cover. 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 Hawaii.



Figure 4. Kelvin Gorospe photo documents a school of rainbow runners (*Elegatis bipinnulatus*) during a safety stop at Farallon de Pajaros, Northern Marianas.

Oceanographic Research. 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 better understand changes in coral reef ecosystem health owing to climate change, Land Based Sources of Pollution (LBSP), over fishing and other reef ecosystem stressors.

During FY 2014 the Oceanography Team continued the implementation of NOAA's National Coral Reef Monitoring Plan-climate (NCRMP-climate) monitoring efforts. The NCRMP-climate philosophy is to collect a standard suite of oceanographic and ecological information throughout each of NOAA's jurisdictions in the Pacific to assess coral reef ecosystem health and quantify spatial and temporal variability related to a changing climate, including the impacts of global warming and ocean acidification, through the deployment of in-situ instrumentation and collection of discrete water and biological samples. The Oceanography Team's involvement within the NCRMP-climate effort is to: 1) investigate nearshore water column thermal structure at 4 depths down to 25m (deploying Seabird-56 STRs); 2) quantify calcification rates of crustose coralline algae (CAUs) and coral communities (*Porites* spp.-coral cores); 3) evaluate the carbonate system through discrete water sampling and CTD hydrocasts; and 4) investigate cryptic invertebrate biodiversity through the ARMS project. These instruments and chemical and biological samples are standardized between the NOAA offices conducting research and monitoring in the Pacific and Atlantic regions providing results that can be compared between basins. During 2013-14, the Oceanography Team implemented the suite of NCRMP-climate by installing instruments and making collections during 3 RAMP cruises (Main Hawaiian Islands, NW Hawaiian Islands, and Mariana Islands) and 1 fly-in mission to Midway and Kure Atolls. During these efforts 393 CAUs, 105 ARMS, 193 STRs, were deployed and 325 water samples were collected.

The Oceanography Team participated in a multi-institutional research effort at Maug in the Northern Mariana Islands during May 2014. Maug is a 3-island group, actually the remains of an exploded volcanic caldera.



Figure 5. Louise Giuseffi practices fish surveys during a training dive on the Sea Tiger wreck off South Oahu.

Within the ring of islands is a shallow water hydrothermal vent system which CRED, NOAA's Pacific Marine Environment Laboratory (PMEL), NOAA's Atlantic Oceanographic and Meteorological Laboratory (AOML), the National Institute of Standards and Technology (NIST), Scripps Institution of Oceanography, Moss Landing Marine Laboratories, and the University of Guam used as a natural ocean acidification research laboratory to investigate the impacts of high CO₂, high temperature waters on the surrounding coral reef communities. The waters around the vent system have low pH (measured as low as 6.9) and high temperature (measured as high as 65 degrees C). Their current composition is similar to that which many global ocean acidification models are projecting for the world's oceans by the end of the century. Therefore, this collaborative effort is very relevant for ocean acidification research. The project anticipates substantial interest in the research from this site in the near future.

In the past year, the Oceanography Team also participated in CRED's ongoing efforts in Timor Leste through supporting field missions conducted by the Fish and Benthic Teams. In the upcoming year the Oceanography Team will conduct a field mission to recover the first-ever deployments of ARMS and CAUs in the Coral Triangle region. These recoveries will help establish baseline calcification rates and expand the record/identification of cryptic invertebrate species on reef ecosystems within the Coral Triangle.

In January 2014, the Oceanography Team participated in a collaborative effort with researchers from Hawaii Pacific University, NIST, and CRED. The Oceanography Team collected 9 *Porites* spp. coral cores around Oahu for a study investigating the impacts of anthropogenic pollution on coral growth rates.

Data Management. In FY 2014, the JIMAR Data Management Team supported the efforts and activities not only for NOAA CRED, but also for several local, regional, national, and international programs. The team's contributions have been largely focused on addressing at least one if not several stages in the data life cycle.



Figure 6. Kevin Lino shadowed by an ulua (*Caranx ignobilis*) during a survey dive at Maug, Northern Marianas.

To improve planning for data management the Team: 1) developed a resource allocation plan used for communication, project planning, and resource prioritization; 2) worked with the PIFSC Data Management Steering Committee (DMSC) to compose and release the PIFSC Data Management Policy and corresponding PIFSC Data Management User Guide; 3) contributed to the DMSC Working Group 3 to develop a Project Prioritization Process; 4) initiated a data management requirements document for American Samoa's Department of Marine and Wildlife Resources (DMWR); and 5) initiated a data management requirements document for two monitoring programs in Guam: the Guam Community Coral Reef Monitoring Program and the Guam Reef Flat Monitoring Program.

To support data collection the Team: 1) fully documented the role of the data manager on project cruises and developed minimum requirements of the position; 2) created a cruise data manager training program that has been used to expand the pool of cruise data manager candidates; 3) provided personnel for the HA1304 (MHI), HA1305 (NWHI), and HA1401 (Marianas) cruises to serve as cruise data manager and provided data management support for the SB1320 (Oahu) cruise; 4) defined a workflow for optical data management and developed scripts to programmatically validate, re-name, migrate, and catalogue imagery; 5) developed a relational data model for the towed optical assessment device (TOAD) data collection and migrated the data to the Oracle database; 6) continued to provide data management support for the benthic image analysis effort; and 7) made minor modifications to the in-production web-based data management interface that was developed for the Guam Long-Term Monitoring Program's coral demographic, reef fish, and macro-invertebrate data collections.

The Team was also involved in numerous data processing activities this past year. For all of the aforementioned missions that took place in FY 2014, the data were processed, quality controlled, and migrated to the CRED's enterprise database.

With regard to data documentation, the Team: 1) generated metadata records for most of the datasets collected during the FY 2013 and FY 2014 missions and submitted those records to the Coral Reef Information Service (CoRIS); 2) developed a metadata template for the Guam Long-term monitoring program; 3) developed new



Figure 7. Kaylyn McCoy during a survey dive off Maug, Northern Marianas.

International Organization for Standardization (ISO) metadata templates for the CRED for several data collections; and 4) continued to implement the Pacific Islands Region Data Documentation Implementation Plan.

To increase data access and dissemination, the Team: 1) continued development of the CRED's online data tool Reef Box; 2) further developed a web application built around the World Register of Marine Species (WoRMS) web service to enable the biological teams to maintain species lists; 3) responded to numerous internal and external requests for data; 4) continued to increase access to the Oracle database in the division using Oracle Structured Query Language (SQL) Developer and Open DataBase Connectivity (ODBC); and 5) upgraded the division-wide data request tracking using JIRA tracking software.

The team also coordinated several outreach and education activities, specifically a series of events for the CRCP-funded "Reef Smart Hawaii" project including a VIP event for stakeholders, two live web-cast events with the JASON Learning program, and four seminars hosted at the Hawaii State Department of Aquatic Resources.

International Programs. This project supports the NOAA and U.S. Agency for International Development (USAID) Mission strategies and associated inter-agency agreement for providing technical assistance and capacity building to Coral Triangle (CT) and other Southeast Asia countries working towards sustainable fisheries and ecosystem-based management. The JIMAR International Programs Team: 1) develops and reviews training curricula, scientific papers and other relevant documents; 2) provides partners with guidance on fisheries management planning and implementation per ecosystem approach to fisheries management (EAFM) guidelines; 3) coordinates and leads capacity building workshops; 4) provides training and technical input on an EAFM; 5) assists partners with incorporating considerations of climate and ocean change into an EAFM; 6) provides countries with climatology, mapping and other data layers along with data analysis support; 7) provides input into data management and spatial framework development; 8) helps to build partner capacity in deployment, retrieval, processing and data analysis from instrumentation used for ocean acidification (OA), climate change, and biodiversity observations; 9) works in scientist-to-scientist collaborations; and 10) assists with development of a reef monitoring program. In addition, JIMAR staff provides travel, meeting and workshop coordination for various



Figure 8. Andrew Gray photographing a school of whitebar surgeonfish (*Acanthurus leucopareius*) off the north shore of Molokai.

regional/national activities and provided input into scoping for future efforts as well as efforts beyond the region.

Project staff provided assistance in program development to partners in Timor Leste, Indonesia, and Philippines, as well as to the Coral Triangle Initiative (CTI) EAFM and Seascapes technical working groups and the Southeast Asia Fisheries Development Center (SEAFDEC) toward institutionalization and implementation of an EAFM for improved management of fisheries and ecosystems. The project helped build capacity through cooperative development, socialization and training of the comprehensive Essential EAFM curricula, developed in a partnership between NOAA, the United Nations Food and Agriculture Organization, Bay of Bengal Large Marine Ecosystem Project, U.S. Coral Triangle Support Partnership and Program Integrator, University of Connecticut Sea Grant, and the Asia-Pacific Fishery Commission. The training has now been replicated at least three times each by Philippines and Malaysia, has been adopted by SEAFDEC, and has been requested by Indonesia and Philippines for institutionalization through their governments and training centers. As a result of these efforts, Indonesia developed fisheries management plans for all eleven of its large fisheries management areas based largely on an EAFM.

In addition to program development and capacity building, the project focused on providing technical assistance through various means. Fish surveys were conducted in Timor Leste and training in methodology, ocean acidification (OA) and biodiversity deployments were complimented by water sampling and analysis. This instrumentation will be retrieved from Timor Leste in September 2014, while the instruments in the Philippines will be retrieved in 2015. The Philippines deployed 10 ARMS to be utilized for outreach and education, and this deployment stems from engagement with the JIMAR CTI Team as part of OA and biodiversity training and technical assistance. In terms of climatology procurement and science for management, climate prediction and night light fishing data for the region have been procured with the project's assistance, and these data are currently being processed and analyzed. Project staff worked to provide Indonesia and Timor Leste with assistance in development of spatial



Figure 9. Ivor Williams, Marc Nadon, and Chip Young between dives off the north shore of Molokai.

frameworks and data management. In addition, JIMAR provided assistance to Indonesia for development of capacity in climate and ocean change monitoring and toward integrating their observational system into the global OA network. Innovative science and technology information related to fisheries management and the mitigation of illegal, and unreported and unregulated fishing were also compiled in partnership with leading global experts for the region.

Overall coordination for these efforts took place throughout the project and included administrative support for USAID activities in which CRED engages, including travel, workshop/meeting coordination, leadership and communication with partners, work plan development, and reporting for the various activities in the objectives above.

Benthic Habitat Mapping Research. 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 addresses 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 Achievements and Unmet Needs” and other CRCP documents. This project collects, processes, and disseminates acoustic and optical benthic habitat mapping data products to fill needs for spatial data in the Pacific Islands. Primary foci of the project in FY 2014 include: 1) collecting and processing mapping data to fill gaps in existing coverage to make seamless benthic habitat map layers that extend from the shoreline to the outer edge of coral reef ecosystems; 2) developing methods to improve mapping data collection, processing, and management; and 3) improving our understanding of the distribution of benthic communities in coral reef ecosystems.

A number of mapping-related projects, distributed across the Pacific Islands Region, were proposed and completed in FY 2014. Previously collected multibeam data around Kahoolawe were processed and made

available on the project's website: http://www.soest.hawaii.edu/pibhmc/pibhmc_mhi_kal_bathy.htm as well as being provided for data syntheses and archives. A three-week long combined acoustic and optical survey was completed around the west and northern sides of Maui. Multibeam surveys were conducted at grounding sites of the USS Port Royal and M/V VogeTrader at the request of local and national management agencies. Project personnel also collaborated with researchers from the University of Hawaii and elsewhere on a 36-day cruise and conducted multibeam mapping the Northwestern Hawaiian Islands aboard the M/V Falkor.

The project's multibeam data collecting is generally limited to depths of 15 m or greater. To fill gaps in seafloor characterization data between depths of approximately 15 m and the shoreline, the team is using WorldView-2 satellite imagery to derive bathymetry data and information on whether the seafloor is covered with sediment (soft) or rock, rubble, etc. Bathymetry data around Swains Island were derived from WorldView-2 imagery and hard/soft data for Niihau and Rose Atoll, also derived from satellite imagery, were integrated with hard/soft data derived from multibeam surveys around those islands.

Two methodological development projects were completed in FY 2014. Operating system code modifications were made to build obstacle avoidance behavior into the project's Autonomous Underwater Vehicle (AUV). That behavior was field tested alongside a pier and in the open ocean during a dedicated small boat mission in FY 2014. A number of problems in the coding were identified and fixed during the mission. Although other refinements are needed, the mission was a solid first step towards developing a reliable obstacle avoidance capability, which is essential for operating in close proximity to the seafloor. Also, the Team prepared a NOAA Technical Memorandum, describing the Team's methods for deriving seafloor bathymetry from WorldView-2 satellite imagery. The memorandum was completed and is in review. Finally, a digital archive and dataviewer for several hundred gigabytes worth of video imagery of the seafloor from American Samoa were created and made available to the public via the project's website: (<https://www.google.com/fusiontables/DataSource?docid=1YQ6X92FNyLv5QS3MK5xBRfON3YQekFREBII668sr#map:id=3>). This work will be expanded to cover the team's video archives from other jurisdictions in future years.

To improve understanding of the distribution of coral reef ecosystem benthic communities, previously collected seafloor imagery around the island of Tau were classified, completing the classification of all video imagery collected during a dedicated mission to the Manua Islands of American Samoa. Additionally, in conjunction with the previously mentioned multibeam survey around Maui, optical surveying was conducted off the Kaanapali-Kehikili area of West Maui. Identified as a priority site by the Hawaii Division of Aquatic Resources and NOAA Coral Reef Conservation Program, these data will be used in the creation of a benthic habitat map of the site.

Marine Debris Research, Removal, and Logistics Support. In FY 2014, JIMAR marine debris staff did not conduct any survey and removal efforts within the Papahānaumokuākea Marine National Monument in the

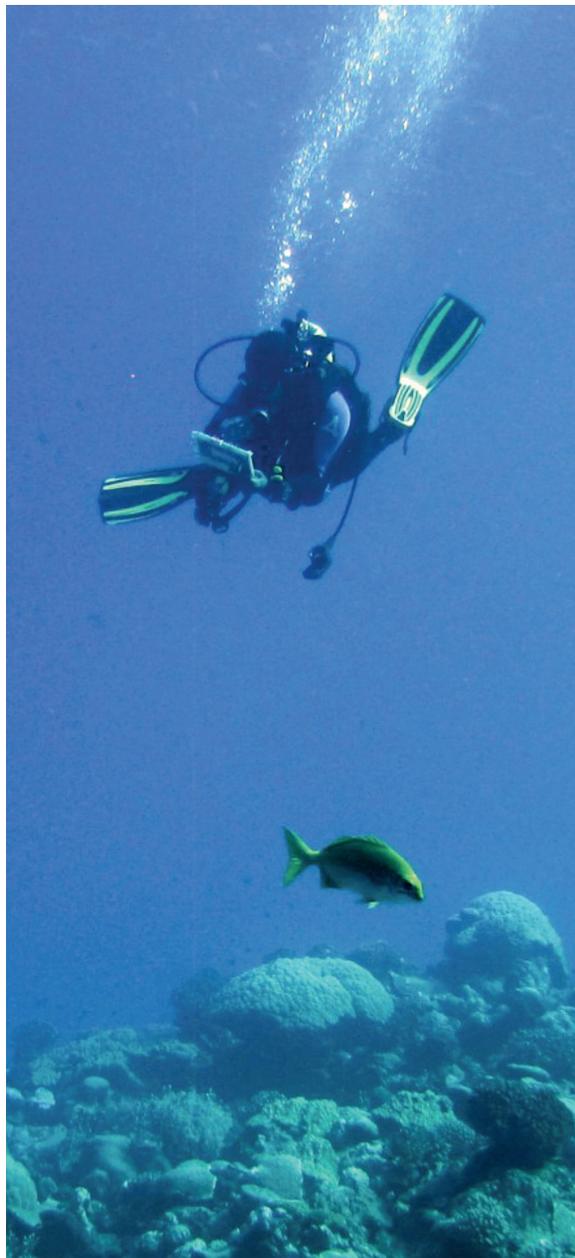


Figure 10. Kelvin Gorospe counts fish during a survey dive at Wake Island.



Figure 11. Mark Manuel helping facilitate an educational booth at the Mauka to Makai (Earth Day) event held at the Waikiki Aquarium on April 19, 2014. The goal was to educate both children and adults of the persistent issues of marine debris and how to preserve and protect Hawai'i's diverse environment.

Northwestern Hawaiian Islands (NWHI) due to the timing of other PIFSC Coral Reef Ecosystem Division (CRED) missions. However, project staff provided planning, logistical, and operational support for the Main Hawaiian Islands RAMP cruise, NWHI Instrumentation cruise, O'ahu RAMP land-based mission, Maui R/V AHI Mapping mission (SB-14-01), Marianas RAMP (HA-14-01) and NWHI R/V Searcher mission (MP-14-08).

The Marine Debris Team also participated in seven outreach and education events that included the International Coastal Clean-up Day (Get a Drift and Bag it) at the Ala Wai Small Boat Harbor, Career Day at Radford High School, Science Club at Holy Nativity School, Mauka to Makai at the Waikiki Aquarium, as well as general presentations at Waiālae Elementary and Le Jardin Academy. Staff also conducted five interviews with Elizabeth Howell of Live Science, Al Jeezera America, World Society for the Protection of Animals, and various school groups. These interviews provided opportunities to highlight the success of CRED's Marine Debris Project and the continual issues that marine debris present to our local coastal resources.

From June 16–23, 2014, the Team participated in a collaborative research cruise aboard the NOAA Ship Hi'ialakai to investigate the effectiveness of Unmanned Aerial Systems (UAS) in detecting marine debris (specifically derelict fishing gear) in the shallow coral reef environments of the NWHI. Although no marine debris was detected during flights around French Frigate Shoals the UAS operating systems have shown the potential for positively identifying marine debris in the remote islands and atolls of the NWHI.

Lastly, marine debris staff published a PIFSC internal report entitled, "Marine debris: removal and assessment at Midway Atoll 2013". This report summarized the team's 2013 shore-based survey and removal effort at Midway Atoll.



Figure 12. Marine debris staff cleaning up the Ala Wai Small Boat Harbor during the annual International Coastal Cleanup Day on September 21, 2013.

Figure 13. Marine debris staff instructing students about the use of Global Positioning System (GPS) in a simulated marine debris exercise at the NOAA Fisheries Pacific Islands Region Science Camp held June 23–26, 2014. Daniel K. Inouye Regional Center, Honolulu, Hawai'i.



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 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, database and software development, design and management, and other information technology support to fisheries agencies participating in the WPacFIN. JIMAR and PIFSC federal staff work cooperatively with island agencies, contractors, fishermen and fish dealers to create data systems that compile, run quality control and synthesize fishery-dependent monitoring data for the island areas of Guam, the Commonwealth of the Northern Mariana Islands (CNMI), Hawaii and American Samoa. 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 Department of Land & Natural Resources, Division of Aquatic Resources (DAR); the Guam Department of Agriculture, Division of Aquatic and Wildlife Resources (DAWR); the Guam Bureau of Statistics and Plans (BSP); and the CNMI Department of Lands and Natural Resources, Division of Fish and Wildlife (DFW). In addition to extensive involvement with compiling and summarizing fish catch and effort monitoring data from WPacFIN partner agencies in the Pacific Islands Region (PIR), the project also provides services in support of vendor monitoring programs that mutually benefit fish dealers and WPacFIN partners in support of developing better weight and value estimates for fisheries landings in the PIR.

Progress during FY 2014

WPacFIN met all annual reporting deadlines for 2014, including those for the NOAA publications Fisheries of the United States (FUS, April 15th) and Fisheries Statistics of the Western Pacific (FSWP, August 31st). The FSWP document was completed for calendar year 2011, and the FUS was completed for 2012 and 2013. The project plans to develop similar summary reports for American Samoa, Guam and CNMI. These reports are compiled and edited by WPacFIN staff using a combination of Visual FoxPro (VFP) and MySQL procedures.

The project contributes to an ongoing conversion of legacy VFP to MySQL programming with C# user interfaces. WPacFIN also met its share of annual requirements for providing raw and summary data to PIFSC's Fisheries Research and Monitoring Division's (FRMD), Highly Migratory Species Regional Fisheries Monitoring Organization (HMS-RFMO) working group in support of annual international reporting and stock assessments.

WPacFIN completed a major upgrade to the legacy VFP Guam and CNMI Boat-based and Shore-based Creel Survey data entry program modules. These upgrades significantly improved quality control for data entry, made forms more interconnected within the system, and provided a more user-friendly application that must remain in use until the new MySQL systems are fully developed. JIMAR staff also made significant inroads towards documenting the creel survey data expansion process for American Samoa, Guam and the CNMI, and converting data expansion algorithms to MySQL stored procedures. Only the shore-based data expansions for Guam and the CNMI remain to be completed.

Migration of legacy VFP databases to MySQL, and from MySQL to Oracle, was completed in March 2014, and the network hardware and software issues have been resolved. Moving the WPacFIN server to the Inouye Research Center (IRC) has significantly reduced a number of network and supporting infrastructure issues. Fortunately, WPacFIN JIMAR staff and federal staff worked through most data migration issues just prior to making the move to IRC.

Project staff assisted PIFSC Scientific Information Systems (SIS) in completing metadata available on the PIFSC website relating to American Samoa, Guam and CNMI creel survey databases. The project's technical writer is currently assisting SIS in cataloging WPacFIN's fishery dependent data for PIFSC's online Fisheries Data Catalog. This project and links to information hosted on the WPacFIN website is targeted for completion by July 31, 2014.

WPacFIN staff updated HDAR's Fisherman Reporting System (FRS) to import data from HDAR's online contractor database into HDAR's in-house commercial fish catch database. The HDAR bottomfish data are used in estimating total landings for the main Hawaiian Islands Deep 7 bottomfish species, which include six snappers and the endemic Hawaiian grouper (refer to Deep 7 Fast Track annual report). WPacFIN software cross references fishermen and dealer reported data to ensure the most accurate data are compiled. WPacFIN software also generates landings weight estimates used to track compliance with the Annual Catch Limit (ACL) for Deep 7 bottomfish, set by the Western Pacific Regional Fishery Management Council (the Council) and the NOAA Pacific Island Regional Office (PIRO).

WPacFIN hosted a creel survey workshop for Pacific island partners at the IRC during April 2014. Members of the WPacFIN Fisheries Data Coordinating Committee's (FDCC) Technical Advisory Subcommittee participated in the workshop, including creel survey staff from the DMWR, DAR, DAWR and the Council. The goal was to share and facilitate development of new ideas and methods for resolving data collection and data analysis issues and to initiate planning for data improvements. JIMAR and federal staff demonstrated the data expansion process, including hands-on examples of how data collection deficiencies can increase the margin of error and reduce geographic and temporal coverage represented in expansion catch and effort estimates.

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 2014

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. In September 2013 JIMAR staff traveled to American Samoa for data collection, to conduct data quality control and to train field workers. All the databases continue to be updated with additional observations. Project activities achieved during FY 2014 include: 1) publication of a brochure detailing Hawaii longline trip expenditures that was distributed to fishermen; 2) data collection for the cost-earnings for Hawaii longline fleet was completed and statistic and economic analyses were conducted and are in progress. An administrative report, co-authored with the Pacific Islands Fisheries Science Center is under preparation; 3) analysis for the economic returns to social networks of fishermen in Hawaii longline fishery are at the stage of data integration and economic analysis; 4) developed a database to present 'Tier 1' economic performance measures for three main fisheries in the Pacific Islands Area based on a standardized format consistent with the national report system; 5) initiated a project for a cost-earnings study for Hawaii and American Samoa small-boat fisheries. The survey instruments, mailing materials, outreach materials were developed and completed. An online version of the survey for Hawaii was also developed; and



Figure 1. Bigeye tuna assembled at the Honolulu Fish Auction.



Figure 2. Hawaii longline fishing fleet at Pier 38 in Honolulu.

6) integration of the datasets for the Hawaii longline fishery were developed which can be used to estimate the net returns for Hawaii longline fishery.

