

JIMAR

Joint Institute for Marine and Atmospheric Research



JIMAR

Annual Report for Fiscal Year 2007

For Cooperative Agreement NA17RJ1230

Thomas A. Schroeder, PhD
Director

Joint Institute for Marine and Atmospheric Research
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Introduction

The Joint Institute for Marine and Atmospheric Research (JIMAR) is a cooperative enterprise involving the National Oceanic and Atmospheric Administration (NOAA) and the University of Hawaii (UH). JIMAR research spans six themes all aligned with the NOAA strategic plan and the University's Indo-Pacific mission. The relevant themes are equatorial oceanography, tsunamis and other long-period ocean waves, climate, tropical meteorology, fisheries oceanography, and coastal research. The scope of these efforts spans the US affiliated Pacific Islands as well as the broader Pacific and Indian Ocean basins. JIMAR brings together research scientists from NOAA line offices, UH, and the global community to conduct research in the broad interests of NOAA. NOAA line offices collaborating in the JIMAR program include the Environmental Research Laboratories (especially Pacific Marine Environmental Lab [PMEL], Atlantic Oceanic and Meteorological Lab [AOML], and Earth System Research Laboratory [ESRL]), National Marine Fisheries Service (NMFS), National Weather Service (NWS), National Environmental Satellite and Data Information Service (NESDIS), and National Ocean Service (NOS). JIMAR also supports student development, outreach, and special training programs. JIMAR intends to be the lead agent for all NOAA research in the Indo-Pacific region and to maintain standards of accomplishment expected of the School of Ocean and Earth Science and Technology (SOEST) at the UH.



Thomas Schroeder, Director

Our mission and vision statements are:

Mission: To conduct the research necessary to properly understand and predict the changes in the Indo-Pacific environment and to conserve and manage coastal and marine resources in the U.S.-affiliated Pacific Islands with a special emphasis on the Hawaiian Islands, for purposes of meeting the Nation's economic, social and environmental needs in these regions.

Vision: To support NOAA's operational and scientific move into the 21st century while recognizing the special character, vulnerabilities, and the role of the Pacific-islands in demonstrating the link between our planet's environment and the global and regional economies.

FY 2007 constituted the 30th year of JIMAR. The expansion of fisheries and coastal research related to the development of the Northwest Hawaiian Islands Marine National Monument has continued. As stated previously (FY 2006 report) in spite of the uncertainty in our future, we have continued to pursue recommendations of our last review. Our collaborative efforts with Hawaii Sea Grant have evolved and we now are facilitating a new proposal to the NOAA Climate Program Office bringing together economists, planners, and hydrologists as well as JIMAR climate scientists to develop management tools for insular urban water supply in a changed climate. JIMAR scientists have also been major contributors to the recently-funded Hawaii Regional Ocean Observing System project, housed within SOEST. We are considering requests from international agencies to provide tsunami training programs and the Director has worked closely with the University administration on emergency (natural disaster) preparedness and curriculum development.

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. He 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 University of Hawaii has undergone a cumbersome reorganization revolving around the re-establishment of a Manoa Chancellor. The President of the University has delegated his responsibilities as Chair of the Administrative Board to the Chancellor.

The Director manages day-to-day operations through the administrative staff (fully-supported by the Cooperative Agreement and returned indirect cost funds), Program Managers (Pelagic Fisheries Research Program [PFRP]), and faculty PI/Directors (University of Hawaii Sea Level Center [UHSLC]). A Council, elected among the Fellows, advises the Director on major expenditures on visiting scientists as well as selection of new and renewed

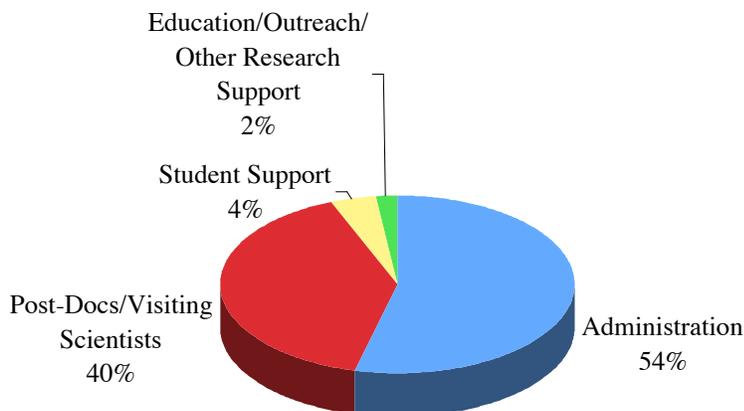
Fellows. The list of current Fellows and Council members are provided below. In light of the current uncertainty over the future of JIMAR under the recompetition of the Cooperative/Joint Institutes, we have decided to continue all existing Fellows for the next biennium and synchronize the appointment periods which had been allowed to drift with arrivals and departures of individuals and development of new themes. In FY 2007, we made one replacement appointment for a NOAA Fellow. 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. Eddie Bernard (PMEL), Dr. Steven Bograd (PFEL), Dr. Richard Brill (NMFS), 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 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, Dr. Akimasa Sumi, and Dr. Michio Yanai.

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.

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

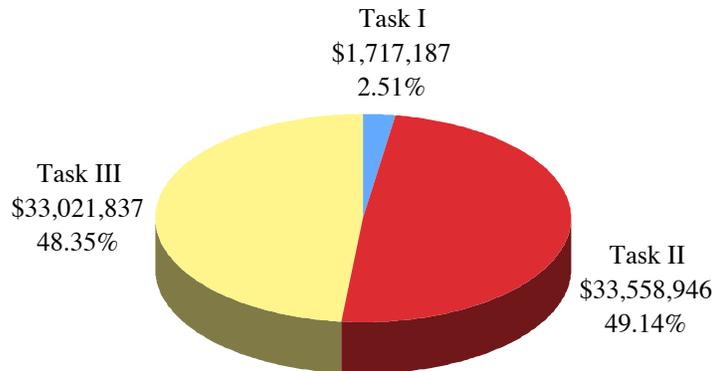
Distribution of JIMAR's Task I NOAA Funding by Activity



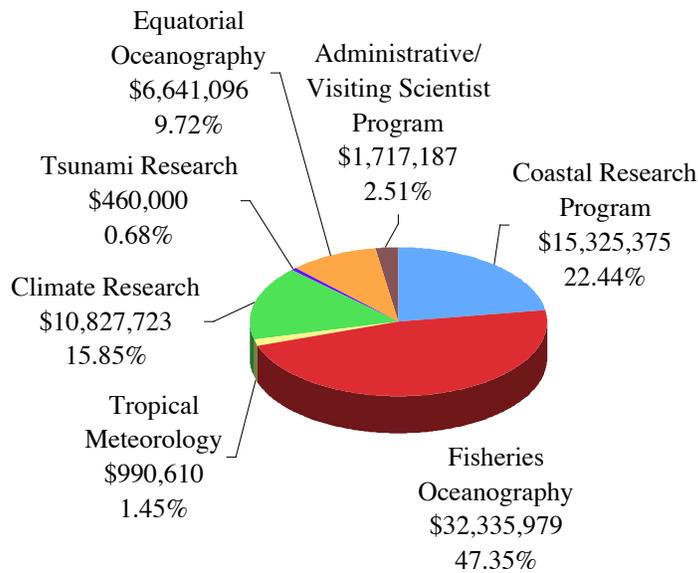
JIMAR science comprises several dozen subprograms. In the aftermath of the Boxing Day tsunami, JIMAR has continued to play a leadership role in the development of an Indian Ocean tsunami warning network. The UH Sea Level Center had developed tide gages which are capable of delivering near-real time high temporal resolution information. The Pacific Tsunami Warning Center has used our Pacific gages as part of their warning network. NOAA funds have been supplemented by grants from the Asia Disaster Preparedness Center and the United Nations.

PFRP has made a significant contribution to the evaluation of archival tag information. Archival tags have been employed on large marine animals for 20 years. One concern has been adequate geolocation of the data retrieved. PFRP scientists have developed a statistical approach, which models light variation as a function of time of day and geographic location. The model produces two geolocations per day. Testing on simulated data, mooring studies, and real deployments have shown the model to be robust. This powerful tool makes it possible to reconstruct the paths of marine animals throughout the oceans.

**Distribution of JIMAR's NOAA Funding by Task
(FY 2002-2007)**



**Distribution of JIMAR's NOAA Funding by Theme
(FY 2002-2007)**



Accomplishments for Fiscal Year 2007

Equatorial Oceanography

JIMAR Senior Fellows are actively involved in equatorial oceanographic research. Current activities include current profiling, sea level monitoring, equatorial circulation studies and dynamic modeling.

The Joint Air-Sea Monsoon Interaction Experiment: Upper Ocean Survey (JASMINE)

P.I.: Peter W. Hacker [Roger B. Lukas and Eric Firing]

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

NOAA Goal(s)

- To understand climate variability and change to enhance society's ability to plan and respond

Purpose of the Project

JASMINE has been a collaborative pilot study of air-sea fluxes, convection and the upper ocean response to atmospheric forcing in the tropical eastern Indian Ocean. The purpose of the field work was to obtain high-quality upper ocean, air-sea flux and atmospheric data sets focusing on the onset phase of the southwest monsoon and its subsequent evolution over the seasonal cycle. The analysis phase focused on documenting the role of intraseasonal processes.

Progress During FY 2007

In accord with project plans and funding, the research and publication of results from JASMINE has been completed. A final activity over the past year has been to use the JASMINE results to help plan and implement the sustained observations for the Indian Ocean via participation in the CLIVAR Indian Ocean Panel.

Penetration of Anthropogenic CO₂ in the Oceans Based on Analysis of Recent WOCE/JGOFS/OACES Carbon Data Using the Remineralization Ratios Obtained by the New Three-End-Member Mixing Model

P.I.: Yuan-Hui Li [Tsung-Hung Pwng]

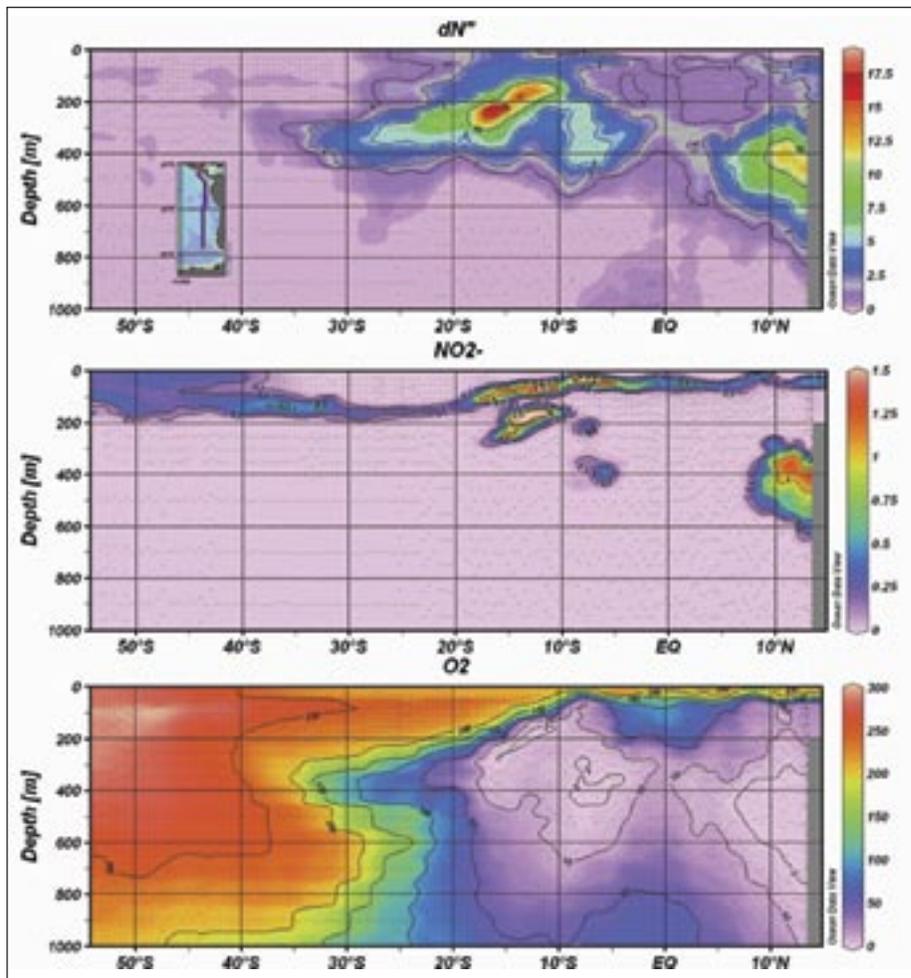
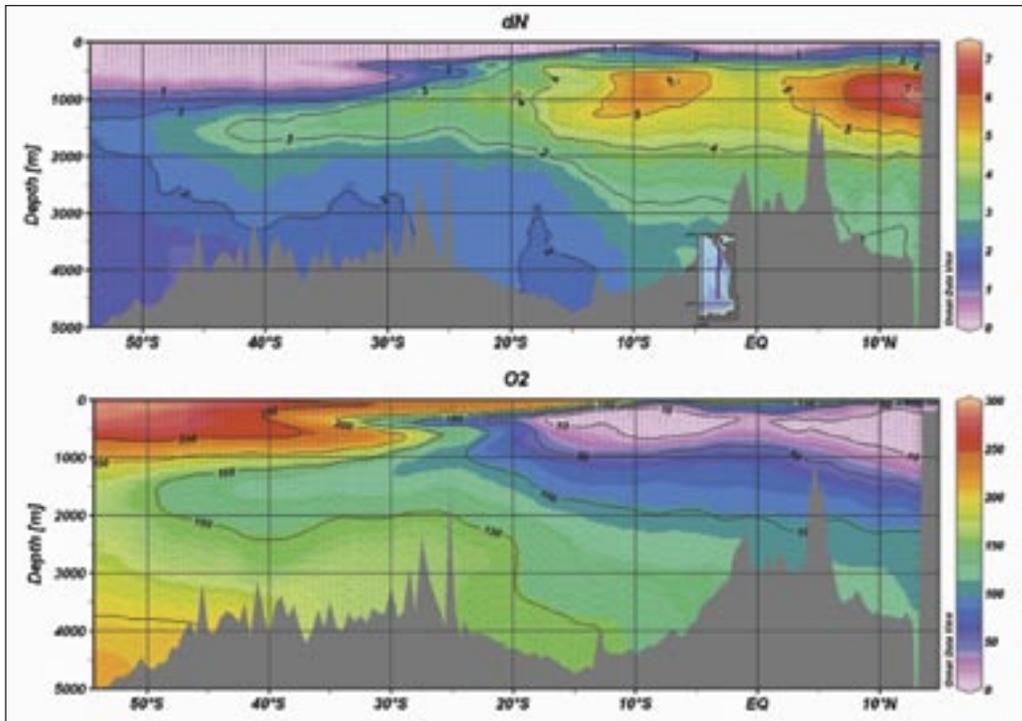
NOAA Office (of the primary technical contact): Atlantic Oceanographic and Meteorological Laboratory

NOAA Goal(s)

- To understand climate variability and change to enhance society's ability to plan and respond
- To serve society's needs for weather and water information

Purpose of the Project

Use the three-end-member mixing model on the complete set of newly synthesized and quality assured WOCE/JGOFS and NOAA global CO₂ survey data to re-evaluate the remineralization ratios throughout the whole ocean basins. The objective of this task is to obtain new values of remineralization ratios for the global oceans and to verify that these ratios do vary systematically among ocean basins as our preliminary results have indicated (Li and Peng, 2002). An additional task is to develop a new method for estimating the penetration of anthropogenic CO₂ in the ocean. The objective of this task is to include the variable remineralization ratios for estimating the anthropogenic CO₂ inventory in the ocean and to provide information from an alternative method for comparison with that derived from the popular ΔC^* method.



(above) Contours of nitrate deficit by partial nitrification (dN ; $\mu\text{mol}/\text{kg}$) and O_2 ($\mu\text{mol}/\text{kg}$) concentrations in a latitude-depth space for the cruise p19 in the eastern Pacific Ocean.

(left) Contours of nitrate deficit by denitrification (dN^* ; $\mu\text{mol}/\text{kg}$), nitrite ($\mu\text{mol}/\text{kg}$), and O_2 ($\mu\text{mol}/\text{kg}$) concentrations in a latitude-depth space for the cruise.

Progress During FY 2007

The model to separate the nitrate deficits produced by the denitrification (dN'') and by the partial nitrification processes (dN ; Li et al, 2006) was applied to the Pacific WOCE data from the cruises p19 and p21E, which traversed the oxygen minimum zones north and south of the eastern equatorial Pacific Ocean. Results are consistent with those obtained from the Arabian Sea. Two dN'' maxima coincide with two nitrite maxima and two O_2 minima in the north-south cross sections of those parameters. Two dN maxima coincide with nitrate or phosphate maxima, and lie within the lower oxycline below the oxygen minimum zones. The dN production within the upper oxycline is appreciable, but not as prominent as in the lower oxycline. The dN'' and dN maxima are in direct contact with the continental shelf and slope sediments, indicating some nitrate deficit inputs from sediments. The nitrate deficit in the bottom water of the Bering Sea is confirmed to be sediment inputs.

University of Hawaii Sea Level Center

P.I.: Mark A. Merrifield

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

NOAA Goal(s)

- To understand climate variability and change to enhance society's ability to plan and respond
- To serve society's needs for weather and water information

Purpose of the Project

The University of Hawaii Sea Level Center (UHSLC) collects, processes, analyzes, and distributes tide gauge data from around the world in support of climate and oceanographic research. The UHSLC focuses on the collection of high frequency measurements, sampled at least every hour, that are available in near-real time usually via geostationary satellites. The center complements the Permanent Service for Mean Sea Level (PSMSL), which is the primary archive for historic monthly-averaged time series of sea level. Data are provided to the UHSLC from ~ 450 stations maintained by 65 international agencies. In addition, the UHSLC directly assists host countries in the maintenance and operation of over 50 stations, including 7 stations with colocated GPS for monitoring land motion at the tide gauge. The UHSLC is an active contributor to the Intergovernmental Oceanographic Commission Global Sea Level Observing System (GLOSS), and participates in operational and scientific oversight through the GLOSS Group of Experts. The UHSLC is primarily concerned with the implementation of the Global Climate Observing System (GCOS) sea level network, a subset of GLOSS designated as particularly important for climate research.

Progress During FY 2007

New station installations and upgrades of existing OCO stations during FY2007 were made primarily in the Indian Ocean in support of the implementation of the Indian Ocean Tsunami Warning System (IOTWS). All but 3 involved substantial financial support from co-sponsoring agencies (the Intergovernmental Oceanographic Commission, IOC; the Asian Disaster Preparedness Center, ADPC; and USAID). Our ability to accomplish these installations at low costs to the co-sponsors was due to our core operational support provided by OCO. In turn, our involvement in this implementation benefited the aims of the global sea level network and OCO by ensuring that all stations are suitable for sea level monitoring as well as tsunami warning. All of these sites are either in the GLOSS Core Network or they will be proposed as new additions to the network at the next GLOSS meeting. In addition, we intend to recommend many of these sites as replacements for nearby GCOS stations that have a low probability of becoming operational. Another of measure of progress during FY2007 is the increase in the number of fast delivery stations reporting to the UHSLC from 171 stations to 216 stations. We had hoped to install gauges in Argentina and Korea during FY2007. Both were delayed due to logistical issues - for Argentina we are still trying to find a way to avoid import duty charges on the equipment, which would be prohibitively high; and in Korea the agency NORI has asked us to hold off until October 2008 for the installation.

From the research perspective, we have been involved in estimates of global sea level rise from tide gauges (presented as a poster at the Jason Science Working Team meeting in Hobart and soon to be submitted as a manuscript), assessing ground motion at tide gauges using InSAR and GPS technologies, and we are preparing two papers on high frequency extreme events observed over the global network.

Tsunami Research

JIMAR originated from the Joint Tsunami Research Effort and has maintained a long collaboration with PMEL in tsunami research. JIMAR scientists have been heavily involved in tsunami hazard mapping and preparedness throughout the Pacific basin with special emphasis on Hawaii. JIMAR scientists have collaborated with PMEL, the Pacific Disaster Center and Hawaii State Civil Defense.

Archiving and Analysis of High-Resolution Sea Level Data from the Hawaiian Islands

P.I.: Douglas S. Luther

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

NOAA Goal(s)

- To serve society's needs for weather and water information

Purpose of the Project

Our purpose is to acquire and archive, in an electronically accessible location, a database of high quality, rapidly-sampled ($\Delta t \leq 6$ minutes) sea level observations from existing Hawaiian shoreline gauges maintained by NOAA agencies. This sea level dataset is publicly available, via the Internet, for both practical applications and research. The archive was originally established with NOAA funding in 1997 to ensure a consistent repository for rapidly-sampled sea level in the Hawaiian Islands for the study of weak tsunamis and related infra-gravity wave signals (including edge waves and harbor resonances) at periods of 1-10 minutes. Beyond studies of these shorter period gravity wave phenomena, the dataset will provide input to the nascent Hawaii-Pacific Ocean Observing and Information System (HI-POOIS) and will assist investigations into the dynamics of ocean phenomena such as internal and external tides (0.5 to 1 day periods), coastal trapped internal waves (1.5 to 5 days period), wind-forced mesoscale variability (3-60 days period), mesoscale eddies (60 to 180 days period), and, as the dataset length increases, interannual variability around the Hawaiian Is. Sea level data from the large majority of the gauges we access would otherwise be lost without this archiving activity; that is, the data is not saved by the agency responsible for maintaining the gauges since data archiving is not a mission of the agency. Therefore, this data rescue 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.



Mary Luther inspects the PTWC sea level gauge in Hanalei Bay, Kauai, Hawaii, which provides data for the Archive of Rapidly Sampled Hawaiian Sea Level (ARSHSL).

Progress During FY 2007

Per the plans for this past year, the Archive of Rapidly-Sampled Hawaiian Sea Level (ARSHSL) was maintained on the World Wide Web (<http://www.soest.hawaii.edu/oceanography/dluther/arshsl.html>) by D. Luther and M.

Luther, in collaboration with the NOAA-sponsored UH Sea Level Center. Data have been automatically and, if necessary, manually downloaded daily, via Internet and telephone links, from 6 NOS and as many as 15 PTWC gauges dispersed around the five main islands of Hawaii in 17 harbors (four harbors have multiple gauges). The data, as originally sampled at 1, 60, 120, or 360 second intervals, 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 users ranging from UH graduate students to government civil engineers, and even PTWC. The applications have ranged from hydrogeology to gravity wave studies to dock design. New users in the past year focused on harbor seiches and tsunamis. 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. Archiving activities required most of the budgeted effort this past year. Additional “value added” enhancement activities accomplished this past year include updating files of concatenated, quality-controlled, hourly-averaged sea level data for low-frequency studies, and improving the automated procedures for acquiring the 1-second data from 3 PTWC gauges.

Gauge maintenance continued to be our greatest concern this past year, since we rely on other NOAA agencies for such activity. Of the 15 PTWC gauges, currently 7 are down, 2 for over a year. We are no longer receiving data from four out of seven harbors on the Big Island. Big Island gauges are more difficult to maintain due to travel constraints.

Inverse Algorithm for Tsunami Forecast

P.I.: Thomas A. Schroeder [Kwok Fai Cheung]

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

NOAA Goal(s)

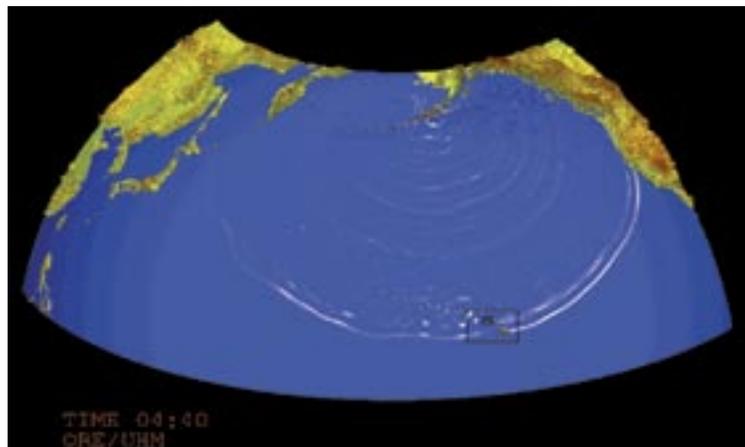
- To understand climate variability and change to enhance society’s ability to plan and respond

Purpose of the Project

The project develops an inverse algorithm to forecast far-field tsunamis based on near-field tsunami data. The algorithm requires a database of pre-computed mareograms. Earlier work of the PI developed and verified the mareogram databases for the Alaska-Aleutian source and Japan-Kuril-Kamchatka regions. The FY07 effort focused on the Peru-Chile source regions and an improvement of the inverse method to describe rupture propagation.

Progress During FY 2007

Extended the inverse algorithm to describe rupture propagation. This is a major improvement to the earlier inverse approach developed by the PI and used by NOAA PMEL that assumes instant rupture of the entire fault. The new algorithm captures the rise time and rupture propagation of large tsunamigenic earthquakes and provides a much better description of the resulting tsunamis. The Oceanographic Office of the Chilean Navy is implementing this latest inverse algorithm for tsunami warning.



Simulation of the 1946 Alaska Tsunami in the Pacific Basin.



Simulated inundation from the 1946 Alaska Tsunami at Oahu North Shore.

Completed the mareogram database for the Peru-Chile source region. Together with the earlier work, this provides a complete tsunami forecast system for the three source regions that poses the highest risk to Hawaii.