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, Edward Glazier

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 increasingly important in the Pacific Islands region. Uses include but are not limited to: a) assessment of the social, cultural, and economic impacts of fishery management measures on individuals, households, and communities; b) identification of possible management alternatives and accompanying social, cultural, and economic objectives; and c) identification of local perspectives regarding the status of marine ecosystems, and sources of human impacts to such ecosystems over time. JIMAR researchers collect valuable sociocultural information to examine the impacts of these emerging 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 2014

During this year, JIMAR researchers: 1) assessed resident users' perspectives on coral reef and watershed conditions and support for management strategies to protect watershed and coral reef resources in West Maui,



Figure 1. Shore-based Fishing in Hilo. Hilo was one of the communities where JIMAR researchers collected qualitative data for validating social indicators for communities in Hawai'i. Hilo is a smaller, more residential town with a small-boat tuna fishery and many residents engaging in shore-based fishing for food. This fisherman hooked a fish and onlookers of all ages gathered to see him bring it in.

Hawai'i; 2) examined the extent of Guam residents' and fishermen's participation in the federal fisheries management process to identify factors that influence whether and how they participate; 3) adapted national social indicators of vulnerability to a variety of types of social and ecological disruptions, for use in Hawai'i; and 4) investigated new developments for the Marine National Monuments (MNM)s near Guam, the Commonwealth of the Northern Mariana Islands (CNMI), and the Pacific Remote Island Areas (PRIAs) that raise a number of sociocultural issues relevant to management of the MNMs.

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

Hawaii Resident Users' Knowledge, Attitudes, and Perceptions (KAP) of Coral Reefs in the Two Hawaii Priority Sites (West Maui). This project involved the administration of a survey in Hawaii's coral reef priority site in West Maui, Hawai'i. The purpose of the survey was to identify resident local knowledge, attitudes, and perceptions (KAPs) regarding coral reef and watershed conditions and to assess local perspectives on a variety of potential resource management strategies for West Maui. JIMAR researchers designed the survey and managed its administration. A contractor conducted the survey in Maui between August 2013 and January 2014. JIMAR researchers then analyzed the survey data and presented results at two meetings: a DAR sharing session for marine resource managers held on April 4, 2014 on Maui, and a community meeting in West Maui for key stakeholders, project partners, and interested residents on May 5, 2014. Based on feedback from the community meeting, additional information is being added to the draft report. The report and a brochure summarizing project findings are in progress and will be made available in the coming year.

What Influences Fishing Community Participation in the Federal Fisheries Management System? A Guam Case Study. This purpose of this study is to examine the extent to which fishermen and other fishing community members in Guam participate in the federal fisheries management process. The study also identifies factors that influence whether and how they participate. JIMAR researchers conducted 30 semi-structured interviews during



Figure 2. Reef fishing occurs alongside military and tourism use in Saipan's coastal zone.

two field visits to Guam in March and June, 2014. Those interviewed include: commercial and non-commercial fishermen, charter boat captains, local and federal marine resource agency personnel, fisheries scientists, and Western Pacific Regional Fishery Management Council (WPRFMC) staff. Additionally, JIMAR researchers observed the management process at several fisheries management meetings, including the 159th Meeting of the WPRFMC on Saipan and Guam in March 2014. Several additional aspects of this research have been ongoing since FY 2013. These include scoping with partners to identify individuals to be interviewed in both Honolulu and Guam, and review of literature and historical documents regarding local fishing practices and management in Guam. A draft report describing factors found to influence participation in federal fisheries management on Guam, and comparison with findings during previous research in St. Croix, USVI, is currently being developed.

Validation of National Social Indicators in Hawaii Fishing Communities. JIMAR researchers are participating in a national initiative to develop standardized social indicators with which to gauge community vulnerability to fishery environmental, social and economic changes, making it possible to compare communities within and across regions with respect to potential social and economic fisheries-related impacts. JIMAR researchers integrated U.S. Census and American Community Survey data with fisheries data to identify valid indicators of change for Hawai'i communities. JIMAR researchers also coordinated with researchers in other regions, contributing data on Hawai'i to a national database for analysis of the indicators across regions. JIMAR staff selected several communities in Hawaii (defined at the census county division level) that represent a broad range of socioeconomic and fishing conditions for further investigating the findings of the social indicators. Researchers interviewed fishermen representing different fishing sectors and other knowledgeable persons in these communities to collect qualitative data for validating the accuracy of the social indicators. A draft report describing development of the indicators and initial community rankings for Hawai'i was written and sent out for peer review. A second report describing the validation process will be drafted following the completion of qualitative data collection in selected communities.

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 activities in the Islands Unit of the Marianas Trench Marine National Monument (MTMNM). The final administrative report was produced and distributed to study participants and interested members of the public. A data report summarizing results from the phone survey of Guam and CNMI residents regarding management preferences for the MTMNM is currently

in the final stages of review. JIMAR staff continues to engage with fishermen and managers regarding policy and regulatory developments related to the MNMs, soliciting comments to inform further research. Project development for this work is currently underway but includes investigating access to fishing grounds for 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 (FMP) developed by the Western Pacific Regional Fishery Management Council (WPRFMC). This FMP was approved by the National Marine Fisheries Service (NMFS) 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 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, and it is the responsibility of the JIMAR PIROP debriefers to train and debrief those observers. The focus is on maintaining the overall quality and integrity of the fisheries-dependent data. Debriefers also perform other duties, as needed, including editing



Figure 1. John Peschon conducting vessel safety drills onboard a US flagged purse seine vessel in American Samoa.



Figure 2. Josh Lee co-teaching at AMSEA training.

data, assisting with daily operational needs, developing program protocols and procedures, filling enforcement-related documents, editing management-related documents, and other tasks.

Progress during FY 2014

Over the reporting period, JIMAR program staff debriefed 84 of 345 total observed trips, and finished data editing process steps on 202 of 514 total trips that were edited during this period. Program staff led instruction sessions and developed a training module for two observer training classes as well. Project staff maintained all current certifications, including Alaska Marine Safety Education (AMSEA) certification, and provided logistical support to the American Samoa fisheries observer program, including conducting required vessel safety drills onboard longline and purse seine fishing vessels. An Institutional Animal Care & Use Committee (IACUC) protocol was developed and approved to enable the handling of live animals as a part of emergency at-sea readiness. The program staff compiled and presented seabird banding data at the annual Pacific Seabird Group meeting in Juneau, Alaska. Staff also participated in both biannual meetings of the Association for the Conservation of Albatross and Petrels (ACAP). This year, program staff was unable to provide training and support to the observer programs of the Forum Fisheries Agency (FFA) and the Secretariat of the Pacific Community (SPC) due to logistical and financial constraints.

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 Regional Office

NOAA Sponsor: Michael Tosatto, Wende Goo

NOAA Goal(s)

- Healthy Oceans
- Resilient Coastal Communities and Economies



Figure 1. NOAA Fisheries Pacific Islands Region outreach and education booths focused on habitat conservation at the Hawaii Ocean Expo 2014. The two-day event attracted an estimated 5,000 attendees who learned about NOAA Fisheries and its mission.

Purpose of the Project

The objectives of this project is to plan, develop, and implement effective communications, outreach and education programs as a partnership between JIMAR and the NOAA Fisheries 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, the JIMAR employees make up a Communications Team that serves as a resource, advisor, and point of contact for outreach and education activities for JIMAR and NOAA Fisheries PIR staff 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 2014

During FY 2014, two new staff members, both Outreach and Education Specialists, joined the JIMAR Communications Team. The two additional Outreach and Education Specialists began work with the Communications Team in March of the fiscal year and assumed the duties related to this position including carrying out and developing outreach and education materials for upcoming events.

During FY 2014, the program produced communications, outreach and education materials that JIMAR and/or NOAA Fisheries PIR 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 provide information to the public, partners, collaborators and stakeholders that describes NOAA's mission to the public and other audiences in easy to understand language and a visually appealing format.

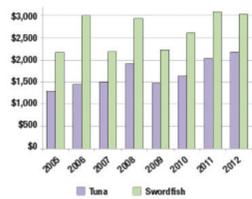


Hawaii Longline Trip Expenditure Study

Since 2004, fishing-trip expenditures data has been collected from the Hawaii-based longline fisheries through a joint effort by the Pacific Islands Fisheries Science Center (PIFSC) Economics Program and the Pacific Islands Regional Office (PIRO) Observer Program. Observers collect the data directly from the longline vessel operator. The participation by fishers in the economic data survey is voluntary. The continuing economic data collection would not succeed without the generous support of vessel owners and operators. Thanks to the fisherman's cooperation, the survey response rate has been excellent. Note: All time-series values are presented in nominal dollars.

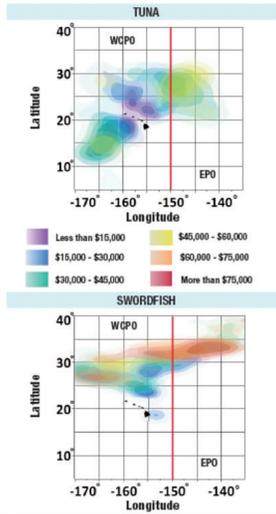
Cost per Set

Results reveal that shallow-set swordfish trips typically cost twice as much as deep-set tuna trips and, on a per-set basis, cost one third more than tuna sets. In part, this is due to longer trip length, greater distances traveled, and larger average vessel sizes in the longline swordfish fishery.



Maps of 2010-2012 Average Trip Cost

Fishing for tuna and swordfish in the Eastern Pacific Ocean (EPO) is typically more expensive than fishing in the Western Central Pacific Ocean (WCPO) due to long distances traveled and corresponding fuel requirements. The red line (150° West) separates the WCPO from the EPO.



The Economics Program thanks everyone who participates in this ongoing research project.

For more information, please contact:
 The Economics Program
 ph: 808-944-2136
 mrling.psn@noaa.gov
 kolter.kalberg@noaa.gov

NOAA Fisheries
 Pacific Islands Fisheries Science Center
 www.pifsc.noaa.gov





Hawaii Longline Trip Expenditures
2004-2012

U.S. Department of Commerce
 National Oceanic and Atmospheric Administration
 National Marine Fisheries Service

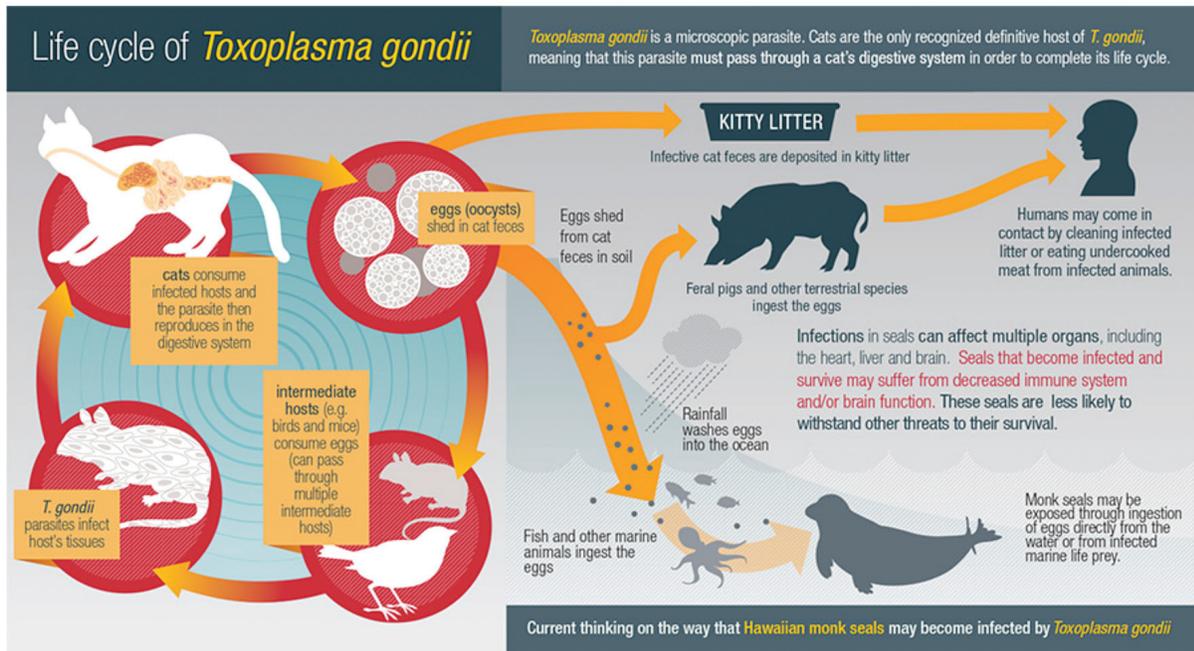


Figure 2. Program staff help interpret and transform complex scientific data, results and concepts into an array of products that are easily understood, visually appealing and compelling. Public understanding and support are key elements to the continued success of JIMAR and NOAA Fisheries Pacific Islands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

The most significant educational activity carried out during 2014 was the NOAA Fisheries Science Camp held at the NOAA Inouye Regional Center (IRC). The camp hosted 60 middle school students as well as six teachers from schools around the island of Oahu. The target audience was eighth graders from public and charter schools, with an emphasis on reaching under-represented students. The students were divided into two groups of 30 for each of two sessions. The two-day camp featured six science modules focused on marine debris, fisheries stock assessment, fish life history, marine food webs, marine plankton and Hawaiian monk seals. NOAA and

JIMAR scientists from PIFSC conducted activities in the IRC building and laboratories, providing the students with unique hands-on experiences. They also exposed campers to the diversity of backgrounds and career fields represented at NOAA Fisheries. From the campers' post evaluations, it was evident that they enjoyed the camp and absorbed the information presented, especially from the fish dissection and marine plankton modules. The teachers provided valuable assistance with the student subgroups as well as feedback on the presentations, activities, and materials.

The events in which the program participated ranged from an elementary class size to over 5,000 at the Hawaii Ocean Expo. JIMAR 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 2014 include the following.

- Hawaii Conservation Conference
- Career fairs for various middle schools
- Welcome Back Whales event at Turtle Bay Resort
- Hawaii Fish and Dive Expo
- Science Alive! Event held at Bishop Museum
- Hawaii Ocean Expo
- Earth Day events around Oahu and one on Moloka'i
- North Shore Ocean Fest at Turtle Bay Resort—A World Ocean's Day Celebration
- NOAA Fisheries Science Camp

Outreach and educational materials and displays produced by project staff during FY 2014 include the following.

- Monthly Employee Brown Bag Seminar series advertisements
- Hawaii Recreational Fishing Expenditures Survey 2014 brochure
- Hawaii Small Boat Survey 2014
- Hawaii Longline Trip Expenditures 2004-2012 brochure
- Banners, posters and displays for Hawaii Fish and Dive Expo, Science Alive! Event at Bishop Museum, Hawaii Ocean Expo, and North Shore Ocean Fest events
- Where Do I Live and Am I a Coral or Rock—habitat educational activity materials
- Hawaiian monk seal prey consumption infographic
- Hawaiian monk seal and *Toxoplasma gondii* life cycle
- Hawaiian monk seal natural history timeline infographic for website
- PIFSC Quarterly Report Bulletins design and layout
- PIFSC Fact Sheets for the Commonwealth of the Northern Mariana Islands (CNMI) and Guam
- PIFSC outreach banners for CNMI and Guam
- Established Twitter account
- Established Facebook page
- 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
- Hawaiian Monk Seal Final Programmatic Environmental Impact Statement newsletter
- Posters, banners, and webpage for NOAA Fisheries Pacific Islands Region 10-Year Recognition event in October 2013
- PIFSC Western Pacific Regional Fishery Management Council report cover
- Coral threats handout
- Honolulu Hale Exhibit—NOAA Legacy—America's First Science Agency

Sustainable Fisheries Initiative

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

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
- Resilient Coastal Communities and Economies

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 via outreach. In addition, JIMAR staff assist the PIRO Sustainable Fisheries Division (SFD) staff with various NOAA fisheries initiatives in the Region, as appropriate.

Progress during FY 2014

During FY 2014, the JIMAR project Social Scientist accomplished the following.

- 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.
- Coordinated Oceanic Libra Corporation's Western Pacific Community Development Program request to the Council and NMFS.

The JIMAR Sustainable Fisheries Outreach and Education Specialist accomplished the following.

- Designed and produced the 2013 Annual Seabird Report.

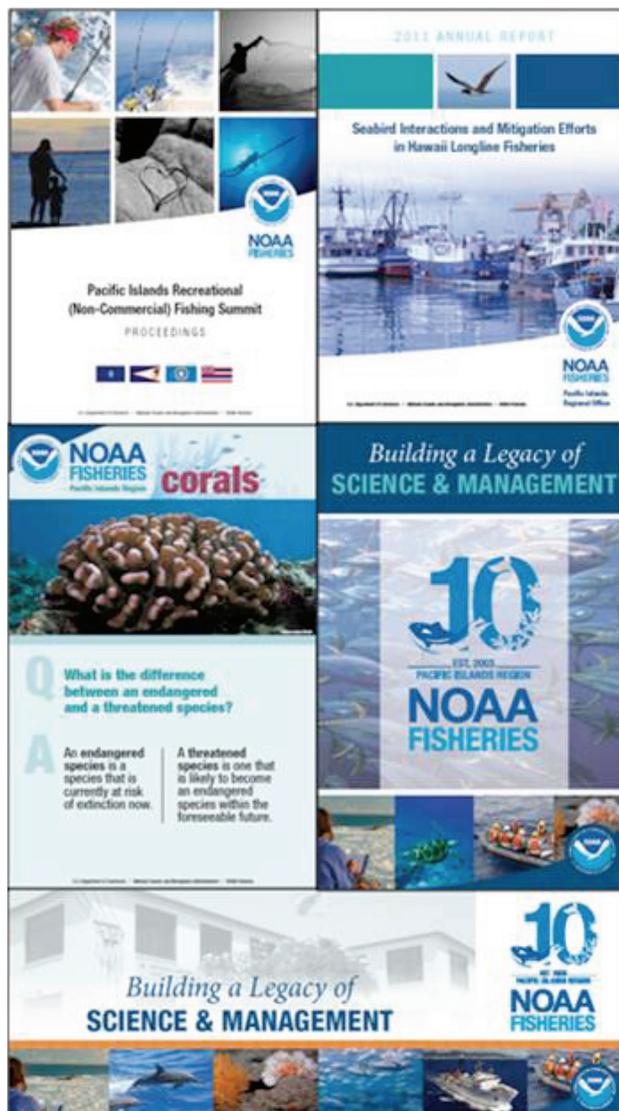


Figure 1. A compilation of some of the posters, report covers, and other imagery that the Outreach and Education Specialist produced during the past year.

- Managed web updates for the SFD website.
- Collaborated with the JIMAR Communications Team on various projects, including the 10 Year Anniversary rollout and report.
- Designed a variety of graphic materials such as fact sheets, posters, announcements, flyers, etc. to educate the public on PIRO and its various programs.
- Set-up and prepared materials for several outreach events including Ocean Expo, Honolulu Hale, and NOAA Fisheries Science Camp.
- Helped PIRO staff in developing poster presentations for national conventions and gatherings.
- Completed design on the “Saltwater Recreational Fishing Attitudes and Preference Survey” for Hawaii.

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 2014

Request for Proposals. No RFP was issued during FY 2014 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.



Figure 1. Students doing fieldwork.

Kevin Weng (P.I.), Martin Pedersen (postdoctoral scholar), and Gen Del Raye (UHM Oceanography graduate student) continued to work on fishery science projects. An expedition to Cross Seamount was undertaken to recover fish tracking equipment in October 2013.

The PFRP undertook a collaboration with a computer scientist to build a website that allows researchers to optimally design acoustic receiver tracking networks. The product is publicly available at: <http://www.soest.hawaii.edu/PFRP/acoustic/pages/webapp.html#>

PFRP program manager. The PFRP program manager served as the co-chair of the steering committee of CLIOTOP–Climate Impacts on Top Predators and presented at the following meetings: 1) IMBER Open Science Conference, Bergen, Norway, June 2014; 2) MAUI Mai Tai meeting, Maui, Hawaii, May 2014; 3) PICES Future, Kona, Hawaii, April 2014; and 4) JIMAR Symposium, Honolulu, Hawaii, November 2013.

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 together with scientists from Japan, Taiwan, Canada, 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 North Pacific Ocean. Researchers on this project also investigate bottomfish, coral reef fishes, 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.

Progress during FY 2014

JIMAR researchers within the PIFSC Stock Assessment Program completed several tasks with pelagic and insular fishes in FY 2014. Progress for the two types of fishes is described separately below.

Pelagic fishes. A benchmark stock assessment for the highly migratory Pacific blue marlin (*Makaira nigricans*) was completed under the auspices of the ISC (Lee et al., 2014c). This assessment was favorably reviewed by three scientists from the Center for Independent Experts (CIE) in March 2014. Catches of blue marlin in the 1950s were almost exclusively from Japanese longline fleets operating in the western Pacific and in subsequent decades, the fleets expanded operations into both hemispheres and across the tropical and subtropical Pacific Ocean. By the 1980s, fleets from Taiwan and many other nations were reporting increasing catches. By the 1990s, annual catch peaked at 25,000 tons, and catch over the last decade has varied between 15,000 and 25,000 tons (Figure 1). Fishery-specific catch, size composition sampling from the catch, and catch-per-unit of effort were used in the modeling of population dynamics of the Pacific blue marlin in the Pacific Ocean as likelihood components. Sex-specific growth curves and natural mortality were used because of the known sexual dimorphism of adult blue marlin. Estimated dynamics were consistent with a stock that is fully exploited and stable over the last several years. The Kobe plots indicate that the Pacific blue marlin stock is currently not overfished and is not subject to overfishing relative to MSY-based reference points.

An updated stock assessment for the highly migratory North Pacific swordfish (*Xiphias gladius*) stock in the western central North Pacific Ocean was completed (Chang et al., 2014). JIMAR staff also assisted with the completion of an assessment for the North Pacific swordfish stock in the eastern Pacific Ocean (Yau et al., 2014). The results, conclusions, and conservation information recommended by the Billfish Working Group (BILLWG) will require endorsement at the 14th Meeting of the ISC Plenary (ISC14) and 10th Regular Meeting of the Scientific Committee for the Western and Central Pacific Fisheries Commission.

During FY 2014 JIMAR staff helped coordinate and/or participated in the ISC13 Plenary meeting, one ISC BILLWG workshop, two ISC Shark Working Group workshops, 5th International Billfish Symposium, the JIMAR/PIFSC Symposium, the World Conference on Stock Assessment Methods for Sustainable Fisheries (WCSAM), and the PIFSC Program Review of Fisheries Stock Assessments. ISC Shark Working Group and Billfish Working Group workshops were convened with significant support from JIMAR staff as lead scientists for the ISC. The goals were to complete the stock assessment and stock projection for North Pacific swordfish and to complete the North Pacific blue shark stock assessment. The JIMAR/PIFSC Symposium, 5th International Billfish Symposium, and WCSAM were convened to communicate recent research developments on stock assessment methods and fishery management approaches to local scientists and students.

Twelve publications (six peer-reviewed and six non-peer-reviewed) related to stock assessment research on Pacific tunas, blue marlin, sharks, and swordfish were published.

Insular fishes. A number of length-based mortality methods and associated computer programs were developed and applied to understand the dynamics of data-poor coral reef fish and Hawaiian bottom fish populations. A computer R package was developed to estimate total mortality from all possible time changes of length composition data under the Bayesian framework. A draft manuscript titled "Assessment of Hawaiian coral reef fish populations using a length-based methodology applied to diver survey and fishery data" and associated GUI software framework was completed, and this report streamlines the PIFSC mission to conduct data-poor stock assessments in the PIR.

A computer program for automating gear calibration analyses was developed and applied to belt transect surveys (old method) and stationary point count data (new method). This is the first reef fish dataset in the PIR to be standardized. A draft manuscript titled "An approach to the standardization of high diversity population abundance datasets" is currently under review.

Additional reef fish work includes the development of probability distributions of life history parameters using Monte Carlo simulations techniques to advance stock assessment modeling of data-poor reef fish species.

JIMAR staff coordinated and participated in a training workshop on length-based mortality estimation for members of the Western Pacific Regional Fishery Management Council (WPRFMC) Hawaii, American Samoa, Guam, and the Northern Marianas Plan Teams. Team members applied the mortality estimators to their own datasets to estimate current fishing mortality rates, and about 20 species were analyzed in the three-day training

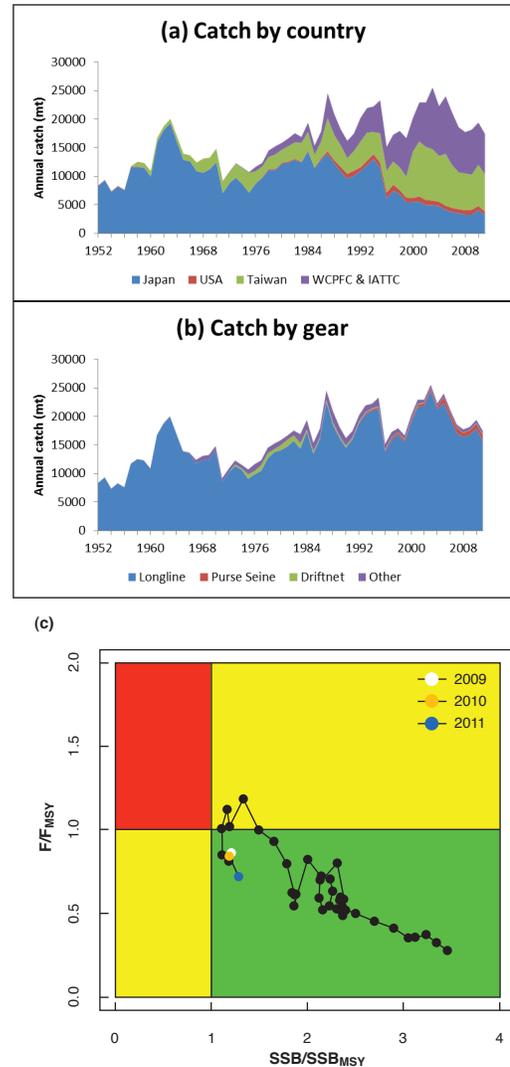


Figure 1. Panels a and b depict annual landings by country and by gear type, respectively, reported by ISC member countries from 1952 through 2010. The Other category in Panel b refers to miscellaneous gears including bait, net, trap, coastal fisheries catch. Panel c is a Kobe plot depicting the relationship between relative fishing mortality and relative spawning biomass from 1971 through 2011.

session. JIMAR also presented current work related to reef fish assessment at the PIFSC Program Review on Stock Assessment Process.

The pilot PIR bottomfish fishery-independent survey transitioned to operational in the Maui-Nui area, and JIMAR staff participated in the at-sea cruises and processing of the data. The survey is a joint cooperative effort between scientists (JIMAR, NOAA and universities) and local fishers to develop a survey to provide estimates of abundance to advance bottomfish stock assessments in the PIR. Surveys include research fishing and a suite of camera system.

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 (CNMI). 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 2014

The CRP JIMAR Project Lead completed a Spring (April 8-28) and Summer (May 12-

Figure 1. Pantropical spotted dolphin with Rota in the background.

June 21) small boat survey effort within the waters surrounding Guam, Saipan, Tinian, and Rota for the photo-identification, biopsy sampling, and satellite tagging of cetaceans. JIMAR staff continued the development of 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 (2010-2014). Genetic analyses of biopsy samples collected 2010-2013 were conducted for these three species and the results will be published in a Tech memo during the summer of 2014.



Figure 2. Adult male Blainville's beaked whale photographed off Rota.

The CRP longline High-frequency Acoustic Recording Package (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. The first fishing charter was completed in July

2013 and consisted of three trips and 43 sets on which five acoustic recorders were deployed. The second fishing charter commenced in November 2013 and was completed in March 2014, also consisting of three trips and a total of 47 acoustically monitored sets. Acoustic data obtained during all chartered trips were analyzed for cetacean presence and classified to the species level when possible.

In addition, the next phase of the project that involves deploying single HARP instruments on vessels across the entire fleet through collaboration with the PIRO Observer Program began in April 2014. To date, six longline vessels have agreed to participate and will take acoustic recorders with them when they are assigned an observer.

The CRP continues to maintain HARPs for long-term continuous recording of cetacean occurrence off the Kona coast of the Island of Hawai'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 Northwestern Hawaiian Islands Research Seasonal Support

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), in collaboration with the NOAA PIFSC Protected Species Division, conducts studies on the Hawaiian monk seal (*Monachus schauinslandi*), the most endangered marine mammal occurring entirely within U.S. jurisdiction. The Northwestern Hawaiian Islands Research Seasonal Support project implements population assessment, health and disease, survival enhancement, foraging, and behavioral research as well as standard enhancement activities on Hawaiian monk seals primarily in the Northwestern Hawaiian Islands (NWHI) to augment year-round program activities in the main Hawaiian Islands (MHI). Field camps are deployed on a seasonal basis to the NWHI to conduct monk seal research.

During deployment, field staff and volunteers collect data and conduct recovery activities at up to six main breeding sites and opportunistically at Necker and Nihoa. Field research activities include visual and photographic monitoring, tagging, pelage bleach marking, health screening, foraging studies, de-worming research, translocation, and other recovery actions. These actions may include hazing or removal of aggressive males and mitigation and deterrence of shark predation, necropsies, specimen collection, behavioral modification, vaccination research, disentangling, abscess treatment, marine debris removal, vaccination, and supplemental feeding of post-release rehabilitated seals.

Progress during FY 2014

During FY 2014, five Biological Research Technicians were hired to lead the research camps at French Frigate Shoals (FFS), Laysan, Lisianski, Pearl and Hermes Reef, and Kure Atoll for the 2014 field season. In addition, four Biological Research Assistants and six volunteers, including one alternate, were recruited and hired to assist field camp leaders. Training for JIMAR staff began on May 27, 2014 and included data collection techniques, Wilderness First Aid, animal handling and abscess treatment, and specimen collection and necropsy techniques. Field personnel participated in securing food stores and quarantine clothing, testing boats, communication systems, and other equipment. Staff also packed equipment and supplies and loaded the NOAA Ship *Hì ialakai*. On June 16, 2014 three field staff and one volunteer departed on the ship for deployment to FFS. The remaining ten field staff and volunteers departed for field deployment on June 24, 2014. During the deployment cruise, JIMAR field staff and volunteers participated in the translocation and monitoring of a juvenile female monk seal that was captured in the MHI for translocation to Laysan Island in order to mitigate behavioral problems associated with human interactions in the MHI. During the project period, field camps at FFS, Laysan, Lisianski, and Pearl and Hermes Reef were established and HMSRP staff successfully began operations. A field camp at Kure Atoll will be established and begin operating outside of the FY 2014 annual reporting period. Activities undertaken by the JIMAR HMSRP during the reporting period involved: 1) collecting survey and life history data and specimens; 2) tagging and marking seals for long-term identification; 3) documenting and mitigating mortality caused by males exhibiting aggressive behaviors towards other seals; 4) shark predation monitoring and mitigation to prevent monk seal pup mortality; and 5) fishing for predatory Galapagos sharks in nearshore areas of pupping sites at FFS.

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 1,100-1,200 individuals 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, individual health, and environmental and oceanographic parameters in the North Pacific. The program develops, tests, and implements tools to assist in recovering the species.

Progress during FY 2014

Activities undertaken by the JIMAR HMSRP included population monitoring and assessment, survival enhancement, foraging ecology characterization, health and disease evaluation, and behavioral research. The



Figure 1. Darren Roberts surveys Hawaiian Monk Seals at the saddle on Mokumanamana. Photo by Mark Sullivan, photos taken under Marine Mammal Research Permit # 6163-01.

majority of field camp personnel were deployed to the Northwestern Hawaiian Islands 2013 field season from July 3 to September 30, 2013. Shorter camps were also established at Lisianski Island from July 3 to July 16, 2013 and September 16 to 22, 2013. In preparation for the camps, JIMAR staff reviewed and revised protocols, trained field personnel in data and specimen collection techniques, and provided logistical support. A short camp was also established at French Frigate Shoals in May 2014. While deployed, 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) including participating in one of the first collaborative monk seal surveys of Ni‘ihau, yielding the highest single day count for an individual island in the MHI. JIMAR personnel also responded to and coordinated monk seal stranding responses in the MHI.

Response events included the mitigation of a seal exhibiting behavioral problems involving human interactions in October 2013 resulting in the translocation of the seal from Kona to Ni‘ihau; JIMAR personnel were essential to the success of this response and translocation event. Staff also participated in necropsies and rehabilitation efforts, including the capture, veterinary care, and husbandry of debilitated seals.

The foraging ecology program continued analysis of MHI seal scat for dietary studies. The program also deployed telemetry equipment, including seal-mounted cameras (a.k.a. Crittercams) to record high-definition video of HMS foraging behavior. During the 2013 field season, JIMAR staff also set up and deployed a new remote camera system designed to expand and enhance monk seal population assessment efforts on Nihoa. Data



Figure 2. Jessie Lopez bleach marks multiple seals without any disturbance on Nihoa. Bleach marks help scientists identify individual seals from a distance. Photo by Mark Sullivan, taken under Marine Mammal Research Permit # 6163-01.S

Figure 3. Mark Sullivan surveys the beach at Nihoa from a distance before approaching. Photo by Jessie Lopez, and taken under Marine Mammal Research Permit # 6163-01.





(left) Figure 4. Loading supplies during the French Frigate Shoals deployment. Photo by Brenda Becker.



(right) Figure 5. Well-known monk seals Kerby and Kaena snooze at the entrance of a pool on Kaena Point, Oahu in July 2014. Photo by Mark Sullivan.

from the camera were retrieved during the 2014 field season deployment cruise.

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. JIMAR personnel collaborated with outside researchers to assess risks posed by *Toxoplasma gondii* to monk seals. 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 conducted ongoing maintenance of 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 14 weaned pups from areas of higher to lower predation risk within the atoll, and 6 pups were translocated from FFS to Laysan. Field staff at Laysan, Lisianski, and Kure Atoll applied a topical anthelmintic to young seals. A JIMAR staff member was the lead author on a manuscript on MHI seal biocontaminant loads incorporating spatial distribution data, and a staff member coauthored manuscripts on body growth and movements in monk seals. Staff also improved upon 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 also participated in outreach activities and in relocating all program personnel, equipment, supplies, specimens, and data to the new Inouye Regional Center. In June 2014, JIMAR staff members participated in a two day NOAA Fisheries Science Camp to introduce students to scientific research (e.g., scat analysis and Crittercam projects) providing hands on opportunities to 8th grade students to learn about projects the program undertakes to understand monk seal foraging ecology.

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 by-catch 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 2014

JIMAR staff manages a Pacific-wide satellite-tracking database, prepare maps, analyze satellite-tracking data, and provide data for publication in peer-reviewed journals. Data have been managed and maps were produced for 39 turtles from six projects throughout the Pacific during FY 2014.

JIMAR, along with PIFSC staff and members of the public, were responsible for the rescue, rehabilitation, and release of 45 stranded sea turtles. Five of these turtles required extended rehabilitation—two at the NMFS Kewalo Research Facility, and three in the new Inouye Regional Center (IRC) life support rehabilitation tanks following MTRP's move to the new facility in March 2014. Four of these turtles suffered fishing line entanglement, three of which required surgical amputation of a front flipper. The fifth turtle suffered a boat strike, needing subsequent surgery to repair its skull and front flipper. Daily care of these five turtles involved feeding, cleaning tanks, administering medications, assisting the veterinarian and conducting external visual exams.

JIMAR and PIFSC staff was responsible for conducting 79 necropsies on stranded marine turtles during FY 2014. Salvaged carcasses were examined externally 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 staff, along with PIFSC researchers, conducted two longline observer-training sessions in FY 2014 (July 18, 2013 and May 1, 2014). JIMAR staff led the hands-on training, demonstrating the proper techniques for tagging turtles, taking measurements, and collecting a skin biopsy for genetic analysis.

JIMAR participated in field captures of juvenile and subadult green turtles on July 8-9, 2013 at the Kawainui study site in Kailua Bay, Oahu, and on January 14, 2014 at Hanauma Bay, Oahu. JIMAR staff also participated in field captures at Hanauma Bay on September 10, 2013. Juvenile green turtles were captured by hand/snorkel or by scoop net and then tagged, measured, weighed, examined and released.

Due to the damage a microburst storm caused to the camp on Tern Island in the French Frigate Shoals, a 41st season of nesting data collection was not possible. Instead, JIMAR MTRP staff participated in a 19-day cruise aboard the NOAA ship Oscar Elton Sette, performing a sea turtle nesting survey of the NWHI from July 3-21, 2013. The resulting 57-page report can be used as a point of reference for future surveys if conditions again do not allow for the normal systematic nighttime collection of nesting data on East Island in the FFS, a major nesting site for Hawaiian green turtles.

JIMAR staff continues to make progress updating and validating records within the Oracle Turtle Data Processing System (OTDPS). During FY 2014, JIMAR updated 141,986 fields within the "Stranding," "Nearshore," and



Figure 1. On December 20, 2013, JIMAR TRP Marine Turtle Research Associate Devon Francke assisted TRP and other NOAA staff in the release of 6 captive-bred Sea Life Park juvenile green turtles approximately 12 miles S-SE of Pearl Harbor, Oahu. Three turtles were equipped with satellite tags to track their movements.

Figure 2. JIMAR TRP Marine Turtle Research Associate Devon Francke (right) and JIMAR TRP Marine Turtle Biological Stranding Associate Sarah Alessi (left), prepping the first sea turtle rehabilitated in the life support tanks at DKIRC for release on April 1, 2014. The turtle stranded in Haleiwa, Oahu, on March 23, 2014 entangled in monofilament fishing line, and received 8 days of treatments for an injured flipper and eye.



“Nesting” databases of OTDPS, and updated and verified hundreds of full records within the “Nesting” database from nesting seasons 1996-1997. Additionally, JIMAR participated with PIFSC staff in the preliminary stages of initializing an updated, more streamlined version of OTDPS.

JIMAR staff provided input and support to researchers from Scripps, University of Hawaii, and Deakin University, Australia on three projects that are analyzing different aspects of the pelagic ecology, movement, and habitat use of pelagic loggerheads in the North and South Pacific.

JIMAR staff co-authored a NOAA Technical Memorandum entitled “40 years of research: Recovery records of green turtles observed or originally tagged at French Frigate Shoals in the Northwestern Hawaiian Islands, 1973-2013”. This report updates a Technical Report written 30 years prior, and encompasses 5,806 recovery records.

The project carefully assembled and catalogued the PIFSC MTRP’s voluminous and bulky historical collection of dried sea turtle skeletal specimens, dating back to 1979. The collection was transferred to the Bernice P. Bishop Museum in Honolulu for archiving and open-access scientific use by future generations of global scientists. The collection includes bone material derived from 59 green turtles, 21 hawksbills, 17 olive ridleys, 6 loggerheads and 2 leatherbacks.

JIMAR staff created an electronic database documenting the contents of every nest the PIFSC Marine Turtle Program has examined since 1996. The samples within the database include eggshells, unhatched eggs, and dead hatchlings sent by program partners and collaborators. Additionally, project staff worked to digitize hard-copy records of nests in the MHI and merged and reformatted the records of DNA samples sent to the Southwest Fisheries Science Center (SWFSC) into a single more user-friendly file.

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 2014

The objectives established for this period included sea turtle conservation, management, and fisheries related mitigation activities within PRECI. The JIMAR Protected Resources Division (PRD) International Turtle Conservation and Management Liaison participated in the 34th Annual Symposium on Sea Turtle Biology and Conservation, attended the Pacific Islands Regional Meeting and had constructive meetings regarding strengthening partnerships on marine turtle research and conservation with stakeholders from Guam and Fiji. Continuing as liaison between international marine turtle conservation project principal investigators and PIRO, project staff served as technical monitor for international marine turtle projects in Federated States of Micronesia (FSM), Cook Islands, Solomon Islands and French Polynesia in addition to territorial projects in Guam, the Commonwealth of the Northern Marianas Islands (CNMI) and American Samoa. On-site technical advisement was provided to American Samoa’s Department of Marine and Wildlife Resources for their marine turtle nesting beach monitoring and education project on Ofu Island. Technical support continued for a marine turtle genetic sampling project in collaboration with NOAA Southwest Fisheries Science Center (SWFSC) scientists to characterize western Pacific green turtle nesting stocks. To advance this research, staff assisted governments of Guam, American Samoa, FSM and CNMI with sample organization and Convention on International Trade of Endangered Species (CITES)

compliance. The JIMAR Project Lead also reviewed datasets from several regional partners before the samples were shipped to and incorporated in the SWFSC archive. The Project Lead also contributed to a draft publication on green turtle stock structure in the western and central Pacific Ocean. In addition, feedback was provided for National Environmental Policy Act documents required to continue collaborative, NOAA funded marine turtle research and management projects in the western and central Pacific Ocean. Project staff assisted the NOAA Monk Seal Program by providing phone support for the monk seal sightings hotline, engaging with the public and providing feedback to citizens on individual seal status.

During FY 2014, the JIMAR PRD Sea Turtle Biologist served as technical monitor for two grant funded projects including Hawaii Island hawksbill monitoring and Maui hawksbill monitoring. In addition, JIMAR staff worked to complete PRD's response to a petition to list eight species of Pomacentrid reef fish under the ESA. JIMAR staff has also been involved in the analysis of information received in response to the proposed listing of 66 coral species and the development of the final listing rule.

JIMAR staff completed numerous mapping projects using GIS software to develop products including: 1) false killer whale bycatch locations; 2) locations of other cetacean and sea turtle interactions in fisheries; 3) Hawaiian monk seal critical habitat designation; and 4) various maps depicting action areas and the extent of acoustic impacts on protected species and habitats for ESA Section 7 consultations.

Project staff also participated in the review of project progress reports and informal Section 7 consultations. JIMAR led the analysis of permitted research activities within the Papahānaumokuākea Marine National Monument and of potential impacts on sea turtles, monk seals, and cetaceans via ESA Section 7 consultations.

JIMAR continued to maintain a 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.

As the Climate Change Point of Contact for all of PIRO, PRECI JIMAR staff continued 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 represented PIRO by serving on two steering committees and one working group for regional climate change organizations.

Sea Turtle Bycatch and 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 work 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.

Progress during FY 2014

Experiments aimed at reducing the bycatch of turtles in coastal gillnet fisheries using long wavelength orange lights to illuminate nets were initiated. Initial results indicate that illuminated nets decreased green sea turtle capture rates. When tested in commercial gillnet fisheries based in Bahia de los Angeles, Baja California Norte,



Figure 1. Working with WWF-Indonesia, IMMAF, and Bogor University, JIMAR researchers initiated bycatch reduction experiments in Borneo aimed at reducing sea turtle interactions with small scale gillnet fisheries.

the results indicated that there were no effects on the overall target catch rates or overall catch value. Further trials in FY 2014–2015 will provide additional sample size. In addition, a pilot study examining potential auditory deterrents were initiated.

Experiments in a small scale gillnet fisheries based in Peru showed that green LED illuminated nets reduce green sea turtle bycatch by 65%. A total of 114 trials were completed in Peruvian fisheries. Results indicate that there was no change in target catch rates. In addition, bird bycatch and sea horse bycatch were also reduced in illuminated nets. Sea turtle bycatch experiments were also initiated in Indonesian and Chilean gillnet fisheries. Finally, poundnet escape trials were also conducted in Kobe, Japan that yielded 4 Pound-net Escape Device (PED) designs. These PED designs will be tested in field experiments in to be conducted in FY 2014-2015.

Research work to understand the energetic and habitat use of pelagic sea turtles included the analysis of sea nettles (*C. fuscescens*), purple stripe (*C. colorata*), egg-yolk (*Phacellophora camtshatica*), and moon jellies (*Aurelia sp.*) from the leatherback conservation area in central California to determine their energy density via bomb calorimetry analysis and trophic status using Compound Specific Nitrogen Stable Isotope Analysis of Amino Acids (CSIA-AA). The energy density was highest for *C. fuscescens* and lowest for *Aurelia sp.* 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. These results provide a better understanding of leatherback biology, energetics, and trophic status, and further strengthen 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) that 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.

Characterization and Dynamics of Mesoscale and Submesoscale Oceanic Variability in the Solomon Sea Simulated by a Nested ROMS Model

P.I.: Mark A. Merrifield

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

NOAA Sponsor: Christopher Sabine [William S. Kessler]

NOAA Goal(s)

- Climate Adaptation and Mitigation

Purpose of the Project

High sea level variability is a prominent feature of the southwest tropical Pacific Ocean where interactions between western boundary currents, equatorial currents and mesoscale processes have the potential to influence the properties of waters upwelled at the equator. While the implications of changing ocean conditions in the equatorial Pacific for ENSO and longer timescale climate variability have long been recognized, the dynamics and origin of enhanced variability in the southwest Pacific are largely unknown. The purpose of this project is to study eddy variability in the Solomon Sea western boundary current system with focus on the meso/submesoscale range (10-200 km) using a high-resolution numerical ocean model supplemented by satellite and in-situ (glider, Argo) data. The project's main objectives are: 1) to characterize the spatial and temporal scales, subsurface structure and evolution of the meso/submesoscale eddies in low latitudes; 2) to diagnose the dynamics of the eddies, including their generation mechanisms and seasonal modulation; and 3) to assess the interactions between the submesoscale, mesoscale and large-scale circulation. The results will inform the physical interpretation of satellite sea surface height observations of these eddies by clarifying their subsurface structures and generation processes.

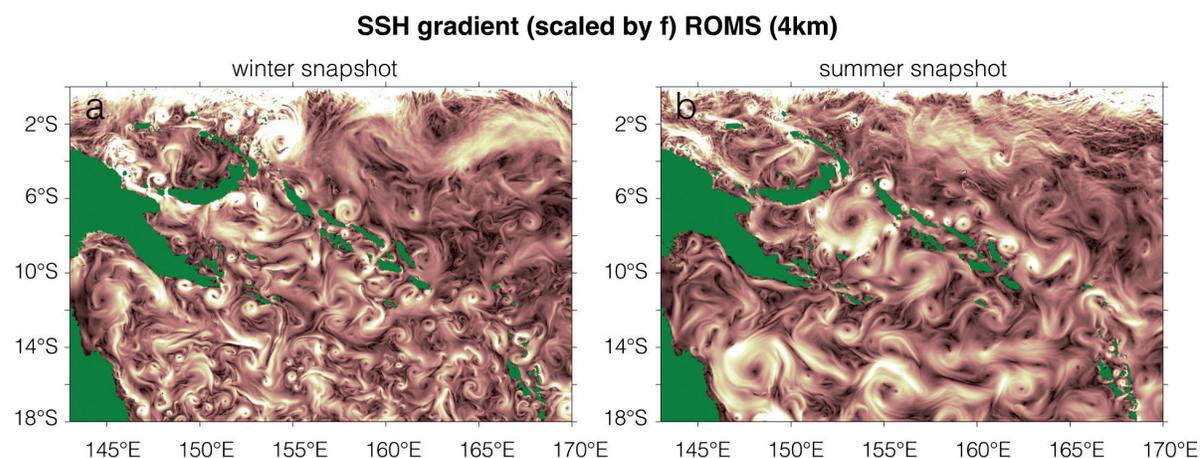


Figure 1. Snapshot of sea surface height (SSH) gradient scaled by the Coriolis frequency f showing the small-scale variability in the southwest Pacific generated in the 4 km model simulation during a) August (austral winter), and b) February (austral summer). Larger number of small eddies and filaments are present during wintertime.

Progress during FY 2014

During Year 1 of the project, focus was put on developing statistical techniques to effectively characterize the spatial and temporal scales of variability of the Solomon Sea western boundary current system. The main Year 1 objectives were to evaluate the differences between surface and deep variability, between western boundary current and interior and to determine the processes that control the seasonal changes in mesoscale eddy activity. These objectives were largely met.