University of Hawaii Sea Level Center—Tsunami Research

P.I.: Mark A. Merrifield

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

NOAA Goal(s)

- To understand climate variability and change to enhance society's ability to plan and respond
- To serve society's needs for weather and water information

Purpose of the Project

The University of Hawaii Sea Level Center (UHSLC) collects, processes, analyzes, and distributes tide gauge data from around the world in support of climate and oceanographic research. The UHSLC focuses on the collection of high frequency measurements, sampled at least every hour, that are available in near-real time usually via geostationary satellites. The center complements the Permanent Service for Mean Sea Level (PSMSL), which is the primary archive for historic monthly-averaged time series of sea level. Data are provided to the UHSLC from ~450 stations maintained by 65 international agencies. In addition, the UHSLC directly assists host countries in the maintenance and operation of over 50 stations, including 7 stations with colocated GPS for monitoring land motion at the tide gauge. The UHSLC is an active contributor to the Intergovernmental Oceanographic Commission Global Sea Level Observing System (GLOSS), and participates in operational and scientific oversight through the GLOSS Group of Experts. The UHSLC is primarily concerned with the implementation of the Global Climate Observing System (GCOS) sea level network, a subset of GLOSS designated as particularly important for climate research.

Progress During FY 2007

The UHSLC continues to provide technical and scientific support to the Indian Ocean Tsunami Warning System (IOTWS) on behalf of the NOAA Office of Climate Observations, USAID, the UNESCO Intergovernmental Oceanographic Commission (IOC), and the Asian Disaster Preparedness Center (ADPC). The water level component of the IOTWS has been fortified significantly with the addition of 25 tide gauge stations by the UHSLC in Indonesia, Thailand, Malaysia, the Philippines, Myanmar, Bangladesh, Sri Lanka, the Maldives, Oman, Kenya, Tanzania, the Seychelles, Mauritius, and Diego Garcia. The stations provide 1-minute data every 15 minutes to regional and national tsunami warning centers via regional meteorological satellites. The data are available to all IOTWS members via the GTS. In addition to contributions made at the station operations level, the UHSLC provides technical advice on the design and implementation of the overall IOTWS. A UHSLC Researcher co-chairs the IOC/IOTWS-I Intersessional Working Group for Sea Level that determines the specifications and locations for the IOTWS CORE network of in situ sea level stations. The UHSLC Director chairs the Global Sea Level Observing System (GLOSS) Group of Experts, which has played an active role in coordinating international partners during the build-up of the IOTWS water level network. Plans are underway to reduce the data latency at Indian Ocean stations located near tsunami generation sites from 15 to 1 minute using INMARSAT. The UHSLC will take part in several more station upgrades in the Indian Ocean, however, attention during the coming year will focus more on the Pacific Tsunami Warning System. The PTWS has identified high priority stations near tsunami generation zones that require more frequent transmissions via GOES satellites. The UHSLC has upgraded 3 of these stations during the past year to 5-minute transmission cycles, and an additional 10 stations will be upgraded during 2008. UHSLC tsunami research has included an analysis of tsunami wave forms recorded at tide gauge sites, particularly contributions associated with local basin resonances.

Climate Research

JIMAR's climate theme evolved in concert with the equatorial oceanography theme. The focus was the El-Nino Southern Oscillation (ENSO) phenomenon in all its oceanic and atmospheric aspects. JIMAR scientists continue to study fundamental aspects of climate and climate variability. The UH Sea Level Center is a major contributor to NOAA's climate program. Our Pacific ENSO Applications Center (PEAC) has continued the JIMAR tradition by developing interdisciplinary approaches to the study of climate impacts and development of experimental forecasts. Partners in PEAC include the NWS Pacific Region, the University of Guam, the Pacific Basin Development Council and NOAA Research through its Climate Program Office.

Compilation, Digitization, and Use of Hawaii State Rainfall Records

P.I.: Pao-Shin Chu

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

NOAA Goal(s)

- To protect, restore, and manage the use of coastal and ocean resources through ecosystem-based management
- To serve society's needs for weather and water information

Purpose of the Project

To compile and digitize historical, monthly rainfall records archived at the Hawaii State Climate Office (HSCO). The state data comes from numerous volunteer observers such as sugar plantations, ranchers, county water companies, and others. The state data are unrelated to the NOAA/NCDC network. Metadata describing changes in the way the observations are taken from the handwritten records have been documented.

Progress During FY 2007

All state gages on the Islands of Hawaii have been inventoried. All digitized data have been entered onto the spreadsheets.

Development of Real-Time Precipitable Water Capability Using the Global Positioning System

P.I.: James H. Foster

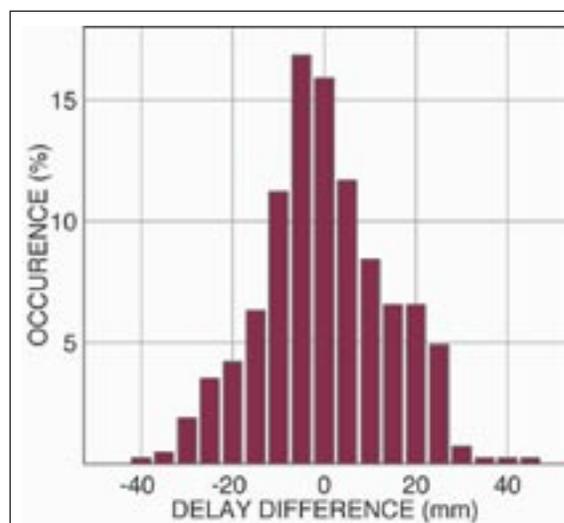
NOAA Office (of the primary technical contact): Environmental Research Laboratory/Forecast Systems Laboratory

NOAA Goal(s)

- To serve society's needs for weather and water information

Purpose of the Project

The project objective is to maximize earth-based GPS resources. It has two primary tasks; the first is to develop, operate and maintain the SkyNet network of GPS meteorology stations in Hawaii, upgrading equipment and processing approach as necessary. The second strand



Histogram of residual differences between GPS estimated and MM5 predicted atmospheric delays for 17 dates, and up to 30 GPS sites, between Jan 2003 and Apr 2005.

is to undertake research that can be applied to maximize the utility of GPS derived integrated precipitable water vapor data to the operational meteorological and climatological community.

Progress During FY 2007

The SkyNet network operated continuously during FY2007, with minor site outages due to equipment failure. The processing software was upgraded to a newer release version, which should improve the quality of the solutions. The GPS site HNLC located at the Honolulu tidegauge site was added to the SkyNet network, and now provides estimates of tropospheric delay hourly. A Memorandum of Understanding with the National Weather Service has been prepared in order to complete the broad-band internet connection of GPS site LIHU located at the Lihue NWS office and allow it to provide hourly data files and be fully incorporated into SkyNet. This process has been delayed slightly by the need to resolve legal issues relating to the installation and operation of equipment on NWS premises. Four new sites PGF1, PGF2, PGF4 and PGF6, located on the south flank of Kilauea Volcano, within Hawaii Volcanoes National Park on the island of Hawaii have been upgraded to provide hourly data, and have been added to the SkyNet processing. These additions bring the number of sites providing hourly estimates of tropospheric delay in the islands to 20.

A geodetic grade GPS receiver and a water-level sensor were installed on the University of Hawaii research vessel Kilo Moana for a research cruise from 08 Dec 2006 to 20 Dec 2006. The data collected during this cruise will be used to test possibility of using ships as GPS IPWV sensor platforms. By adapting and tuning the processing software used for high precision kinematic GPS position solutions it should be possible to get IPWV with sufficient accuracy for weather modeling.

Our paper “Precipitable water and the lognormal distribution” exploring the statistics of water vapor distributions over was published in the Journal of Geophysical Research. In addition a paper “Mitigating atmospheric noise for InSAR using a high resolution weather model” was published in Geophysical Research Letters. In this paper we explored the possibility of modeling the artifacts caused by water vapor in the atmosphere in order to improve the resolution of space-based radar images of ground motion.



The Kilo Moana with a radar tidegauge installed provide one of the data streams needed to explore the possibility of using ships as a platform for GPS meteorology.

Effects of the Andes on Eastern Pacific Climate

P.I.: Shang-Ping Xie [Yuqing Wang]

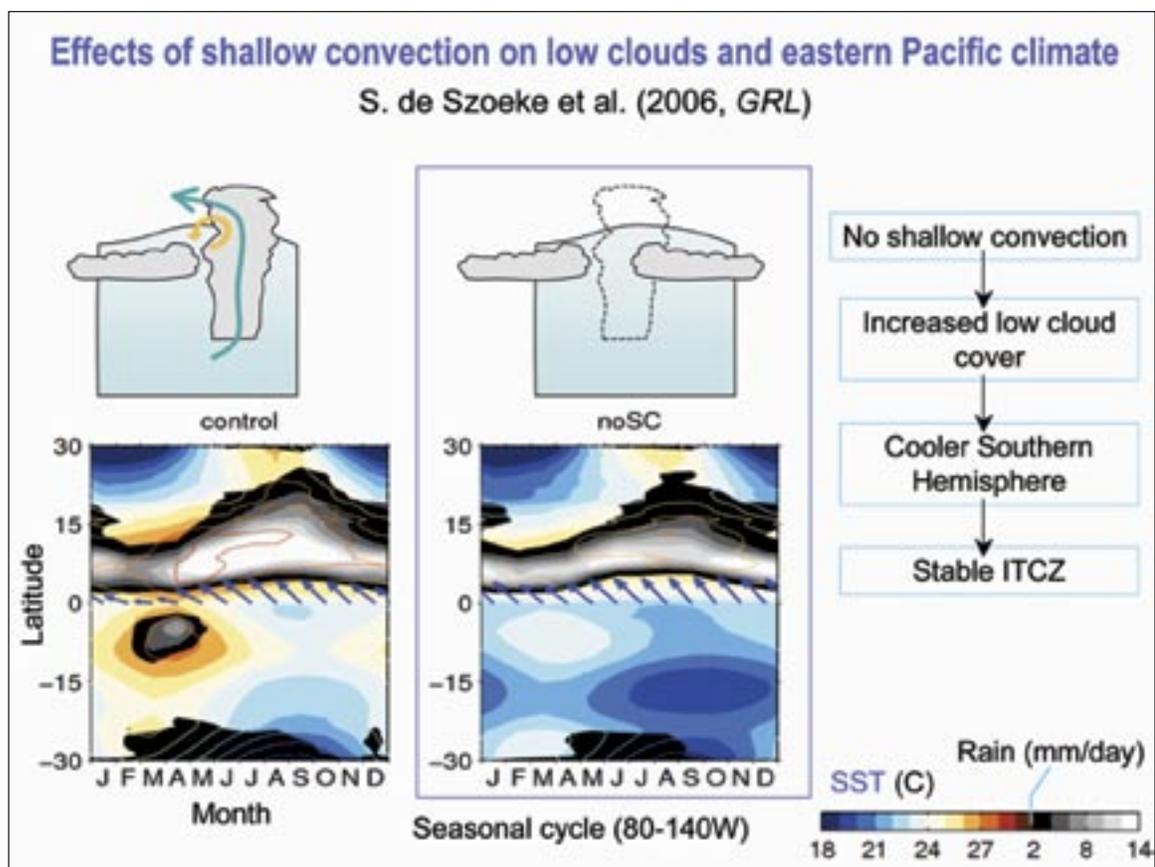
NOAA Office (of the primary technical contact): Climate Program Office

NOAA Goal(s)

- To understand climate variability and change to enhance society’s ability to plan and respond

Purpose of the Project

The eastern equatorial Pacific is home to El Nino and Southern Oscillation, but the mean state and the seasonal cycle of its climate are still poorly simulated in state-of-the-art climate models. The goal of this study is to better understand and simulate eastern Pacific climate in general and the effect of the steep Andes in particular.



Time-latitude sections of sea surface temperature (color shade in °C) and precipitation (gray shade in mm/day) in the eastern tropical Pacific in the control simulation (left panel) and a run in which shallow cumulus convection is artificially turned off (middle). Without shallow convection, cloudiness increases especially south of the equator, cooling the ocean there and thereby strengthening the meridional asymmetry with the rain band never moving south of the equator.

Progress During FY 2007

A regional ocean-atmosphere coupled model (ROAM) has been applied to study eastern tropical Pacific climate. The ROAM simulates the observed climate quite realistically, including the northward displaced intertropical convergence zone, an equatorial cold tongue and their annual cycle. The model has been used to study the formation of a sharp sea surface temperature front north of the equator, and the effects of shallow cumulus convection in the Southeast stratus cloud region. State-of-the-art climate models have long suffered systematic errors in simulating eastern Pacific. We have evaluated more than a dozen models participating in the IPCC Fourth Assessment Report.

Enhancement of Data and Research Activities for Climate Studies at the International Pacific Research Center

P.I.: Julian P. McCreary, Jr. [Peter W. Hacker and James T. Potemra]

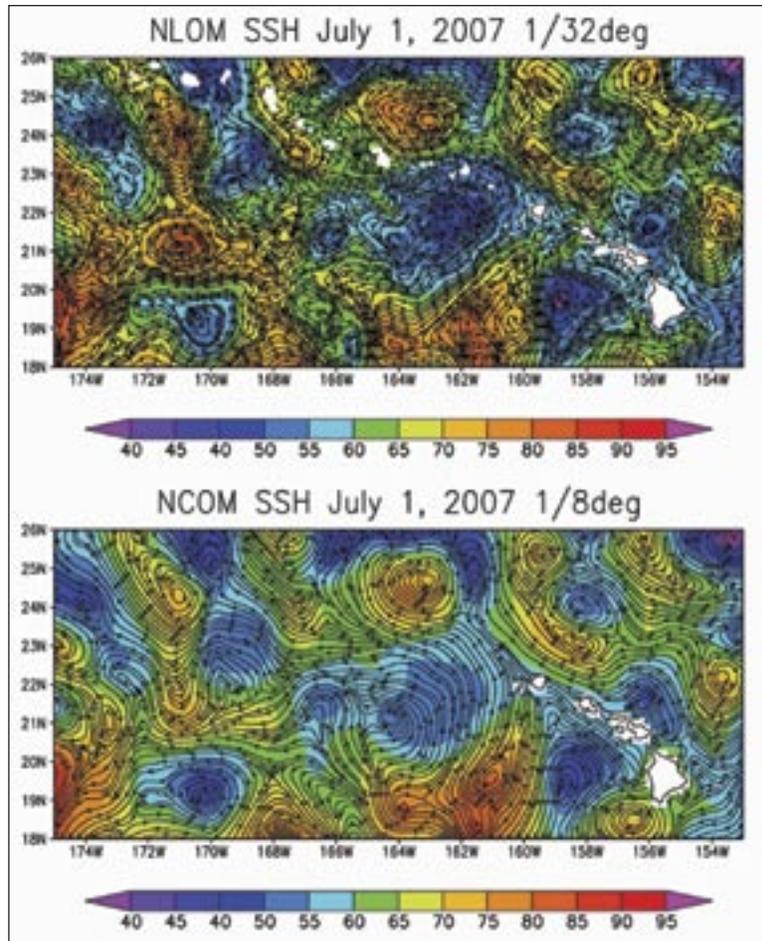
NOAA OFFICE (Of the primary technical contact): National Environmental Satellite, Data, and Information Service/National Climate Data Center

NOAA Goal(s)

- To understand climate variability and change to enhance society's ability to plan and respond

Purpose of the Project

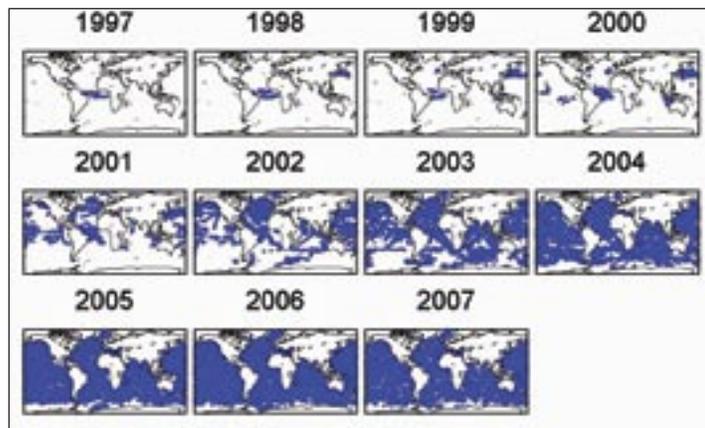
The project enhances the operation of and the activities at the Asia-Pacific Data-Research Center (APDRC) within the International Pacific Research Center (IPRC) at the University of Hawaii. The project’s overarching goals are, in part, to implement infrastructure in support of the Global Ocean Data Assimilation Experiment (GODAE) and to enhance activities in support of the Pacific Region Integrated Data Enterprise (PRIDE) in order to advance NOAA’s mission objectives and meet critical regional needs for ocean, climate and ecosystem information for applications users. 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 general public. The mission of the APDRC is to increase understanding of climate variability in the Asia-Pacific region: by developing the computational, data management, and networking infrastructure necessary to make data resources readily accessible and usable by researchers; and by undertaking data-intensive research activities that will both advance knowledge and lead to improvements in data preparation and data products.



Sea Surface Height (SSH) and upper-layer circulation pathways from the Navy Research Laboratory’s NLOM and NCOM nowcast products for the Hawaiian Islands region. These GODAE products are updated daily at <http://apdrc.soest.hawaii.edu>.

Progress During FY 2007

The project has continued to operate and upgrade the Data Server System (DSS) in collaboration with national and international partners, and continues to build the data archive with focus on atmospheric, oceanic, air-sea flux, and model and satellite-derived products. In addition, the web-based data management tools continue to be upgraded to allow easy access to metadata, product information, and product search capability. A significant value-added activity and resulting product is the completion of YoMaHa’07 (Lebedev et al., 2007), a global, Argo-based, surface and deep velocity product. We continue to expand our activities in support



Annual distribution of Argo velocity estimates in YoMaHa’07. The technical report and YoMaHa’07 dataset are available at <http://apdrc.soest.hawaii.edu/projects/index.html>.

of applications and research users by providing easy access to the operational and delayed-mode ocean products prepared in the context of GODAE. A major accomplishment has been the serving of the global Navy Research Laboratory (NRL) Layered Ocean Model (NLOM) surface layer products (both near-real-time and forecasts) and, a recent addition, the multi-layer NRL NCOM (Navy Coastal Ocean Model) in the Hawaiian Islands region from January 1, 2005 to the present. High-resolution models, needed for downscaling operational models in the Hawaiian Islands region, have been tested with various spatial resolutions, atmospheric forcing fields and boundary conditions and are now implemented at 4 km and 1 km resolution in the Hawaiian Islands region. Operational nowcasts and forecasts are planned for late 2007.

Additional progress includes: a second year of PRIDE projects to develop integrated data products for the Pacific region; planning for pilot observations in support of assimilation-based, regional high-resolution ocean models; completion of data rescue and historic data quality control activities focusing on Indian and Pacific Ocean XBT data; assistance with regional coordination in support of GCOS (Global Climate Observing System) and GOOS (Global Ocean Observing System) programs focusing on regional data server implementation and support; and enhancement of Argo regional center activities and products. Results from PRIDE activities for product development are made available at the APDRC website: <http://apdrc.soest.hawaii.edu> under the “Projects” heading. New products also available via the “Projects” heading include: monsoon monitoring; climate indices, and Mean Dynamic Ocean Topography.

Investigating the Transport and Transformation Mechanisms of Atmospheric Mercury in the Remote Central North Pacific Marine Free Troposphere

P.I.: Thomas A. Schroeder [Darryl T. Kuniyuki]

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

NOAA Goal(s)

- To understand climate variability and change to enhance society’s ability to plan and respond

Purpose of the Project

Primary Objective

Collection of Atmospheric Mercury Speciation Data. Provide for the collection and analysis of semi-continuous high altitude (11,400 feet) measurements of Hg^0 , RGM, and Hg^P at MLO, Hawaii. The objectives of this task will be to accumulate a long-term record of ambient Hg^0 , RGM, and Hg^P 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 affect the transport and transformation mechanisms of atmospheric mercury. This includes aerosol particulate measurements, collection and analysis, gas and particulate phase halide sample collection and analysis, semi-continuous gas and particulate phase halide collection and analysis, semi-continuous ozone, sulfur dioxide, elemental carbon, and meteorology measurements. All of the data are to be organized and archived in a database. Some data and theories will be place on the MLO website and other types of media for outreach purposes.



Aidan Colton in front of the Ambient Ion Monitor.

Progress During FY 2007

The prototype instrument the “Ambient Ion Monitor” (AIM) was running most of the year with many fixes and “tweaking” of the procedures. This instrument provides the semi-continuous gas and particulate phase halide

collection and analysis portion listed above. Eventually the AIM's performance became reliable enough to replace the "Sequential Fine Particle Sampler" (SFPS) which was removed on June 5, 2007. This will alleviate the lab work done at the Hilo site. All other project's data were collected and maintained as scheduled

Profiling CTD Float Array Implementation and Ocean Climate Research

P.I.: Thomas A. Schroeder [Gregory C. Johnson]

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

NOAA Goal(s)

- To understand climate variability and change to enhance society's ability to plan and respond

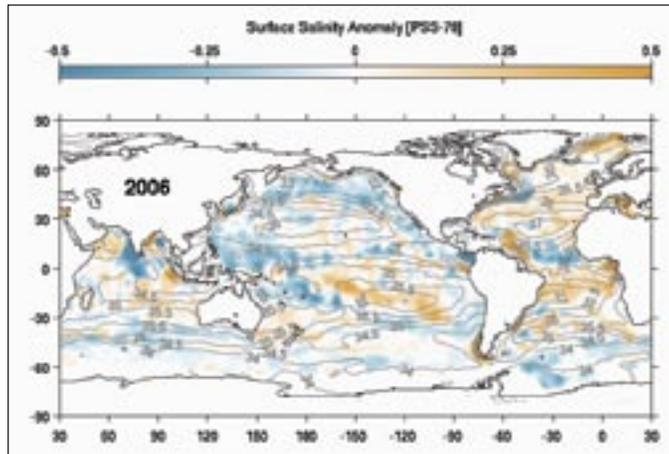
Purpose of the Project

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

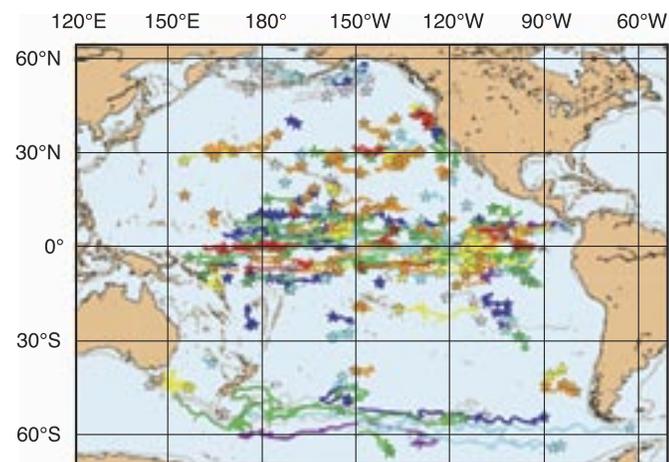
Progress During FY 2007

E. Steffen completed testing of 80 floats and installed Lithium batteries 82 floats in FY2007. She found potentially serious problems in one or more subsystems of a large number of floats with and worked with the manufacturers and other Argo groups to repair these subsystems and resolve some of the underlying manufacturing and supply problems that caused the issues. She also monitored float performance, kept up with float registrations, and helped to find and sort out float database issues. She located deployment opportunities and coordinated logistics for 66 float deployments from 14 cruises on 7 ships. She visited 4 ships at which she tested floats, loaded floats, and gave deployment training. Stated goals were met.

J. Lyman produced and analyzed yearly maps of global upper ocean heat content from 1993 through 2006 using in situ thermal data. Using satellite altimetry data he worked with JIMAR Senior Fellow Dr. Gregory C. Johnson to quantify global upper ocean heat content sampling error estimates from 1955 through 2006. They also worked on annual sea surface salinity anomalies in 2005 and 2006. This year Lyman was an author or co-author of four published manuscripts, and he presented results at a national scientific meeting. Stated goals were met.



Surface salinity anomalies for 2006 from a mix of real-time and delayed-mode quality controlled Argo Data relative to World Ocean Atlas (2001 edition) climatological values (in colors, with climatological values contoured in grey at 0.5 intervals). Generally, subtropical salinity maxima appear higher and tropical and subpolar salinity minima appear lower in 2006 than in the climatology.



Locations (stars) and trajectories (lines) of Argo floats prepared by JIMAR float research Analyst E. Steffen as of 9 July 2007. Grey indicates floats that have not reported for the last 20 days or more, colors more recently reporting floats.