Project researchers used a combination of eddy kinetic energy (EKE) diagnostics, energetics and statistics of coherent structures applied to the output of a high-resolution (4 km) climatologically-forced ocean model validated by altimetry and glider data, to characterize the vertical and seasonal variations of mesoscale variability in the Solomon and Coral Seas. Researchers found that surface EKE is generally enhanced in the southwest Pacific with a pronounced annual cycle that has a phase difference between large-scale and small-scale variability. Small mesoscale eddies, predominantly cyclonic, are abundant in late winter (August to September), coinciding with the timing of deepest mixed layer and strongest vertical velocity. The highest EKE in the southwest Pacific is found subsurface in the Gulf of Papua, at the depth of the low-latitude western boundary current velocity core. Variability associated with the western boundary current, especially downstream of topographic obstacles, dominates the thermocline and intermediate level EKE. The results from this work were submitted (and accepted) as a manuscript to the *Journal of Geophysical Research* in a Special Issue on Western Pacific Ocean Circulation and Climate.

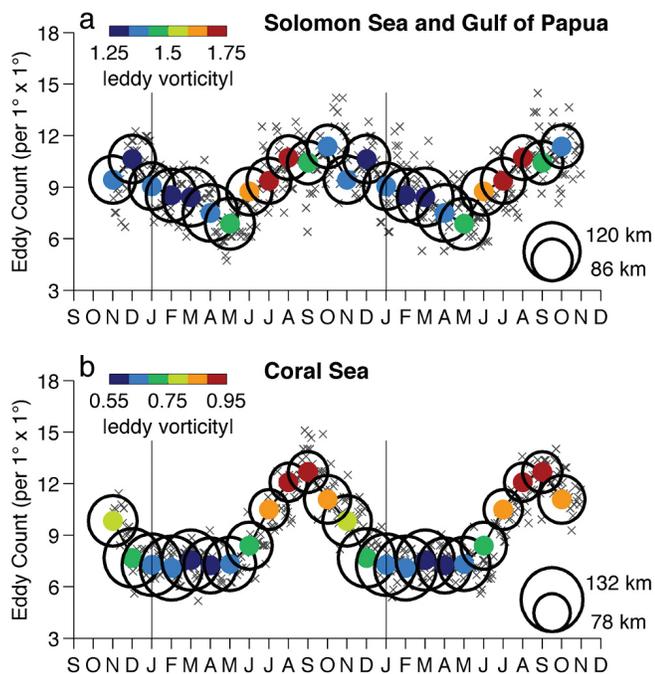


Figure 2. Monthly climatology of detected eddy count, size and vorticity at 50 m, spatially-averaged for (a) the Solomon Sea region, and (b) the Coral Sea. For each region, the eddy count is given as a number of eddies per month and per square degree of ocean. The average eddy scale per month is indicated by the size of the circle, with the minimum and maximum scale shown in the legend. The color dots indicate the average eddy vorticity for the month (combined for cyclones and anticyclones). The grey crosses are the instantaneous model data (every 2 days). For both regions, there is a shift from a large number of small and intense eddies from July to October, to fewer but large and weak eddies from December to May.

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) project is to ensure that tide gauge data from around the world are collected, quality assessed, distributed, and archived for use in climate, oceanographic, ocean engineering, and geophysical research. While UHSLC assembles time series from a large number of tide gauge stations, the project's primary focus is the set of stations that constitute the Global Sea Level Observing

System (GLOSS) and the Global Climate Observing System (GCOS). The GLOSS and GCOS networks cover most major oceanic islands and island chains, with a subset of available continental coastal stations distributed evenly around the margins of ocean basins. Because of their importance for global and regional sea level reconstructions, vertical land motion monitoring is recommended at all GLOSS and GCOS stations and the UHSLC maintains 11 continuous Global Positioning System (GPS) receivers at these stations. A primary objective of the UHSLC is to maintain two tide gauge datasets: the Fast Delivery dataset, which provides preliminary, quality-assured, hourly tide gauge data within 4-6 weeks of collection, and the Research Quality dataset, which is an archive of hourly tide gauge data that have undergone a complete quality assessment generally within 1 year of collection. The Research Quality database is maintained in collaboration with the National Oceanographic Data Center. The UHSLC acquires tide gauge data from nearly 500 tide gauge stations maintained by 65 international agencies. UHSLC technicians and data analysts collaborate directly with international partners to maintain 80 high profile stations that are important for the global sea level observing effort. UHSLC involvement ensures that research quality datasets are available from otherwise sparsely sampled areas of the global ocean, and that developing nations have access to training, technical support, and data processing services as needed.

Progress during FY 2014

During FY 2014 the project met all its objectives for data management as the core function of each database was maintained and both databases were expanded to take on new station installations as they became available. Station operation objectives during FY 2014 were largely met, as project staff was able to visit and service the required number of stations, with additional support provided by remotely supervised repairs by UHSLC technicians in consultation with onsite technical counterparts. Due to permitting issues, the project was unable to install a GPS station at a UHSLC tide gauge as planned, but expects to remedy this situation early in FY 2015 with an installation likely at Yap or Christmas Island.

Two projects recently completed will serve as the foundation for UHSLC research in the coming year. The first was an in depth study of the relationship between wind-forcing and decadal variability in coastal sea level along the west coast of North America. The second study employed a novel method to define basin-scale regions suitable for historical analyses of spatial variation in decadal rates of sea level change. UHSLC is currently working to combine these results with the suite of Coupled Model Intercomparison Project (CMIP5) simulations to produce near-term (10-20 years) projections of sea level change in the East Pacific based on the historical relationships between atmospheric and coastal sea level variability. In addition, the second study referenced above resulted in the identification of a unique pattern of sea level change in tropical and southern latitudes associated with increased subsurface warming in the Indian-South Pacific region (Figure 1). In coming months, UHSLC will begin work to investigate the dynamical origin of this subsurface warming in both observations and ocean models. Finally, the project will leverage sea surface height fields from the suite of CMIP5 models to understand the frequency domain relationship between rates of global mean sea level (GMSL) change estimated from satellites and tide gauges. This work will have implications for the uniqueness of the current rate of GMSL rise in the historical record.

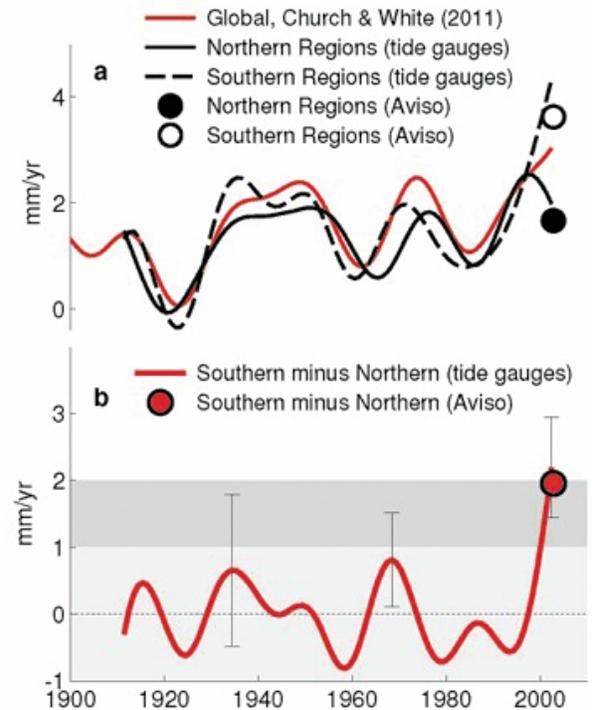


Figure 1. (a) Twenty-year rates of change in mean sea level over northern and southern regions from tide gauges and satellites (Aviso) with a reconstruction of global mean sea level. (b) The difference between mean rates over northern and southern regions from tide gauges and satellites. Uncertainties (1σ) are shown for the three largest differences in rate.

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 Niño 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 Climatic 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 2014

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. 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 makes sure 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 cooperation 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 (both hardware and software) by attending meetings and workshops and through dialogue with other groups to provide future direction and

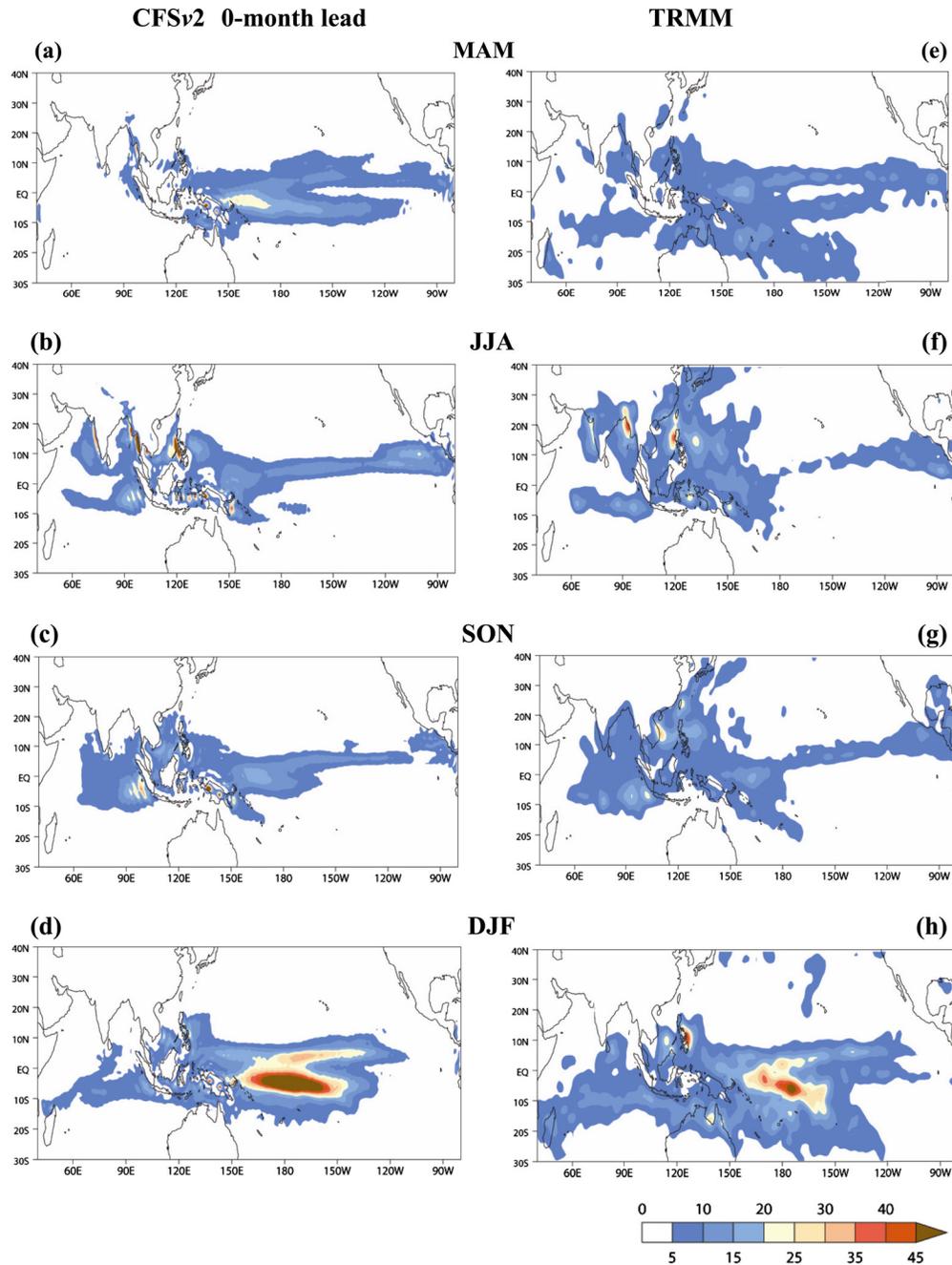


Figure 1. Seasonal precipitation variance ($\text{mm}^2 \text{day}^{-2}$) estimated from (left) CFSv2 L0 hindcast and (right) observations. [Annamalai et al., 2014].

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 model output from coupled model experiments as part of the CMIP-5 collection. Daily downloads of various operational models continue.

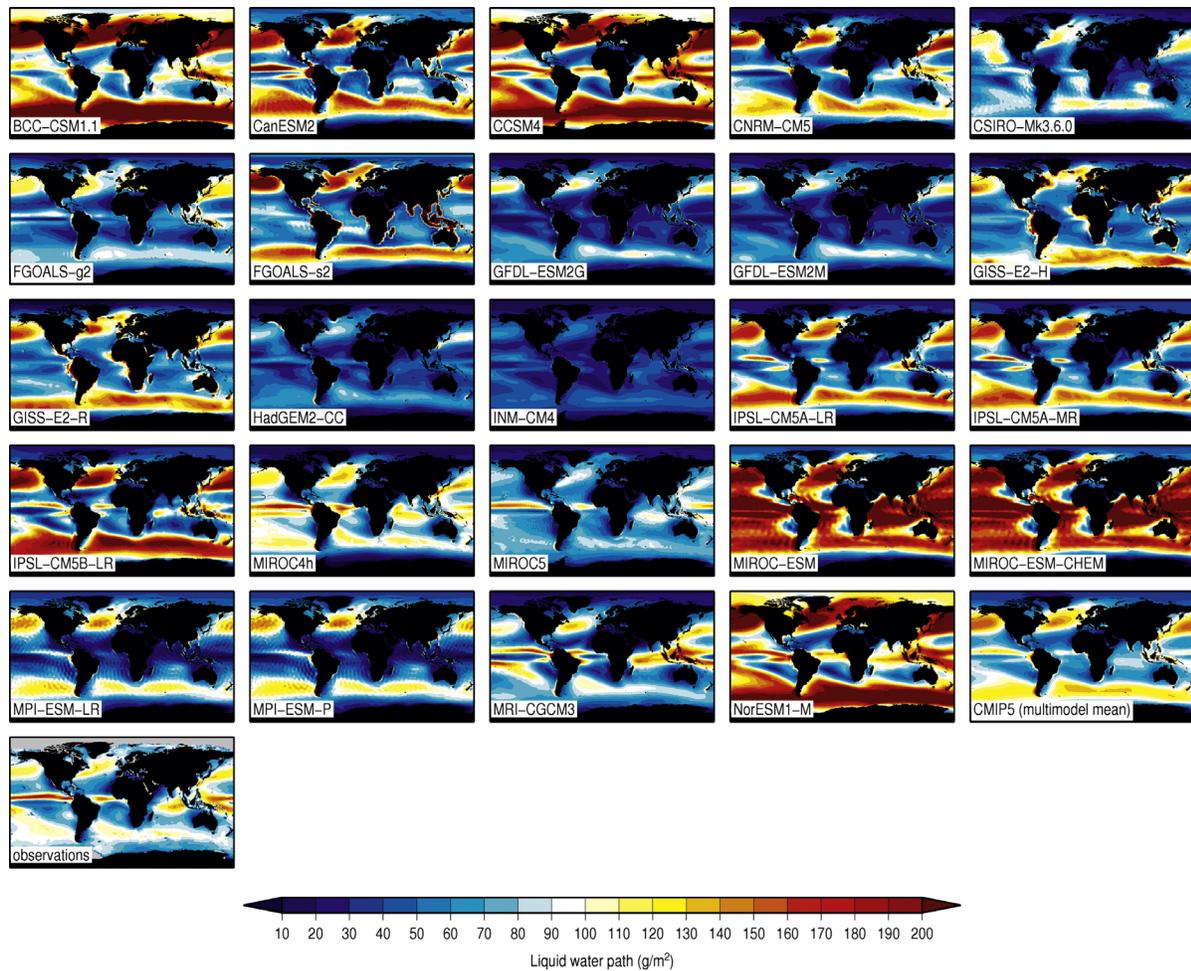


Figure 2. The 20-yr average LWP (1986–2005) from the CMIP5 historical model runs and the multimodel mean in comparison with the UWisc satellite climatology (1988–2007) based on SSM/I, TMI, and AMSR-E. [Lauer and Hamilton, 2013].

The APDRC has also been actively storing and providing access to a regional coupled model of the Hawaiian Islands. In all, the APDRC has archived about 300 TB of data (a 30% increase from last year): approximately one third of this CMIP-5 output (95 TB); one third is output from the Center for Earth Information Science and Technology (CEIST; includes AFES/OFES/CFES output from the Earth Simulator); and one third all other data sets. Other notable additions to the APDRC data library include output from the NOAA Geophysical Fluid Dynamics Laboratory (GFDL) ocean model, Hadley Centre EN4 sub surface analyses, and output from the Data Assimilation system of the Korean Institute of Ocean Science and Technology (KIOST).

The APDRC CMIP5 data archive has been used in a number of research projects led by IPRC scientists, already resulting in journal publications for some of these projects. Collaborative research between IPRC and the NOAA Climate Prediction Center has resulted in experimental seasonal rainfall predictions that are being made available in an APDRC projects page (http://apdr.c.soest.hawaii.edu/projects/seasonal_prediction/)

Another focus of this past year was support for the Pacific Climate Information System (PaCIS). The APDRC took over management of all the PaCIS web pages (e.g., <http://apdr.c.soest.hawaii.edu/PaCIS/>). In addition, the APDRC developed custom “dashboard” pages for different Pacific Island regions (e.g., Guam, Vanuatu, etc.) and sectors (e.g., droughts, coral reefs, sea level, etc.).

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

Formulation of Localized Sea Level Rise/Coastal Inundation 'Extremes' Scenarios for Pacific Islands

P.I.: Mark A. Merrifield

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

NOAA Sponsor: John Marra

NOAA Goal(s)

- Climate Adaptation and Mitigation
- Resilient Coastal Communities and Economies

Purpose of the Project

This project seeks to develop best practices and methodologies that can be used to formulate probabilistic estimates of extreme sea level events under a changing climate for specific locations in the Pacific Islands. A primary objective is the development of proof-of-concept products in support of decision-making ranging from area-wide vulnerability assessment related to climate adaptation planning and disaster risk reduction to site-specific analysis related to design and maintenance of facilities and infrastructure at select Department of Defense sites. An extreme value distribution analysis is used, applied to long tide gauge records that allows for temporal variations in the location, scale, and shape parameters of the distribution function. These variations can include mean sea level rise and modes of climate variability. The time-varying parameterizations allow for the decomposition of extreme water levels into various components (e.g., tidal versus nontidal, patterns versus trends) that can be recombined for specific locations and time.

Progress during FY 2014

The extreme value analyses of tide gauge data collected in the Pacific Island region confirmed that there is considerable variation from location to location with respect to the primary contributors of extreme sea level events. For most locations, tides and seasonal variability dictate the extreme distributions. For some locations, non-tidal low frequency (climate variability) and/or high frequency (tropical or extra-tropical storm) contributions are significant. The results confirm that trends in extreme water levels tend to follow trends in mean sea level, although a few locations did exhibit minor extreme trends in addition to the mean sea level trend. Guidelines were developed on how to develop similar extreme products for new sites not considered in this study. The methodology can be extended to consider total water level variations, which include the effects of wave-driven extremes; however, for most sites only wave model hindcasts are available for extreme value analyses. This project has expanded the capacity to communicate the risks of sea level rise/coastal inundation, and more broadly the impacts of climate change and climate variability.

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: Russell Schnell [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 semi-continuous 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 2014

Activity was centered on conducting additional tests and measurements to remedy and mitigate observed mercury measurement artifacts at MLO. Prior testing at MLO provided conclusive evidence for the presence of Hg⁰-HgP measurement artifacts in the inlet glassware of the commercial system. A site visit by the P.I. in May 2014 provided an opportunity to install additional apparatus to reduce the observed artifacts by increasing the relative humidity in the sample air stream without negatively impacting other aspects of mercury species collection and measurement. Assessments of the changes to the experimental system are ongoing. Future work is planned to better characterize and optimize the measurement methodologies for mercury species measurement.



Figure 1. Nash Kobayashi coating the interior of the denuder with a potassium chloride solution. The coating is what captures the mercury compound molecules to be analyzed by the system.

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: Raymond Tanabe

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 Niño–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.

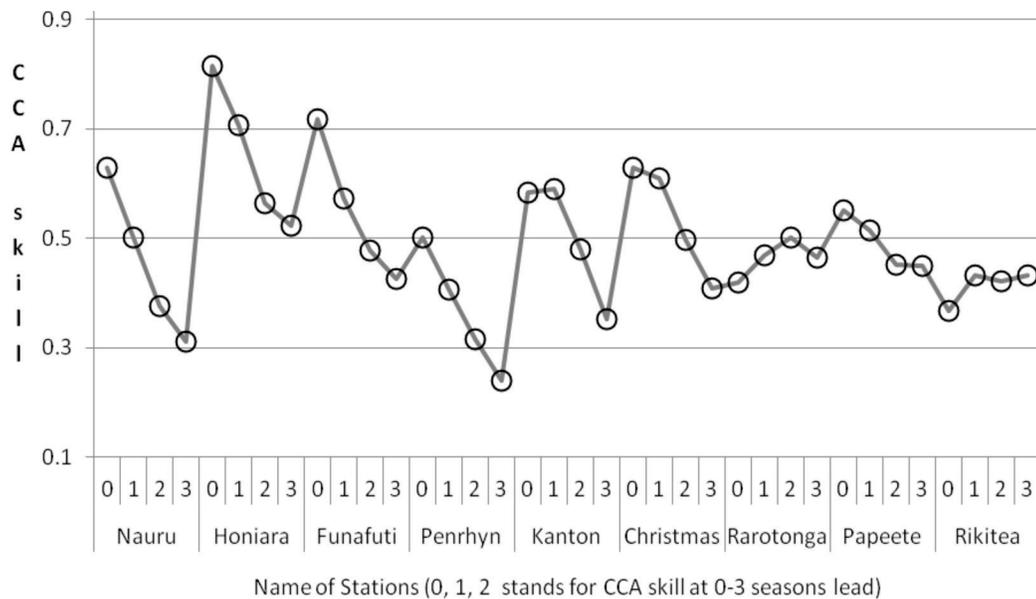
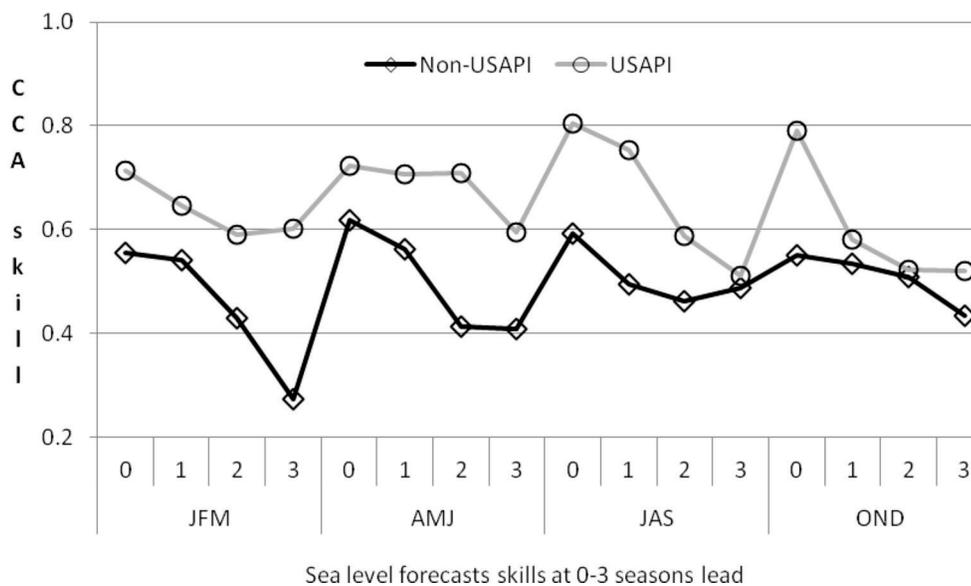


Figure 1. SST-U-based Canonical Correlations Analysis (CCA) hindcast forecasts for the non-USAPI stations (average correlation co-efficient skills at zero to three seasons-lead time). Note that any skill above of 0.3 is useful, skills higher than 0.5 is said to be good, skills higher than 0.6 is considered very good, and skill higher than 0.8 is considered excellent.

Figure 2. Comparison of SST-U-based average forecast skills for the non-USAPI and USAPI stations.