Roles of Ocean-Atmosphere-Land Interaction in Shaping Tropical Atlantic Variability

P.I.: Shang-Ping Xie

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

NOAA Goal(s)

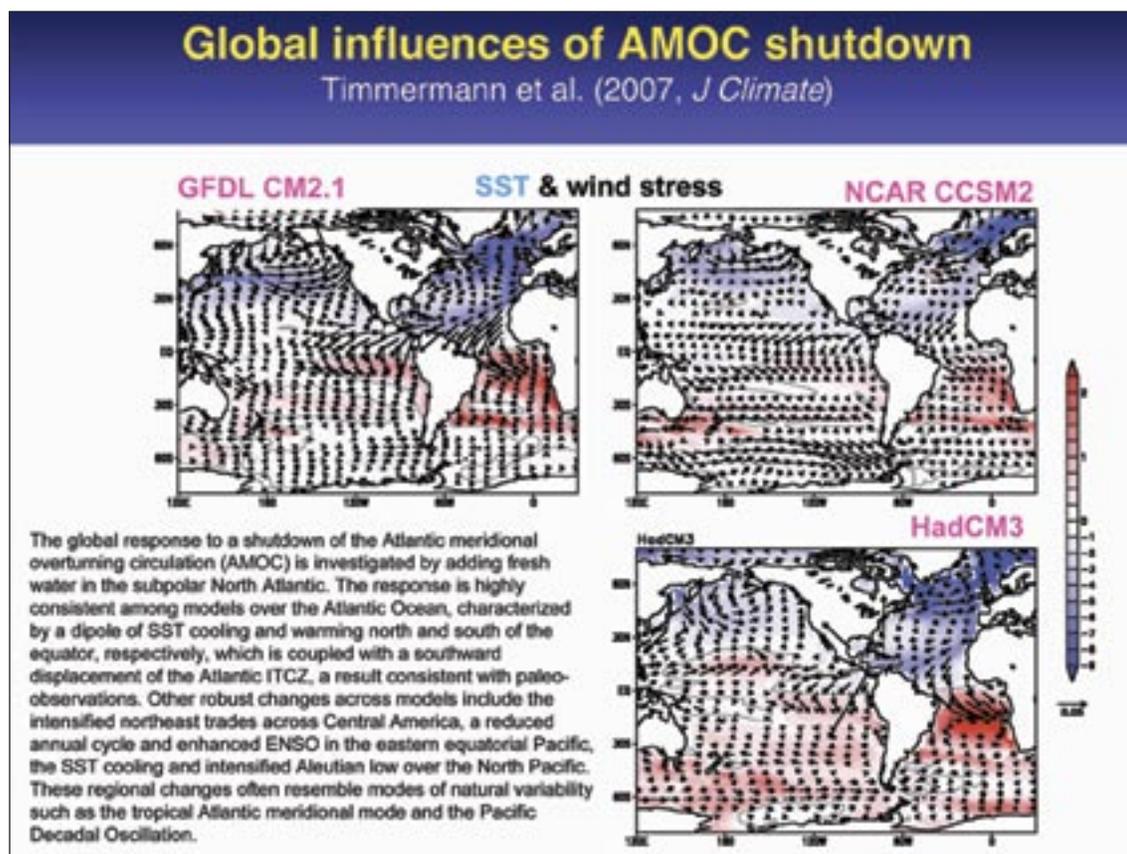
- To understand climate variability and change to enhance society's ability to plan and respond

Purpose of the Project

Tropical Atlantic variability affects the climate on the surrounding continents, but its mechanisms remain unclear. The purpose of this project is to better understand the interaction of the ocean, atmosphere and land and its role in tropical Atlantic variability.

Progress During FY 2007

The lack or inadequate development of the equatorial cold tongue remains a major error in tropical Atlantic climate simulations by coupled GCMs participating in the IPCC Fourth Assessment (AR4). We have analyzed the IPCC AR4 models and showed that the errors exist in stand-alone atmospheric GCMs and are amplified by ocean-atmosphere interaction upon coupling with the ocean. Recent Paleoclimate observations suggest that the Atlantic ITCZ shifts meridionally in sync with Heinrich events in the high-latitude North Atlantic. By applying



The global response to a shutdown of the Atlantic meridional overturning circulation (AMOC) is investigated by adding fresh water in the subpolar North Atlantic. The response is highly consistent among models over the Atlantic Ocean, characterized by a dipole of SST cooling and warming north and south of the equator, respectively, which is coupled with a southward displacement of the Atlantic ITCZ, a result consistent with paleo-observations. Other robust changes across models include the intensified northeast trades across Central America, a reduced annual cycle and enhanced ENSO in the eastern equatorial Pacific, the SST cooling and intensified Aleutian low over the North Pacific. These regional changes often resemble modes of natural variability such as the tropical Atlantic meridional mode and the Pacific Decadal Oscillation.

fresh-water forcing over the subpolar North Atlantic in coupled GCMs, we show that the shutdown of the Atlantic meridional overturning circulation and the resultant cooling indeed lead to a southward displacement of the Atlantic ITCZ, triggering a series of coupled adjustments over the tropical Pacific and elsewhere.

Pacific ENSO Applications Center

P.I.: Thomas A. Schroeder

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

NOAA Goal(s)

- To understand climate variability and change to enhance society's ability to plan and respond

Purpose of the Project

The Pacific ENSO Applications Center (PEAC) was established in 1994 as a cooperative effort among the University of Hawaii (JIMAR), University of Guam, National Weather Service Pacific Region, and the Pacific Basin Development Council. PEAC provides climate services to Hawaii and U.S.-Affiliated Pacific Islands. In recent years PEAC has slowly evolved into an operational branch of the NWS Pacific Region.

Progress During FY 2007

A moderate warm event occurred in 2006-2007. PEAC provided advanced information on seasonal sea level and rainfall anomalies. Based upon all available ENSO-forecast models PEAC developed an impact scenario. Details included expected variations in tropical cyclone locations and frequencies. The information was disseminated to the user communities via monthly teleconferences as well as printed newsletters and the World Wide Web. Special bulletins were issued describing actions taken by affected agencies and communities.

A major scientific effort for the past year was development of an improved outlook for extremes of sea level on seasonal and annual scales. Using a Generalized Extreme Value (GEV) model, the L-moments method has been used to estimate the likelihood of extremely high or low sea levels. A bootstrap method is used to define the exceedance probability level of upper and lower bounds at the 90% confidence level. Finally, as an aid to decision analysis for coastal hazards management, a comprehensive seasonal sea level outlook is prepared from a composite of (i) SST-based canonical correlation analysis model forecasts, (ii) low and high tide predictions and (iii) likelihood of extreme high and low sea levels by season. This product is then disseminated via teleconference and newsletter.

Warm Pool Dynamics in the Interaction Between Asian Summer Monsoon and ENSO

P.I.: H. Annamalai

NOAA OFFICE (Of the primary technical contact): Climate Program Office

NOAA Goal(s)

- To understand climate variability and change to enhance society's ability to plan and respond

Purpose of the Project

The goals of the proposed research are to understand the interactive nature between the Asian Summer Monsoon (ASM) and ENSO and to assess the contributions of the warm-pool dynamics to this interaction. Our approach is through data analysis and a suite of atmospheric and ocean model experiments. The project is based on the following hypothesis: During its evolution, the ASM-related convection moves north/northwestward from the equatorial Indo-Pacific regions whereas the ENSO-related convection/heat source moves eastward along the equator in the Pacific. In effect, during the boreal summer of El Niño years, the single major heat source (monsoon in the warm pool) is partitioned into two separate pieces (monsoon and El Niño). These two heat sources subsequently interact leading to changes in the thermally direct circulations which in turn modulate the convection and SST in the warm pool leading to local air-sea interaction. These changes in regional air-sea interaction can directly interact with the ASM and subsequently affect the ENSO evolution.

Progress During FY 2007

The PI was invited to give a key note address on “Systematic Errors in the simulation of mean and variability of the Asian summer monsoon in climate models” in the WGNE workshop on Systematic Errors in Climate and Weather models, San Francisco, Feb. 2007. A brief highlight of the manuscript that investigated the monsoon and its relationship with ENSO in the IPCC coupled models is provided below.

The South Asian summer monsoon and its relationship with ENSO in the IPCC-AR4 simulations (J. Climate, 20, 1071-1092)

In this paper we use the extensive integrations produced for the IPCC Fourth Assessment Report (AR4) to examine the relationship between ENSO and the monsoon at interannual and decadal timescales. We begin with an analysis of the monsoon simulation in the 20th century integrations. Six of the 18 models were found to have a reasonably realistic representation of monsoon precipitation climatology. For each of these six models SST and anomalous precipitation evolution along the equatorial Pacific during El Niño events display considerable differences when compared to observations. Out of these six models only four (GFDL_CM_2.0, GFDL_CM_2.1, MRI, and MPI_ECHAM5) exhibit a robust ENSO-monsoon contemporaneous teleconnection, including the known inverse relationship between ENSO and rainfall variations over India. Lagged correlations between the all-India rainfall (AIR) index and Nino3.4 SST reveal that three models represent the timing of the teleconnection, including the spring predictability barrier which is manifested as the transition from positive to negative correlations prior to the monsoon onset. Furthermore, only one of these three models (GFDL_CM_2.1) captures the observed phase lag with the strongest anticorrelation of SST peaking 2-3 months after the summer monsoon, which is partially attributable to the intensity of simulated El Niño itself. We find that the models that best capture the ENSO-monsoon teleconnection are those that correctly simulate the timing and location of SST and diabatic heating anomalies in the equatorial Pacific, and the associated changes to the equatorial Walker Circulation during El Niño events. The strength of the AIR-Nino3.4 SST correlation in the model runs waxes and wanes to some degree on decadal timescales. The overall magnitude and timescale for this decadal modulation in most of the models is similar to that seen in observations. However, there is little consistency in the phase among the realizations, suggesting a lack of predictability of the decadal modulation of the monsoon-ENSO relationship.

The analysis was repeated for each of the four models using results from integrations in which the atmospheric CO₂ concentration was raised to twice pre-industrial values. From these “best” models in the double CO₂ simulations there are increases in both the mean monsoon rainfall over the Indian sub-continent (by 5-25%) and in its interannual variability (5-10%). We find for each model that the ENSO-monsoon correlation in the global warming runs is very similar to that in the 20th century runs, suggesting that the ENSO-monsoon connection will not weaken as global climate warms. This result, though plausible, needs to be taken with some caution because of the diversity in the simulation of ENSO variability in the coupled models we have analyzed. The implications of the present results for monsoon prediction are discussed.

The Effects of the Stratospheric Quasi-biennial Oscillation on Seasonal Predictability of Tropospheric Circulation in the Northern Hemisphere Extratropics

P.I.: Kevin P. Hamilton

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

NOAA Goal(s)

- To understand climate variability and change to enhance society’s ability to plan and respond

Purpose of the Project

The quasi-biennial oscillation (QBO) of the prevailing zonal wind in the tropical stratosphere is probably the most predictable aspect of the circulation anywhere in the atmosphere. The zonal-mean zonal winds in the tropical stratosphere can be accurately forecast for at least several months in advance. If the stratospheric QBO systematically affects the tropospheric circulation, then the QBO potentially provides some useful contribution to seasonal tropospheric forecasting. Unfortunately, the stratospheric QBO itself is not likely to be represented well in numerical models currently used for seasonal predictions, and thus any potential that the QBO offers for

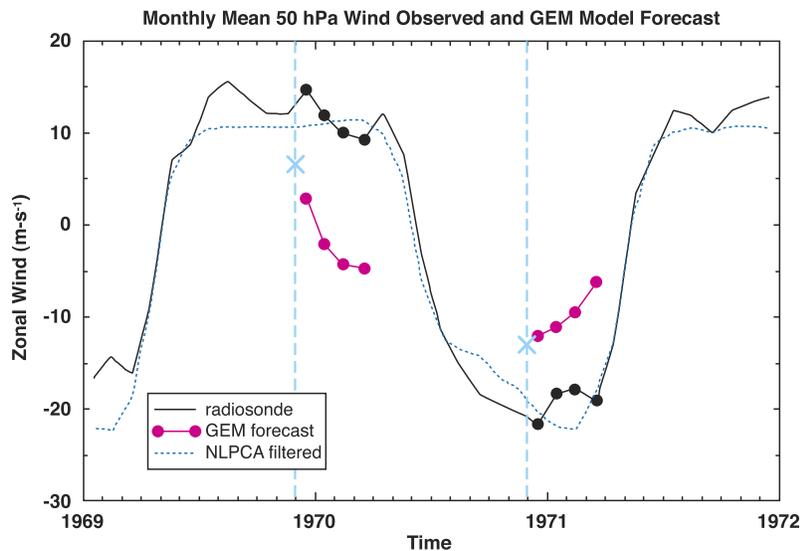
seasonal forecasting is not exploited well by current numerical-model based forecast systems. This project is investigating the possible role of the tropical stratospheric QBO in the seasonal climate of the troposphere with a view to developing practical enhancements to current seasonal forecasting systems.

Progress During FY 2007

Monthly mean results from the Canadian “second historical forecasting project” (HFP2) have been analyzed. HFP2 consists of a collection of 34 years of retrospective seasonal forecasts for the period 1969-2003 using four different global models. We have considered the forecasts initialized at December 1 and run for 4 months. For each model an ensemble of 10 members was run. So we are analyzing 34 years x 4 models x 10 ensembles = 1360 integrations, each integration extending from December through March. Each forecast is initialized with realistic atmospheric conditions based on the NCEP reanalyses and is run with specified (and evolving SSTs). The first aspect of the forecasts investigated was whether the tropical stratospheric QBO is well-represented in the forecast model runs. Analysis of the monthly-mean zonal-mean zonal wind at 50 hPa in the numerical forecasts shows that, although on December 1 the tropical stratospheric winds in the model are initialized to be close to those observed, they quickly relax towards a (very unrealistic) state of weak easterlies.

If the information from the QBO is to be used in forecasts either through some assimilation into the numerical model or through an a posteriori statistical correction, then actual forecasts of the QBO equatorial winds need to be made. In practice, given the long time scale of the QBO a useful seasonal “forecast” of the QBO winds could be obtained through persistence. In this project, however, we have developed a much more skillful

forecast procedure for the QBO winds. Specifically we filter the standard historical equatorial wind time series using a single non-linear principal component analysis (NLPCA) approach. The NLPCA representation is smoother than the raw series, and it seems likely that the NLPCA filtered time series is more representative of the actual zonal-mean winds than the individual single station observations. We have developed a forecasting procedure which is based on an assumption of a standard rate of progress through the NLPC and have demonstrated that very accurate seasonal forecasts of the stratospheric QBO state are possible for seasonal timescales.



Results for retrospective forecasts of the equatorial stratospheric winds with the Canadian Global Environmental Multi-scale (GEM) operational weather prediction model. The monthly-mean 50 hPa observed zonal wind is plotted together with a filtered version obtained with a nonlinear principal component analysis (NLPCA) reconstruction. The black circles emphasize the monthly wind observations for two December-March periods. The blue crosses show the equatorial zonal-mean zonal wind on December 1 as represented in the NCEP reanalyses data set used to initialize the forecasts. The red circles show the monthly-mean equatorial zonal-mean zonal wind at 50 hPa in the GEM forecasts that were initialized on (or near) December 1.

Dynamics of Pacific Decadal Climate Variability and ENSO Modulation

P.I.: Fei-Fei Jin

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

NOAA Goal(s)

- To understand climate variability and change to enhance society’s ability to plan and respond

Purpose of the Project

Significant decadal variations in the Pacific have been identified together with evidence of the strong decadal modulations of the frequency, amplitude and predictability of El Niño-Southern Oscillations (ENSO). Our understanding of the decadal variability is still limited. The aim of this proposed research focuses on the roles of the tropical ocean-atmosphere interaction in the decadal climate variations of the tropical Pacific and decadal modulations of ENSO. Particularly, we will examine the relevance of the decadal modes (recently found as analytical solutions of a reduced-gravity model by the PI) of tropical ocean dynamics to the decadal climate variability of the tropic Pacific. We will investigate the coupled mechanisms which modify the decadal modes of the tropical ocean into coupled modes. We will study the interaction of the coupled decadal modes with ENSO and explore nonlinear scenarios which allow large amplitude modulations of ENSO. We will also explore the implications of these deterministic processes to the regime predictability of the ENSO activity

Progress During FY 2007

- We found that with a proper adjustment in parameters and basic state, the Zebiak and Cane model supports both QQ and QB variability at the same time as it is observed. We will exam how quasi-quadrennial (QQ) and quasi-biennial (QB) variability will affect the predictability of ENSO.
- We developed an ENSO instability index that measures the growth rate of ENSO.
- We also proposed a new concept of so-called noised induced instability due to the interaction between MJO and ENSO.

Tropical Meteorology

The JIMAR tropical meteorology theme was developed in response to the move of the National Weather Service (NWS) Honolulu Forecast Office to the UH Campus. The move was associated with the modernization of the NWS and was motivated in part by the long history of interaction between the Honolulu Forecast Office and the UH Department of Meteorology. Interactions among faculty, students, and NWS staff have been excellent. NWS supports student research through the NWS Education Fund (supported by in-lieu-of-rent monies) and the NWS Pacific Region Fellowship Program. Interactions with the Pacific Region extend to climate service (see ENSO Applications discussion under the climate theme) and establishment of the International Pacific Training Desk.

National Weather Service Fellows

P.I.: Thomas A. Schroeder

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

NOAA Goal(s)

- To serve society's needs for weather and water information.

Purpose of the Project

In lieu of rent funds support graduate students in tropical meteorology within the UH Department of Meteorology.

Progress During FY 2007

Matthew Sitkowski completed his MS program. He worked with JIMAR Senior Fellow Gary Barnes in analyzing the rapid intensification of Hurricane Guillermo (1997). Guillermo rapidly intensified over the eastern Pacific and was sampled over two days by NOAA aircraft. Data from 70 dropwindsondes were quality controlled, treated with a cubic spline, and processed through a MATLAB program to create low-level thermodynamic and kinematic fields. Additionally, nearly one thousand radar images were used in the analysis. Latent heat release

(LHR) was calculated over a 60 km radius from the circulation center to determine the relationship between intensity change and LHR trends. Several similarities and differences, some unexpected, were noted between days. Despite the rapid intensity increase, Guillermo's structure remained resilient. Aircraft data from 700 hPa revealed remarkable similarities in temperature, dewpoint, wind speed and vertical velocity for each day. The reflectivity field exhibited a wave number one pattern on each day with highest values favoring the eastern portion of the storm and asymmetries appeared in both the tangential and radial wind fields. A difference of 15 ms⁻¹ in total wind speed between the northeast and southwest quadrants of eyewall was present on both days.

National Weather Service International Pacific Training Desk

P.I.: Thomas A. Schroeder

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

NOAA Goal(s)

- To understand climate variability and change to enhance society's ability to plan and respond
- To serve society's needs for weather and water information

Purpose of the Project

The International Pacific Training Desk provides training in modern operational meteorology to interns selected from the Weather Services of nations within World Meteorological Organization Regional Association 5. The interns are hosted by the Honolulu Weather Service Forecast Office. They attend various functions at the University of Hawaii Department of Meteorology as well as are introduced to climate services provided by the JIMAR Pacific ENSO Applications Center. It is hoped that the training provided at the Pacific Desk will enable the participating countries to begin to issue their own forecast products, if not already doing so, and for others to upgrade their capabilities. Since the inception of the Pacific Desk in 2001, Tonga and Tuvalu began to issue forecast products routinely and Niue and Kiribati have been doing so experimentally.

Progress During FY 2007

In the past year the Pacific Desk served 5 interns from the Solomon Islands, Kiribati, Tonga, Philippines and Samoa.

Fisheries Oceanography

Fisheries oceanography has become the largest component of JIMAR. The program has three components: collaborative research with the Pacific Islands Fisheries Science Center (PIFSC) of the National Marine Fisheries Service (NMFS); collaborative research with the Pacific Environmental Group in Monterey, CA; and the Pelagic Fisheries Research Program (PFRP), managed by JIMAR in cooperation with the PIFSC and the Western Pacific Regional Fishery Management Council.

Fisheries Oceanography: Methods Aimed to Reduce Sea Turtle-Longline Interactions: Tests of Modified Baits and Fishing Gear

P.I.: Thomas A. Schroeder [Samuel G. Pooley, John H. Wang, Yonat Swimmer]

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

NOAA Goal(s)

- To protect, restore, and manage the use of coastal and ocean resources through ecosystem-base management

Purpose of the Project

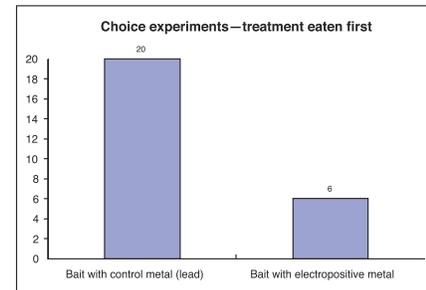
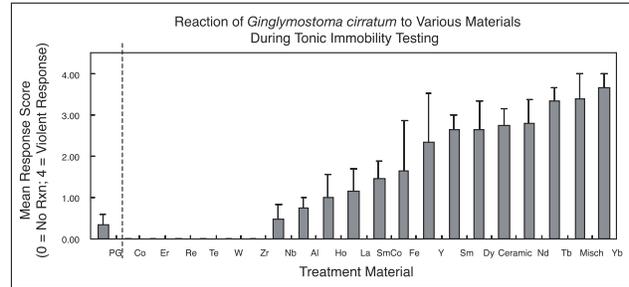
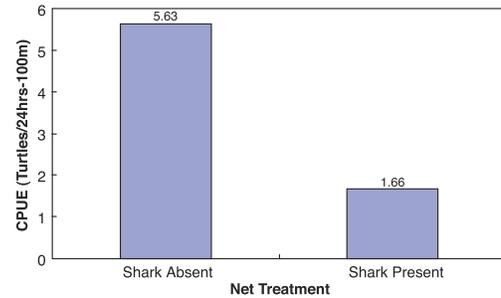
Our work is in the area of sea turtle bycatch reduction research, including studies with captive sea turtles and open ocean field trials, and has recently been expanded to conduct bycatch mitigation research with sharks. Specific work under this JIMAR grant includes experiments on longline fishing vessels in foreign fisheries to identify means to reduce sea turtle bycatch, and provides an opportunity to tag incidentally-caught and released sea turtles to determine post-release survivorship. Additionally, this grant funds studies on the sensory and behavioral biology of sea turtles and sharks with the ultimate aim to reduce rates of incidental capture in fisheries.

Progress During FY 2007

We identified numerous projects relating to the sensory functioning of sea turtles and target species that we had hoped to accomplish. Funds from this grant were successfully used for studies in the visual ecology of loggerhead and leatherback sea turtles (see Eckert et al, Lohmann et al 2007, Fritsches et al. 2007) and fish species (see Johnsen 2007 and Frisches et al 2007), which were all presented at a sensory physiology meeting and documented (Swimmer and Wang 2007 NOAA Tech Memo).

Extensive work was done in the area of shark silhouettes and modified light sticks in fisheries in Baja, California, Mexico. While the initial studies were somewhat preliminary in nature, the results suggested that the location was ideal in terms of high CPUE of sea turtles and sharks, thereby proving to be an excellent environment to test potential mitigation methods. We also conducted trials with electropositive metals to determine their potential efficacy in deterring feeding behavior in sharks along Oahu’s North Shore, and once again, results have been promising.

As for our turtle tagging efforts, we have successfully tagged loggerhead sea turtles in the South Atlantic Ocean during longline fishing operations during the past year. Satellite telemetry devices placed on tags have proven successful in identifying turtles’ post-release movements and survivorship. While we had originally planned to tag up to 10 turtles with platform terminal transmitters, due to some electronic complications with the tags, data tracks for eight turtles have been accumulated to date. We hope to remedy the problem by returning tags for repair, and having them back in the hands of fisheries observers for the upcoming fishing season.



(top) Preliminary field trials using turtle monitoring nets suggest that the presence of shark shapes near nets decreases the number of turtles caught. (middle) Reaction of immobilized juvenile nurse sharks, *Ginglymostoma cirratum*, when exposed to various test materials (chemical element symbols) during tonic immobility. (bottom) Preliminary results from field trials in North Shore, Oahu on the effects of E+ metals on the feeding behaviors of galapagos sharks (*Carcharhinus galapagensis*). Preliminary data indicates that baitfish associated with a piece of lead metal will be eaten over baitfish associated with an electropositive metal.

Fisheries Oceanography: Protected Species Investigation: Marine Turtle Research Program

P.I.: Thomas A. Schroeder [Samuel G. Pooley, Stacy A. Kubis, George Balazs]

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

NOAA Goal(s)

- To protect, restore, and manage the use of coastal and ocean resources through ecosystem-base management

Purpose of the Project

The purpose of this project includes eleven discrete elements that consist of: 1) research to reduce or mitigate high-seas and coastal fishery bycatch of sea turtles; 2) research on the general biology, life history and ecology of sea turtles in coastal marine habitats and on nesting beaches; 3) monitoring of sea turtle population trends for stock assessments; 4) simulation modeling of long term sea turtle datasets to better understand population dynamics; 5) health assessments and disease investigations with focus on sea turtle fibropapilloma tumor disease; 6) administration of a sea turtle stranding and salvage network for research and live turtle rehabilitation; 7) training, capacity building and sea turtle information exchange with other Pacific islands; 8) educational outreach to the public focused on sea turtle research results; 9) experimentation with remote viewing digital imagery for sea turtle monitoring and research; 10) maintenance of efficient and secure computerized storage, management, and retrieval of sea turtle research data; and 11) administration of observer training in the collection of sea turtle data aboard commercial longline fishing vessels.

Progress During FY 2007

In the FY2006 annual report, MTRP identified the following goals for FY2007: 1) continue research of the pelagic ecology and movements of sea turtles to develop management strategies to reduce bycatch; 2) continue research on fibropapillomatosis disease, with emphasis on specimens obtained from the Hawaii sea turtle stranding and salvage program; 3) continue captive care and rehabilitation of captive-reared and stranded turtles; 4) conduct studies on the foraging ecology of green turtles in collaboration with researchers at the University of Hawaii, Hilo; and 5) summarize capture and tagging data from fieldwork in the main Hawaiian Islands. Progress toward these goals is discussed below.



JIMAR Biological Technician, Erin Siebert, captures a juvenile green turtle at Hanauma Bay for tagging, measurements, and external examination.

- A new collaborative project was established in FY2007 with the Noumea Aquarium in New Caledonia. Loggerhead sea turtle hatchlings are currently being reared in captivity for future release and satellite tracking to study their behavior and movements in pelagic habitats. JIMAR Marine Turtle Research Biologist, Stacy Kubis, manages the growth data and monitors growth rates for consistency and potential health problems. JIMAR Marine Turtle Specialist, Denise Parker, manages a Pacific-wide satellite-tracking database, prepares maps, analyses satellite-tracking data, and provides data for publication in peer-reviewed journals. The New Caledonia satellite tracking data will be added to the database and Denise Parker will continue to provide maps to our collaborators.
- MTRP JIMAR staff members were instrumental in the continued research on fibropapillomatosis through the Hawaii sea turtle stranding and research program. Dead stranded turtles or turtles stranded alive and euthanized due to their poor condition were necropsied and tissue samples were collected for histopathology and fibropapilloma research. JIMAR Biological Technicians, Erin Siebert and Darren Marshall, were instrumental in the administration and conduction of the stranding and salvage research program. Regular Biological Technician duties involved responding to strandings and assisting with necropsies. Darren Marshall was responsible for managing sample collections and shipping samples to research collaborators.