Progress during FY 2014

In order to meet the increasing demand for longer lead-time forecasts (e.g., 6-12 months), the PEAC Center, as part of the advances in operational sea level forecasts, recently incorporated both SST and trade winds (U) for modulating sea level variability on longer time scales. The combined SST and U-based forecasts are found to be more skillful on longer time-scales. This improvement has enabled the capability of PEAC clients in the USAPI region to develop a more efficient long-term response plan for hazard management.

In the Regional Integrated Water Level Service meeting (held in Honolulu on January 10-11, 2012) discussions among representatives of the U.S. National Oceanic and Atmospheric Administration (NOAA), New Zealand’s

National Institute for Water and Atmospheric Research (NIWA) and Met Service, Australia's Bureau of Meteorology (BOM), and Commonwealth Scientific and distribution Research Center (CSIRO) revealed that development and distribution of 'seasonal water level outlooks' in the entire Pacific basin region is an area of mutual interest. PEAC scientists were therefore motivated to establish an experimental framework for the development of sea level-related seasonal and annual outlooks tailored towards coastal flooding/erosion risk warning and water resources management for the non-USAPI region. The project added nine new stations (i.e., Nauru, Honiara, Funafuti, Penrhyn, Kanton, Christmas, Rarotonga, Papeete, and Rikitea) from the non-USAPI South Pacific region to the project's season-to-annual sea level forecasting scheme (Fig. 1). Project findings revealed that the overall forecast skills for the non-USAPI region are slightly weaker than the USAPI region (Fig. 2).

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 (*p*CO₂). 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 2014

The project provided partial salary support for Dan Sadler who oversees maintenance of instrumentation used for high resolution, remote measurements of atmospheric and surface ocean CO₂ partial pressure (*p*CO₂) and seawater pH. Sadler oversaw installation and testing of shipboard CO₂ systems used 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 is also responsible for maintaining, calibrating, and installing pCO₂ and pH sensors for this mooring.

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.

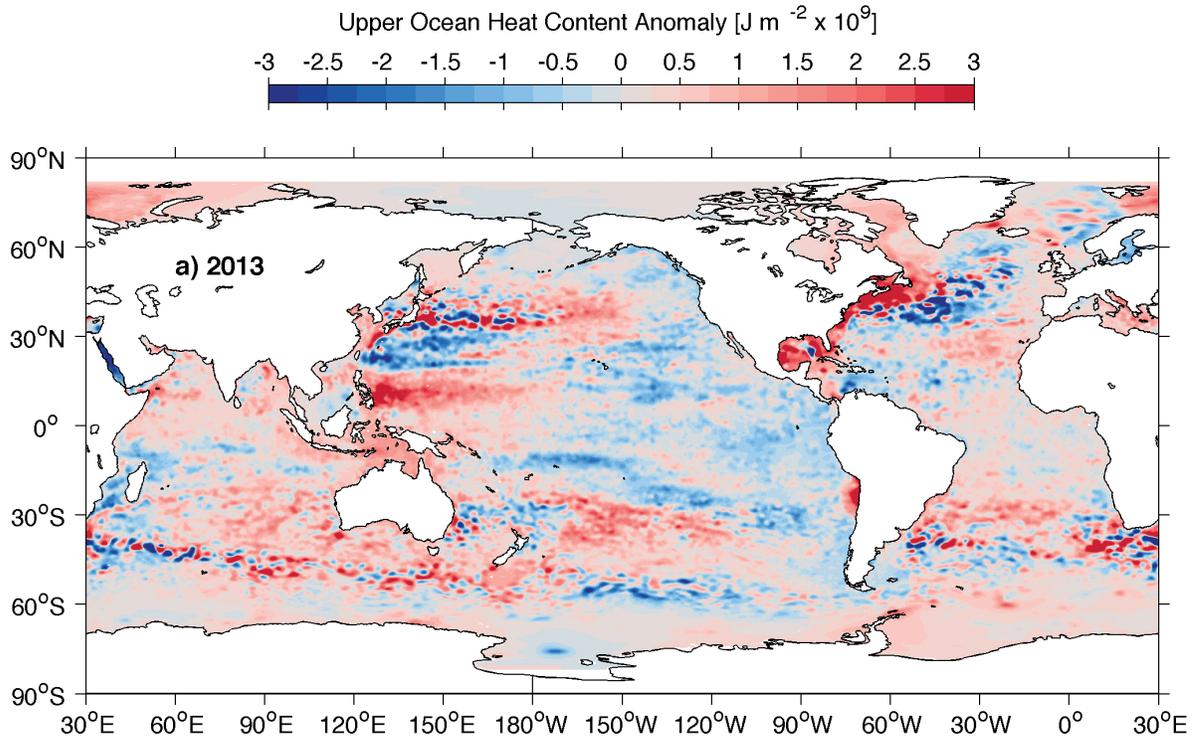


Figure 1. Upper Ocean (0–700 dbar) Ocean Heat Content Anomaly [10^9 J m^{-2}] for 2013 relative to 1993–2013 estimated using in situ (mostly from Argo in recent years) temperature data and satellite altimeter sea surface height data (in colors, with red being warm and blue cold).

Progress during FY 2014

E. Steffen and the PMEL float lab took delivery of 87 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 to accommodate the new type of float being used. 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.

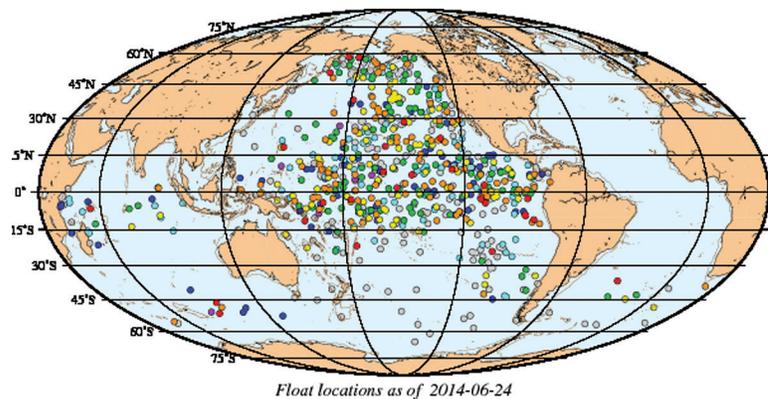


Figure 2. Locations (filled circles) of Argo floats prepared by JIMAR float research analyst E. Steffen as of 24 June 2014. Grey indicates floats that have not reported for the last 20 days or more, colors more recently reporting floats.

J. Lyman produced and analyzed (with JIMAR Senior Fellow Dr. Gregory Johnson) yearly maps of global upper ocean heat content from 1993 through 2013 (Figure 1) combining in situ thermal data and satellite altimetry data, as well as yearly maps of sea surface salinity from 2005 through 2013. 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 five journal articles (two of these are annual *State of the Climate in 2012* report sections). Stated goals were met.

Seasonal Forecasts and Extreme Event Projections for Pacific Island Sea Level

P.I.: Mark A. Merrifield

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

NOAA Sponsor: John Marra

NOAA Goal(s)

- Weather-Ready Nation
- Resilient Coastal Communities and Economies

Purpose of the Project

The Pacific ENSO Applications Climate Center (PEAC) has been preparing seasonal mean sea level forecasts for Pacific islands since 2005. The forecasts include Honolulu and Hilo as well as the US-affiliated Pacific Islands (USAPI) stations: Chuuk, Guam, Kapingamarangi, Kwajalein, Malakal, Majuro, Pago Pago, Pohnpei and Yap. The El Niño-Southern Oscillation (ENSO) climate cycle or, more specifically, the time series of tropical sea surface temperature (SST) and zonal wind fields have been generally skillful predictors for the USAPI, but not for the Hawaiian archipelago. The objective of this study is to find a better predictor for seasonal sea levels at Honolulu, Hilo and other stations in the Hawaiian Islands: Nawiliwili; Mokuoloe; Kahului; and Kawaihae.

Progress during FY 2014

PEAC operational sea level forecasts use a CCA statistical model based on 30-years of data: the leading EOFs of the USAPI tide gauge records for a given season (for example, January-February-March) are correlated with the leading EOFs of tropical Pacific SST and zonal wind from a prior season (for example, October-November-December). The predictive skill is then assessed through leave-one-out cross validation. In this study, predictors for the Hawaiian Islands were evaluated using linear regressions with the individual stations. Predictors included the leading EOFs of the PEAC data set and those of other data sets covering the Tropical Pacific, the North Pacific and the Pacific east of Hawaii; SST and zonal wind, alone and combined, and SST combined with 2-component wind stress or wind-stress curl; and climate indices such as the MEI, PDO, PNA and NPGO. None of these predictors produced improved skill or useful forecasts for Hawaii.

Another approach relied on time series of sea level to the east of Hawaii. Observation of AVISO satellite altimetry data suggests that sea surface anomalies propagate westward at approximately two degrees per month. Thus, for example, changes in sea surface height six degrees east of a Hawaii station may correlate with local sea level variability three months (or one season) hence. Forecasts for the Hawaiian Islands derived from regression on the 20-year altimetry time series have greater predictive skill than forecasts based on the various 30-year climate indicators. According to the PEAC website (prh.noaa.gov/peac/), forecasts are thought to be of useful (but still poor) skill if the mean cross-validation correlation coefficient, R , lies between 0.3 and 0.4. Skill levels greater than 0.4 and 0.6 are considered to be fair and good, respectively. Forecasts for the Hawaiian Islands based

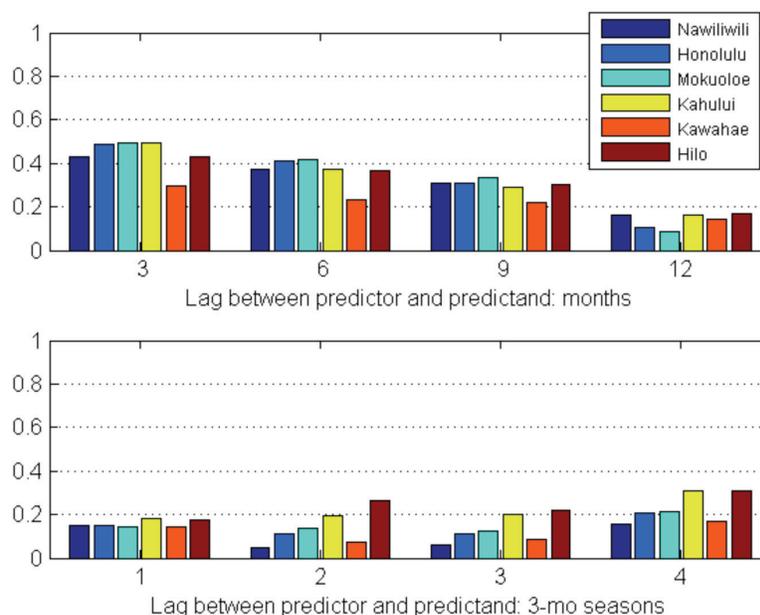


Figure 1. Comparison of the skill of monthly prediction based on AVISO altimetry (top panel) to that of seasonal prediction based on the tropical Pacific SST field (bottom panel). Skill measure is the mean cross-validation correlation coefficient R for all months (seasons) of the year. AVISO lagged regression months (3, 6, 9, 12) selected to correspond to SST lagged 3-month-averaged seasons (1,2,3,4).

on the AVISO record are fair, while those based on tropical SST, typical of all the wind-SST combinations tested, are not considered useful (see Figure 1). The sea level-AVISO regressions have been done with monthly time-series. Short-term predictions, with one to two months lead-time, have predictive skills between 0.5 and 0.6.

Tropical Meteorology

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

Improved Automation and Performance of VORTRAC Intensity Guidance (g1)

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.

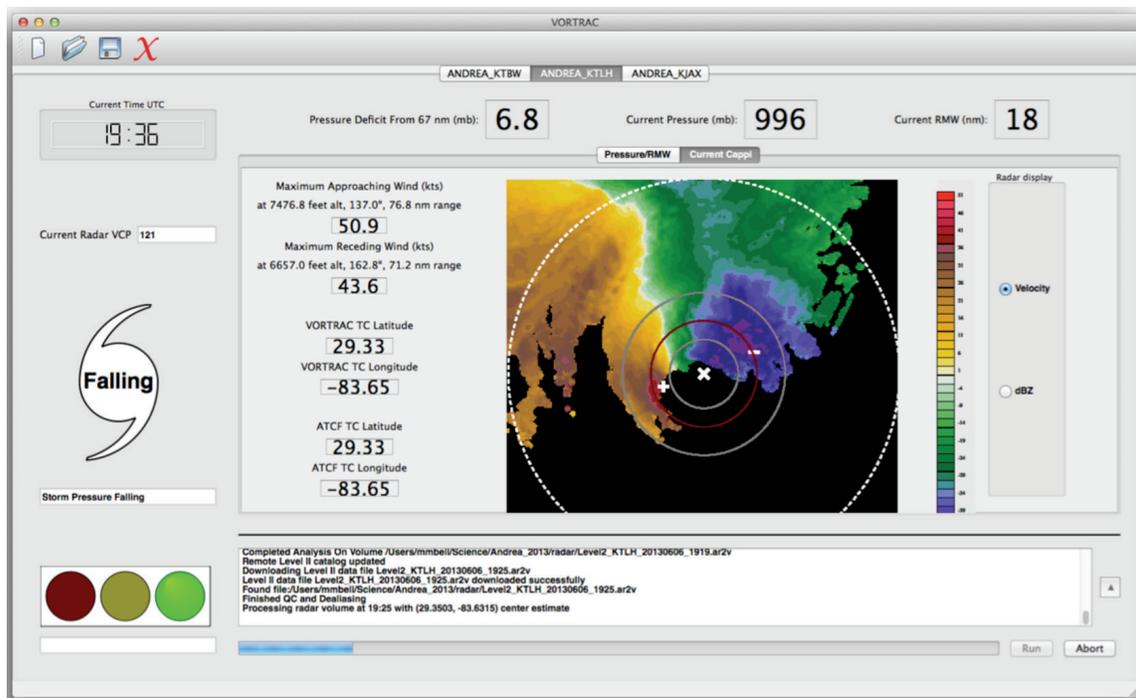


Figure 1. Screenshot from Tropical Storm Andrea (2013) landfall.

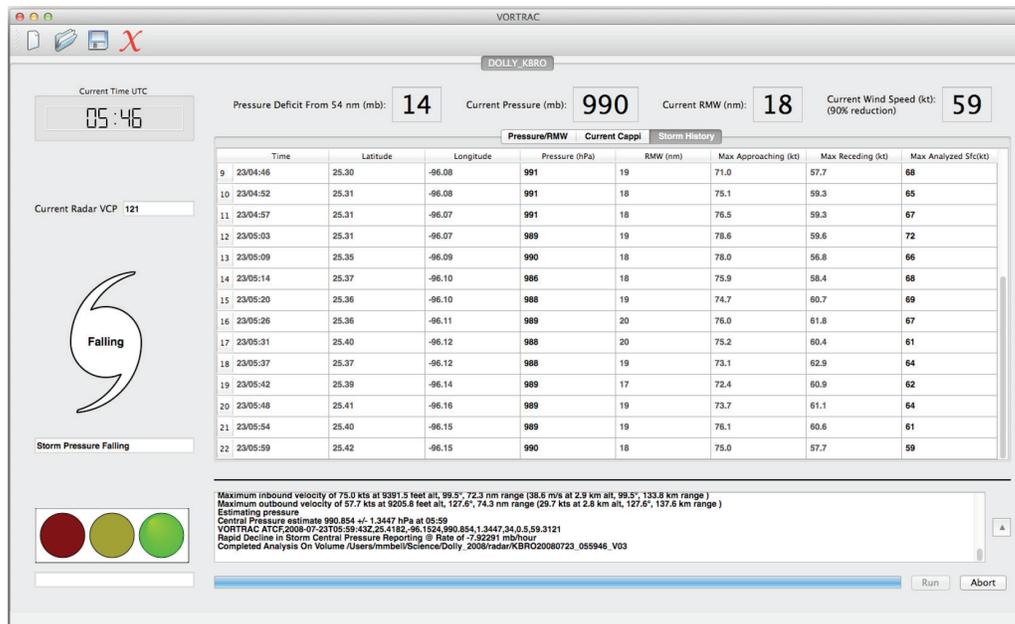


Figure 2. Screenshot from real time VORTRAC showing new Storm History table and maximum analyzed wind speed reduced to the surface.

Progress during FY 2014

The accomplishments achieved during FY 2014 can be summarized in three categories: 1) improve and update the VORTRAC algorithms, 2) identify potential points of failure and improve the logic and robustness of VORTRAC 2.0 in real-time operations, and 3) improve the functions and graphical user interface (GUI) based on inputs from NHC POCs. The upgrade from VORTRAC 1.0 to VORTRAC 2.0 has greatly improved the robustness, automation, and features of the software package, including a new Storm History table and maximum analyzed surface wind speed output.

Real-time tests with the improved automation using operational data streams worked well, including a test with Tropical Storm Flossie as it impacted the Hawaiian Islands. A major effort for upgrading VORTRAC 2.0 was to optimize operation parameters and characterize VORTRAC-derived TC structures. Without many suitable U.S. TC landfall cases, this was accomplished by testing VORTRAC 2.0 using 12 historical landfalling cases from 2005–2011 and comparing with Best Track and Air Force reconnaissance data when available. These results suggest that VORTRAC can retrieve intensification trends when the storm has sufficient organization and radar echo coverage. The two storms in the test set with significant intensification (Dolly and Humberto) were both well captured by a time-averaged analysis.

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: Raymond Tanabe

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 2014

During FY 2014, the NWS Fellowship Program provided ongoing educational support to the Geology and Geophysics (GG), Oceanography, and Meteorology departments. The NWS Fellowship funds were used to: 1) provide salaries for lecturers and teaching assistantships in Geology and Geophysics and Meteorology; 2) support the graduate and Global and Environmental Science programs in the Oceanography department; 3) support scholarships for GG students to attend a mainland summer field camp; and 4) provide travel support for Meteorology researchers to make a presentation on tropical cyclones at the 31st Hurricanes and Tropical Meteorology Conference, held in San Diego, March 31–April 4, 2014.

Three Meteorology graduate students were supported by the NWS Fellowship funds of which two recently completed their theses. Shannon McElhinney's thesis is entitled, "Observations of supergradient winds in the tropical cyclone boundary layer". His research work, conducted under the supervision of Michael Bell, deals with how supergradient jets in the boundary layer may contribute to secondary eyewall formation. And Thomas Winning, working with Yi-Leng Chen, completed his thesis entitled, "Detection of the inversion layer over the central North Pacific using GPS radio occultation". A journal paper, in press at *Monthly Weather Review*, entitled, "Eye and eyewall traits as determined with the NOAA WP-3D lower-fuselage radar" is co-authored by Carl Barnes who received support during his time as a NWS Fellow.

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

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 2014

The project is on schedule to meet its goals. Below is a list of accomplishments.

- Oversight and maintenance with NWSFO HFO staff of the network feed of satellite data to the Pacific Region Headquarters and the NWSFO.
- Lightning Algorithm completion and port of Pseudo reflectivity lightning product to AWIPS II.
- Development and maintenance of web page to serve polar orbiting satellite imagery to UH students and faculty and the public.
- Development of new pages for hyper-spectral data and products (Figure 1).
- Developed and provide vog aerosol product (Figure 2).
- Mentoring of graduate students using the polar orbiting satellite imagery and data for their research projects.
- Promoted use of high-resolution satellite data and GOES-R products in the classroom.

Collaborators during this year include:

- Roy Huff–Satellite liaison
- Jordan Gerth–General AWIPS and GOES-R network support

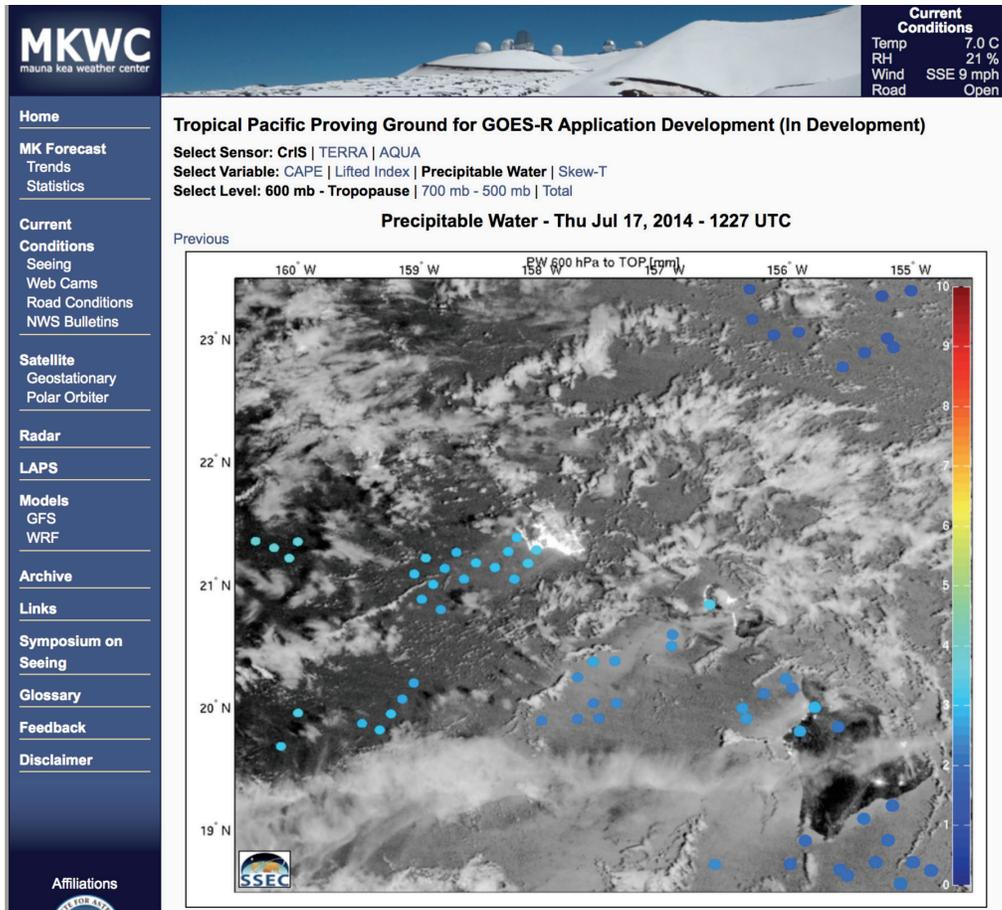
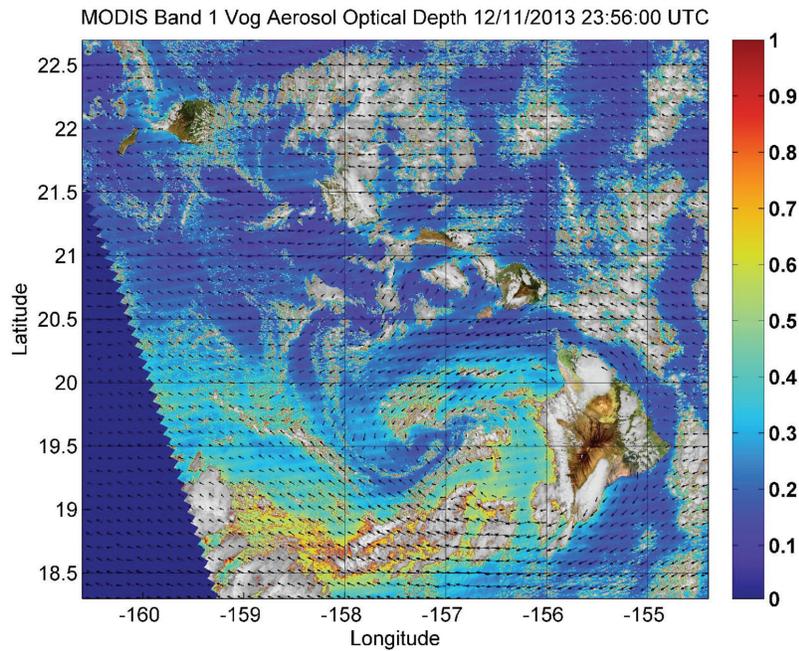


Figure 1. Screen capture of MKWC PW product from derived from CriS instrument.