- JIMAR Biological Technicians, Erin Siebert and Darren Marshall, along with NMFS MTRP staff, were responsible for the care and rehabilitation of stranded sea turtles and 11 captive-bred and captive-reared green turtles at the NMFS Kewalo Research Facility. Erin Siebert was responsible for overseeing the daily care of all sea turtles under MTRP care. Daily care involved feeding, cleaning tanks, administering medication, and conducting external visual exams. JIMAR Marine Turtle Research Biologist, Stacy Kubis, was responsible for coordinating and conducting monthly measurements of the 11 captive-reared turtles.
- JIMAR Marine Turtle Research Biologist, Stacy Kubis, participated in collaborative research on green turtle foraging ecology with faculty and students from the University of Hawaii, Hilo at a study site in Kapoho on the Big Island of Hawaii. Field work was conducted in September 2006 and April/May 2007. Turtles were captured, tagged, measured, and sampled, and the habitat was sampled for forage abundance and diversity. This project will continue in FY2008.
- The Marine Turtle Research Program has been conducting ocean captures of marine turtles in the main Hawaiian Islands (MHI) since 1977. Numerous scientific publications have resulted from this work. JIMAR Marine Turtle Research Biologist, Stacy Kubis, summarized the capture and tagging data for the MHI by year and island.
- In addition to the goals listed for FY2007, JIMAR Marine Turtle Research Biologist, Stacy Kubis, presented a paper at the 27th Annual Symposium on Sea Turtle Biology and Conservation in Myrtle Beach, South Carolina on body condition in Hawaiian green turtles.
- A new JIMAR Marine Turtle Research Associate position was filled in April 2007 with the hiring of Irene Nurzia-Humburg. From June through mid-July 2007, Ms. Nurzia-Humburg conducted training, logistical support, and data collection at East Island, French Frigate Shoals for the 2007 green turtle nesting season.
- JIMAR Marine Turtle Stranding Specialist, Maria Carnavale, was hired in late May 2007 and is in the training phase with the MTRP, learning about program operations and sea turtle biology.



JIMAR Marine Turtle Research Biologist, Stacy Kubis, measures a Sea Life Park captive-bred and reared honu at the NMFS Kewalo Research Facility.

Fisheries Oceanography: Protected Species Research Program

P.I.: Thomas A. Schroeder [Samuel G. Pooley and George Antonelis]

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

NOAA Goal(s)

- To protect, restore, and manage the use of coastal and ocean resources through ecosystem-based management

Purpose of the Project

The project comprises two components, the Marine Mammal Research Program (MMRP), and the Marine Turtle Assessment Program (MTAP). The purpose of MMRP is to study the relationship between environmental/oceanographic parameters and demographic trends of the endangered Hawaiian monk seal and cetaceans in the Pacific Islands Region (PIR). Monk seals and cetaceans are apex predators and represent important components of the marine ecosystem. Much is known about monk seal population dynamics, and monitoring programs are in currently place. The project has recently begun to collect scientific information on cetacean stock identification, abundance and population trends in PIR to fully characterize cetaceans' role in this highly complex environment.

By obtaining a better understanding of the environmental factors that directly and indirectly influence protected species population growth, managers will be able to make more informed decisions concerning ongoing conservation and recovery efforts.

The purpose of MTAP is to determine distribution, abundance, vital rates, and population trends of the five marine turtle species in the PIR, including leatherback, loggerhead, green, hawksbill, and olive ridley turtles. Currently, basic information on population status and stock structure are far from complete for many of these stocks, yet various threats, including directed harvest, habitat loss, and fishery bycatch are known to impact marine turtles. Consequently, a primary focus of this program is to develop population models to assess the impact of various threats on marine turtle stocks. Also, because marine turtles are broadly distributed and often face similar threats in the world's oceans, the pursuit of methods for evaluating populations and impacts tends to be a collaborative process among scientists from around the world.

Progress During FY 2007

The MMRP component included monk seal population monitoring and assessment, characterization of foraging ecology, and evaluation of health and disease. Monk seal assessment studies in the Main Hawaiian Islands (MHI) continued in 2007 through the efforts of a full time sightings coordinator and a cadre of responders collecting data whenever seals were reported in the MHI; and historical and current MHI sighting data have been entered into a database.



JIMAR Research Supervisor Maire Cahoon collects monk seal scat sample for dietary analysis.

The health and disease project trained a full complement of 12 field researchers in seal necropsy and sampling techniques, and processed the resulting samples from the field season. The health & disease project also assisted in the captive care of Hawaiian monk seals, including twin pups maintained temporarily at the Kewalo Research Facility, as well as six weaned pups maintained for six months in a temporary pen at Midway Atoll. The cetacean biology investigation completed a survey of cetaceans in the Northwestern Hawaiian Islands (NWHI), deployed a high frequency acoustic recording package (HARP) at Ladd Seamount in the NWHI, and renewed, serviced, and downloaded data from the HARP deployed off Palmyra Atoll in 2006 to monitor occurrence of cetaceans in that area. The cetacean biology program also initiated a community-based collaborative photo identification catalog for spinner dolphins in the Pacific Islands Region (PIR). See: <http://pipin.org/community/>

The MTAP component was successful in filling a part time data entry position and has completed entering all haulout records of turtles in the NWHI.

Fisheries Oceanography: Analysis on Bycatch by U.S. Pacific Islands Fisheries

P.I.: Thomas A. Schroeder [Samuel G. Pooley, Christofer Boggs, Marti McCracken]

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

NOAA Goal(s)

- To protect, restore, and manage the use of coastal and ocean resources through ecosystem-based management

Purpose of the Project

The purpose of this project is to estimate the bycatch in the Pacific Islands Region. The project will compile

existing estimates (mostly for protected species) and make rigorous new estimates of fish bycatch based on observer data for the fisheries where there is an observer program. For other fisheries where data is less available, estimates will be based on any available sources including surveys, research fishing using similar gear types, and descriptive reports on these or similar fisheries. Extrapolations from limited observations or reports will be made using effort reported by the fisheries or estimated from monitoring of commercial landings. The adequacy of estimates and the type of data improvements required for reliable bycatch estimation will be evaluated and discussed in related reports.

Progress During FY 2007

In FY 2007 completed work included: (1) protected species incidental take estimates for years 2005 and 2006 for the Hawaiian Longline Deep Set (Tuna) Fishery; (2) compiling of protected species incidental takes for years 2005 and 2006 for the Hawaiian Longline Shallow Set (Swordfish) Fishery (this fishery has 100% coverage); (3) estimates of total discards (count and weight) by fish species for years 2005 for the Hawaiian Longline Deep Set (Tuna) Fishery; (4) compiling of total discards (counts) by fish species for year 2005 for the Hawaiian Longline Shallow Set (Swordfish) Fishery and the estimation of discards by weight. When applicable, the efficiency of different appropriate statistical estimators were compared and the most efficient one used. The data quality in the other Pacific Islands Region has been reviewed but not analyzed at this time.

This project also included enhancements to the Hawaii Longline Observer Data System (LODS), including expanding the application to begin supporting American Samoa longline observer data. This observer program is being established with the objective of providing data for accurate bycatch estimates. Additionally, a System Issues Manager application was designed and deployed to facilitate reporting and tracking of data system issues and enhancement requests. Furthermore, a web-based data downloading tool, referred to as Data Trawler, was completed and deployed in year 2006. Data Trawler was used by scientists to download data required for the estimation of bycatch in the Hawaiian Longline Fisheries. Continued data administration support of LODS has ensured the quality, security, and high availability of data to scientists estimating bycatch.

Fisheries Oceanography: Ecosystems Observation Research Program

P.I.: Thomas A. Schroeder [Samuel G. Pooley and Michael P. Seki]

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

NOAA Goal(s)

- To protect, restore, and manage the use of coastal and ocean resources through ecosystem-based management

Purpose of the Project

This 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 the scientific advice to those charged with management of the resources as mandated by legislation; e.g., Reauthorized Magnuson Stevens Act, Marine Mammals Act, Endangered Species Act, etc. Current specific tasks include support for data management of the various observing system inputs and characterization of critical habitat for pelagic species.

Progress During FY 2007

Two key events highlight the project during FY 2007. First, project staff made significant progress in compiling instructional documentation for Western Pacific Fisheries Information Network (WPacFIN) software products, including the Catch and Revenue Data Integration System and the Commercial Landing Data Processing System. These products support fisheries monitoring efforts in the Western Pacific. In addition, project staff completed data dictionaries for WPacFIN software products and the completed the annual publication entitled Fisheries Statistics of the Western Pacific, volume 22 during this project period. Initial work plans for this year centered on hiring a researcher to assist in data analysis to support stock assessment of target and non-target species. Existing staff on other projects and new collaborations with federal partners allowed the project to re-program funds toward fisheries monitoring efforts for this work period.

Second, the project supported ongoing efforts to characterize the oceanography of the Transition Zone Chlorophyll Front (TZCF) as critical habitat for pelagic loggerhead turtles and as fishing grounds for the Hawaii-based longline fleet. Using high performance liquid chromatography (HPLC), the vertical distribution of chloro- and accessory pigments are being evaluated from samples collected along a meridional survey through the TZCF. This research will result in the first in situ assessment of phytoplankton faunal composition through this high gradient region and provide valuable insight into this complex ecosystem.

Fisheries Oceanography: Synthesis of Historical Data and Research Results on Sea Turtle Bycatch Reduction in Longline Fishing

P.I.: Thomas A. Schroeder [Samuel G. Pooley, Christofer Boggs, Yonat Swimmer]

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

NOAA Goal(s)

- To protect, restore, and manage the use of coastal and ocean resources through ecosystem-based management

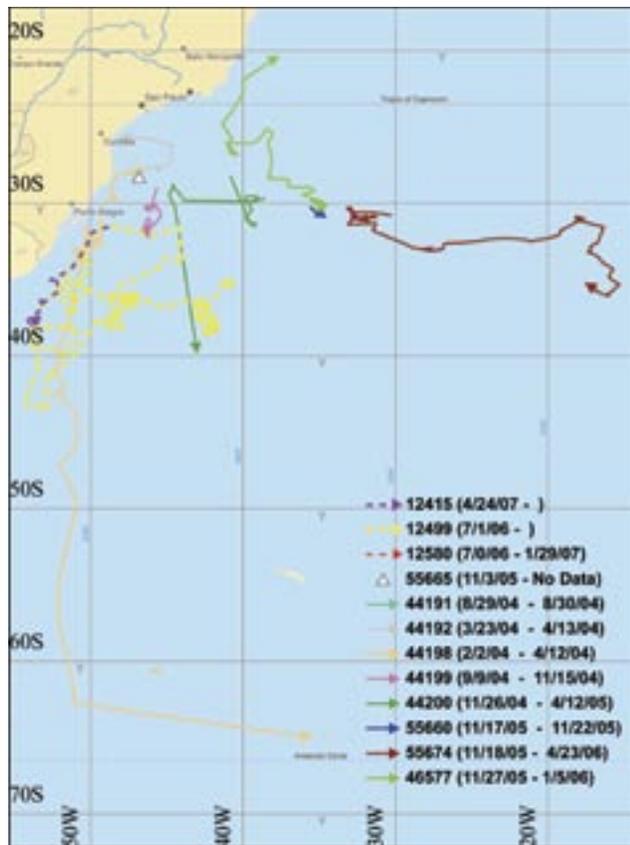
Purpose of the Project

This work involves analysis and synthesis of bycatch data from historical fishery surveys and fishery monitoring, and research results from previous and ongoing NOAA/NMFS and JIMAR studies of sea turtle interaction and release from fishing gear. Goals of this project include: 1) comparisons between historic and recent records of sea turtle interactions; 2) utilizing data obtained from sea turtles tagged with telemetry devices at sea to determine turtle movements, habitat choices, and probability of survival after various forms and severity of fishery interactions; and 3) utilizing data on the physiological and behavioral reactions of sea turtles and fish to lights colors and other stimuli associated with bait and fishing gear to develop ideas for improved fishing gear that would be equally or more selective for target fish species while reducing turtle bycatch.

This project will involve collaboration with other programs, organization of meetings and expert reviews, extensive communications and logistical arrangements, travel management, data compiling, collating, digitizing, scanning, annotating, and archiving, report preparation and editing, and personnel management activities. As such, the Turtle Bycatch Synthesis budget will provide for extensive administrative assistance for these and closely-related activities.

Progress During FY 2007

The work accomplished has focused more on our second objective (telemetry of turtles) than on the first, which involved a comparison of historic and recent sea turtle interactions in fisheries. One reason for this slippage is that the comparative work has recently been completed by an independent contractor for the WCPFC, and thus our work would have been duplicative. However, we have made great strides in our analysis and interpretation of tag



Movements of loggerhead sea turtles tagged with pop-up satellite archival tags or platform terminal transmitters after their release from fishing gear off the coast of Brazil in the South Atlantic Ocean.

(right) Example of corrected values of most probable horizontal movements of an olive ridley sea turtle after use of Kalman filter with incorporation of sea surface temperature (solid line) and without (dashed line).



data from sea turtles incidentally captured and released from longline fishing gear. Specially, Lianne McNaughton has used the Kalman filter (with SST component) to identify the most probable tracks of 11 olive ridley turtles tagged during previous years from a Costa Rican longline fishery and of nearly 50 loggerhead sea turtles tagged in the N. Pacific and S.W. Atlantic Oceans. We also worked with collaborators at the NOAA SWSC- Environmental Research Division in Monterey, California to correlate turtles' movements with oceanographic features.

Administratively, we surpassed our annual goals in hosted meetings, attended meetings, and logistics support for a number of domestic and international research programs.

Marine Resource Dynamics and Assessment Program (MARDAP): Cooperative Research

P.I.: Thomas A. Schroeder [Samuel G. Pooley, Michael K. Musyl, Christofer Boggs]

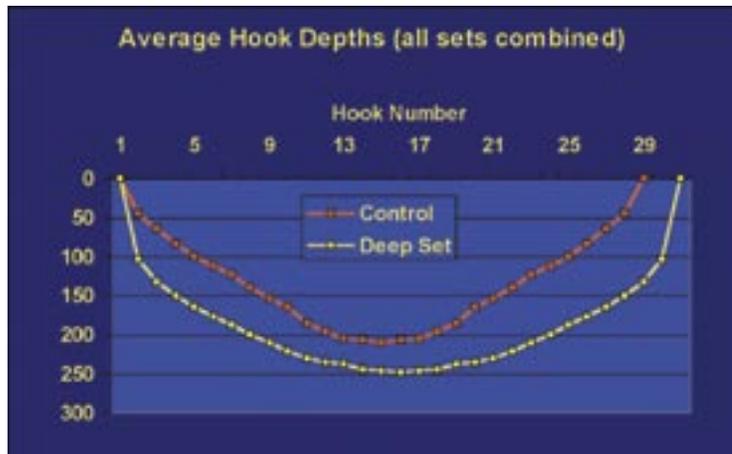
NOAA Office (of the primary technical contact): National Marine Fisheries Service/Pacific Islands Fisheries Science Center

NOAA Goal(s)

- To protect, restore, and manage the use of coastal and ocean resources through ecosystem-based management

Purpose of the Project

The project was originally funded to instigate and coordinate cooperative research between NOAA Fisheries Service scientists and the fishing industry, fishery managers, and academic researchers by encouraging collaboration, improving communication, and using the fishermen's expertise and vessels to answer scientific questions of immediate importance to industry and managers. In 2004, funds were added specifically to research marlin bycatch reduction in the Hawaii tuna longline fishery with funding provided by the Reducing Bycatch Program of NOAA.



Average hook position depths (as measured by Temperature-Depth-Recorders) comparing 45 control (normal) and 45 experimental (deep-set) longline sets.

Current commercial tuna longline setting techniques were altered to test a method developed by the SPC to eliminate all shallow set hooks (less than 100 m depth) from tuna longline sets. By eliminating all shallow set hooks, researchers hoped to maximize target catch of deeper dwelling species such as bigeye tuna, reduce the bycatch of turtles and other protected species, and reduce the incidental catch of many other non-target but marketable species (e.g., billfish and sharks).

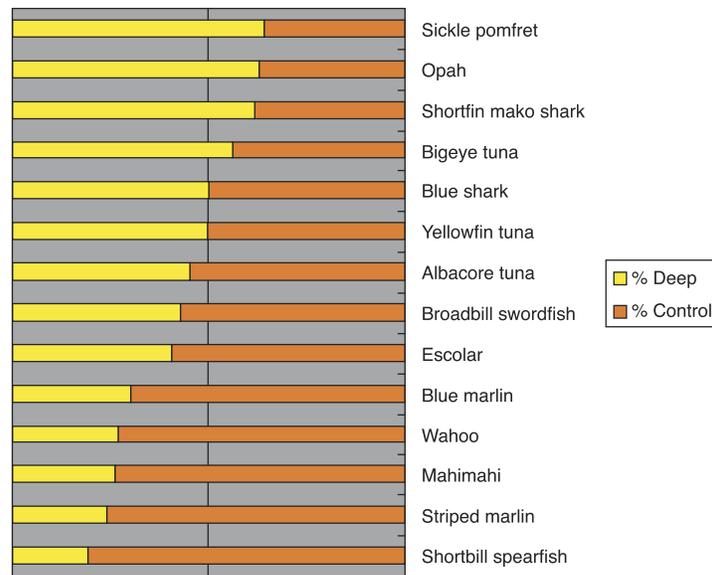
Progress During FY 2007

As planned from the previous fiscal year, a single commercial longline vessel was contracted to perform 90 longline sets (45 sets using the deep setting technique and 45 control sets using standard methods), and all the experimental trials were completed. Project personnel entered relevant data into a database and performed several checks to ensure data accuracy and integrity. Results of the project were presented at the 2007 Tuna Conference and a preliminary draft manuscript has been completed. The project has attained goals set from the previous year.

Summary of project results

A deep set was achieved by attaching paired 3 kg lead weights directly below paired floats on long portions of the mainline, thereby sinking the entire fishing portion of the line below the target depth of the shallowest hook (100 m). Except for additional lead weights, floats, and floatlines that the project provided, only very slight modification of existing longline fishing gear and methods was required. The vessel alternated between the deep setting technique on one day's set and their standard technique (control) on the next day's set. Catch by gear type was recorded and temperature depth recorders (TDRs) were attached to the gear during every set to determine fishing depth of the gear.

Catch totals on the deep set gear were greater for both bigeye tuna (*Thunnus obesus*) and moonfish (*Lampris guttatus*); whereas catch of less valuable incidental fish (e.g., striped marlin (*Tetrapturus audax*) and wahoo (*Acanthocybium solandri*) was lower. Temperature depth recorders placed on the gear verified that the deep setting method did achieve the goal of ensuring that all hooks sink to below 100 m while the shallow hooks in the control set gear consistently fished at about 40 m of depth. The deep setting method effectively placed all of a set's hooks at depths where bigeye tuna were more likely to be encountered. The results have shown that the deep setting technique does work and would be practical to incorporate into existing fishing practices in Hawaii's tuna longline fleet without jeopardizing catch rates of bigeye tuna. Furthermore, an economical analysis revealed that the deep set gear in this experiment generated six per cent more revenue than did the control gear, indicating that the enhanced catch of bigeye tuna and some non-target species of value offset the diminished catch of some other non-target but marketable species.



Longline catches of pelagic fishes and sharks using 45 control and 45 experimental (deep-set) gear sets.

Marine Resource Dynamics and Assessment Program (MARDAP): Economics of Fisheries Initiative

P.I.: Thomas A. Schroeder [Samuel G. Pooley and Minling Pan]

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

NOAA Goal(s)

- To protect, restore, and manage the use of coastal and ocean resources through ecosystem-based management

Purpose of the Project

This research program has focused on economic assessments on commercial and recreational fisheries in Pacific Islands Areas, initiated in July 2000. The first task of FY2006 (July 1 2006 to June 30, 2007) is to support the

ongoing economic data collection program which assesses changes in key economic indicators in Hawaii-based longline fishery. The second task is to assess changes in key economic indicators in American Samoa longline fishery through establishing an economic data collection program. Finally, an annual cost-earnings study, initiated in FY2006, was to carry out statistical and economic analysis based on the 2005 fishing operation status of the Hawaii longline fleet.

Progress During FY 2007

Assessed changes in key economic indicators in Hawaii longline and Northwestern Hawaiian Islands (NWHI) bottomfish fisheries. The goal was achieved. The detailed progress included:

- A total of 248 trips with economic data were collected from Hawaii longline fisheries in FY 2006. The response rate was about 69%, which is 7% higher compared to the response rate (62%) in FY2005.
- A draft report on the First Year of Economic Data Collection Add-on to an Existing Data Collection System was under preparation. This report aimed to document the process of establishing the data monitoring system, and also to present a summary of the economic data (mainly trip expenditure) collected through the routine monitoring program.

Explored the possible options for scientific data collection in American Samoa longline fishery. The goal was achieved. The detailed progress included:

- Established the economic data collection through the NMFS observer program in the American Samoa in FY2007
- Obtained the first set of trip costs data of American Samoa longline fleet

Continued the cost-earning study of Hawaii longline fleet started in 2006. The goal was achieved. The detailed progress included:

- Developed a database to enter the survey data

Integrated cost-earnings data from three databases: the trip cost data from the observer add-on program, the fix cost information from person-to-person survey, and the revenue data from the Hawaii state dealer reports.

Marine Resource Dynamics and Assessment Program (MARDAP): Western Pacific Stock Assessment Review Process

P.I.: Thomas A. Schroeder [Samuel G. Pooley and Gerard DiNardo]

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

NOAA Goal(s)

- To protect, restore, and manage the use of coastal and ocean resources through ecosystem-based management

Purpose of the Project

The Western Pacific Stock Assessment Review Process (WPSARP) is intended to improve the quality and reliability of stock assessments conducted by Pacific Islands Fisheries Science Center (PIFSC) scientists, by insuring rigorous and independent scientific review of completed assessments. WPSARP is a collaborative program between the PIFSC, NMFS Pacific Islands Regional Office (PIRO), JIMAR and the Western Pacific Regional Fisheries Management Council (Council).

Progress During FY 2007

During FY2007, a WPSARP Coordinator was to be hired. However, agreements on the structure and scope of the WPSARP between the project collaborators have only recently been adopted. This delay will push back the hiring of a Coordinator until FY2008. In the mean time, a workshop to review the data supporting bottomfish stock assessment in the Hawaiian Archipelago is in the planning stages and tentatively scheduled for late 2007.

Marine Resource Dynamics and Assessment Program (MARDAP): Research Support

P.I.: Thomas A. Schroeder [Samuel G. Pooley and Susan Kamei]

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

NOAA Goal(s)

- To protect, restore, and manage the use of coastal and ocean resources through ecosystem-based management

Purpose of the Project

To provide research support for fishery data monitoring and research operations as part of the ongoing research under the Marine Resource Dynamics Assessment Program (MARDAP). Project funds support on-going research operations conducted at the Pacific Islands Fisheries Science Center on the University of Hawaii campus and at the Kewalo Research Facility.

Progress During FY 2007

Facilities Maintenance

The maintenance assistant provided JIMAR principal investigators and scientific staff with facilities support including basic carpentry, plumbing, and general upkeep of JIMAR facilities. In addition, the maintenance assistant provided considerable logistical support for facilities projects at the 2570 Dole Street location. All goals set for this project period were met.

Administrative Support

Project funds supported two administrative associate positions during this time period. Incumbents provides principal investigators and scientific staff with a wide range of administrative services, including travel coordination and administration, budget reconciliation and planning, procurement, and general correspondence and office administration. All goals set for this project period were met.

Fishery Monitoring

As proposed, the specialist continued logbook collection, vessel monitoring, maintenance of the current vessel inventory, and liaison duties. This year, all swordfish trip and trips in the Eastern Pacific Ocean were fast-tracked due to the big eye tuna quota in place. The specialist responded to 5-10 requests for fishing trip information weekly from the debriefers and responded to all requests from the Office of Law Enforcement. All goals set for this project period were met.

Marine Resource Dynamics and Assessment Program (MARDAP): Research Support SIS

P.I.: Thomas A. Schroeder [Samuel G. Pooley, Susan Kamei, Jerry Wetherall]

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

NOAA Goal(s)

- To protect, restore, and manage the use of coastal and ocean resources through ecosystem-based management

Purpose of the Project

Provide technical Web services and scientific editorial services to JIMAR research staff at Pacific Islands Fisheries Science Center (PIFSC).

Progress During FY 2007

Web Services—The Webmaster implemented the Web Development Plan and directed the Web Team. As proposed, she further developed capacity for dynamic web content delivery and enhanced the web site using improved templates. Management of web content processing was improved. Conformance with NOAA web guidelines was ensured.

Scientific Editing—The Scientific Editor provided comprehensive professional editing services to program

staff, covering a full range of technical documents. She improved publications design, layout, and production with new software (Adobe InDesign) and helped plan for testing and implementation of a web-based manuscript processing system.

Marine Resource Dynamics Assessment Program (MARDAP): Sociocultural Profile of Pacific Islands Region Fishing Ports

P.I.: Thomas A. Schroeder [Samuel G. Pooley and Stewart Allen]

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

NOAA Goal(s)

- To protect, restore, and manage the use of coastal and ocean resources through ecosystem-based management

Purpose of the Project

Part of the ongoing research under the Marine Resource Dynamics Assessment Program (MARDAP), the purpose of this project is to develop a social and cultural data base of fishing ports and associated communities in Hawaii, Guam, Commonwealth of the Northern Marianas, and American Samoa. The goal is to provide a standard set of information for Western Pacific fishing communities and ports that is consistent with profiles currently being developed in other parts of the country. The information generated will be used to assess the effects of fishing regulations and other actions on social and cultural aspects of fisheries. Comparison of Western Pacific ports with other ports nationwide also will allow us to document the unique social and cultural aspects of Western Pacific fishing activity, as well as reveal commonalities.



Participants in the 2006 4-H Summer Fisheries Workshop head into the water to learn the technique of chenchulu fishing. Photo by Stewart Allen.

Progress During FY 2007

The 2006 annual report listed three activities to be conducted in FY2007.

- *Complete fieldwork and associated analyses to identify fishing patterns at the sub-island scale for Guam and Hawaii.* Fieldwork and associated analyses have been completed for Hawaii and Guam.
- *Produce a report describing Pacific Islands fishing communities and patterns of dependency at the sub-island scale for Hawaii and Guam.* The report on Guam as a fishing community has been completed and peer-reviewed and is now in the process of being published as a NOAA Technical Memorandum. The report on Hawaii is scheduled to be completed in September, 2007, approximately two months later than anticipated in the FY2007 JIMAR proposal.



Vatia on the island of Tutuila is one of the villages participating in the American Samoa community-based fisheries management program. Photo by Stewart Allen.

The delay is due to a decision to have the edits and updates performed through a half-time UH graduate research assistantship (Geography Dept.), rather than through a full-time research assistant.

- *Develop a strategy and begin collecting data for identifying fishing patterns at the sub-territory/commonwealth scale for American Samoa and the Commonwealth of the Northern Marianas.* Funding to collect data and produce reports on American Samoa and CNMI as fishing communities was obtained in FY2007 from NMFS through its National Standard 8 program. The PI and social research project manager have made two trips to American Samoa and have developed an outline for the fishing community reports. An initial field visit to CNMI to begin data collection is scheduled for FY2008.

Marine Resource Dynamics and Assessment Program (MARDAP): Stock Assessment Research Program

P.I: Thomas A. Schroeder [Samuel G. Pooley and Gerard DiNardo]

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

NOAA Goal(s)

- To protect, restore, and manage the use of coastal and ocean resources through ecosystem-based management

Purpose of the Project

The goals of this project are to assess: (1) the status of pelagic stocks in the Pacific Ocean; (2) the status of insular resources in the Pacific Islands Region (e.g., bottomfish); and (3) the impact of fishing on these stocks. During technical reviews of NWHI insular resource assessment procedures, it was recommended that collaborative research programs between the industry, the PIFSC, and the University of Hawaii (UH) be developed to: (1) provide independent estimates of population size; (2) generate updated estimates of population dynamics; (3) further our understanding of the ecological role of lobsters in NWHI ecosystem; and (4) advance crustacean stock assessment methodologies. Technical reviews of pelagic stock assessment procedures resulted in similar recommendations, with an eye on broadening potential collaborators to address Pacific-wide issues. Currently, PIFSC conducts assessments of pelagic fish stocks in the Pacific Ocean collaboratively with scientists from Japan, Taiwan, Korea, China, Mexico, and the IATTC under the auspices of the International Scientific Committee (ISC). Priority is given to billfish and oceanic sharks species in the Pacific Ocean, including marlins, swordfish, and blue shark.

Progress During FY 2007

The JIMAR FY2006 annual report outlined four goals for FY 2007, including: (1) the continuation of spiny and slipper lobster tagging experiments at Necker Island, Maro Reef, Gardner Pinnacles and Laysan Island; (2) conducting the NWHI lobster resource survey in June 2007; (3) collecting bottomfish samples from the NWHI to re-estimate biological parameters (e.g., growth); and (4) completing pelagic (blue shark and striped marlin) and insular (NWHI lobster and bottomfish) stock assessments, and advancing population model development.



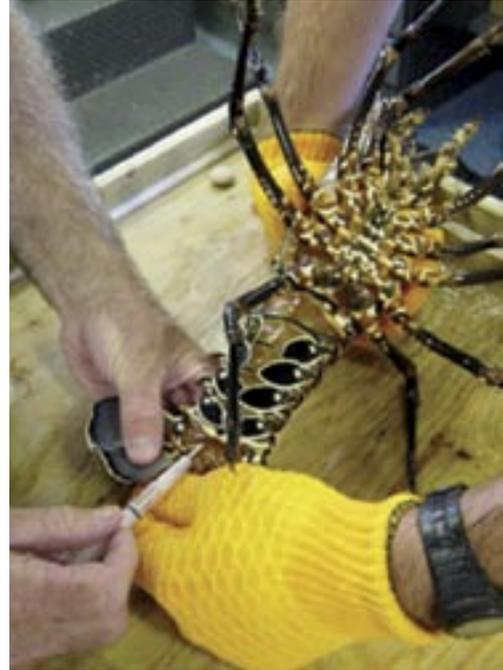
Scientists taking measurement of carapace length of slipper lobster prior to PIT tagging.



Scientists participating in the March 2007 meeting of the ISC Marlin and Swordfish Working Groups.

Of the goals articulated, the following were accomplished.

- Lobster tagging**—Two commercial fishing vessels were chartered in FY2007 to conduct lobster tagging experiments. One vessel was chartered from June 16–July 15, 2007 and conducted tagging operations at Necker Island and Gardner Pinnacles. The other vessel was chartered from July 18–August 16, 2006 and conducted tagging operations at Laysan Island and Maro Reef. JIMAR staff provided oversight on all scientific elements of the experiments. The 2006 charter was a success; approximately 1,300 spiny and slipper lobsters at Laysan Island and 5,300 spiny and slipper lobsters at Maro Reef were tagged and released. The 2007 charter was not completed at the time this report was written, but all indications suggest a successful cruise. Current tagging data was analyzed to estimate spiny and slipper lobster growth and movement patterns and compared to historical growth patterns. Numerous presentations on the lobster tagging experiment were presented by JIMAR staff to the Western Pacific Regional Fisheries Management Council (WPRFMC).
- NWHI lobster resource survey**—The 2007 NWHI lobster resource survey was conducted from June 13 to July 12, 2007 aboard the NOAA Ship *Oscar Elton Sette*. During the cruise, a suite of experiments and data collection activities were conducted by both PIFSC and JIMAR scientists. Data from the survey are being edited and keypunched. In addition, bycatch associated with the NWHI annual lobster resource survey was analyzed to determine the utility of using these data to assess fishing impacts to the NWHI ecosystem.
- Collection of bottomfish data**—Bottomfish sampling was conducted during the 2007 NWHI lobster resource survey to collect biological samples from endemic snappers and groupers. From each fish caught, morphometric measurements were recorded, and a scale and fin clip sample collected.
- Complete pelagic and insular stock assessments and advance population models**—Numerous stock assessments were completed with assistance from JIMAR staff, and significant progress on population model development also occurred in FY 2007. A spatially-explicit population model for spiny lobster that incorporates all available fishery-dependent and fishery-independent data was developed in collaboration with scientists from the University of British Columbia. The model captures the spatial structure of lobster populations in the NWHI, and the connectivity of local populations through larval transport. A spatially-structured population model was developed for deep-slope bottomfish stocks in the Hawaiian archipelago, and a stock assessment conducted. In addition, Dr. Shelley Clarke (formally with JIMAR) along with scientists from PIFSC, Imperial College London and Japan conducted a North Pacific blue shark stock assessment. Lyn Wagatsuma provided program oversight and analytical support (graphical analyses) for North Pacific pelagic stock assessments conducted by the PIFSC, most notably the striped marlin assessment that was completed under the auspices of ISC during March 2007 in Taipei, Taiwan.



Scientists inserting PIT tags into spiny lobster.

Western Pacific Fisheries Information Network Project

P.I.: Thomas A. Schroeder [Michael Quach]

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

NOAA Goal(s)

- To protect, restore, and manage the use of coastal and ocean resources through ecosystem-based management

Purpose of the Project

The Western Pacific Fisheries Information Network Project, funded through JIMAR (referred to here as WPacFIN JIMAR), is an ongoing project that partners with and supports the primary Western Pacific Fisheries Information Network Program (referred to here as the WPacFIN Program) based at the Pacific Islands Fisheries Science Center (PIFSC). WPacFIN JIMAR focuses on improving the availability of accessible, timely, and high-quality fisheries data needed for research and fisheries management.

The WPacFIN Program improves the data processing and management capabilities of fisheries scientists, researchers, and managers at JIMAR, the University of Hawaii, the National Marine Fisheries Service, and the Western Pacific Fisheries Management Council (WPFMC). It also gives technical support to participating fisheries agencies in American Samoa, Hawaii, Guam, and the Commonwealth of the Northern Mariana Islands (CNMI). The WPacFIN Program integrates local and federal island data, shares them through data share agreements, and manages them in the WPacFIN Program's central office at PIFSC. The WPacFIN Program also provides direct access to data for authorized users and fulfills data requests for researchers and fisheries management agencies.

In support of the WPacFIN Program, WPacFIN JIMAR primarily provides applications development/maintenance and technical support for American Samoa and Hawaii. WPacFIN JIMAR staff also assist in producing routine annual report products such as the *Fisheries of the United States (FUS)*, *Fishery Statistics of the Western Pacific (FSWP)*, and status reports for the Bottomfish and Pelagics Fishery Management Plans for American Samoa and Hawaii. They also update and maintain the WPacFIN Program website at the PIFSC, which provides public access to nonconfidential fisheries data, charts, various reports, and general information on related fisheries and island agencies.

Progress During FY 2007

The WPacFIN JIMAR project has made significant progress in providing technical support and applications development. Project staff designed, programmed, and implemented numerous computer applications in the island agencies and in the central WPacFIN office. These applications process a wide range of data collected by fisheries researchers in the island agencies and make these data available to authorized users. Several existing applications were redesigned and reprogrammed to address changes in the fisheries and new requirements. Six of the 10 proposed activities outlined last year were completed, as well as responding to numerous data summary requests from island agencies, WPFMC, PIFSC, PIRO and NOAA Head Quarters. Of the tasks not completed, three were due to personnel issues at the American Samoa Department of Marine and Wildlife Resources (DMWR) Office, and the fourth activity to assist DMWR and Hawaii in the creation of new FEP plan team report modules awaits the Council to define the reporting requirements.

Data Administration of Pelagic Fisheries Data

P.I.: Thomas A. Schroeder [Samuel G. Pooley and Karen Sender]

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

NOAA Goal(s)

- To protect, restore, and manage the use of coastal and ocean resources through ecosystem-based management

Purpose of the Project

This project supports data administration for the Pacific Islands Fisheries Science Center (PIFSC) and its fisheries partners under the Fisheries Oceanography Program and as a part of the Fisheries Information System (FIS) initiative. Scientists from NOAA Fisheries, JIMAR, and other programs at the University of Hawaii conduct collaborative research in fisheries and biological oceanography. Data administration ensures that fisheries data are managed as a resource and that the quality, security, and accessibility of data support these programs. Additionally, PIFSC and FIS have recognized that a critical component to supporting collaborative research and science is a comprehensive catalog of Fisheries data assets. InPort, the Fisheries Information System "Information Portal," and is intended to serve as an electronic catalog of fisheries-dependent data holdings. It went into production in December 2005.

Progress During FY 2007

In 2006, work on this project produced enhancements to the Hawaii Longline Observer Data System (LODS), including expanding the application to begin supporting American Samoa longline observer data, enhanced data reports, additional data fields in response to new requirements, and other improvements to increase data entry and data processing efficiencies. Additionally, a System Issues Manager application was designed and deployed to facilitate reporting and tracking of data system issues and enhancement requests. Continued data administration support of LODS has ensured the quality, security, and high availability of data to fisheries scientists and managers.

Continuing support and development of the FIS InPort metadata catalog has resulted in the adoption of this tool by ten state and federal fisheries partners. There are approximately 1500 catalog items registered in InPort. The major InPort development focus has been on responding to user reports of application issues and enhancement requests. Development of the second release of InPort (v. 1.1) includes enhanced metadata searching and extraction and additional metadata detail modules. This new version is currently in the testing phase and is scheduled to be deployed in summer 2007.

PIFSC has continued the development of data management tools in support of both PIFSC and the national Fisheries Information System. In 2006, the project team completed development and deployment of Data Trawler, a web-based data downloading tool. Data Trawler provides secure, point-and-click access to a user authorized list of PIFSC data. Users with no database experience can easily access and download data. Users with SQL knowledge may choose to refine the default database query. User queries can be saved for use or modification in later sessions. Data Trawler has become a primary data access tool for PIFSC scientists. Over 500 on-line data queries have been served to PIFSC scientists in the last half of FY07, greatly increasing the timeliness and efficiency of data access.

Satellite Remote Sensing Research Program

P.I.: Thomas A. Schroeder [Samuel G. Pooley and Jeffrey J. Polovina]

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

NOAA Goal(s)

- To protect, restore, and manage the use of coastal and ocean resources through ecosystem-base management

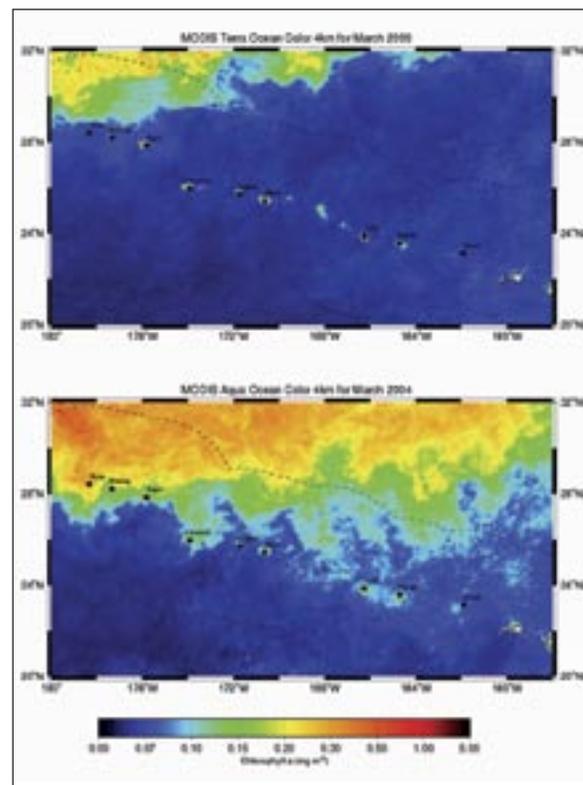
Purpose of the Project

This project has two related aspects. To use satellite remotely sensed oceanographic data to describe ocean dynamics, particularly features of importance to living marine resources, and to use satellite remotely sensed data together with data on movement of pelagic animals to define the critical oceanic habitats of these pelagic animals.

Progress During FY 2007

Progress met the objectives of using satellite remotely-sensed oceanographic data to understand population dynamics. Specifically during FY07, satellite remotely-sense chlorophyll and sea surface temperature data were

(right) Satellite-derived winter surface chlorophyll in March 2000 (top) and March 2004 (bottom) indicating the interannual variation in the Transition Zone Chlorophyll Front (TZCF) relative to the northern atolls of the Hawaiian Archipelago. Winters when the TZCF is shifted further south result in higher monk seal pup survival at the northern atolls in the Hawaiian Archipelago.



used to improve our understanding of the link between monk seal population dynamics and oceanography in the northern atolls of the Northwestern Hawaiian Islands.

Satellite Remote Sensing Research Related to the West Coast Integrated Ocean Observing System

P.I.: Thomas A. Schroeder [Franklin B. Schwing]

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

NOAA Goal(s)

- To protect, restore, and manage the use of coastal and ocean resources through ecosystem-base management
- To understand climate variability and change to enhance society's ability to plan and respond
- To serve society's needs for weather and water information
- To support the nation's commerce with information for safe, efficient, and environmentally sound transportation

Purpose of the Project

The purpose of this project is 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 efforts are undertaken to: 1) improve understanding of marine environmental variability and its impacts on living marine resources, 2) develop improved living marine resource assessment models, and 3) apply satellite remote sensing technology to the improvement of management of economically and ecologically important marine resources.

Progress During FY 2007

The Satellite Remote Sensing project in FY07 was focused on developing and expanding infrastructure and communication systems for a wide variety of satellite data and products in support of NOAA's mission and the Regional Associations and partners of IOOS. This is in addition to the fundamental goal of supplying oceanographic data sets as the West Coast regional node (WCRN) of the NOAA CoastWatch program. Several highlights from FY07 efforts are listed below.

- *New Harmful Algal Bloom Detection Product*—In FY07, CoastWatch developed and deployed near real time Chlorophyll deviation product to assist sampling efforts of state and municipal agencies concerned with the detection and monitoring of Harmful Algal Blooms in the State of Oregon. An example is shown in Figure 1. This work was performed in collaboration with the NOAA Cooperative Institute for Oceanographic Satellite Studies at Oregon State University.
- *New Alaska Browser*—Per the request of scientists at NOAA Fisheries Alaskan

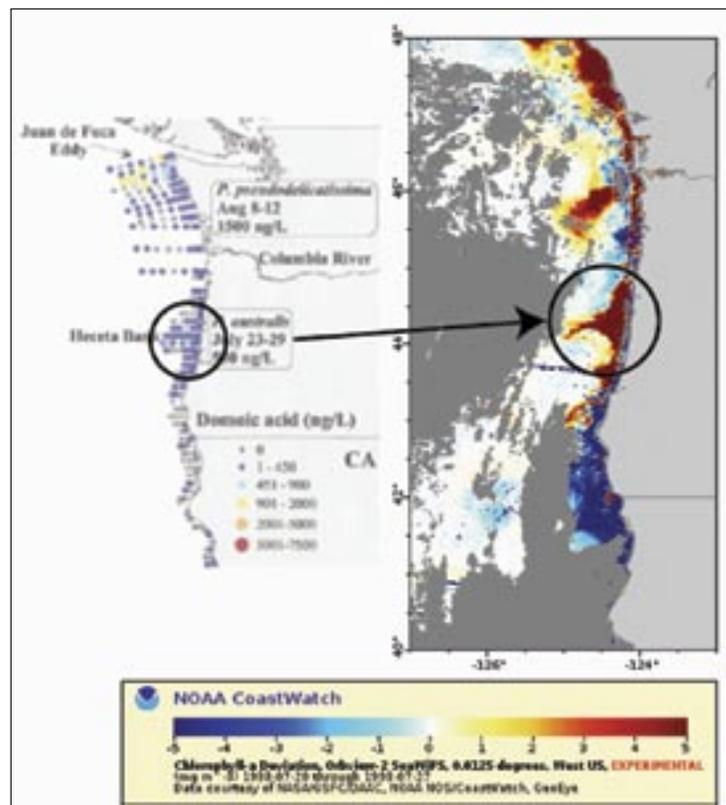


Image showing domoic acid concentration off Heceta Banks during July 1998 along with the chlorophyll deviation product derived from the satellite-borne SeaWiFS imagery several days prior to the in situ surveys.

Fisheries Science Center, an Alaska version of the West Coast Satellite data browser has been developed and deployed. The browser includes features specific to the region, such as the serving of sea ice data. Data managers at the Alaskan Ocean Observing System (an IOOS RA) have also expressed interest in the capabilities and underlying technology of the Alaskan browser. All data are made available by methods following the recommendations of the IOOS Data Management and Communications (DMAC) team, including simple browse, Live Access Server, OpENDAP, and Web Coverage Services. This work was supported by out-year funding from the NOAA Satellite Research & Operations program.

- *Client-Side Tools for Data Integration*—Having established a variety of data servers to provide data to customers, we have shifted focus to develop so-called “client-side” tools that enable the user to import data directly into the software environment of their choice. These tools are popular with non-specialists as they allow the integration of a full suite of satellite data sets without the need to learn new programming languages or handle a seemingly endless array of data formats. The programs have been introduced to over 100 scientists and managers, through a series of training workshops held in California, Oregon, Hawaii and Indonesia.
- *Climatologies for CoastWatch Data Browser*—We have developed long-term means (or “climatologies”) to help marine researchers and resource managers place the near real time environmental data within the context of the regional ocean dynamics. These compliment the time series for the many geophysical parameters that are served via IOOS DMAC-recommended methods by the OceanWatch Live Access Server and the CoastWatch Browser. This work was supported by out-year funding from the NOAA Satellite Research & Operations Program.

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

P.I.: Thomas A. Schroeder [Franklin B. Schwing]

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

NOAA Goal(s)

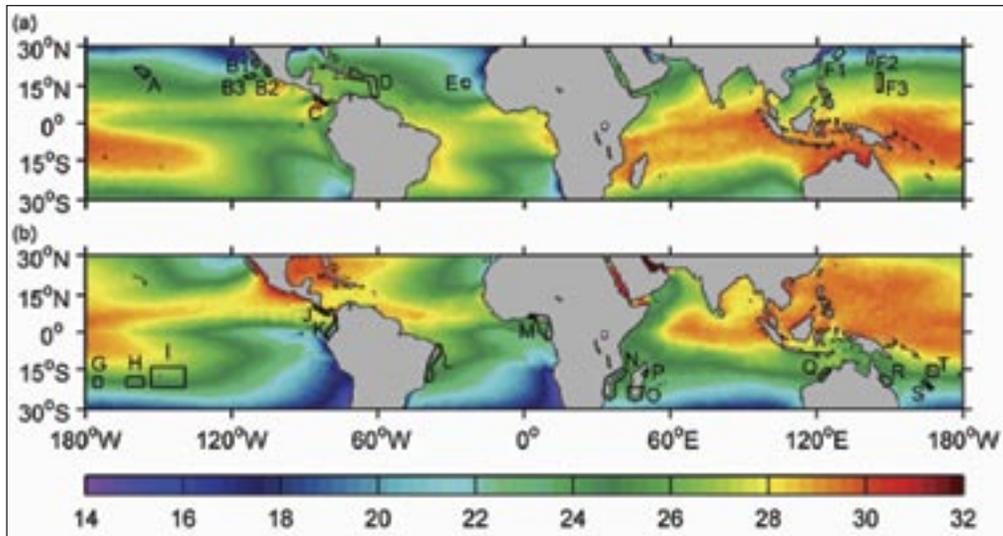
- To protect, restore, and manage the use of coastal and ocean resources through ecosystem-based management
- To understand climate variability and change to enhance society’s ability to plan and respond

Purpose of the Project

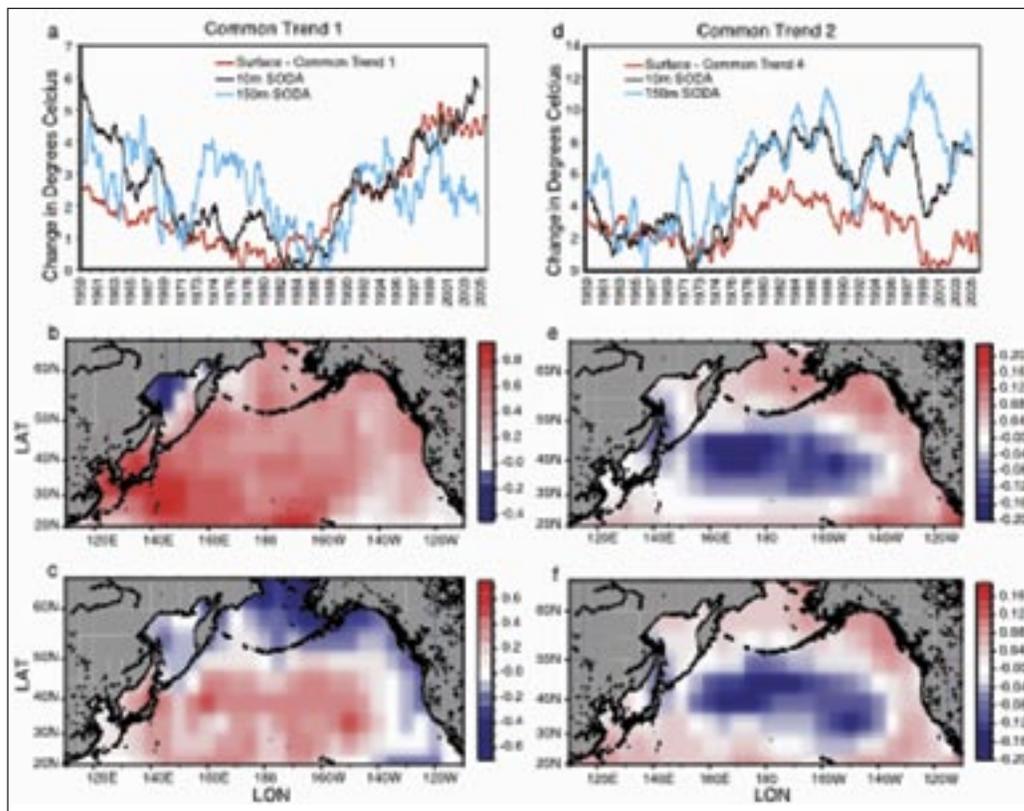
The project’s purpose is to describe the characteristic modes of variability in the North Pacific Ocean over interannual to decadal time scales, from analysis of historical data bases and numerical ocean model output, and to conduct research related to the application of in situ and satellite remote sensing data products for marine fisheries and other ocean users requirements, based on a mechanistic understanding of the links between physical forcing and ecological response. These research efforts are being undertaken to: 1) improve understanding of marine environmental variability and its impacts on living marine resources, 2) develop improved living marine resource assessment models, and 3) apply satellite remote sensing technology to improve the management of economically important marine resources. This will aid in our understanding of environmental variability in time and space, and improve our ability to manage economically important and protected marine resources.

Progress During FY 2007

As part of the NOPP funded research, efforts to improve our understanding of the movements and distribution of top predators in relation to environmental variability focused on three endangered species: humpback whales, blue whales, and leatherback sea turtles, using a combination of in-situ and satellite remote sensing data. The annual migration of eastern South Pacific humpback whales from Antarctica to Central America was used as a case in point to demonstrate that the distribution of humpback whale wintering areas worldwide closely follows the distribution of the warmest temperatures in any given ocean basin (Figure 1), probably as an energy-conserving strategy for newborn whales (Rasmussen et al., 2007). A historical review of blue whale occurrence in the southern hemisphere revealed that its distribution is restricted to regions where dynamic oceanographic processes like upwelling and frontal meandering lead to high biological production and high euphausiid standing stocks, while being completely absent from the oligotrophic central gyres (Branch et al., 2007). In contrast, the migration of satellite-tagged



Worldwide distribution of wintering areas (black polygons) for (a) ten Northern (A-F) and (b) 14 Southern (G-T) Hemisphere humpback whale populations, overlaid on climatological SST for February and August, respectively. Letter codes bear no relationship to Southern Hemisphere stock designations by the IWC. From Rasmussen et al. (2007).