Figure 2. Image of aerosol optical depth for December 11, 2013, derived from MODIS and surface wind data.



- 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/Hiro Gosden–AWIPS I localization
- John Porter–development of aerosol algorithm (Figure 2)

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.

Archive of Rapidly Sampled Hawaiian Sea Level

P.I.: Douglas S. Luther

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

NOAA Sponsor: Christopher Sabine

NOAA Goal(s)

- Weather-Ready Nation

Purpose of the Project

The Archive of Rapidly Sampled Hawaiian Sea Level (ARSHSL) provides an Internet-accessible, public database of rapidly-sampled ($\Delta t \leq 6$ minutes) sea level observations from existing Hawaiian coastal sea level gauges maintained by NOS and PTWC. NOAA originally established the archive in 1997 to ensure a consistent repository for rapidly sampled sea level in the Hawaiian Islands for the study of weak tsunamis and related infragravity wave signals (including edge waves and harbor resonances) at periods of 2–40 minutes. The archive is maintained with funding support through JIMAR. Sea level data from two-thirds of the gauges accessed by the project is not generally available to the public or research communities; that is, the data is not prepared and offered to the public by the agency (PTWC) responsible for maintaining the gauges, because these activities are not part of the mission of that agency. Therefore, this data archiving and dissemination activity provides as complete a dataset as possible of sea level fluctuations at the coasts of the Hawaiian Islands for current and future research and practical applications. Past applications of the archived data have ranged from hydrogeology to gravity wave studies to dock design. Predominant users in the past year focused on infragravity waves at periods of 2 minutes to several hours in support of the development of both harbor surge and beach flooding “nowcasts” and forecasts for NOAA’s PacIOOS.

PacIOOS and JIMAR continue funding support of graduate student Assaf Azouri, who is analyzing the 13 years of PTWC sea level data from Haleiwa Harbor in ARSHSL to determine the relationships between Haleiwa’s suite of infragravity wave fluctuations and their many forcing pathways (e.g., wind-generated swell directly forcing harbor infragravity waves; versus, swell forcing coastal infragravity waves that then force harbor infragravity waves). Azouri has been working with PacIOOS product developers (especially, Martin Guiles) to create and refine a product (http://www.soest.hawaii.edu/pacioos/data_product/harborsurge/index.php) for PacIOOS that will forecast the occurrence of potentially damaging infragravity wave currents in Haleiwa Harbor up to a few days into the future. This work is being extended to other harbors, using the archived high-resolution sea level data in ARSHSL to establish the initial set of parameters of the transfer function from swell to harbor infragravity waves.

Progress during FY 2014

Per the plans for this past year, the ARSHSL has been maintained on the World Wide Web (<http://ilikai.soest.hawaii.edu/arshsl/techrept/arshsl.html>) by M. Luther and D. Luther, in collaboration with the NOAA-funded U. H. Sea Level Center (M. Merrifield, Director). One-minute and six-minute data from six NOS gauges are retrieved from NOAA’s Tides & Currents web site (<http://tidesandcurrents.noaa.gov/>), rather than through the

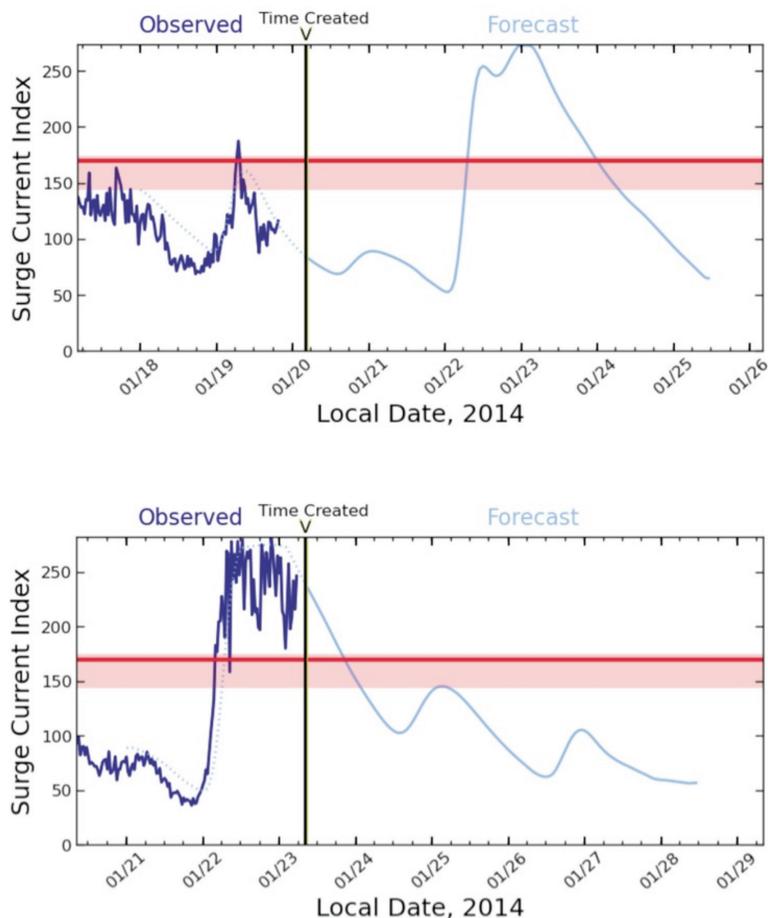


Figure 1. The existence and availability (through ARSHSL) of long-duration, rapidly-sampled sea level observations from Haleiwa Harbor was the most important factor enabling the creation and release this past year of a metric of water current surges within the harbor. The top frame of this figure shows the forecasted Hale'iwa Harbor Surge Current Index for the high swell event forecasted by NOAA's Wave Watch III for Jan 22, 2014, on the North Shore of Oahu. An index higher than 170 was deemed potentially dangerous to harbor infrastructure, docked boats and navigation. The high surge event was forecast as early as Jan. 17, but only the Jan. 20, 4AM HST, forecast is shown. On the left side of the forecast 'Time Created' in the plots is the hindcast for the surge metric. The lower frame in the figure shows the actual hindcast Surge Current Index the day after the maximum swell event. For a complete description of the plotted variables, see the PacIOOS web site: http://oos.soest.hawaii.edu/pacioos/data_product/harborsurge/index.php.

special communications pathways originally established for ARSHSL. PTWC sea level gauge data (1-second or 2-minute samples, depending on the gauge) have been automatically or, if necessary, manually downloaded, via Internet and telephone links from up to 14 PTWC gauges (in 12 harbors). All the sea level data, as originally sampled from a total of 17 harbors (some harbors have multiple gauges and, over time, some gauges have been decommissioned) dispersed around the five main islands of Hawaii, are stored on the ARSHSL web site, usually after both a low-level quality control check and elimination of extreme outliers. Access to the web site is unrestricted, with past users ranging from U.H. graduate students to government civil engineers, and even PTWC.

A technical report on the ARSHSL was prepared in January 1998, and is periodically updated on the web site. Logs of all data holdings and processing activity are being maintained on the web site for each station. As expected, archiving activities required most of the budgeted effort this past year. Per the plans stated in last year's report, an additional "value added" activity accomplished this past year was the updating of files of concatenated, quality-controlled, hourly-averaged sea level data for studies of low-frequency phenomena, especially to aid modeling and prediction of sea level inundation hazards around Oahu for NOAA's PacIOOS.



Figure 2. Flooded road and parking lot on the south side of Hale'iwa Harbor during the early morning hours of Jan 22, 2014. Substantial flooding in the immediate neighborhood of the harbor accompanied the high current surge.

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 University of Hawaii Sea Level Center (UHSLC) maintains 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 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 2014

For the Pacific Ocean, three stations (Hiva Oa, Nuku Hiva, La Libertad) were visited by UHSLC technicians, which fell short of project expectations of five visits. The reason for the slippage is due to unexpected logistical

delays in arranging a maintenance trip to Peru. The project expects to complete this trip in the first quarter of FY 2015. Project technicians were able to resurrect a former PTWC station in the Pacific, Kapingamarangi (Pohnpei, FSM), which had been inactive for many years. For the Caribbean, the project was able to visit 5 stations (Punta Cana, Puerto Plata, Curacao, El Porvenir, and Santa Marta) during FY 2014, meeting project expectations.

The project contributed to a study of the tsunami waveform measured at various sensors throughout Kwajalein and Majuro Atolls in the Republic of the Marshall Islands. The study highlighted the importance of standing modes within the atoll lagoons, the lack of an amplified tsunami signal on the fringing reefs fronting the outer rim of the atolls, and the spectral character of the tsunami signal at different phases of the event.

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., et al.	7/16/13	A model of loggerhead sea turtle (<i>Caretta caretta</i>) habitat and movement in the oceanic North Pacific	21st Annual Hawaii Conservation Conference: Honolulu, HI, July 16-18, 2013	Presentation		Ecosystem Modeling
Abecassis, M., I. Semina, P. Lehodey, P. Gaspar, D. Parker, and G. Balazs	9/5/13	A model of loggerhead sea turtle (<i>Caretta caretta</i>) habitat and movement in the oceanic North Pacific	PLOS ONE, 8, 9, e73274	Journal Article	http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0073274	Marine Turtle Research Program
Abecassis, M., et al.	2/27/14	Characterizing a Hawaiian ecosystem hotspot using passive and active acoustic data	Ocean Sciences Meeting: Honolulu, HI, Feb. 23-28, 2014	Presentation		Ecosystem Modeling
Abraham, J.P., et al.	9/1/13	A review of global ocean temperature observations: Implications for ocean heat content estimates and climate change	Reviews of Geophysics, 51, 450-483	Journal Article	http://dx.doi.org/10.1002/rog.20022	Profiling CTD Float Array Implementation and Ocean Climate Research
Annamalai, H., J. Hafner, A. Kumar, and H. Wang	5/1/14	A framework for dynamical seasonal prediction of precipitation over the pacific islands	Journal of Climate, 27, 3272-3297	Journal Article	http://dx.doi.org/10.1175/JCLI-D-13-00379.1	Enhancement of Data and Research Activities for Climate Studies at the International Pacific Research Center (IPRC)
Asher, J.	2/25/14	Distribution and relative abundance of reef fish species and apex predators in shallow and mesophotic habitats in the main Hawaiian Islands determined from remote stereo-video surveys	Ocean Sciences Meeting: Honolulu, HI., Feb. 23-28, 2014	Presentation	http://www.sgmeet.com/osm2014/default.asp	Sustaining Healthy Coastal Ecosystems
Baker, J., T. Johanos, T. Wurth, and C. Littnan	January 2014	Body growth in Hawaiian monk seals	Marine Mammal Science, 30, 1, 259-271	Journal Article		Hawaiian Monk Seal Research Program
Becker, J. M., M. A. Merrifield, and M. Ford	1/12/14	Water level effects on breaking wave setup for Pacific Island fringing reefs	Journal of Geophysical Research Oceans, 119, 914-932	Journal Article	doi:10.1002/2013JC009373	The University of Hawaii Sea Level Center
Benbow, S., et al.	4/1/14	Lessons learnt from experimental temporary octopus fishing closures in south-west Madagascar: Benefits of concurrent closures	African Journal of Marine Science, 36, 31-37	Journal Article	doi:10.2989/1814232X.2014.893256	Stock Assessment Research Program
Birkeland, C., et al.	11/20/13	Safety in numbers? Abundance may not safeguard corals from increasing carbon dioxide	BioScience, 63, 12, 967-974	Journal Article	doi:10.1525/bio.2013.63.12.9	Sustaining Healthy Coastal Ecosystems
Brainard, R. E., et al.	12/2/13	Incorporating climate and ocean change into extinction risk assessments for 82 coral species	Conservation Biology, 27, 1169-78	Journal Article	doi:10.1111/cobi.12171	Sustaining Healthy Coastal Ecosystems

Brodziak, J., and L. Fletcher	7/1/13	Quarterly summaries of Pacific blue marlin size composition data	ISC Billfish Working Group: Shimizu, Japan, May 20-28, 2013. ISC/13/BILL-WG-2/01	Workshop Proceedings		Stock Assessment Research Program
Brodziak, J., and W. A. Walsh	8/22/13	Model selection and multimodel inference for standardizing catch rates of bycatch species: A case study of oceanic whitetip shark in the Hawaii-based longline fishery	Canadian Journal of Fisheries and Aquatic Sciences, 70, 12, 1723-1740	Journal Article	doi:10.1139/cjfas-2013-0111	Stock Assessment Research Program
Burgess, G. H., et al.	6/16/14	A re-evaluation of the size of the White Shark (<i>Carcharodon carcharias</i>) population off California, USA	PLOS ONE, doi: 10.1371/journal.pone.0098078	Journal Article	http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0098078	Pelagic Fisheries Research Program
Chan, H.	4/9/14	Hawaii small boat survey 2014 poster	Poster presented at Waialua Boat Club meeting	Presentation		Economics of Fisheries Initiative
Chan, H., and M. Pan	6/3/14	Hawaii small boat survey 2014 flyer	PIFSC Flyer distributed at Pier 38 and fisher's forum (on 6/25/2014)	Presentation		Economics of Fisheries Initiative
Chan, H., and M. Pan	6/9/14	Letter to fishermen about the Hawaii small boat survey 2014	PIFSC website	Presentation	http://www.pifsc.noaa.gov/news/hawaii_small_boat_survey_2014.php	Economics of Fisheries Initiative
Chang, Y. J., A. J. Y. Yau, and J. Brodziak	4/1/14	Stock assessment of western and central North Pacific Ocean swordfish (<i>Xiphias gladius</i>) through 2012	ISC Billfish Working Group: Honolulu, Hawaii, Feb. 11-19, 2014. ISC/14/BILL-WG-1/02	Workshop Proceedings		Stock Assessment Research Program
Chang, Y. J., G. DiNardo, and C. L. Sun	11/19/13	Modelling the impacts of climate variation on the habitat suitability of swordfish, <i>Xiphias gladius</i> , in the equatorial Atlantic Ocean	Climate and Change, The Second JIMAR/PIFSC Symposium: Honolulu, Hawaii, Nov. 19, 2013	Presentation		Stock Assessment Research Program
Chang, Y. J., J. Brodziak, J. O'Malley, and G. DiNardo	7/19/13	Application of Bayesian hierarchical production models with time-varying parameters to North Sea haddock	World Conference on Stock Assessment Methods: Boston, MA, July 17-19, 2013	Presentation		Stock Assessment Research Program
Chang, Y. J., J. Brodziak, J. O'Malley, H. H. Lee, G. DiNardo, and C. L. Sun	11/8/13	Model selection uncertainty and multi-model Inference in production modeling: Simulation study of the Pacific billfish stocks	5th International Billfish Symposium: Taipei, Taiwan, Nov. 4-8, 2013	Presentation		Stock Assessment Research Program
Church, J. A., et al.	2013	Sea level change. In: Soker, T., et al. (eds.), Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change	Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA	Report		The University of Hawaii Sea Level Center

Comfort, C., and K. Weng	2014	Environmental drivers of vertical behavior of <i>Hexanchus griseus</i> in Hawaii	Deep Sea Research II.	Journal Article	http://dx.doi.org/10.1016/j.dsr2.2014.04.005	Pelagic Fisheries Research Program
Copeland, A. M., et al.	2/27/14	Investigating the relationship between foraging odontocetes and ocean acoustic biomass off the Kona coast of the Island of Hawaii	Ocean Sciences Meeting: Honolulu, HI, Feb. 23-28, 2014	Presentation		Ecosystem Modeling
Copeland, A. M., et al.	3/14/14	Investigating the relationship between foraging odontocetes and ocean acoustic biomass off the Kona coast of the Island of Hawaii	39th Annual Albert L. Tester Memorial Symposium: Honolulu, HI, March 12-14, 2014	Presentation		Ecosystem Modeling
Copeland, A. M., et al.	5/5/14	Investigating the relationship between foraging odontocetes and ocean acoustic biomass off the Kona coast of the Island of Hawaii	135th Meeting of the Acoustical Society of America: Providence, RI. May 5-9, 2014	Presentation		Ecosystem Modeling
Deroba, J. J., et al.	1/18/14	Simulation testing the robustness of stock assessment models to error: some results from the ICES strategic initiative on stock assessment methods	ICES Journal of Marine Science, 2014	Journal Article	doi:10.1093/icesjms/fst237	Stock Assessment Research Program
Dutton, P., M. Jensen, K. Frutchey, A. Frey, E. LaCasella, G. Balazs, J. Cruce, A. Tagarino, R. Farman, and M. Tatarata	in press	Genetic stock structure of green turtle (<i>Chelonia mydas</i>) nesting populations across the Pacific islands	Pacific Science	Journal Article		Protected Resources Environmental Compliance Initiative (PRECI)
Ehse, J., R. Watkins, and J. Rooney	11/19/13	Nearshore depth derivation in the U.S. Pacific Islands Region using WorldView-2 multispectral satellite imagery (poster presentation)	Climate and Change, The Second JIMAR/PIFSC Symposium: Honolulu, Hawaii, Nov. 19, 2013	Presentation		Sustaining Healthy Coastal Ecosystems
Flower, K. R., et al.	7/1/13	Toward ecosystem-based coastal area and fisheries management in the Coral Triangle: Integrated strategies and guidance	The USAID Coral Triangle Support Partnership	Workshop Proceedings	http://www.uscti.org	Sustaining Healthy Coastal Ecosystems
Ford, M., J. M. Becker, M. A. Merrifield, and Y. T. Song	12/3/13	Marshall Islands fringing reef and atoll lagoon observations of the Tohoku tsunami	Pure and Applied Geophysics, 2013	Journal Article	doi:10.1007/s00024-013-0757-8	The University of Hawaii Sea Level Center – Tsunami Research
Fuentes, M., et al.	6/14/14	Adaptive management of marine mega-fauna in a changing climate	Mitigation and Adaptation Strategies for Global Change	Journal Article	doi: 10.1007/s11027-014-9590-3	Protected Resources Environmental Compliance Initiative (PRECI)
Gove, J.	11/19/13	Environmental drivers for Pacific coral reef ecosystems	Climate and Change, The Second JIMAR/PIFSC Symposium: Honolulu, Hawaii. November 19, 2013	Presentation		Sustaining Healthy Coastal Ecosystems
Grace-McCaskey, C. A.	4/4/14	Knowledge, attitudes, and perceptions of coral reefs in Hawaii's Priority Sites [presentation of preliminary survey results]	Hawaii DLNR DAR Sharing Session Meeting: Maui, April 4, 2014	Presentation		Human Dimensions of Fishing and Marine Ecosystems in the Western Pacific

Grace-McCaskey, C. A., and L. Sievanen	11/19/13	Reef fishing in Saipan: Patterns, trends, and importance	Workshop in Saipan: Saipan, CNMI, Nov. 19, 2013	Presentation		Human Dimensions of Fishing and Marine Ecosystems in the Western Pacific
Grace-McCaskey, C. A., and L. Sievanen	2/26/14	Saipan fisheries workshop data for use in reef fishery SEEM analysis	WPRFMC SEEM Working Group Meeting: Honolulu, HI, Feb. 26, 2014	Presentation		Human Dimensions of Fishing and Marine Ecosystems in the Western Pacific
Hazen, E.	6/3/13	Using movement models, foraging events, and environmental data to identify bluefin tuna hotspots in the California current	Fisheries and the Environment (FATE) Meeting: Miami, FL, June 2-6, 2013	Presentation		Climate Change and Ecosystem Variability in the North Pacific Ocean and the Dynamics of Marine Resource Populations
Heenan, A., and I. D. Williams	11/6/13	Monitoring herbivorous fishes as indicators of coral reef resilience in American Samoa	PLOS ONE, doi: 10.1371/journal.pone.0079604	Journal Article	http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0079604	Sustaining Healthy Coastal Ecosystems
Hobday, A. J., J. D. Bell, T. R. Cook, M. A. Gasalla, and K. C. Weng	in press	Reconciling conflicts in pelagic fisheries under climate change	Deep Sea Research II.	Journal Article		Pelagic Fisheries Research Program
Hristova, H. G., W. S. Kessler, J. C. McWilliams, and M. J. Molemaker	2/24/14	On eddy distribution and seasonality in the southwest Tropical Pacific	Ocean Sciences Meeting: Honolulu, HI, February 23-28, 2014	Conference Proceedings	http://www.sgmeet.com/osm2014/viewabstract.asp?AbstractID=15382	Characterization & Dynamics of Mesoscale and Submesoscale Oceanic Variability in the Solomon Sea Simulated by a Nested ROMS Model
Hristova, H. G., W. S. Kessler, J. C. McWilliams, and M. J. Molemaker	in press	Mesoscale variability and its seasonality in the Solomon and Coral Seas	J. Geophys. Res.-Oceans, 119, doi:10.1002/2013JC009741	Journal Article	http://doi.org/10.1002/2013JC009741	Characterization & Dynamics of Mesoscale and Submesoscale Oceanic Variability in the Solomon Sea Simulated by a Nested ROMS Model
Johanos, T., A. Harting, T. Wurth, and J. Baker	12/6/2013	Rangewide movements of the Hawaiian monk seal	Marine Mammal Science, 30, 3, 1165-1174	Journal Article	Doi: 10.1111/mms.12084	Hawaiian Monk Seal Research Program
Johnson, G. C., J. M. Lyman, G. S. E. Lagerloef, and H.-Y. Kao	8/1/13	Global oceans: Sea surface salinity [in: "State of the Climate in 2012"]	Bull. Am. Met. Soc., 94, 8, S57-S60	Journal Article	http://dx.doi.org/10.1175/2013BAMSStateoftheClimate.1	Profiling CTD Float Array Implementation and Ocean Climate Research
Johnson, G. C., et al.	8/1/13	Global oceans: Ocean heat content [in: "State of the Climate in 2012"]	Bull. Am. Met. Soc., 94, 8, S50-S53	Journal Article	http://dx.doi.org/10.1175/2013BAMSStateoftheClimate.1	Profiling CTD Float Array Implementation and Ocean Climate Research

Johnson, N. C., D. C. Collins, S. B. Feldstein, M. L. L'Heureux, and E. E. Riddle	2/1/14	Skillful wintertime north american temperature forecasts out to 4 weeks based on the state of ENSO and the MJO	Weather and Forecasting, 29, 23-38	Journal Article	doi: http://dx.doi.org/10.1175/WAF-D-13-00102.1	Enhancement of Data and Research Activities for Climate Studies at the International Pacific Research Center (IPRC)
Kalberg, K., and M. Pan	12/19/13	Hawaii longline trip expenditure 2004-2012	PIFSC brochure	Presentation		Economics of Fisheries Initiative
Kelly, K.A., L. Thompson, and J. Lyman	2/1/14	The coherence and impact of meridional heat transport anomalies in the Atlantic Ocean inferred from observations	Journal of Climate, 27, 1469-1487	Journal Article	http://dx.doi.org/10.1175/JCLI-D-12-00131.1	Profiling CTD Float Array Implementation and Ocean Climate Research
Kobayashi, D., R. Farman, J. Polovina, D. Parker, F. Christiansen, G. Hays, M. Rice, and G. Balazs	in press	"Going with the flow" or not: Evidence of positive rheotaxis in oceanic juvenile loggerhead turtles (<i>Caretta caretta</i>) in the South Pacific Ocean using satellite tags and ocean circulation data	PLOS ONE	Journal Article		Marine Turtle Research Program
Kotowicz, D.	11/19/13	People in a changing climate: Human dimensions of climate impacts in the Pacific Islands	Climate and Change, The Second JIMAR/PIFSC Symposium: Honolulu, Hawaii, Nov. 19, 2013	Presentation		Human Dimensions of Fishing and Marine Ecosystems in the Western Pacific
Kotowicz, D.	2/25/14	Managing historic and scientific resources in the Marianas Trench Marine National Monument	Ocean Sciences Meeting: Honolulu, HI, Feb. 23-28, 2014	Conference Proceedings		Human Dimensions of Fishing and Marine Ecosystems in the Western Pacific
Kotowicz, D.	4/14/14	Coastal storms assessment data report	Coastal Vulnerability Assessment Workshop, Regional Island Sustainability Conference: Guam, April 15-16, 2014	Presentation		Human Dimensions of Fishing and Marine Ecosystems in the Western Pacific
Kotowicz, D.	6/25/14	Human dimensions of climate change	Climate Science Teacher Institute for High School Teachers: Kaneohe, Oahu, HI, June 18-20, 23-26, 2014	Presentation		Human Dimensions of Fishing and Marine Ecosystems in the Western Pacific
Lauer, A., and K. Hamilton	7/1/13	Simulating clouds with global climate models: A comparison of CMIP5 results with CMIP3 and satellite data	Journal of Climate, 26, 3823-3845	Journal Article	http://dx.doi.org/10.1175/JCLI-D-12-00451.1	Enhancement of Data and Research Activities for Climate Studies at the International Pacific Research Center (IPRC)
Lauer, A., C. Zhang, O. Elison-Timm, Y. Wang, and K. Hamilton	12/1/13	Downscaling of climate change in the Hawaii region using CMIP5 results: On the choice of the forcing fields	Journal of Climate, 26, 10006-10030	Journal Article	http://dx.doi.org/10.1175/JCLI-D-13-00126.1	Enhancement of Data and Research Activities for Climate Studies at the International Pacific Research Center (IPRC)