Results from a common trend analysis of subsurface temperature data from the Simple Ocean Data Assimilation (SODA) model for 5-degree boxes in the North Pacific. a) Common trend 1 at 10m (black line) and 150m (blue line) depth. Common trend 1 from a state-space analysis of sea surface temperature data (red line) is shown for comparison. b) Correlation pattern between the univariate trend and common trend 1 at the 10m depth. c) Correlation pattern between the univariate trend and common trend 1 at 150m depth. d) Common trend 2 at 10m (black line) and 150m (blue line) depth. Common trend 4 from a state-space analysis of sea surface temperature data (red line) is shown for comparison. e) Correlation pattern between the univariate trend and common trend 2 at 10m depth. f) Correlation pattern between the univariate trend and common trend 2 at 150m depth. From Bessey and Mendelssohn (2007).

leatherback sea turtles in the eastern Pacific takes them through an intricate system of strong zonal currents near the equator and into an area with the lowest mean and eddy kinetic energy in the oligotrophic South Pacific gyre, possibly as a strategy that maximizes the capture of their gelatinous prey (Palacios et al., 2007b).

Research in support of the US GLOBEC Northeast Pacific Program and related activities has focused on understanding how local processes in the California Current and Gulf of Alaska ecosystems modulate large-scale climate forcing to produce a heterogeneous mesoscale response. Two approaches have been used: (1) analyzing long-term time series of oceanographic variables to describe spatial (sub-ecosystem to basin and global) and temporal (intraseasonal to interannual) patterns of variability (Bessey and Mendelssohn 2007; Mendelssohn and Bessey 2007; Schwing et al., 2007b); and (2) developing indicators of climate and environmental variability applicable to the management of living marine resources. The time series analyses have focused on differentiating climate signals associated with long-term trends, changes in seasonality, and rapid climate shifts, all of which have significant ecosystem consequences, as well as their associated spatial patterns (Figure 2). Development of a nutrient-based indicator of the biological utility of upwelled waters in the California Current System has continued into this year (Palacios et al. 2007a). An analysis of field data to determine dormancy timing in two species of copepods, and related variations in timing to varying physical ocean conditions was also completed, as well as an individual based model of copepod dormancy timing which is forced using the analyzed field data.

Pelagic Fisheries Research Program: Program Management

P.I: John R. Sibert

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

NOAA Goal(s)

- To protect, restore, and manage the use of coastal and ocean resources through ecosystem-base management
- To understand climate variability and change to enhance society's ability to plan and respond

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 2007

PFRP funding for FY 2007 was reduced to a level that did not allow new projects to be funded resulting from the January 2007 request for proposals. Nevertheless, funds were sufficient to continue existing projects.

The momentum of existing projects enabled the PFRP to continue to be highly productive. Researchers affiliated with the PFRP contributed 16 oral presentations and two posters to the 58th Lake Arrowhead Tuna Conference in May, 2007. (In this context it should be noted that the fledgling Large Pelagics Research Center at the University of New Hampshire, only in its second full year of operation, contributed three oral presentations to the Tuna Conference. Research sponsored by independent University-based programs is clearly having an impact on science-base management of fisheries' highly migratory fish stocks.)

Progress on goals from FY 2007:

- Education and training—No progress was achieved on plans to create a graduate degree program in fisheries at the University of Hawaii. Nevertheless the PFRP directly supported graduate students and indirectly supported several other through individual projects.
- Facilitate international collaboration in research on pelagic fisheries.
- The PFRP actively supported the GLOBEC/IGBP program CLIOTOP through participation of the PFRP Program Manager in the CLIOTOP Steering Committee, sponsorship of a one-day CLIOTOP workshop on "The Role of Squid in Pelagic Marine Ecosystems" during the 2006 PFRP PI meeting, and assistance in organizing the first CLIOTOP Symposium "Climate Impacts on Oceanic Top Predators", December 3-7, 2007, La Paz, Mexico.

- The PFRP is a sponsor of 2nd International Symposium on Tagging and Tracking Marine Fish with Electronic Devices October 8-11, 2007, Donostia-San Sebastian, Spain.
- The PFRP Program Manager was invited to present lectures at National Taiwan University in Taipei. The outcome of these talks was a follow-up visit by PFRP Researcher, Dr. Michael Musyl, who was able to assist Taiwanese colleagues in electronic tagging of sailfish. This informal collaboration may lead to important opportunities for the study of billfish over the entire Pacific Ocean.
- PFRP staff and researchers participate in the Scientific Committee and Specialist Working Groups of the Western and Central Pacific Fisheries Commission. The third regular session of the WCPFC Scientific Committee will meet 13-24 August 2007 in Honolulu.
- PFRP sponsored a booth at the First Annual Hawaii Fishing and Seafood Festival, Oct. 8, 2006, Pier 38, Honolulu. The high attendance surpassed organizers' expectations. PFRP publications and brochures were distributed, selected project posters were displayed, and a PFRP staff person was present to answer questions.

A General Bayesian Integrated Population Dynamics Model for Protected Species

P.I.: John R. Sibert [Mark Maunder]

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

NOAA Goal(s)

- To protect, restore, and manage the use of coastal and ocean resources through ecosystem-base management

Purpose of the Project

The objective of the project is to generate a general Bayesian integrated modeling framework for protected species modeling that can be applied to multiple species and used to provide management advice. Models will be developed based on the general framework and used to estimate the effect of fisheries on the protected species populations.

Progress during FY 2007

The application of the general framework to the black footed albatross and the yellow-eyed penguin was completed and the results presented as a poster at the EURING conference. In addition, a presentation titled "Comparison of estimators for mark-recapture models using AD Model Builder" using the penguin and albatross mark-recapture data was given at the EURING conference and a manuscript has been prepared and submitted for the proceedings. The application of the general framework to the Tern Island population of black footed albatross has not been completed and was not presented at the EURING conference. The lack of completion of this project is due to staff changes at the IATTC. The ADMB course was not taught in Seattle due to lack of interest by statisticians. MM attended the Stock Synthesis II workshop in Seattle, but did not attend the PI meeting in Hawaii due to the low relevance of the theme topic. We conducted research into methods to include information in models of protected species and to estimate uncertainty. In particular, the research on random effects presented at the EURING conference. We collaborated with Tore Schweder at the Centre for Ecological and Evolutionary Synthesis to investigate bias in assessment models and use of confidence distributions to represent uncertainty. MM attended a related workshop in Norway, funded by the Centre for Ecological and Evolutionary Synthesis and a manuscript is in preparation. Collaboration with Jaume Forcada at the British Antarctic Survey continued on a limited basis.



Small Boat Action at Cross Seamount, Fall 2007

A simplified general model for protected species designed to include multiple sources of mortality on multiple populations was developed. This model was based on using the Baranov catch equation to model the multiple sources of mortality. A preliminary model was developed in AD Model Builder and applied to the Hawaiian black footed albatross population. Dr Carlos Alvarez-Flores was contracted to complete the model and application. MM collaborated with Jon Schnute and James Ianelli to outline future prospects of a software framework for fisheries stock assessment. Much of this software framework is based on concepts used in this project. A book chapter and a journal article have been accepted for publication.

An Analysis of Archaeological and Historical Data on Fisheries for Pelagic Species in Guam and the Northern Mariana Islands

P.I.: John R. Sibert [Judith R. Amesbury and Rosalind Hunter-Anderson]

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

NOAA Goal(s)

- To protect, restore, and manage the use of coastal and ocean resources through ecosystem-base management

Purpose of the Project

MARS is producing a report on the long-term data concerning fisheries for pelagic species in Guam and the Northern Mariana Islands. The report is based mainly on archival review. However we are also conducting interviews with fishermen on each of the four major islands (Guam, Saipan, Tinian, and Rota). In addition, we have had two collections of archaeological fish bones from Guam analyzed by Foss Leach of New Zealand to add to the data from the Prehistoric Period. We have also sent a Japanese-speaking researcher, Wakako Higuchi of Guam, to Japan to obtain fishery data from the Japanese Period in the Northern Marianas.

Progress during FY 2007

Hunter-Anderson has completed Chapter 1, Overview of the Prehistory of the Mariana Islands. Amesbury has obtained the radiocarbon dates from the Ylig Project and has written most of Chapters 2, 3, and 4 with the fishery data from the Prehistoric Period, Spanish Period, and Twentieth Century. Wakako Higuchi's work on the pre-war Japanese fisheries in the Northern Marianas has been published.

An Assessment of Small Boat Yellowfin and Bigeye Tuna Operations and Regulatory Scenarios in the Main Hawaiian Islands

P.I.: John R. Sibert [Edward W. Glazier]

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

NOAA Goal(s)

- To protect, restore, and manage the use of coastal and ocean resources through ecosystem-base management

Purpose of the Project

The primary goal of this project was to provide PFRP and the WPRFMC with valid and reliable information regarding historic and contemporary trends in commercial pursuit of yellowfin and bigeye tuna by the small-boat handline fleet operating around the Main Hawaiian Islands. Especial focus was applied to: (a) description and spatial analysis of private FAD fishing offshore the Big Island (b) description and explanation of changes in extent and manner of use of various gear, and (c) description and explanation of trends in market and distribution of BET and yellowfin by small-boat handline operators. The secondary purpose of the project was to characterize the economic, social, and cultural contexts within which the BET/yellowfin small-boat commercial fisheries are conducted in the MHI.

Progress during FY 2007

Project completed

Comparing Sea Turtle Distributions and Fisheries Interactions in the Atlantic and Pacific

P.I.: John R. Sibert [Selina Heppell and Molly Lutcavage]

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

NOAA Goal(s)

- To protect, restore, and manage the use of coastal and ocean resources through ecosystem-base management

Purpose of the Project

We are conducting quantitative and qualitative analyses of existing data on the ecology, distribution and fishery interactions of leatherback and loggerhead sea turtles in the North Pacific and North Atlantic oceans. Our primary goal is to use a comparative approach to determine why populations of sea turtles in the Atlantic appear to be stable or increasing, while populations of the same species in the Pacific are declining, even though fisheries interactions occur in each ocean basin. Because of great concerns for turtle survival, and their protected status under the Endangered Species Act, sea turtle take in pelagic fisheries has resulted in complete closures (e.g., Hawaii, Grand Banks) or major restrictions on effort and area for the US fleet (e.g., NE Distant Sector, Atlantic). Scientific understanding of the extent and nature of world-wide take patterns in pelagic and inshore fisheries, and impacts on stock rebuilding, is incomplete, at best. Our PASTA research project is now comprised of an interdisciplinary group of sea turtle biologists, fisheries scientists, demographers, and oceanographers from federal and international agencies and academia.

Steering Committee: Molly Lutcavage, Selina S. Heppell, Tomo Eguchi, David S. Kirby, Rebecca Lewison, Abigail McCarthy, Melissa Snover, Yonat Swimmer

Progress during FY 2007

PASTA II met in San Diego August 22-25, 2006. Day one was a meeting of the original PASTA attendees, who presented findings and discussed synthesis. Day 2 included additional invitees from sea turtle and oceanographic fields to critically evaluate and contribute to our assessment. A full report from PASTA II is forthcoming. New participants in PASTA II included: Bryan Wallace from Duke University, Irene Kinan from the WPRFMC, Shaleyla Kelez, also from Duke University, Andy Meyers at the University of New Hampshire Large Pelagics research center, Mark Maunder from the IATTC, and Jennifer Purcell, a gelatinous zooplankton biologist from Western Washington University.

At PASTA II we discussed progress made on life-history models that incorporate age structure (time lags) and changes in vital rates for each species and are then compared with nesting beach trends and size distribution data. We also discussed movement models, specifically for hatchling dispersal, that utilize nesting distributions, remotely sensed data, current maps and satellite tracking information to determine likely overlaps for turtles and various fisheries. Prior to the PASTA II meeting, we created a series of large maps of nesting beaches. During the meeting we invited participants to add the locations of recently discovered nesting beaches and foraging grounds to these maps. These were helpful in compiling our maps of nesting beach trends and in determining which beaches were on our list of index beaches for both species and both basins.

In addition to the PASTA II meeting in San Diego, we convened the majority of PASTA participants at the International Sea Turtle Symposium in Myrtle Beach, SC this February. At this "PASTA 2.5" meeting we focused on the best way to publish the work we've done as the PASTA group. Specifically, the group discussed ideas for a Bioscience review paper, a NCEAS working group, and presenting PASTA conclusions at the ClioTop meeting in December.

Anticipated products include a report that provides descriptions and results of demographic models, preliminary results from a hatchling dispersal model, and maps that show the trends in nesting beach numbers for both species in both basins over the time period for which those data are available. The conservation efforts made in those same locations will also be included on those maps, as well as the coastal and pelagic fisheries near nesting beaches. We are also completing an analysis of the reproductive values of sea turtles caught in various fisheries in

each ocean basin (manuscript complete, will be submitted to Journal of Applied Ecology). We have also generated a list of alternative hypotheses for population differences, along with their predicted effects on age/size structure, population growth, and/or population distribution, a list of critical research needs (data gaps), and prototypes of new, integrated assessment models. We anticipate 1 overview paper of our approach and findings for publication in a peer-reviewed journal, plus 2-4 papers authored by PASTA attendees that contribute to the effort.

Describing the Vertical Habitat of Bigeye and Albacore Tunas and Post Release Survival for Marlins in the Central Pacific Longline Fisheries with Pop-up Archival Transmitting Tags

P.I.: John R. Sibert [Jeffrey J. Polovina and Michael P. Seki]

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

NOAA Goal(s)

- To protect, restore, and manage the use of coastal and ocean resources through ecosystem-base management

Purpose of the Project

To describe the vertical habitat and horizontal movements of bigeye and albacore tunas in the central Pacific. These tunas are target species in longline fisheries in both Hawaii and American Samoa, and an understanding of the habitats and movements of these species is needed as a background to fisheries management.

Progress during FY 2007

Based on analysis of pop-up tag date we've determined that opah, in the central North Pacific, generally inhabit a 50–400 m depth range and a 8–22°C temperature range. They are frequently found in shallower depths, between 50 and 150 m, during the night, and in greater depths ranging from 100 to 400 m during the day. However, opah are constantly moving vertically within this broad habitat. During the day, they are very likely to spend at least a little time in depths shallower than 175 m; while at night, excursions occurring below 200 m are not uncommon. Their vertical speeds are generally less than 25 cm/s; however, a burst descent in excess of 4 m/s has been recorded.



The deepwater fish Opah (Lampris guttatus), one of the species of deepwater fish caught in the Hawaii-based longline fishery and a species we tagged with electronic tags to describe their habitat.

Economic Fieldwork on Pelagic Fisheries in Hawaii

P.I.: John R. Sibert [Minling Pan]

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

NOAA Goal(s)

- To protect, restore, and manage the use of coastal and ocean resources through ecosystem-base management

Purpose of the Project

The primary objective of this multi-year project is to provide detailed economic information especially cost of operation data on Hawaii-based domestic pelagic fishing vessels such as longliners, trollers and handliners, and charter boats. Cost-earnings report(s) (published as JIMAR/SOEST reports) on each of these fisheries has been prepared since the project began in 1994. As a result, the data from these studies have been used in a variety of economic and social analyses for these fisheries by PFRP projects-and by the National Marine Fisheries Service to support the fishery management in the Western Pacific Islands Region.

There are two main tasks under this project within FY2007.

- To continue research effort on technological changes and the impact on fishing effort in the Hawaii-based longline fishery (received funds from PFRP FY2006, Co-PI: Mr. David G. Itano, JIMAR, Pelagic Fisheries Research Program, University of Hawaii);
- To initiate and conduct a valuation of spinner dolphin excursions in Hawaii.

Progress during FY 2007

Task A. We conducted a study to explain patterns of adoption of new technology and the resulting effects on fishing productivity in the Hawaii-based longline fishery. This study is among the few that address the effects of introducing new technology into a fishery. This matter is important because technological innovation can significantly affect fishing capacity. A multiple linear regression model was computed to estimate the effects of technological factors on productivity. This model indicated, for example, that a 1% increase in hook numbers should yield a 0.9% increase in catch rates (catch per set). Other factors that exerted positive effects on fishing capacity were vessel speed, vessel length, and use of sea surface temperature maps. It is expected that this work will be useful in determining the appropriate capacity of this fishery within the overall context of the national effort to control total fishing effort.

Task B. We conducted a study to assess willingness to pay for different types of activities or services on these spinner dolphin excursions in Hawaii. This research work was initiated in response to current management concerns within the National Marine Fisheries Services (NMFS) regarding the Hawaiian spinner dolphin. Because spinner dolphin excursions in Hawaii have increased in popularity in recent years, there are concerns that the behavior of Hawaiian spinner dolphins could be altered by human proximity, including possible harassment associated with dolphin excursions. NMFS is considering whether to propose a suite of regulations to protect wild spinner dolphins, in order to prevent possible harm to dolphins. In order to understand the potential economic impact(s) of the proposed regulations on the dolphin viewers and the tour industry, the first step of the study was to survey excursion providers to determine the factors that affect consumers' willingness to pay for the spinner dolphin excursions. These factors included boat type and boat size, as well as the activities offered (e.g., viewing or swimming with the dolphins), any guarantee that may be offered, and price. The second step was to survey visitors (and some residents) concerning their willingness to pay for different types of activities associated with spinner dolphin excursions in Hawaii. These survey results were analyzed to determine the significance of each of the aforementioned five factors on willingness to pay.

Evaluation of Data Quality for Catches of Several Pelagic Management Unit Species by Hawai'i-based Longline Vessels and Exploratory Analyses of Historical Catch Records from Japanese Longline Vessels

P.I.: John R. Sibert [William A. Walsh, Keith A. Bigelow]

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

NOAA Goal(s)

- To protect, restore, and manage the use of coastal and ocean resources through ecosystem-base management

Purpose of the Project

This project was intended to generate well-documented and verified data sets for use in multi-species modeling efforts. The work continued and expanded upon two previous Pelagic Fisheries Research Program (PFRP) projects ("Distributions, Histories, and Recent Catch Trends with Six Fish Taxa Taken as Incidental Catch by the Hawaii-based Commercial Longline Fishery" by W.A. Walsh and S.G. Pooley, and "Comparisons of Catch Rates for Target and Incidentally Taken Fishes in Widely Separated Areas of the Pacific Ocean" by W.A. Walsh and S.G. Pooley.

Progress during FY 2007

This project has been completed. Related activities in FY 2006 consisted of completion of a paper summarizing the results ("Corrected Catch Histories and Logbook Accuracy for Billfishes (Istiophoridae) in the Hawaii-based

Longline Fishery”, by William A. Walsh, Keith A. Bigelow, and Russell Y. Ito. It is now in the final stages of in-house review at the Pacific Islands Fisheries Science Center. The paper will be submitted to the peer-reviewed journal *Fisheries Research*; the expected submittal date is July or August 2007. The Abstract from the paper follows.

Abstract

This paper presents corrected catch histories, standardized catch rates, and evaluations of the accuracy of federally mandated commercial logbooks for billfishes (Istiophoridae: blue marlin, *Makaira nigricans*, striped marlin, *Tetrapturus audax*, shortbill spearfish, *T. angustirostris*, black marlin, *M. indica*, and sailfish, *Istiophorus platypterus*) taken as incidental catch by the Hawaii-based longline fishery. The study (March 1994–February 2004) was undertaken because billfish misidentifications in logbooks caused by similarities in body size, shape, and coloration have long represented a major challenge in monitoring this fishery. The objective was to improve understanding of the composition and magnitude of incidental billfish catches. This paper represents a substantive expansion upon an earlier, published analysis of blue marlin catch data by using a longer time series, including all of the istiophorid billfishes taken by this fishery, and providing estimates of standardized catch rates. Results generated by fitting generalized additive models to fishery observer data, applying the model coefficients to the corresponding predictor variables in logbook reports, and comparing the logbook results to sales records documented that the nominal catch data for all species were significantly biased, with inflated estimates for blue marlin, black marlin, and sailfish and negatively biased totals for striped marlin and shortbill spearfish. These biases were caused primarily by misidentifications, the most common of which was striped marlin logged as blue. Sailfish, and to a greater extent, black marlin, were rare in the incidental catch of this fishery. After correction of the data, striped marlin was shown to be the dominant species, in both numbers and biomass. Bycatch of billfishes appeared to be rather minor in scope, primarily involving discards of striped marlin and small shortbill spearfish at times of peak abundance. Standardized catch rates for blue marlin, striped marlin, and shortbill spearfish appeared stable during this short 10-year time series. We conclude that nominal catch data for billfishes can be highly biased as a result of mistakes by a small number of fishermen, even in a carefully monitored fishery, and that the techniques employed herein proved useful in identifying, characterizing, and correcting such bias. The corrected data will serve as the foundation for a research database intended for use in stock assessments and ecosystem-based research.

Fishery Dynamics in the Samoan Archipelago

P.I.: John R. Sibert [Keith A. Bigelow, Adam Langley, John Hampton]

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

NOAA Goal(s)

- To protect, restore, and manage the use of coastal and ocean resources through ecosystem-base management

Purpose of the Project

The purpose of the project is to improve understanding of the dynamics of south Pacific albacore. Major objectives include: 1) to analyze the spatial and temporal dynamics and fishery interaction of longline fisheries within and around the American Samoa EEZ, 2) to compare albacore fishery dynamics in other Pacific Island Countries and Territories (PICTs) longline fisheries, and 3) to improve the regional albacore stock assessment.

Progress during FY 2007

- *Objective 1*—A Fisheries Research Analyst started working on the project in January 2006. Longline logbook data were merged with oceanographic data (e.g., sea surface temperature, ocean color, dynamic height and subsurface temperature measurements) using spatio-temporal information. The resulting dataset was used to investigate variations in catch of the American Samoa based longline fishery. Generalized Linear Models (GLMs) and General Linear Mixed Models (GLMMs) were the exploratory statistical tools employed with a negative binomial error distribution. Results indicated, that catch is linearly related to effort. Catch and landings were largely explained by vessel size and effort.

- *Objective 2*—A co-PI (AL) completed an analysis of south Pacific albacore dynamics for the Fiji and French Polynesia longline fisheries. Results indicated that catch and CPUE appeared directly related to seasonal fluctuations and trends in fisheries in adjacent EEZ waters are likely to be influenced by similar variations in oceanographic conditions. Inter-annual variation in albacore catch rates were also evident in most of the PICT fisheries. The sustained period of low catch rates that commenced in late 2002 appears to be attributable to inter-annual variation in oceanographic conditions and at a local scale, very high levels of fishing effort appear to be capable of causing localized depletion of albacore tuna.

- *Objective 3*—Considerable reappraisal of the underlying model structure of the south Pacific albacore stock assessment was conducted in 2005 and 2006. Investigations in 2005 included: appropriate stratification of the model spatially and by fishery, investigation of the performance of the model to the assumptions of seasonal movement between model regions, ability to estimate age specific natural mortality, and various sensitivity analyses with regard to the assumptions of the number of age classes and initial conditions. Investigations in 2006 included key biological inputs such as growth, natural mortality, and age at maturity.

Results of the project were presented at a south Pacific albacore fisheries forum sponsored in September 2006 by the Western Pacific Regional Fisheries Management Council.

Human Dimensions Analysis of Hawaii's *Ika-Shibi* Fishery

P.I.: John R. Sibert [Edward W. Glazier]

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

NOAA Goal(s)

- To protect, restore, and manage the use of coastal and ocean resources through ecosystem-base management

Purpose of the Project

The general goal of the project was to provide PFRP and WPRFMC with information needed to optimally manage Hawaii's *ika-shiba* fishery and associated resources. More specifically, our goal was to: (1) describe how the fishery is configured in social and economic terms, (2) identify and analyze factors that have influenced change in rates of participation and production over time, and (3) describe and explain how and why participants have been implicated in and/or have reacted to such changes.

Progress during FY 2007

Project completed.

Incidental catch of Non-target Fish Species and Sea Turtles: Comparing Hawaii's Pelagic Longline Fishery Against Others

P.I./Sponsor Name: John R. Sibert [John Kaneko and Paul Bartram]

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

NOAA Goal(s)

- To protect, restore, and manage the use of coastal and ocean resources through ecosystem-base management

Purpose of the Project

The purpose is to evaluate the incidental catch rates of non-target fish species and sea turtles in Hawaii's longline fishery and make comparisons with other pelagic longline fisheries using a methodology patterned after Hall (1999). A report titled: *Catch to Bycatch Ratios: Comparing Hawaii's Longline Fisheries with Others*, was prepared and distributed as SOEST 0-05 JIMAR Contribution 04-352. Later in 2005, an extension of the project was awarded. The purpose of the extension is to develop (where possible) pelagic longline gear profiles of Japanese and Taiwanese longline fleets in the WCPO producing ultra-low temperature (ULT) frozen sashimi

bigeye tuna. Efforts will be made to expand (where possible) the pelagic longline profiles to include information on the number and size of vessels, fish hold capacity, type of refrigeration/freezer, target species and target market in addition to the information on gear and fishing practices.

Progress During FY 2007

For the project extension period, we proposed a combination of desk-based work and travel to attempt to collect information detailing fishing gear configurations and operating methods from Taiwanese ULT freezer tuna longline vessels to complete the fleet operational profiles. Several interviews were completed during this period with representatives of vessels in this fleet, through the assistance of industry contacts in Taiwan. A trip to Kaohsiung Taiwan had been planned, but we again faced scheduling conflicts with the bilingual tuna industry specialist and contacts in Taiwan.

Incorporating Oceanographic Data in Stock Assessments of Blue Sharks and Other Species Incidentally Caught in the Hawai'i-based Longline Fishery

P.I: John R. Sibert [Pierre Kleiber and Hideki Nakano]

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

NOAA Goal(s)

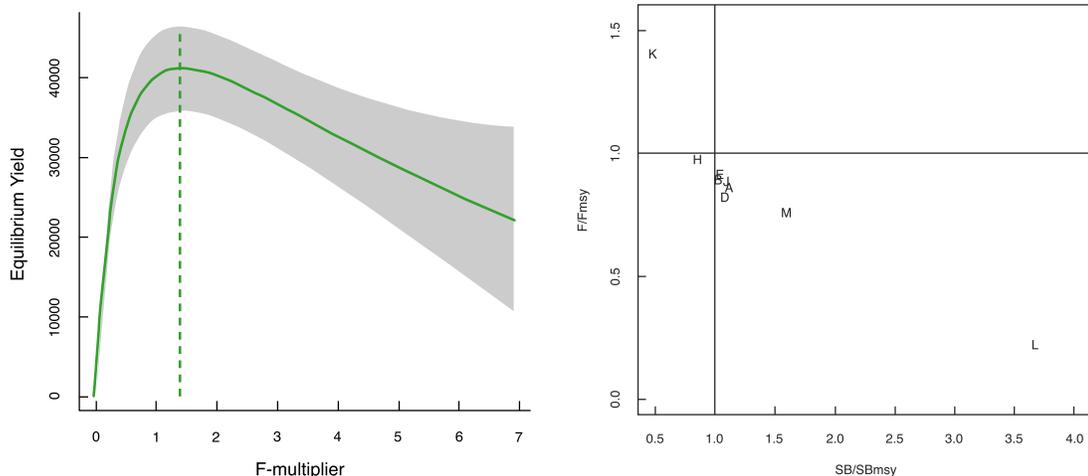
- To protect, restore, and manage the use of coastal and ocean resources through ecosystem-base management

Purpose of the Project

Improve habitat based standardization of longline effort by accounting for the affects of current shear and other oceanographic features on the depth distribution of longline hooks and the degree to which that distribution overlaps the depth distribution of particular fish species.

Progress During FY 2007

- Contracted with Otter Research Ltd. to add enhancements to MULTIFAN-CL (MFCL) was fulfilled.
- A renewed blue shark stock assessment was conducted using some of the new MFCL capabilities.



(left) Equilibrium yield (1000 mt) as a function of fishing mortality multiplier. The shaded areas represent approximate 95% confidence intervals. Dashed line indicates F_{MSY} , the point of maximum yield. (right) Average (1998–2002) F/F_{MSY} vs. SB/SB_{MSY} for a range of alternate model fits conducted under a variety of constraints and conditions. Subscripts give the fishery impact measured as ratio of exploited spawning biomass to unexploited spawning biomass averaged over years 1998 through 2001. "A" is the basecase.

Instrumented Buoys as Autonomous Observatories of Pelagic Ecosystems

P.I.: Kim N. Holland [Laurent Dagorn]

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

NOAA Goal(s)

- To protect, restore, and manage the use of coastal and ocean resources through ecosystem-base management

Purpose of the Project

To develop an autonomous platform that is capable of using acoustic survey methods (“sonar”) to census the aggregations of pelagic fishes that assemble around FADs and to use this tool to study the temporal dynamics of these aggregations.

Progress During FY 2007

The part of this project that was delegated to Scripps personnel for design and fabrication of the prototype has been slowly approaching completion. The slow pace was dictated by loss of key technical personnel at Scripps and reduction of parallel sources of funding. However, testing of a ship-born prototype was completed in Spring 2007. We anticipate field deployment of the prototype in Hawaii in winter 2007.

Integrated Modeling for Hawaiian Albatross Populations

P.I.: John R. Sibert [Jean-Dominique Lebreton, Dan Goodman]

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

NOAA Goal(s)

- To protect, restore, and manage the use of coastal and ocean resources through ecosystem-base management

Purpose of the Project

Analyze available information concerning Black-footed (*Phoebastria nigripes*) albatross (BFAL for the sake of brevity in what follows) with the aim of assessing the status of populations in relation with the potential impact of longline fisheries.

Progress during FY 2007

Analyses were completed and written down, partly as a thesis and partly as articles and (currently) manuscripts.

Integrative Modeling in Support of the Pelagic Fisheries Research Program: Spatially Disaggregated Population Dynamics Models for Pelagic Fisheries

P.I. John R. Sibert

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

NOAA Goal(s)

- To protect, restore, and manage the use of coastal and ocean resources through ecosystem-based management
- To understand climate variability and change to enhance society’s ability to plan and respond

Purpose of the Project

The general objective of this research is to integrate the results of different components of the Pelagic Fisheries Research Program into a consistent framework that integrates knowledge of fish movement and population

dynamics, the fishing process, economics and oceanography. The primary focus is the development of spatial models of pelagic fish population dynamics that explicitly include movement, mortality, and fisheries. The work emphasizes collaboration with other PFRP projects.

Progress during FY 2007

- *Analyze currently-used light-based geolocation algorithms to identify and correct the source of the autocorrelated latitude bias.*

Latitude estimates computed by all manufacturers of archival tags and PSATs are biased and autocorrelated. These inaccuracies are attributable to small errors in measuring time of sunrise and sunset and are amplified by the inherent mathematical structure of the astronomical coordinate transformations that are used to compute latitude from the position of the Sun. Preliminary attempts to incorporate theoretical formulations of bias and variance into state-space models to correct “raw” geolocation estimates are promising, but further work is required to produce a generally useful algorithm.

A new state-space model was completed to estimate the most probable track of geographic positions directly from a series of light measurements. The model estimates two geographic positions per day, without reducing the daily light data to two threshold crossing times, its covariance structure is designed to handle high correlations due to for instance local weather conditions, and it can estimate the yearly pattern in latitude precision by propagating the data uncertainties through the geolocation process. This model will find wide application among archival tag and PSAT users and is in the public domain. A paper describing this model was accepted for publication.

- *Continue develop and support kfSST and kftrack software.*

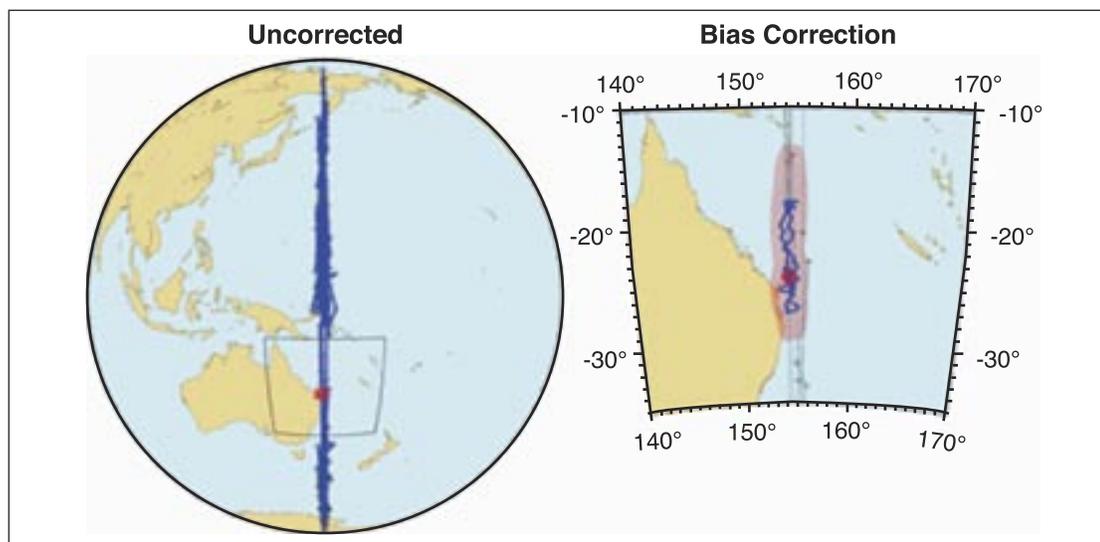
kfSST was improved by application of the “unscented Kalman filter” for greater accuracy in approximating non-linear terms and by implementation of an improved method of averaging sea surface temperatures. The unscented Kalman filter was also introduced into kftrack in the context of exploring the bias correction mentioned above.

- *Continue development of electronic tagging data repository.*

The electronic tagging data repository is functional.

- *Collaboration on the “Mixed-resolution models for investigating individual to population spatial dynamics of large pelagics” project.*

This project has largely been postponed. Sporadic work has been carried out, and some important technical problems have been solved. These include how to represent the movement field in a flexible, but still tractable manner. The reason for postponing this project is that the light based geolocation model turned out to be more



Effect of systematic geolocation errors. Map on the left shows the track of a bigeye tuna tagged with an archival tag in the Coral Sea using position estimates from the tag manufacturer's geolocation algorithm. Map on the right shows the track reconstructed from the same data using a prototype bias correction algorithm. Blue line is the track. Triangles are the release and recapture position. Shaded area is the 95% confidence region around the reconstructed track.

successful than anticipated. Work on the mixed resolution model was postponed in order to meet user demand for the new light-based model.

- *Continue work on parameter optimization in SEAPODYM.*

Adjoint-based methods for maximum likelihood parametric assimilation of fisheries data into SEAPODYM were successfully developed and applied to skipjack (*Katsuwonus pelamis*) and bigeye (*Thunnus obesus*) tunas in the Pacific Ocean. The estimated biological parameters are consistent with current knowledge of the physiology and behavior of these two species. A manuscript is in preparation.

Modeling Longline Effort Dynamics and Protected Species Interaction

P.I.: PingSun Leung [Naresh Pradhan and Samuel G. Pooley]

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

NOAA Goal(s)

- To protect, restore, and manage the use of coastal and ocean resources through ecosystem-based management

Purpose of the Project

The general aim of the proposed study is to refine and extend the existing fleet dynamic model, and the specific objectives and tasks are as follows.

- Extend the longline trip level time-series data set to 2002.
- Re-estimate the technical and economic interrelationships among different species landed and the entry/stay/exit behavior.
- Estimate the catch-effort relationships for each species and for each fleet.
- Analyze the factors, rate, and degree of protected species interaction (e.g., turtles, and seabirds) with longline fishing activities.
- The information generated above will be incorporated into the existing fleet dynamic model in maximizing fishery welfare and fishing effort considering broader implications on protected species and stock conditions.

Progress during FY 2007

The major activities of this project have been completed by December 31, 2006. We have used the period from July 1 to December 31, 2006 as planned to finalize the two journal articles which have now been accepted for publication. The first article (to appear in *Applied Economics*) summarizes the modification and improvement of the existing fleet effort dynamic model in maximizing fishery welfare by incorporating protected species, seasonal and spatial features in the longline fishery. The second article (to appear in *Journal of Environmental Management*) employed a distance function approach to model sea turtle interaction as an undesirable output in Hawaii's longline fishery. This approach provides a method of calculating temporal and trip-specific cost of sea turtle bycatch reduction without assuming any policy intervention. Such information can be useful in analyzing tradeoffs between number of incidental take of sea turtles and the marginal cost of sea turtle bycatch.

All the objectives have been achieved and the results have been summarized in several journal articles.

Modeling the Eco-physiology of Pelagic Fishes and Sharks with Archival and Pop-up Satellite Archival Tags (PSATs)

P.I.: John R. Sibert [Michael K. Musyl, Christina Larsen, Hans Malte, Richard C. Brill]

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

NOAA Goal(s)

- To protect, restore, and manage the use of coastal and ocean resources through ecosystem-base management
- To serve society's needs for weather and water information

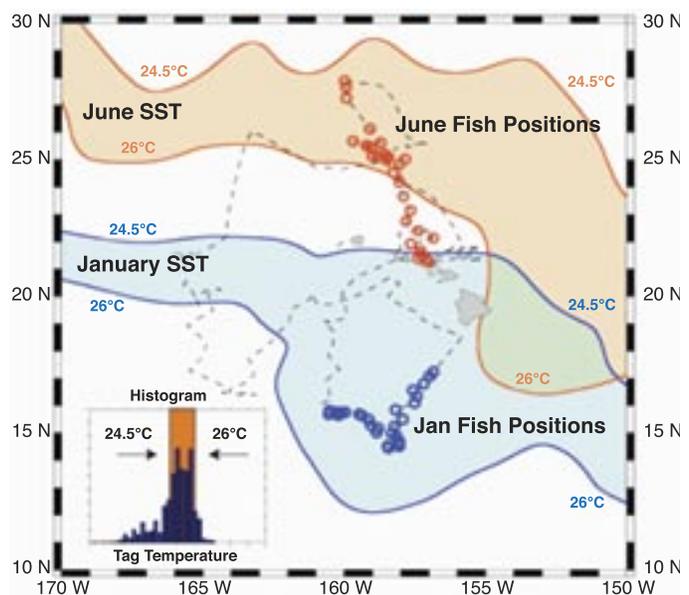
Purpose of the Project

Project uses available data from archival and PSAT tags to develop IBMs (individual based models) to describe the eco-physiology of different species of large pelagic fishes and sharks. This project complements data already collected on a number of pelagic species and will be linked to existing PFRP projects by Musyl, Brill, and Moyes. Thus the study will be a collaboration between the University of Hawaii/JIMAR/PFRP, VIMS/ National Marine Fisheries Service, and the Dept. of Zoophysiology, University of Aarhus, Denmark. Our ultimate goal is to develop model(s), which will be applicable to many different pelagic fish and shark species. Using these models we can evaluate the possible importance of specific oceanographic parameters in an unbiased fashion, which will allow for intra- and inter-species comparison. A second purpose of this study is to explore failure (or conversely success) scenarios in pop-up satellite archival tags (PSATs) attached to pelagic fish, sharks and turtles. Specifically, this aspect of the study is designed to look for explanatory variables in the context of PSAT retention rates, percentage retrieved satellite data (i.e. depth, temperature, geolocations), and tag failure. By examining several factors and information about PSATs attached to vastly different pelagic species, it is anticipated that certain patterns/commonalities may emerge to help improve our understanding of attachment methodologies, selection of target species and experimental design. Lastly, information derived from this study will allow an unprecedented and critical appraisal of the overall efficacy of the technology.

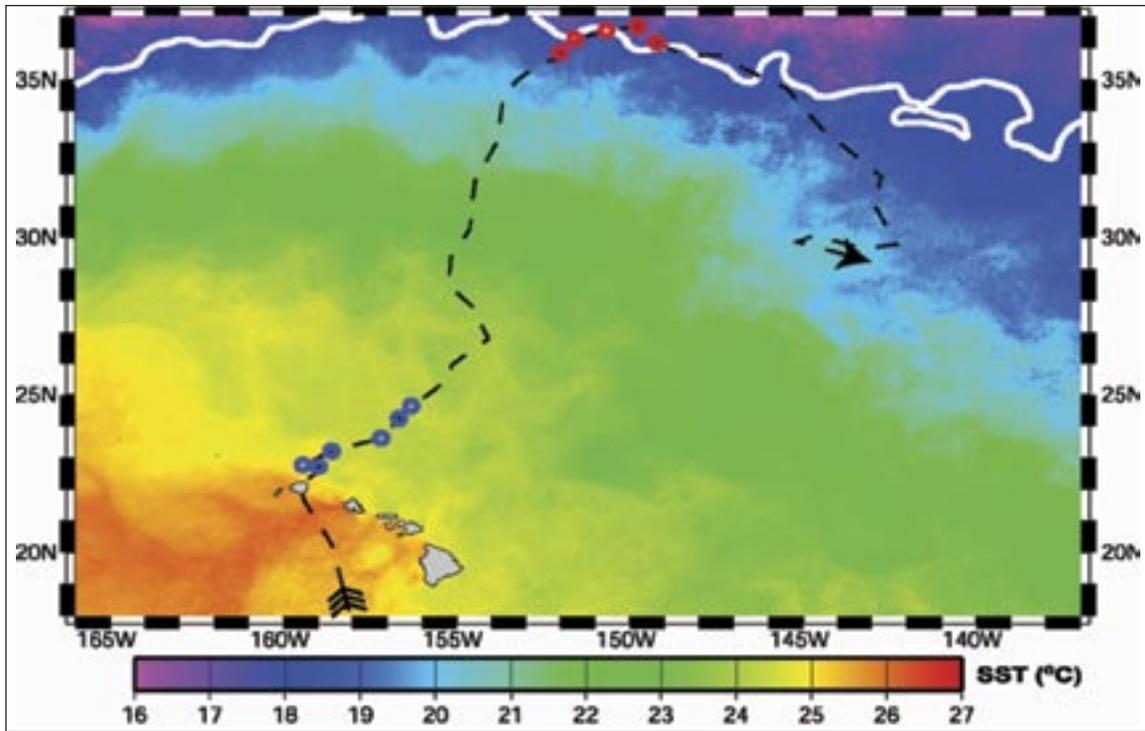
Progress during FY 2007

At present, the PI is adding final information to the PSAT Performance database. This database already contains information from >660 tags across 18 pelagic taxa (including 3 marine turtle species). Preliminary results indicate tags have an overall reporting rate of ca. 79% but PSATs attached to certain species (e.g. swordfish, bigeye thresher shark) have lower reporting rates ($\approx 30\%$). It is important to state that non-reporting tags (21%) are not synonymous with mortality. It is anticipated that this study will examine information from over ≈ 700 -750 PSATs. In discussion among members of the "PSAT Performance Group", consensus was reached to publish the manuscript detailing this work (see below) in the current fiscal year rather than adding additional data. Extra information can be added later when these data are publicly posted on the PFRP website. The PI has organized failure and survival analysis of the database using Weibull, log-normal, and Kaplan-Mier procedures with specialized engineering software and other procedures in the R statistical package. Tagheads developed by the project are providing long term retention in pelagic fishes (e.g. swordfish, 80 to 240 days).

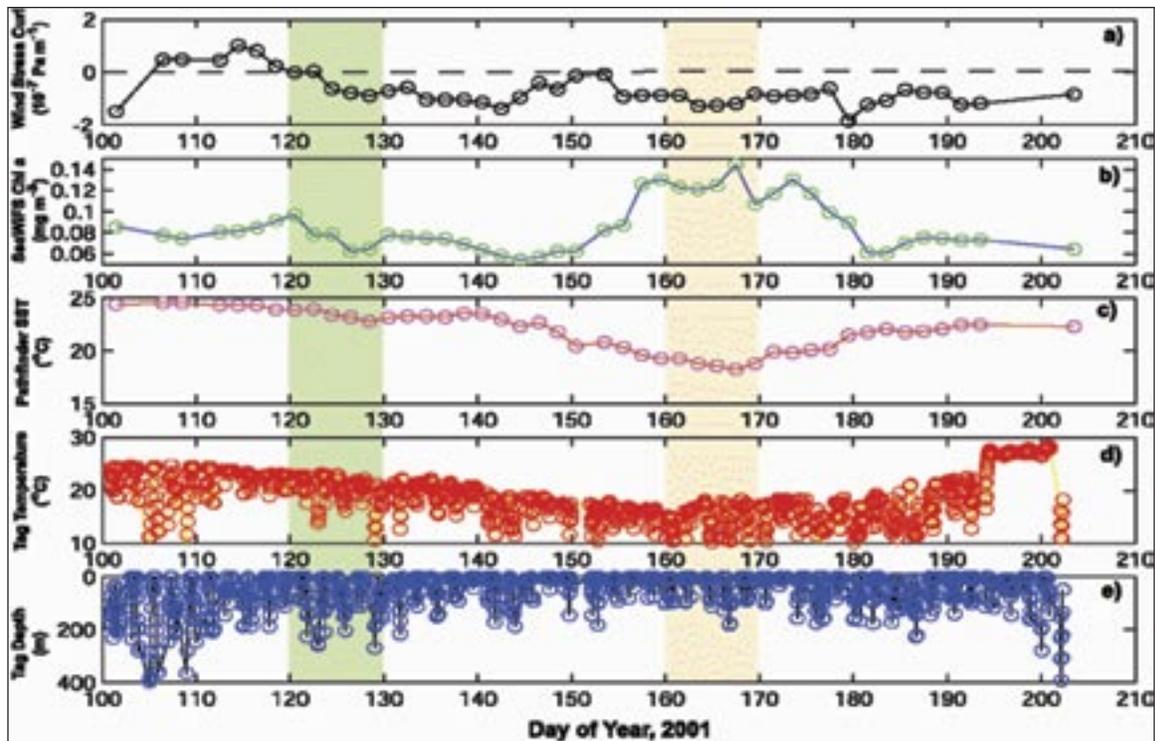
The development of an oceanographic database (and associated tools) to examine/correlate movements patterns of PSAT tagged animals with various oceanographic parameters—on temporal and spatial scales (i.e. both horizontal and vertical vectors) is operational and PSAT information are now linked to this source. The PI is in discussions with Dr. David Sims (Marine Biological Association of the UK, School of Biological Sciences, Univ. Plymouth) and Dr. Diego Bernal (Univ. Massachusetts) to continue development of IBMs (Unfortunately Dr. Malte, Univ. Aarhus, could not continue on the project). Three manuscripts specifically examining PSAT tagged animals from the project have now been completed (papers by Bernal et al., Malte et al. and Sims et al.). The person hired as a Research Associate resigned with little prior notice thus leaving the senior PI to finish tasks slated for this position.



Potential distribution of White-Tip Shark habitat during January and June. Based on satellite-derived SST from GOES, AVHRR, MODIS, AMSR-E Blend. Frequency distribution and temperature measured by PSAT on shark shown in histogram.



Blue shark (female ca. 2m FL) traveled 4210 km during 102 days at liberty at mean speed of 41 km/day. Locations in Tropical Waters and near STCZ shown in blue and red circles, respectively, superimposed on GOES SST averaged for 30 May through 9 June 2001. Heavy white line shows location of the STCZ.



Satellite-derived a) wind stress curl, b) Chlorophyll a, and c) SST mean values for the 1° lat./long. Square surrounding estimated daily positions of the fish from the PSAT, d) hourly temperature, and e) hourly tag depth recorded by PSAT.

Oceanographic Characterization of the American Samoa Longline Fishing Grounds for Albacore, *Thunnus Alalunga*

P.I.: John R. Sibert [Michael P. Seki and Jeffrey J. Polovina]

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

NOAA Goal(s)

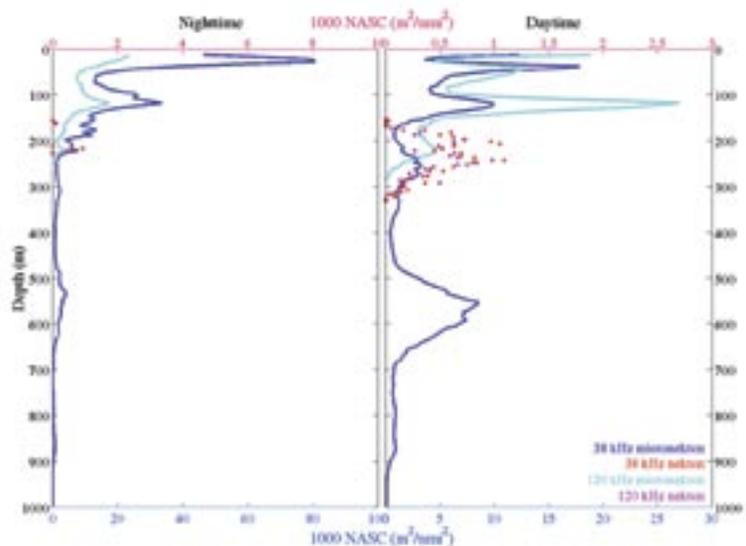
- To protect, restore, and manage the use of coastal and ocean resources through ecosystem-based management

Purpose of the Project

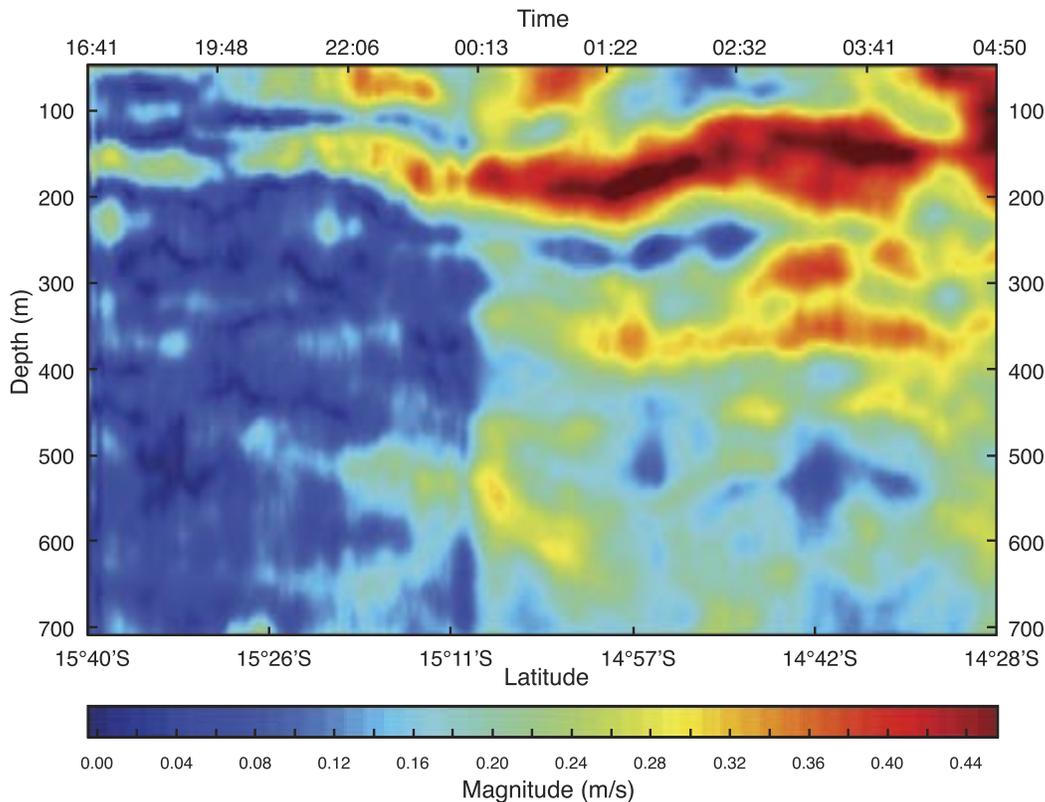
The American Samoa domestic longline fishery has undergone extraordinary growth, particularly in the fleet composition of large vessels (>20 m in length) that have fueled a fivefold increase in fishing effort and landings from 1999 to 2001. The most intense period of the expansion occurred during 2001, when the total number of hooks set increased tenfold from 860 thousand during 2000 to 8.6 million in 2002. The target species of the longline fleet is albacore tuna, *Thunnus alalunga*, which dominates the catch. The fisheries performance for albacore peaked with 334 thousand fish caught during 2002, which was followed by a steep decline in 2003–2005 and a modest come back in 2006. Oceanographically there has been little study regarding the pelagic habitat in the American Samoa region. The current research undertakes the task of characterizing the pelagic habitat and fishing grounds occupied by the American Samoa longline fishery through the use of satellite oceanographic remote sensing and *in situ* shipboard surveys. Coupled with the oceanographic assessment will be fishery information to develop a functional understanding of the spatial and temporal occupation and movement tendencies of large South Pacific albacore and the role of the environment on longline gear performance and catch. These data include albacore depth distribution and gear performance obtained from commercial longlines instrumented with time-depth-temperature recorders (TDRs) and the set level catch information from the American Samoa fishery logbook program.