Lee, H. H.	5/20/14	Science and technical approaches to data rich stocks: Pacific Blue Marlin	2014 PIFSC Stock Assessment External Review	Presentation		Stock Assessment Research Program
Lee, H. H., et al.	6/22/14	Sex-structured population dynamics of blue marlin <i>Makaira nigricans</i> in the Pacific Ocean	Fisheries Science	Journal Article	doi:10.1007/s12562-014-0762-6	Stock Assessment Research Program
Lee, H. H., et al.	3/28/14	Stock assessment of blue marlin in the Pacific Ocean in 2013	CIE review document	Report	http://isc.ac.affre.go.jp/pdf/ISC13pdf/Annex%2010-%20Blue%20marlin%20stock%20assessment.pdf	Stock Assessment Research Program
Lee, H. H., K. R. Piner, R. D. Methot, and M. N. Maunder	1/24/14	Use of likelihood profiling over a global scaling parameter to structure the population dynamics model: an example using blue marlin in the Pacific Ocean	Fisheries Research, 158, 138-146	Journal Article	doi:10.1016/j.fishres.2013.12.017	Stock Assessment Research Program
Lee, W.-C., M. Bell, and P. Harasti	11/26/13	Joint hurricane testbed final report	National Hurricane Center web page	Conference Proceedings	http://www.nhc.noaa.gov/jht/11-13reports/Final_WLee_JHT13.pdf	Improved Automation and Performance of VORTRAC Intensity Guidance
Lopez, J., K. D. Hyrenbach, C. Littnan, and G. M. Ylitalo	6/13/14	Geographic variation of persistent organic pollutants in Hawaiian monk seals <i>Monachus schauinslandi</i> in the main Hawaiian Islands	Endangered Species Research, 24, 249-262	Journal Article	doi: 10.3354/esr00602	Hawaiian Monk Seal Research Program
Lyman, J. M., and G. C. Johnson	3/1/14	Estimating global ocean heat content changes in the upper 1800 m since 1950 and the influence of climatology choice	Journal of Climate, 27, 1946-1958	Journal Article	http://dx.doi.org/10.1175/JCLI-D-12-00752.1	Profiling CTD Float Array Implementation and Ocean Climate Research
Merrifield, M.	11/19/13	Global and regional sea-level rise projections from the IPCC AR5	Climate and Change, The Second JIMAR/PIFSC Symposium: Honolulu, Hawaii, Nov. 19, 2013	Presentation		The University of Hawaii Sea Level Center
Merrifield, M. A., et al.	8/1/13	Sea level variability and change [in: "State of the Climate in 2012"]	Bulletin of the American Meteorological Society, 94, 8, S121-S123	Journal Article		The University of Hawaii Sea Level Center
Misa, P., B. Vargas-Angel, E. Looney, and J. Anderson	6/23/14	Coral reef disease dynamics in the U.S. Pacific Territories and States	The 3rd Asia-Pacific Coral Reef Symposium: Pingtung, Taiwan, June 23-27, 2014	Presentation		Sustaining Healthy Coastal Ecosystems
Nadon, M.	5/21/14	Data poor-er assessment: Coral reef fish	2014 PIFSC Stock Assessment External Review	Presentation		Stock Assessment Research Program
O'Malley, J., Y. J. Chang, and J. Brodziak	7/19/13	Dealing with temporal structure with Bayesian surplus production models: Georges Bank yellowtail flounder	World Conference on Stock Assessment Methods: Boston, MA. July 17-19, 2013	Presentation		Stock Assessment Research Program
Pan, M., and H. Chan	6/1/14	Letter to fishermen about the Hawaii small boat survey 2014	Hawaii Fishing News, 40, 5, 20	Presentation		Economics of Fisheries Initiative

Pan, M., H. Chan, and K. Kalberg	6/6/14	Tracking the changes of economic performance indicators for the main commercial fisheries in the Western Pacific areas 2012 update	Pacific Islands Fisheries Science Center Internal Report IR-14-017	Report		Economics of Fisheries Initiative
Parker, D., C. King, M. Rice, and G. Balazs	2014	First use of a GPS satellite tag to track a post-nesting hawksbill (<i>Eretmochelys imbricata</i>) in the Hawaiian Islands with an indication of possible mortality	Marine Turtle Newsletter, 142, 10-13	Journal Article		Marine Turtle Research Program
Parker, D., G. Balazs, M. Rice, and S. Tomkiewicz	2014	Variability in reception duration of dual satellite tags on sea turtles tracked in the Pacific Ocean	Micronesica, 3, 1-8	Journal Article		Marine Turtle Research Program
Pattantyus, A., and S. Businger	2014	On the interaction of tropical cyclone Flossie and emissions from Hawaii's Kilauea volcano	Geophys. Res. Lett., 41, 11, 4082-4089	Journal Article	doi:10.1002/2014GL060033.	Tropical Pacific Testbed (TPT) for GOES-R Application Development
Pedersen, M., and K. Weng	2013	Estimating individual animal movement from observation networks	Methods in Ecology and Evolution, 4, 10, 920-929	Journal Article	doi: 10.1111/2041-210X.12086	Pelagic Fisheries Research Program
Pomeroy, R., R. Brainard, M. Moews, A. Heenan, J. Shackeroff, and N. Armada	2014	Coral Triangle regional ecosystem approach to fisheries management (EAFM) guidelines	The USAID Coral Triangle Support Partnership	Workshop Proceedings	http://www.coraltriangleinitiative.org/sites/default/files/resources/Guidelines_int_NEW_final-proof2.pdf	Sustaining Healthy Coastal Ecosystems
Rooney, J.	1/30/14	Geology of coral reefs of the Northwestern Hawaiian Islands	Presentation made to the UHM graduate class on the Geology and Geophysics of the Northwestern Hawaiian Islands	Presentation		Sustaining Healthy Coastal Ecosystems
Rooney, J.	10/30/13	Benthic habitat mapping in the Main Hawaiian Islands	Hawaii Coral Reef Initiative Mid-day Seminar Series and NOAA Reef Smart Program	Presentation		Sustaining Healthy Coastal Ecosystems
Rooney, J., F. Lichowski, R. Suka, J. Taylor, F. Knighton, and G. Cohen	3/13/14	Mapping benthic habitats in the West Maui coral reef ecosystem	West Maui Ridge to Reef Research Coordination and Collaboration Workshop: Honolulu, HI, March 13-14, 2014	Presentation		Sustaining Healthy Coastal Ecosystems
Rooney, J., T. DeCarlo, A. Choen, and W. Thompson	2/28/14	Growth rates of <i>Leptoseris hawaiiensis</i> : Data required for managing impacts to mesophotic reefs in the Main Hawaiian Islands	Ocean Sciences Meeting: Honolulu, HI, Feb. 23-28, 2014	Presentation		Sustaining Healthy Coastal Ecosystems
Sievanen, L.	5/5/14	Knowledge, attitudes and perceptions of coral reefs in West Maui [presentation of preliminary survey results]	Community Presentation (Lahaina, HI)	Presentation		Human Dimensions of Fishing and Marine Ecosystems in the Western Pacific

Sievanen, L.	4/4/14	Knowledge, attitudes and perceptions of coral reefs in West Maui [presentation of preliminary survey results]	Hawaii DLNR DAR Sharing Session Meeting: Maui, April 4, 2014	Presentation		Human Dimensions of Fishing and Marine Ecosystems in the Western Pacific
Sievanen, L., and C. A. Grace-McCaskey	11/1/13	What do your neighbors think? Knowledge, attitudes and perceptions of coral reefs in South Kohala	Reef Talk Series (Puako, HI)	Presentation		Human Dimensions of Fishing and Marine Ecosystems in the Western Pacific
Sievanen, L., and C. A. Grace-McCaskey	10/9/13	Knowledge, attitudes and perceptions of coral reefs in South Kohala	Hawai'i Fisheries Local Action Strategy Meeting (Honolulu, HI)	Presentation		Human Dimensions of Fishing and Marine Ecosystems in the Western Pacific
Sievanen, L., and C. A. Grace-McCaskey	7/16/13	Understanding resource users' knowledge, attitudes, and perceptions of coral reefs in South Kohala	21st Annual Hawaii Conservation Conference: Honolulu, HI. July 16-18, 2013	Presentation		Human Dimensions of Fishing and Marine Ecosystems in the Western Pacific
Sprintall, J., et al.	6/22/14	The Indonesian seas and their role in the coupled ocean-climate system	Nature Geoscience, 7, 487-492	Journal Article	doi:10.1038/ngeo2188	Enhancement of Data and Research Activities for Climate Studies at the International Pacific Research Center (IPRC)
Staples, D., et al.	2014	Essential ecosystem approach to fisheries management training course	http://www.fao.org ; www.boblme.org ; http://www.pifsc.noaa.gov/cred/eafm_training/index.php#partners	Workshop Proceedings	http://www.pifsc.noaa.gov/cred/eafm_training/index.php#partners	Sustaining Healthy Coastal Ecosystems
Stolz, D. C., S. Businger, and A. Terpstra	2014	Refining the relationship between lightning and convective rainfall over the ocean	Journal of Geophysical Research-Atmospheres, 119, 2, 964-981	Journal Article	doi:10.1002/2012JD018819	Tropical Pacific Testbed (TPT) for GOES-R Application Development
Sun, C. L., S. Z. Yeh, Y. J. Chang, H. Y. Chang, and S. L. Chu	7/1/13	Reproductive biology of female bigeye tuna <i>Thunnus obesus</i> in the western Pacific Ocean	Journal of Fish Biology, 83, 2, 250-271	Journal Article	doi: 10.1111/jfb.12161	Stock Assessment Research Program
Tagami, D., H. Wang, and Y. J. Chang	4/1/14	Spatial distribution of swordfish catches for longline fisheries in the western and central North Pacific and eastern Pacific Ocean	ISC Billfish Working Group: Honolulu, Hawaii, Feb. 11-19, 2014. ISC/14/BILL-WG-1/03	Workshop Proceedings	http://isc.ac.affrc.go.jp/reports/bill/bill_2014_1.html	Stock Assessment Research Program
Thompson, P. R., G. T. Mitchum, C. Vonesch, and J. Li	12/1/13	Variability of winter storminess in the eastern United States during the twentieth century from tide gauges	Journal of Climate, 26, 3, 9713-9726	Journal Article	http://dx.doi.org/10.1175/JCLI-D-12-00561.1	The University of Hawaii Sea Level Center
Thompson, P. R., M. A. Merrifield, J. R. Wells, and C. M. Chang	6/15/14	Wind-driven coastal sea level variability in the Northeast Pacific	Journal of Climate, 27, 4733-4751	Journal Article	doi: http://dx.doi.org/10.1175/JCLI-D-13-00225.1	The University of Hawaii Sea Level Center
Vargas-Angel, B.	3/13/14	Determining the efficacy of watershed management activities in the Honokowai-Wahikuli watersheds, West Maui	West Maui Ridge to Reef Research Coordination and Collaboration Workshop: Honolulu, HI. March 13-14, 2014	Presentation		Sustaining Healthy Coastal Ecosystems

Vargas-Angel, B.	4/2/14	2014 Mariana Islands RAMP cruise overview and preliminary results	University of Guam	Presentation		Sustaining Healthy Coastal Ecosystems
Vargas-Angel, B.	4/15/14	NOAA-CRED Overview	APASEEM Saipan	Presentation		Sustaining Healthy Coastal Ecosystems
Vargas-Angel, B.	6/29/14	NOAA-CRED Overview	Maui Community College	Workshop Proceedings		Sustaining Healthy Coastal Ecosystems
Walsh, W. A.	11/8/13	CPUE standardizations and model selection for billfishes in the Hawaii-based pelagic longline fishery in 1995-2011	5th International Billfish Symposium: Taipei, Taiwan, Nov. 4-8 2013	Presentation		Stock Assessment Research Program
Walsh, W. A., and G. DiNardo	3/1/14	Blue shark catch rates in the Hawaii-based pelagic longline fishery in 2000–2012: A re-evaluation of observer catch data and standardizations for both fishery sectors	ISC Shark Working Group: La Jolla, CA, Jan. 13-18, 2014. ISC/14/SHARKWG-1/06	Workshop Proceedings	http://isc.ac.affrc.go.jp/reports/shark/shark_2014_1.html	Stock Assessment Research Program
Walsh, W.A., and J. Brodziak	4/1/14	Catch rate standardization for swordfish <i>Xiphias gladius</i> in the shallow-set sector of the Hawaii-based pelagic longline fishery: 1995–2012	ISC Billfish Working Group: Honolulu, Hawaii, Feb. 11-19, 2014. ISC/14/BILLWG-1/5	Workshop Proceedings	http://isc.ac.affrc.go.jp/reports/bill/bill_2014_1.html	Stock Assessment Research Program
Wang, J., J. Barkan, S. Fisler, and Y. Swimmer	5/1/14	Illuminating innovations in fisheries technology reduce bycatch	SWOT: The state of the World's Sea turtles, 9, 26-27	Journal Article	http://www.seaturtlestatus.org/sites/swot/files/report/043014_SWOT%20Report%209_FinalB.pdf	Sea Turtle Bycatch and Mitigation: Research and Development
Wang, J., J. Barkan, S. Fisler, C. Godinez-Reyes, and Y.I. Swimmer	7/24/13	Developing ultraviolet illumination of gillnets as a method to reduce sea turtle bycatch	Biology Letters, 9, 5, 20130383	Journal Article	doi: 10.1098/rsbl.2013.0383	Sea Turtle Bycatch and Mitigation: Research and Development
Wang, S.-P., M.N. Maunder, K. Piner, A. Aires-da-Silva, and H.H. Lee	1/18/14	Evaluation of virgin recruitment profiling as a diagnostic for selectivity curve structure in integrated stock assessment models	Fisheries Research, 158, 158-164	Journal Article		Stock Assessment Research Program
Weijerman M., C. Birkeland, G.A. Piniak, M.W. Miller, C.M. Eakin, P. McElhany, M.J. Dunlap, M. Patterson, and R.E. Brainard	4/1/14	Endangered Species Act listing: Three case studies of data deficiencies and consequences of ESA "threatened" listing on research output	Current Opinion in Environmental Sustainability, 7, 15-21	Journal Article	doi:10.1016/j.cosust.2013.11.026	Sustaining Healthy Coastal Ecosystems
Weng, K.	11/19/13	Energy speculating tunas vs. energy conserving sharks in the future ocean	Climate and Change, The Second JIMAR/PIFSC Symposium: Honolulu, Hawaii, Nov. 19, 2013	Presentation		Pelagic Fisheries Research Program
Weng, K.	11/1/13	A pilot study of deep-water fish movement with respect to marine reserves	Animal Biotelemetry, 1, 17	Journal Article	doi:10.1186/2050-3385-1-17, http://www.animalbiotelemetry.com/content/1/1/17	Pelagic Fisheries Research Program

Weng, K. C., S. Nicol, and A. J. Hobday	in press	Fishery management, development and food security in the Western and Central Pacific in the context of climate change	Deep Sea Research II.	Journal Article		Pelagic Fisheries Research Program
Williams, G., et al.	1/22/14	Ocean warming and acidification have complex interactive effects on the dynamics of a marine fungal disease	Proc. R. Soc. B, 281, 1778, 20133069	Journal Article	doi:10.1098/rspb.2013.3069	Sustaining Healthy Coastal Ecosystems
Yau, A. J. Y., Y. J. Chang, and J. Brodziak	4/1/14	Stock assessment of swordfish (<i>Xiphias gladius</i>) in the Eastern Pacific Ocean through 2012	ISC Billfish Working Group: Honolulu, Hawaii, Feb. 11-19, 2014. ISC/14/BILL-WG-1/01	Workshop Proceedings	http://isc.ac.affrc.go.jp/reports/bill/bill_2014_1.html	Stock Assessment Research Program
Yeh, F., G. Balazs, D. Parker, C. Ng, and H. Shi	2014	Novel use of satellite tracking as a forensic tool to determine foraging ground of a rescued green turtle (<i>Chelonia mydas</i>)	Marine Turtle Newsletter, 142, 1-3	Journal Article	-	Marine Turtle Research Program
Zamzow, J.	11/22/13	An overview of the Coral Reef Ecosystem Division's Fish Team	University of Hawaii Marine Biology Graduate Program seminar series	Presentation		Sustaining Healthy Coastal Ecosystems
Zamzow, J.	2/13/14	An overview of the Coral Reef Ecosystem Division's Fish Team	Reef Smart Division of Aquatic Resources seminar series	Presentation	http://www.hcrissri.hawaii.edu/MDSS/MDSS.html	Sustaining Healthy Coastal Ecosystems
Zgliczynski, B. J., I. D. Williams, R. E. Schroeder, M. O. Nadon, B. L. Richards, and S. A. Sandin	9/1/13	The IUCN Red List of Threatened Species: an assessment of coral reef fishes in the US Pacific Islands	Coral Reefs, 32, 3, 637-650	Journal Article	doi:10.1007/s00338-013-1018-0	Stock Assessment Research Program

Appendix I List of Acronyms

ACAP	Association for the Conservation of Albatross and Petrels
ACL	Annual Catch Limit
ACSPO	Advanced Clear-Sky Processor for Oceans
ACT	Annual Catch Target
ADMB	Automatic Differentiation Model Builder
AFES	Atmospheric Model for the Earth Simulator
AMSEA	Alaska Marine Safety Education Association
AOML	Atlantic Oceanographic and Meteorological Laboratory
APDRC	Asia-Pacific Data Research Center
ARL	Air Resources Laboratories
ARMS	Autonomous Reef Monitoring Structure
ARSHSL	Archive of Rapidly-Sampled Hawaiian Sea Level
ASCAT	Advanced SCATterometer
ATCF	Automated Tropical Cyclone Forecasting (System)
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
B-WET	Bay Watershed Education and Training
BET	Big Eye Tuna
BotCam	Bottomfish video Camera
BMU	Bioerosion Monitoring Unit
BRT	Bycatch Reduction Technology
BSP	Guam Bureau of Statistics and Plans (BSP)
CAU	Calcification Acidification Units
CCA	Canonical Correlation Analysis
CIE	Center for Independent Experts
CITES	Convention on International Trade of Endangered Species
CLIOTOP	Climate Impacts on Top Predators
CMIP	Coupled Model Inter-comparison Project
CMS	Content Management System
CNMI	Commonwealth of the Northern Mariana Islands
CO ₂	Carbon Dioxide
CoRIS	Coral Reef Information System

CPY	Cycles per year
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
CT	Coral Triangle
CTD	Conductivity-Temperature-Depth
CTI	Coral Triangle Initiative
DAR	Division of Aquatic Resources, Hawaii Department of Land and Natural 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
DSCRTP	Deep Sea Coral Research and Technology Program
EAFM	Ecosystem Approach to Fisheries Management
ECV	Essential Climate Variable
EEZ	Exclusive Economic Zone
EKE	Eddy Kinetic Energy
ENSO	El Niño Southern Oscillation
EOFs	Empirical Orthogonal Functions
ESA	Endangered Species Act
FBSAB	Fisheries Biology and Stock Assessment Branch
FCMA	Fishery Conservation and Management Act
FDCC	Fisheries Data Coordinating Committee
FFA	Forum Fisheries Agency
FFS	French Frigate Shoals
FMB	Fisheries Monitoring Branch
FMP	Fishery Management Plan
FRMD	Fisheries Research and Monitoring Division
FRS	Fisherman Reporting System
FSM	Federated States of Micronesia
FSWP	Fishery Statistics of the Western Pacific

FUS	Fisheries of the United States
FY	Fiscal Year
GAC	Global Area Coverage
GCOS	Global Climate Observing System
GDS	GrADS DODS Server
GEOSS	Global Earth Observation System of Systems
GFDL	Geophysical Fluid Dynamics Laboratory
GG	Geology and Geophysics
GIS	Geographic Information System
GLOSS	Global Sea Level Observing System
GMSL	Global Mean Sea Level
GNOME	General NOAA Operational Modeling Environment
GODAE	Global Ocean Data Assimilation Experiment
GOES	Geostationary Operational Environmental Satellite
GPS	Global Positioning System
GrADS	Grid Analysis and Display System
GSFC	Goddard Space Flight Center
GTS	Global Telecommunications System
HARP	High-frequency Acoustic Recording Package
HDAR	Hawaii Division of Aquatic Resources (DAR)
Hg	Mercury
Hg0	Elemental Mercury
HgP	Particulate Mercury
HI	Hawaii
HIC	Hawaii Information Consortium
HIMB	Hawaii Institute of Marine Biology
HiOOS	Hawaii Ocean Observing System
HMS	Hawaiian Monk Seal
HMSRP	Hawaiian Monk Seal Research Program
HMS-RFMO	Highly Migratory Species - Regional Fisheries Monitoring Organization
HPU	Hawaii Pacific University
HRPT	High Resolution Picture Transmission
HYCOM	Hybrid Coordinate Ocean Model
IACUC	Institutional Animal Care & Use Committee
IATTC	Inter-American Tropical Tuna Commission
IC-4D	Interactive Calibration of Four Dimensions

ICES	International Council for the Exploration of the Sea
IEA	Integrated Ecosystem Assessment
IMBER	Integrated Marine Biogeochemistry and Ecosystem Research
InPort	Information Portal
IOOS	Integrated Ocean Observing System
IPRC	International Pacific Research Center
IRC	Inouye Regional Center
ISC	International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean
ISO	International Organization for Standardization
ITS	Information Technology Support
JAMSTEC	Japan Agency for Marine-Earth Science and Technology
JIMAR	Joint Institute for Marine and Atmospheric Research
KAPs	Knowledge, Attitudes and Perceptions
KIOST	Korean Institute of Ocean Science and Technology
LAS	Live Access Server
LBSP	Land-Based Sources of Pollution
LED	Light-Emitting Diode
LH	Life History
MAPCO2	Moored Autonomous pCO ₂ System
MARAMP	Marianas Archipelago Reef Assessment Monitoring Program
MEI	Multivariate ENSO Index
MHI	Main Hawaiian Islands
MLO	Mauna Loa Observatory
MMPA	Marine Mammal Protection Act
MNM	Marine National Monuments
MODIS	Moderate Resolution Imaging Spectral Spectroradiometer
MOUSS	Modular Underwater Stereoscopic System
MTMNM	Marianas Trench Marine National Monument
MTRP	Marine Turtle Research Program
NASA	National Aeronautics and Space Administration
NCRMP	National Coral Reef Monitoring Program
NEPA	National Environmental Policy Act
NGO	Non-Governmental Organization
NHC	National Hurricane Center
NIST	National Institute of Standards and Technology

NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
Non-USAPI Region	Non-U.S. Affiliated Pacific Islands Region (Nauru, Honiara, Funafuti, Penrhyn, Kanton, Christmas, Rarotonga, Papeete, and Rikitea)
NOS	National Ocean Service
NPGO	North Pacific Gyre Oscillation
NSF	National Science Foundation
NWFSC	Northwest Fisheries Science Center
NWHI	Northwestern Hawaiian Islands
NWSFO HFO	National Weather Service Forecast Office, Hawaii Forecast Office
OA	Ocean Acidification
OAR	Office of Oceanic and Atmospheric Research
OCONUS	Outside Continental United States
ODBC	Open DataBase Connectivity
OFES	Ocean model For Earth Simulator
OPeNDAP	Open-source Project for a Network Data Access Protocol
ORS	Ocean Remote Sensing
OTDPS	Oracle Turtle Data Processing System
PacIOOS	Pacific Islands Ocean Observing System
PaCIS	Pacific Climate Information System
PDO	Pacific Decadal Oscillation
PEAC	Pacific ENSO Applications Climate Center
PED	Pound-net Escape Device
PFRP	Pelagic Fisheries Research Program
PI	Principal Investigator
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
PNA	Pacific North Atlantic Teleconnection Pattern
POES	Polar orbiting Operational Environmental Satellite
POPs	Persistent Organic Pollutants
PRD	Protected Resources Division
PRECI	Protected Resources Environmental Compliance Initiative
PRH	Pacific Region Headquarters

PRIAs	Pacific Remote Island Areas
PRSN	Puerto Rico Seismic Network
PSC	Pacific Services Center
PSG	Pacific Seabird Group
PTWC	Pacific Tsunami Warning Center
PYSO	PIFSC Young Scientist Opportunity
QA/QC	Quality Assurance/Quality Control
RAMP	Reef Assessment and Monitoring Program
RCUH	Research Corporation of the University of Hawaii
RGM	Reactive Gaseous Mercury
ROMS	Regional Ocean Modeling System
ROV	Remotely Operated underwater Vehicle
SCADA	Supervisory Control and Data Acquisition
SCEP	Statewide Cultural Extension Program
SEAFDEC	SouthEast Asia Fisheries Development Center
SEAPODYM	Spatial Ecosystem and Population Dynamics Model
SEEM	Social, Ecological, Economic, and Management
SFD	Sustainable Fisheries Division
SIS	Scientific Information Services
SL	Sea Level
SLP	Sea Life Park Hawaii
SOEST	School of Ocean and Earth Science and Technology
SOP	Standard Operating Procedure
SOS	Science on a Sphere
SPC	Secretariat of the Pacific Community
SSC	Scientific and Statistical Committee
SSH	Sea Surface Height
SST	Sea Surface Temperature
STEM	Science Technology Engineering and Math
STR	Subsurface Temperature Recorder
SWFSC	Southwest Fisheries Science Center
SWS	SeaWater System
TB	Terrabyte
TC	Tropical Cyclone
TDS	THREDDS-DODS Server

THREDDS	Thematic Real-time Environmental Distributed Data Services
TOAD	Towed Optical Assessment Device
TPPG	The Tropical Pacific Proving Ground
TPT	Tropical Pacific Testbed
TRP	Turtle Research Program
UAS	Unmanned Aerial System
UFA	United Fishing Agency
UH	University of Hawaii
UHM	University of Hawaii at Manoa
UHMC	University of Hawaii Marine Center
UHSLC	University of Hawaii Sea Level Center
USAF	United States Air Force
USAID	United States Agency for International Development
USAPI	U.S. Affiliated Pacific Islands (Guam, Palau, Yap, Pohnpei, Majuro, Kwajalein, and Pago Pago)
UV	Ultraviolet
VFP	Visual Fox Pro
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
WCSAM	World Conference on Stock Assessment Methods for Sustainable Fisheries
WHOI	Woods Hole Oceanographic Institution
WHOTS	WHOI Hawaii Ocean Time-series Station
WoRMS	World Register of Marine Species
WPacFIN	Western Pacific Fisheries Information Network
WPFMC	Western Pacific Fisheries Management Council
WPRFMC	Western Pacific Regional Fishery Management Council
WSR-88D	Weather Surveillance Radar-1988 Doppler

Appendix II Visiting Scientists

DATE	NAME/AFFILIATION	PURPOSE OF VISIT
05/19/13-05/28/13	Lennon Thomas Lead Rapporteur/Fisheries Analyst PIFSC/Western Pacific Regional Fishery Management Council Honolulu, HI	Participate in the International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean, Billfish Working Group Workshop and present billfish catch statistics and size-at-catch data for Pacific island country fisheries operating in the western central Pacific Ocean and eastern Pacific Ocean, as well as standardized catch-per-unit effort time series from the Pacific Blue Marlin caught in Taiwanese and Chinese long line fisheries and collaborate with scientists from JIMAR and PIFSC in Shizuoka, Japan.
06/03/13-06/07/13	Elliott Hazen Assistant Research Professor UC Santa Cruz Pacific Grove, CA	Present results on his FATE proposal on bluefin tuna heat increment of feeding events in the California current at the Larval Fish/Fisheries and the Environment (AFATE) Conference in Miami, Florida.
06/03/13-06/04/13	Wendy E.D. Piniak Knauss Sea Grant Fellow North Carolina State University Raleigh, NC	Visit Loggerhead Instruments to meet with engineers to complete the development and construction of the sea turtle acoustic deterrent devices (ADDs) in Sarasota, Florida.
06/17/13-06/19/13	Shang Chen Senior Scientist Research Center for Marine Ecology, First Institute of Oceanography Qingdao, Shandong, China	Present seminar on the “Marine Ecosystem Services and the Contribution from Marine Ecosystem to Economics” and to discuss collaborative research with the JIMAR staff about economics of fisheries initiative.
06/17/13-06/20/13	Murray Ford Lecturer University of Auckland Auckland, New Zealand	Discuss ongoing research topics with UHSLC and JIMAR students and staff to formalize several manuscripts in preparation.
07/04/13-07/23/13	Lennon Thomas Fisheries Research Analyst Western Pacific Regional Fishery Management Council Honolulu, HI	Participate in the 2013 International Scientific Committee (ISC) Plenary Meeting and associated Working Group Workshops, Shark Working Group, Billfish Working Group, and collaborating with scientists from JIMAR and PIFSC in Busan, Korea.

07/06/13-07/22/13	Michael Dreyfus Research Biologist Centro Regional de Investigaciones Pesqueras, Ensenada, Mexico	Participate in the 2013 International Scientific Committee (ISC) Plenary Meeting and associated Working Group Workshops in Busan, Korea.
07/06/13-07/22/13	Luis Fleischer Research Biologist Centro Regional de Investigaciones Pesqueras, La Paz, Mexico	Participate in the 2013 International Scientific Committee (ISC) Plenary Meeting and associated Working Group Workshops in Busan, Korea.
07/09/13-07/17/13	Claire Simeone Veterinarian The Marine Mammal Center Sausalito, CA	Collaborate and train with JIMAR and PIFSC staff to undertake field research to deploy National Geographic video cameras to monitor the diet and foraging behavior of Hawaiian monk seals.
07/22/13	Richard Carbone Chief Scientist Earth Observing Laboratory, NCAR Boulder, CO	Discuss collaborative research with Dr. Roger Lukas on Western Pacific warm pool SST structure occurrence of deep moist atmospheric convection/rainfall.
07/24/13	Erika Euker Hollings Scholar Student Intern College of William and Mary Williamsburg, VA	Participate in the 2013 JIMAR/PIFSC Summer Intern Symposium.
07/24/13	Alexandra Giametti Hollings Scholar Student Intern Eckerd College, Denver, CO	Participate in the 2013 JIMAR/PIFSC Summer Intern Symposium.
07/24/13-07/30/13	Wuyang Hu Professor University of Kentucky, Dept. of Agricultural Economics, Lexington, KY	Present seminar on the Consumer Preference and Demand for Fish: A Comparison between Coastal and Inland States and work with JIMAR economic staff on existing data and draft paper of the collaborative research.
08/12/13-08/23/13	Kalie'a Carlson Graduate Assistant University of Hawaii Honolulu, HI	Participate in the 2013 PIFSC Reef Assessment and Monitoring Program HA-13-04 to collect data to monitor near shore physical and ecological factors associated with ocean acidification and general water quality.
09/5/13-09/07/13	Gary Mitchum Professor/Associate Dean University of South Florida, College of Marine Sciences St. Petersburg, FL	Participate in the Fifth Session of the JCOMM Observations Coordination Group Meeting in Silver Spring, Maryland.

11/06/13-11/12/13	Melisa Menendez Garcia Researcher University of Santander, Environmental Hydraulic Institute Santander, Spain	Participate in the Sea Level Rise/Coastal Inundation “Extremes” Scenarios Workshop and collaborate with JIMAR scientists.
11/05/13-11/07/13	Kathleen McInnes Principal Research Scientist CSIRO Marine and Atmospheric Research-Aspendale Victoria, Australia	Participate in the Sea Level Rise/Coastal Inundation “Extremes” Scenarios Workshop.
11/06/13-11/07/13	Jayantha Obeysekera Chief Modeler South Florida Water Management District, West Palm Beach, FL	Participate in the Sea Level Rise/Coastal Inundation “Extremes” Scenarios Workshop.
11/06/13-11/07/13	Shari Gallop Research Fellow University of Southampton, European Way, National Oceanography Centre, Southampton, Hampshire, UK	Participate in the Sea Level Rise/Coastal Inundation “Extremes” Scenarios Workshop.
11/06/13-11/07/13	Nicholas Fauchereau Climate Scientist National Institute of Water and Atmospheric Research (NIWA) Auckland, New Zealand	Participate in the Sea Level Rise/Coastal Inundation “Extremes” Scenarios Workshop.
11/06/13-11/07/13	John Hunter Antarctic Climate & Ecosystems Cooperative Research Centre Tasmania, Australia	Participate in the Sea Level Rise/Coastal Inundation “Extremes” Scenarios Workshop.
11/06/13-11/07/13	David Jay Professor Portland State University, Civil & Environmental Engineering Portland, OR	Participate in the Sea Level Rise/Coastal Inundation “Extremes” Scenarios Workshop.
11/06/13-11/08/13	Andre Van der Westhuysen Research Oceanographer I.M. Systems Group Rockville, MD	Participate in the Sea Level Rise/Coastal Inundation “Extremes” Scenarios Workshop.

11/09/13-11/30/13	Robert Pomeroy Professor and Sea Grant Fisheries Extension Specialist University of Connecticut-Avery Point, Groton, CT	Facilitate and participate in the WPP-718 Arafura Sea Fisheries Ecosystem Management Planning Workshop in Bogor, Indonesia (11/09-11/15/13). Participate in the Regional Plan of Action (RPOA)-Illegal, Unreported, and Unregulated (IUU) Fishing Workshop, and meet with the Regional Development Mission Asia (RDMA) and the U.S. Department of Interior (DOI) in Kota Kinabalu, Malaysia (11/16-11/24/13). Participate in the South East Asia Fisheries Development Centre (SEAFDEC) Conference in Penang, Malaysia (11/24-11/30/13).
11/14/13-11/21/13	Ryan Rykaczewski Assistant Professor University of South Carolina, Marine Science Program Columbia, SC	Present work related to climate change and marine ecosystem responses at the JIMAR/PIFSC Symposium, and meet with JIMAR/PIFSC staff to discuss research.
11/18/13-11/19/13	Junjie Zhang Assistant Professor UC San Diego, School of International Relations and Pacific Studies La Jolla, CA	Present work related to climate change and fisheries management at the JIMAR/PIFSC Symposium.
11/18/13-11/20/13	Daniel Barshis Assistant Professor Old Dominion University, Department of Biological Sciences Norfolk, VA	Present work related to climate change and coral reef ecology at the JIMAR/PIFSC Symposium and conduct research collaboration meetings.
11/19/13	Nichole Price Project Scientist UC San Diego, Scripps Institute of Oceanography La Jolla, CA	Present work related to climate change and coral reef ecology at the JIMAR/PIFSC Symposium.
11/19/13	Joan Kleypas Scientist III National Center for Atmospheric Research, Climate and Global Dynamic Boulder, CO	Present work related to changes in coral reef ecosystems in response to climate change at the JIMAR/PIFSC Symposium.
12/04/13-12/05/13	Richard Carbone Science Advisor Earth Observing Laboratory, NCAR Boulder, CO	Participate in MJO research opportunities and continue collaborative research with various University of Hawaii faculty members.

12/09/13-12/13/13	Cleridy Lennert-Cody Stock Assessment Scientist Inter-American Tropical Tuna Commission, La Jolla, CA	Participate in the International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean (ISC) Shark Working Group CPUE Workshop, collaborate with JIMAR and PIFSC to analyze North Pacific blue shark fishery statistics, and conduct a provisional blue shark stock assessment.
01/02/14-01/07/14	Alexander Rabinovich Research Scientist Institute of Ocean Sciences Sidney, BC, Canada	Present his research and discuss various topics related to tsunami research with JIMAR and UH-SOEST researchers.
01/16/14-01/28/14	Robert Pomeroy Professor and Sea Grant Fisheries Extension Specialist University of Connecticut-Avery Point, Groton, CT	Assist in the facilitation of the Essential Ecosystem Approaches to Fisheries Management in Bangkok, Thailand.
01/27/14-02/02/14	Claire Simeone Veterinarian The Marine Mammal Center Sausalito, CA	Collaborate with JIMAR and PIFSC scientists to attach a National Geographic video camera to Hawaiian monk seals and serve as an attending veterinarian during the instrumentation procedures.
04/21/14-05/02/14	Ingrid Van Putten Researcher CSIRO Marine and Atmospheric Research-Hobart Tasmania, Australia	Collaborate on developing an approach to modeling the available socio-economic information for Guam and linking it to the current spatially explicit ecological model for the shallow coral reef ecosystems around Guam and give a seminar on her work in the Torres Strait and discuss socioeconomic assessment approaches.
02/02/14-02/04/14	Scott Large Research Associate Integrated Statistics, Inc. Woods Hole, MA	Present results on how to estimate ecosystem thresholds and how these thresholds can be used as ecosystem reference points in management.
02/22/14-03/07/14	Ron Hoeke Research Officer CSIRO Marine and Atmospheric Research-Aspendale Victoria, Australia	Discuss various topics related to ocean wave research with JIMAR and CRED researchers, and collaborate on historical wave model simulations.

04/07/14	Richard Carbone Science Advisor Earth Observing Laboratory, NCAR Boulder, CO	Present seminar entitled: "Revisiting the role of Sea Surface Temperature Structure in Tropical Oceanic Rainfall" and discuss with various University of Hawaii faculty future research opportunities related to seminar topic.
04/21/14-04/29/14	Guy Woppelmann Professor Universite de la Rochelle La Rochelle, France	Discuss common research interests related to global sea level rise and give a seminar on recent work.
04/22/14-04/24/14	E. Brendan Roark Assistant Professor Texas A&M University, Department of Geography Stable Isotope Geosciences Facility Ocean Drilling and Sustainable Earth Science (ODASES) College Station, TX	Participate in the Pacific Islands Deep Sea Coral Research Needs Workshop and provide expertise on deep corals in the Pacific Island's region.
04/22/14-04/23/14	Henry Reiswig Adjunct Professor University of Victoria, Biology Department Victoria, BC, Canada	Participate in the Pacific Islands Deep Sea Coral Research Needs Workshop and provide expertise on deep coral and sponges in the Pacific Island's region.
05/18/14-05/23/14	Steven Murawski Professor University of South Florida, College of Marine Science St. Petersburg, FL	Participate in Review Panel for the 2014 Stock Assessment Program Review.
05/19/14-05/23/14	Keith Criddle Professor University of Alaska Fairbanks, School of Fisheries and Ocean Sciences Fairbanks, Alaska	Participate in Review Panel for the 2014 Stock Assessment Program Review.
05/19/14-05/23/14	Yong Chen Professor University of Maine Orono, ME	Participate in Review Panel for the 2014 Stock Assessment Program Review.
06/02/14-06/06/14	Jeffrey Leis Honorary Research Professor University of Tasmania, Institute for Marine and Antarctic Research Hobart, Tasmania, Australia	Provide technical expertise in the morphological identification of pelagic eteline snapper specimens that were collected offshore of the Main Hawaiian Islands.

Appendix III Workshops and Meetings Hosted by JIMAR

Second JIMAR/PIFSC Symposium

Climate and Change

November 19, 2013

Koi Room, Imin Conference Center, UH Manoa

Melanie Abecassis	Matt Dunlap	Cindy Knapman
Tamoko Acoba	Guerin Earhart	Ingrid Knapp
Greta Aeby	Kainalu Ehman	Don Kobayashi
Francois Ascani	Julia Ehse	Hal Koike
Jake Asher	Aly El-Kadi	Dawn Kotowicz
Hatsue Bailey	Marie Ferguson	Darren Lerner
Michele Barnes-Mauthe	Carly Fetheroff	Ryan Longman
Dan Barshis	Eric Firing	Katie Lubarsky
Charles Roman Battisti	Chip Fletcher	Martha Maciasz
Ali Bayliss	Devon Francke	Jim Maroh
Courtney Beavers	Erik Franklin	Kaylyn McCoy
Charles Birkeland	Abby Frazier	R. Duncan McIntosh
Laura Brewington	Tobias Friedrich	Margaret McManus
Donna Brown	Giacomo Giorli	Mark Merrifield
Barb Bruno	Stuart Goldberg	Vanessa Michelou
Ian Caldwell	Whitney Goodell	Paula Misa
Pat Caldwell	Andrew Gray	William Misa
Glenn Carter	Kevin Hamilton	Charles Monciel
Felipe Carvalho	Darrell Herbert	Eric Mooney
Miguel Castrence	Kate Hanson	Camilo Mora
Yi-Jay Chang	Jeff Hare	Mike Mottl
Megumi Chikamoto	Marie Hill	Lucas Moxey
Rashid Chowdhury	Mark Hixon	Shikiko Nakahara
Anela Choy	Amee Hoover	Anna Neuheimer
Kassi Cole	Cindy Hunter	Marjorie Nieh
Adrienne Copeland	Matt Iacchi	Carl Noblitt
Kati Corlew	Melissa Iwamoto	Rachel Nunn
Courtney Couch	Krista Jaspers	Talia Oglione
Chelsie Counsell	Danielle Jayewardene	Tom Oliver
Fenny Cox	Phoebe Jefcoats	Kara Oshiro
Annick Cros	Yanli Jia	Minling Pan
Patrick Cross	Abby Johnson	Arlene Pangelinan
Pat Curry	Paul Jokiel	Francois Paquay
Rachel Dacks	T. Todd Jones	Michael Parke
Rusty Day	Chris Jury	Frank Parrish
Mark Deakos	Sam Kahng	Kelly Pearson
Gen Del Raye	Lauren Kaiser	Gadea Perez-Andujar
Jade Delevaux	Susan Kamei	Jeff Polovina
Chris Demarke	Keith Kamikawa	Noah Pomeroy
Ed DeMartini	Victoria Keener	Sam Pooley
Amanda Dillon	Jennifer Keller	Nichole Price
Gerard Dinardo	Jamie Kelso	Alex R.
Megan Dolores	EunJung Kim	Benjamin Richards
Mary Donovan	Jack Kittinger	Cristi Richards
Jeff Drazen	Joanie Kleypas	Monica Risso

(Second JIMAR/PIFSC Symp.)

Kuulei Rodgers	Kosta Stamoulis	Bernardo Vargas-Angel
Andrew Rollo	Dieter Stelling	Sarah Vasconcellos
John Rooney	Yuko Stender	Luis Vega
Megan Ross	Sam Stevenson	Roberto Venegas
Andrew Rossiter	Rhonda Suka	Oliver Vetter
Ryan Rykaczewski	Megan Sundberg	William A. Walsh
Dana Sackett	Dione Swanson	Maya Walton
Kelly Sage	Soltan Szabo	Haiying Wang
Jane Schoonmaker	Jamie Sziklay	Mariska Weijerman
Robert Schroeder	Darryl Tagami	Kevin Weng
Brett Schumacher	Brian Taylor	Matthew Widlansky
Francois Seneca	Lennon Thomas	Raphael Williams
Alessandra Shea	Axel Timmerman	Christopher Winn
Eileen Shea	Molly Timmers	Kevin Wong
John Sibert	Travis Thyberg	Annie Yan
Nyssa Silbiger	Jackie Troller	Charles Young
Celia Smith	Chen-Te Tseng	Chelsey Young
Craig Smith	Nikolai Turetsky	Zuojin Yu
Katie Smith	Ryan Ueunten	Junjie Zhang
Emilia Sogin	Kyle Van Houtan	
Pavica Srsen	Matthew Vandersande	

**AD Model Builder Developer Meeting
September 18-22, 2013
Marine Research Institute &
University of Iceland
Reykjavik, Iceland**

Casper Berg
Höskuldur Björnsson
Mollie Brooks
Bjarki Elvarsson
David Fournier
Chris Grandin
Birgir Hrafnkelsson
Kasper Kristensen
Arni Magnússon
Steve Martell
Anders Nielsen
Finlay Scott
Inna Senina
Hans Skaug
Gunnar Stefánsson
Ben Stevenson
Athol Whitten

**ADMB Executive Committee Meeting
May 27-30, 2014
Mandarin Room, Imin Conference Center,
UH-Manoa**

Johnoel Ancheta
Jim Cannon
James Ianelli
Steve Martell
John Sibert
Paul Wessel

Participation via Skype:
Dave Fournier
Kasper Kristensen
Anders Nielsen
Arni Magnusson
Hans Skaug
James Thorson
Athol Whitten

Appendix IV JIMAR Personnel

Information as of June 30, 2014

Category	Number	Unknown	High School	Associates	Bachelors	Masters	Ph.D.
Research Scientist	20	0	0	0	0	0	20
Visiting Scientist	0	0	0	0	0	0	0
Postdoctoral Fellow	0	0	0	0	0	0	0
Research Support Staff	118	0	5	6	71	34	2
Administrative	13	0	0	1	9	2	1
Undergraduate Students	15	0	15	0	0	0	0
Graduate Students	21	0	0	0	10	11	0
Received less than 50% NOAA support	2	0	0	0	0	0	2
Total	189	0	20	7	90	47	25
Located at Lab (include name of lab)	3 - PMEL 9 - PIRO 120 - PIFSC 3 - ESRL						
Obtained NOAA employment within the last year	2						
Postdoctoral Fellows and Students from Subgrantees	Postdocs: 0 Students: 0						

Appendix V Awards

Hing Ling Chan

- 2013 NOAA General Counsel Award: General Team Awards (Shallow Set Longline Fishery Team)

Adrienne Copeland

- First Place Award, Best Student Presentation in Animal Bioacoustics, 135th Meeting of the Acoustical Society of America, May 5-9, 2014, Providence, Rhode Island

David A. Fournier, John R. Sibert, et al.

- Jointly received the Optimization Methods and Software Editorial Board's 2013 Charles Broyden Prize for the paper Fournier et al (2013) "AD Model Builder: Using automatic differentiation for statistical inference of highly parameterized complex linear models". This prize is awarded to the best paper published in the journal from the previous year and the distinction that it is made freely available.
- Jointly received the Optimization Methods and Software Editorial Board's 2014 Editor's Choice Award for the paper Fournier et al (2013) "AD Model Builder: Using automatic differentiation for statistical inference of highly parameterized complex linear models". This award winning paper is currently listed as the most read for the journal and is ranked second for most cited.

Marie Hill

- Nominee for 2013 RCUH Employee of the Year

Jennifer Metz Kane and Kim Maison, NOAA Fisheries PIRO Green Team

- Runner-up: Energy and Environmental Stewardship Award. Awarded by Sustainable Energy & Environmental Programs, Department of Commerce, April 2014. This award recognizes the team's creative and successful efforts to create a more sustainable environment at work.

Megan Moews

- 2013 NOAA PIFSC Team Member of the Year

Ashley Tomita

- Nominee for 2013 RCUH Employee of the Year

Appendix VI Graduates

Jamie Gove, PhD

“Biological Physical Interactions in Pacific Coral Reef Ecosystems”

Jennifer Metz Kane, MS

“Needs Assessment: Hawaiian Monk Seal Outreach and Education Programming for the Hawai‘i Visitor Community”

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.

		FY14
Peer-Reviewed	JIMAR Lead Author	18
	NOAA Lead Author	7
	Other Lead Author	21
Non-Peer-Reviewed	JIMAR Lead Author	51
	NOAA Lead Author	9
	Other Lead Author	3