Progress during FY 2007

Analyses of data from the second year of the project (FY06) have been completed. Results of analyses completed during FY07 seem to confirm that anticyclonic eddies in the American Samoa fishing grounds are predominantly formed from SECC waters. On the average, SECC waters contain higher micronekton biomass than SEC waters, but nekton biomass does not seem to be related to either micronekton biomass or water characteristics. ADCP current data indicates that the vertical extent of mesoscale eddies formed in the region is maximum 200 m in depth or less. Nekton biomass seems to be related to current magnitudes in the upper 200 m, while relationship between current magnitudes and micronekton biomass is not evident. Nekton aggregations were observed almost exclusively between 200 and 300 m below the surface (Fig. 1), coinciding with the depths where tagged albacore spent most of their time during the first survey of the area, (March, 2004; first year of the project). These depths also correspond to depths of a thin, persistent micronekton layer which shows acoustic characteristics consistent with relatively higher biomass of crustaceans, found to be preferred by albacore, relative to those in the shallow and deep scattering layers.



Horizontally averaged Nautical Area Scattering Coefficients (NASC) for micronekton (blue and turquoise lines, bottom axis) and nekton (red and pink dots, top axis) at 38 kHz (blue and red) and 120 kHz (turquoise and pink) frequencies, separated for daytime (left panel) and nighttime (right panel).



Net current magnitudes along a south to north transect approaching the island of Tutuila from the south. Note the relatively strong subsurface jet between 100 and 200 m depth north of 15°15'S.

Currents show evidence of persistent subsurface jets, predominantly at 150 m, 200-300 m and at 500-600 m depths, presumably formed by island or other topographic effects. Highest currents in the fishing grounds, exceeding 5 cm/s, were observed south of Tutuila during nighttime, at 150-200 m depth (Fig. 2). These currents are propagating southwest in the region where the highest micronekton biomass were observed consistently during both years of the observations.

Sociological Baseline of Hawaii Longline Industry

P.I.: John R. Sibert [Stewart Allen]

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

NOAA Goal(s)

- To protect, restore, and manage the use of coastal and ocean resources through ecosystem-base management

Purpose of the Project

The Hawaii-based longline fishing industry has been heavily regulated with little analysis of the socio-cultural impacts of those regulations and management. The ethnically diverse makeup of longline industry participants in Hawaii and the dynamic nature of the industry highlight the need for primary data on contemporary sociocultural characteristics. Project researchers are addressing this problem by:

- Compiling a comprehensive social profile of the longline fishing industry of Hawaii; and
- Providing social profile information to decision-makers on regulatory impacts and implementation strategies

Progress during FY 2007

The main emphasis has been writing a series of reports. Three peer-reviewed publications were published in FY 2006, with a fourth scheduled to be published in September 2007 and another subsequently. One of the above papers incorporates description of shoreside businesses and the fish distribution system, but additional fieldwork still needs to be conducted to further explore these initial findings and a separate report developed on the distribution chain (with a focus on sociocultural aspects). We had planned to have that fieldwork take place during FY2006, but it is being conducted this summer and fall in conjunction with fieldwork taking place as part of a longline research project funded under the Fisheries Disaster Relief Program. Once that proposal was funded it made sense to combine the fieldwork into a single contract (with Amy Gough, who conducted the original set of longline oral histories); I am looking for a UH graduate student who will be able to work with Amy and then continue on his/her own during FY2007 to complete the remaining fish distribution portion of the study.

Spatial Modeling of the Tradeoff between Sea Turtle Take Reduction and Economic Returns to the Hawaii Longline Fishery

P.I.: John R. Sibert [Minling Pan and Shichao Li]

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

NOAA Goal(s)

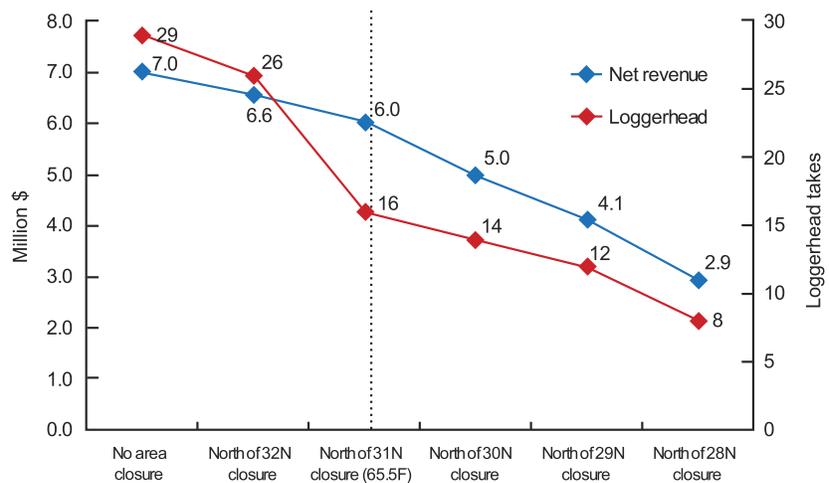
- To protect, restore, and manage the use of coastal and ocean resources through ecosystem-base management

Purpose of the Project

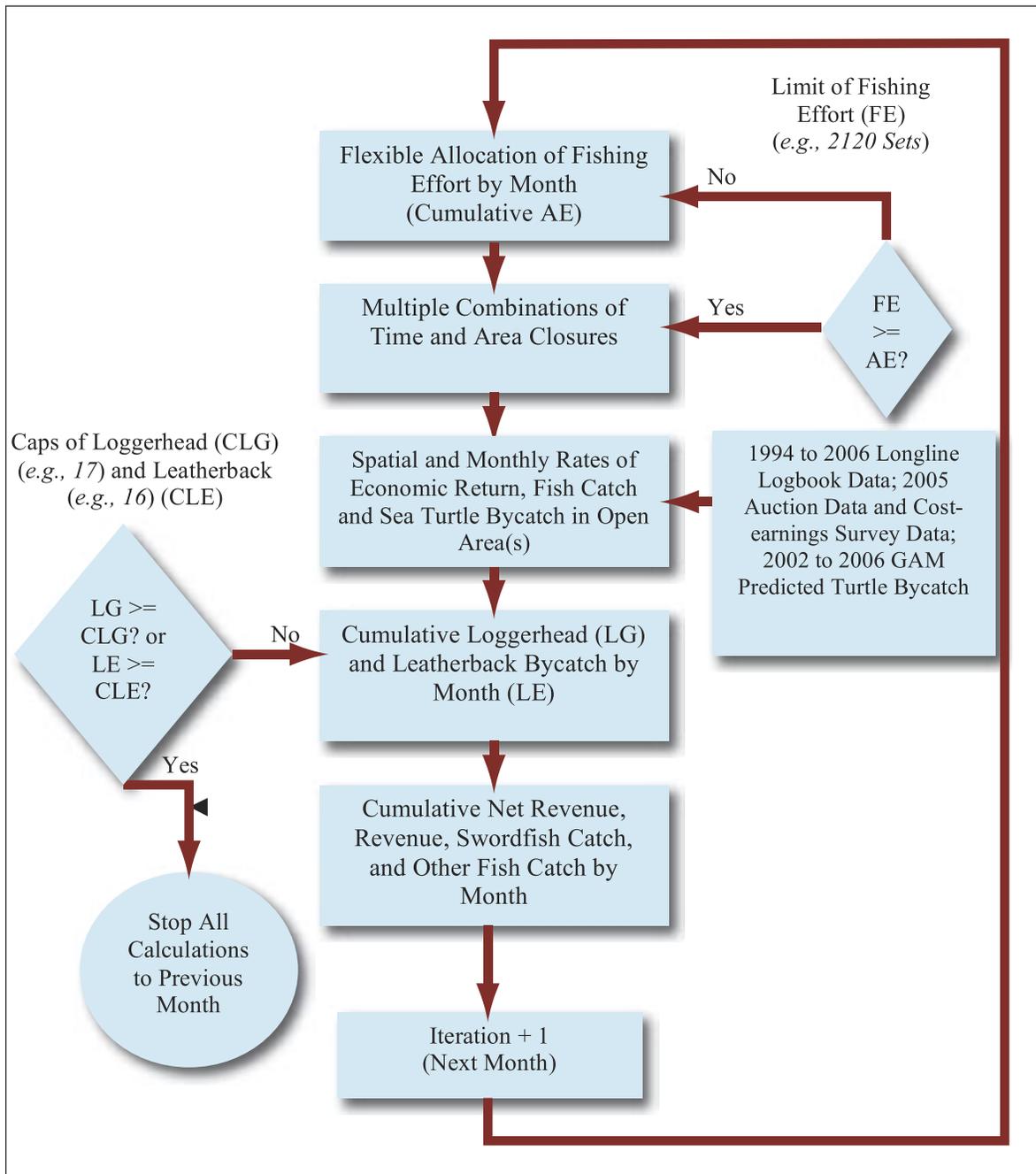
Construct a bio-economic model to explore tradeoffs between sea turtle take reductions and economic return for the Hawaii-based longline fishery. Through simulation analysis of multiple time and area closures, the study assesses possible policy options that allow fishing opportunity to be maximized without exceeding the caps on sea turtle interactions.

Progress during FY 2007

- Developed a bio-economic model to explore tradeoffs between sea turtle take reductions and economic returns. Generalized Additive Models were applied to predict sea turtle interactions, and a cost function based on a regression analysis was built into the model to assess economic returns.
- Performed simulation analysis of time and area closures. The study assessed possible policy options that allow fishing opportunity to be maximized without exceeding the caps on sea turtle interactions. Several levels of fishing effort were employed in the evaluations. The study provided a suite of feasible policy options for the management of the shallow-set Hawaii-based longline fishery that targets swordfish.
- Finished a draft of the technical report (for JIMAR publication) and a draft manuscript targeting journal publication. These drafts were under review and revision.



An example of trade-offs of sea turtle takes and economic returns under various policy alternatives.



Flow Diagram for Time and Area Closure Simulation Model.

Survivorship, Migrations, and Diving Patterns of Sea Turtles Released from Commercial Longline Fishing Gear, Determined with Pop-up Satellite Archival Transmitters

P.I.: John R. Sibert [Yonat Swimmer, Richard C. Brill, Michael K. Musyl, Lianne McNaughton]

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

NOAA Goal(s)

- To protect, restore, and manage the use of coastal and ocean resources through ecosystem-based management

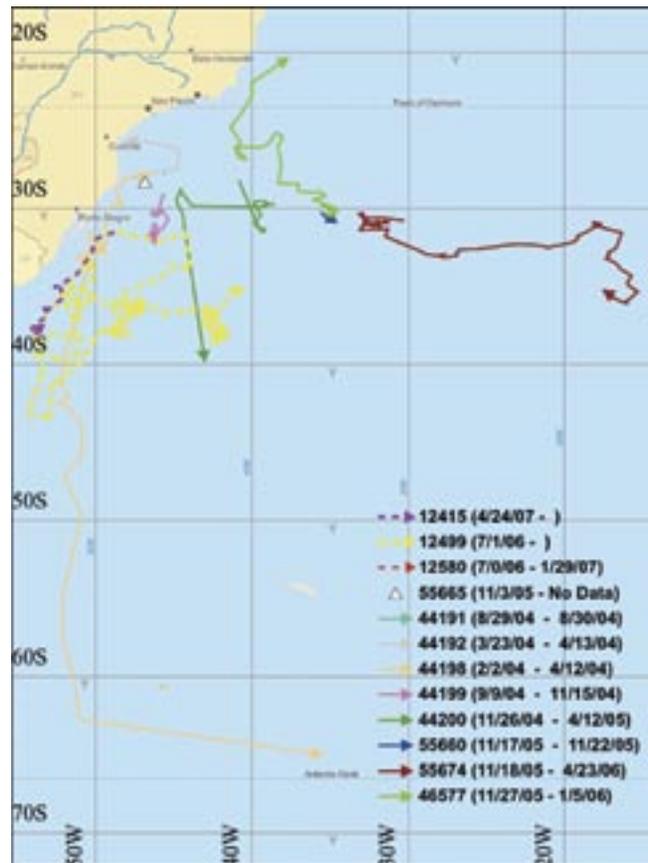
Purpose of the Project

To provide estimates of post-release mortality of hard shelled sea turtles caught and released in longline fishing gear. Our research set out to tag sea turtles with both pop-off satellite archival tags (PSATs) as well as platform terminal transmitters (PTTs) in order to track the movements of turtles after their release from a fisheries encounter. We have worked with observers in numerous foreign longline fisheries with relatively high sea turtle encounter rates in order to tag as many individual turtles as possible. An original goal to compare the movements of longline-caught turtles to “controls” was previously completed (see publication list). Additionally, we sought to use biochemical parameters of incidentally-caught and released turtles to determine likelihood of mortality associated with different types of hooking (e.g. deep or shallow).

Progress during FY 2007

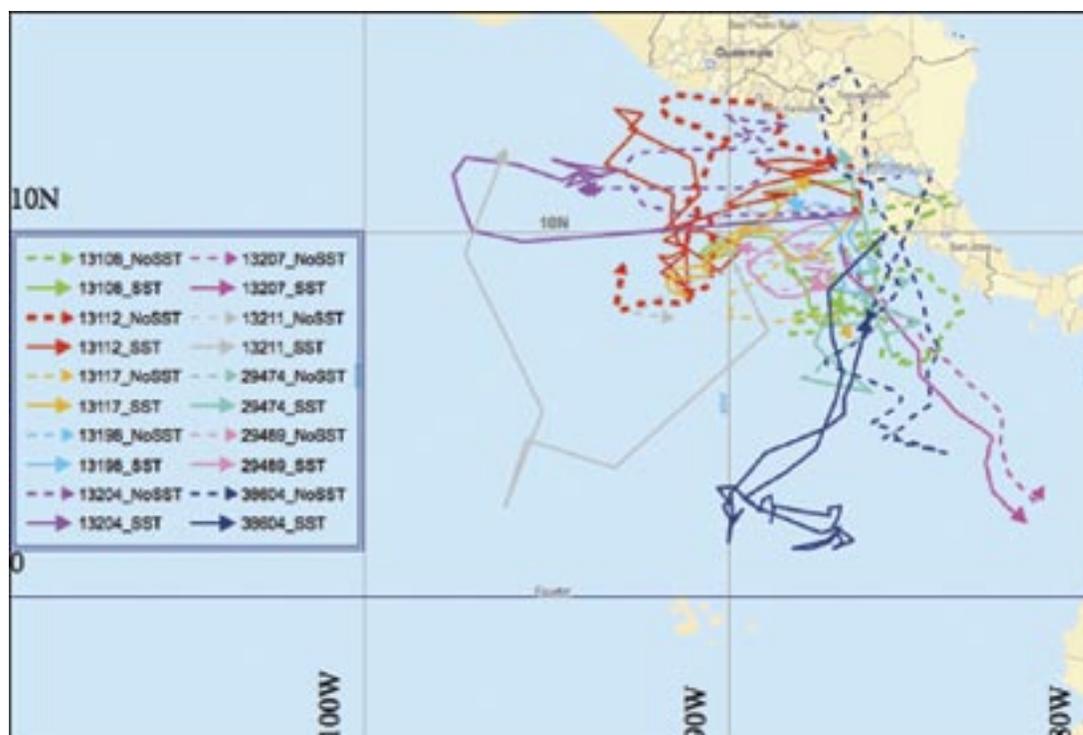
In the past 4 years, we have trained over 75 observers in Hawaii, California, Brazil and Costa Rica. During FY07, we accomplished the following work (related to this grant) in these countries.

- *Brazil*—Working with collaborating scientists and fishermen, we tagged an additional 4 loggerhead sea turtles with PTT’s. We currently have tracking data (in various stages, some still tracking) for 12 loggerhead turtles released from fishing gear. We trained the observers during previous years, and this year we had the observers attach slightly fewer PTT’s as we had anticipated, and this was largely due to a delayed start in the fishery (February vs. November) as a result in limited availability of the correct bait for the fishing experiments.



Movements of loggerhead sea turtles as tracked with PSATs or PTTs after their release from commercial longline fishing gear off the coast of Brazil (courtesy of Lianne McNaughton).

- *Costa Rica*—We used the Kalman filter (with SST component) to identify the most probable tracks of 11 olive ridley turtles tagged during previous years. We also worked with collaborators at the NOAA SWSC-Environmental Research Division in Monterey, California to correlate turtles’ movements with oceanographic features. This work is nearly complete and an ms is in process.
- *California/Hawaii*—Working with Milani Chaloupka, a contracted collaborator, we used a Bayesian approach to interpret PSAT data from loggerhead sea turtles tracked in the N. Pacific Ocean after their release from



Movements of olive ridley sea turtles tracked after their release from longline fishing gear off the coast of Costa Rica. Most probable tracks are from light-based geolocations filtered with the Kalman filter both with (solid line) and without (dashed line) incorporation of SST (courtesy of Lianne McNaughton).

commercial longline vessels. These turtles were tagged and released from commercial vessels during 2001-2006.

- *Biochemical parameters study*—We have successfully subcontracted this work to Amanda Southwood at the University of N. Carolina, Wilmington, and we have assisted in her ability to acquire blood samples through our collaborative research efforts.

Regime Shifts and Recruitment in Western and Central Pacific Ocean Tuna Fisheries

PI: John R. Sibert [David S. Kirby, Adam Langley, Valerie Allain]

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

NOAA Goal(s)

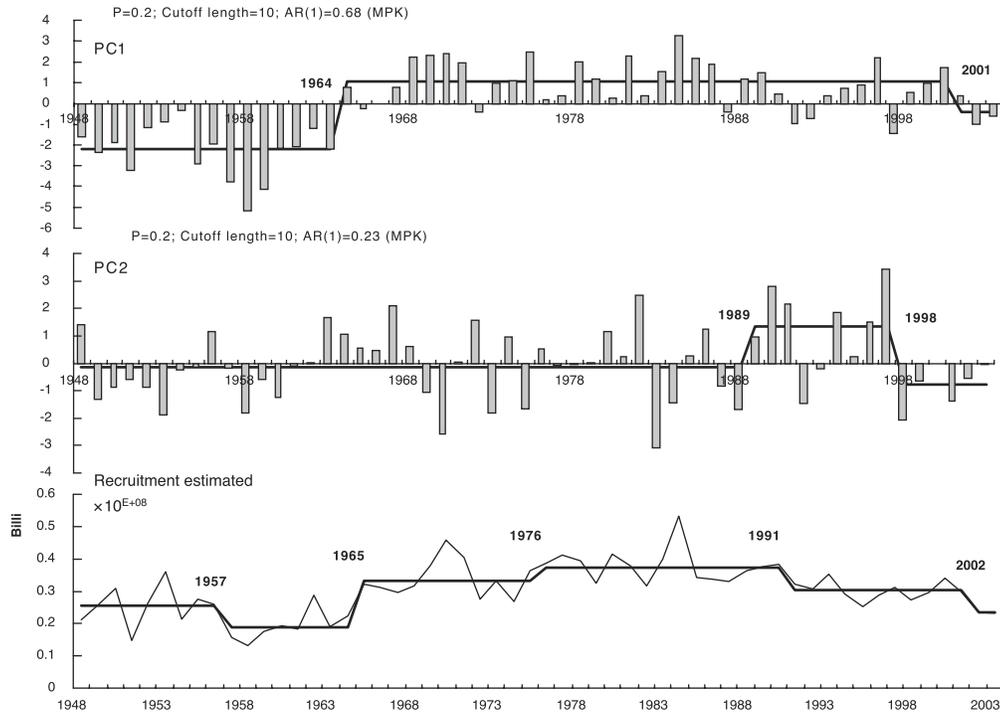
- To protect, restore, and manage the use of coastal and ocean resources through ecosystem-based management
- To understand climate variability and change to enhance society's ability to plan and respond

Purpose of the Project

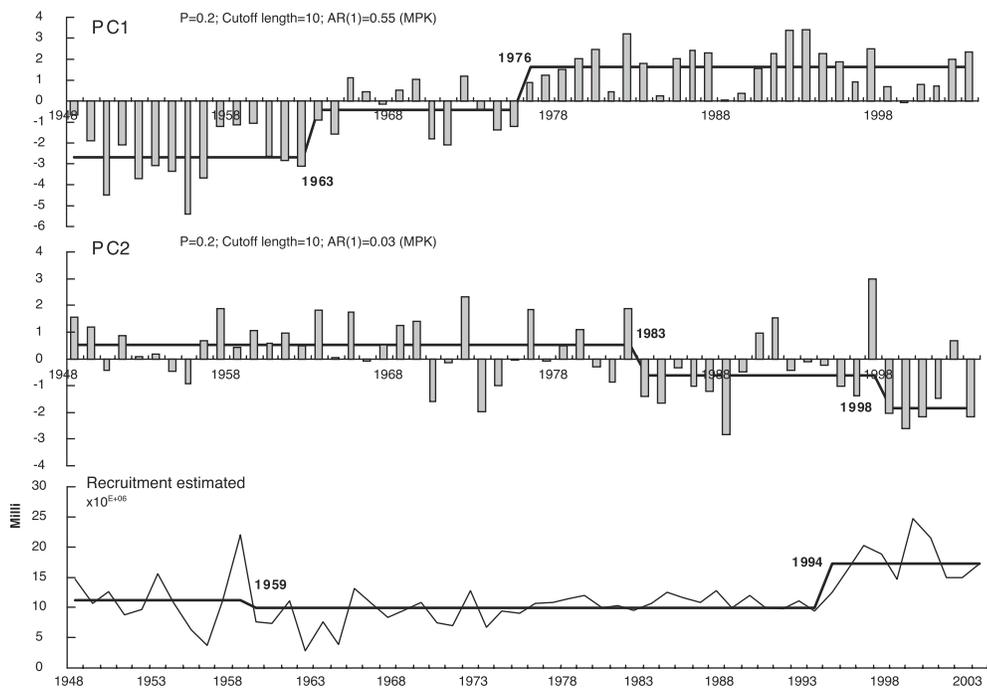
To detect and characterise long-term environmental variability in time series of physical, biological and fisheries data; to determine whether the 'regime shifts' documented for the North Pacific are evident in the tropical WCPO; and to incorporate indicators of long-term environmental variability in tuna recruitment estimation.

The project has three components, each of which has a PI and Research Assistant (RA).

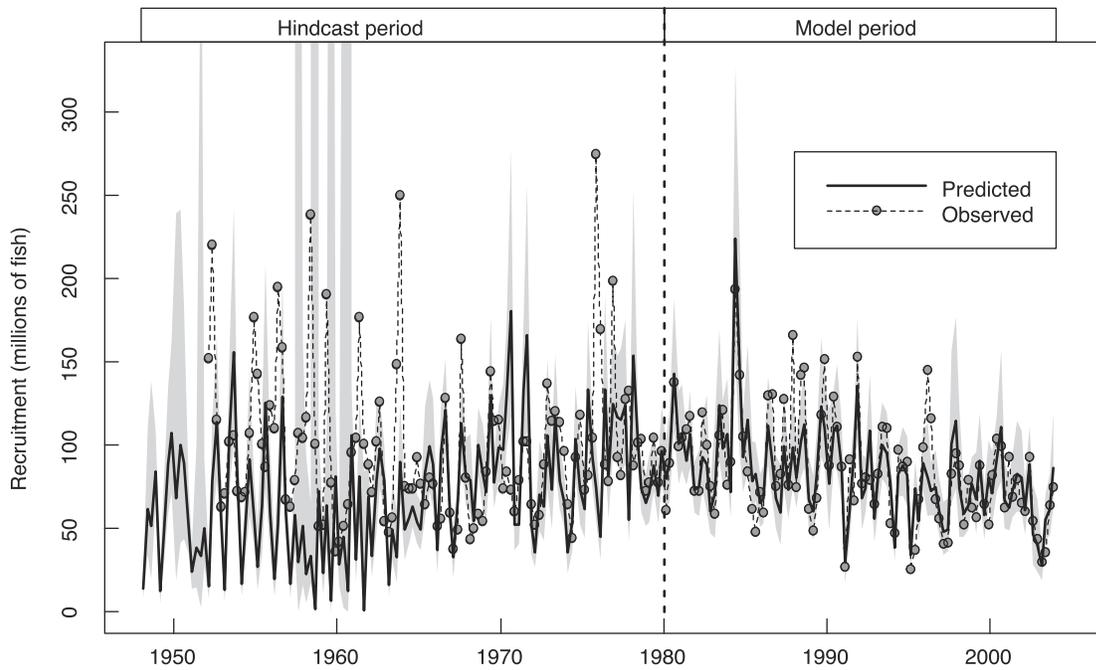
- Exploratory data analysis of ecosystem model input/output plus comparable datasets, using various methods for multivariate time-series analysis to derive ecosystem indicators (PI: David S. Kirby; RA: Karine Briand)
- Use ecosystem indicators to improve recruitment estimation for tunas in the stock assessment software MULTIFAN-CL (PI: Adam Langley; RA: Karine Briand)



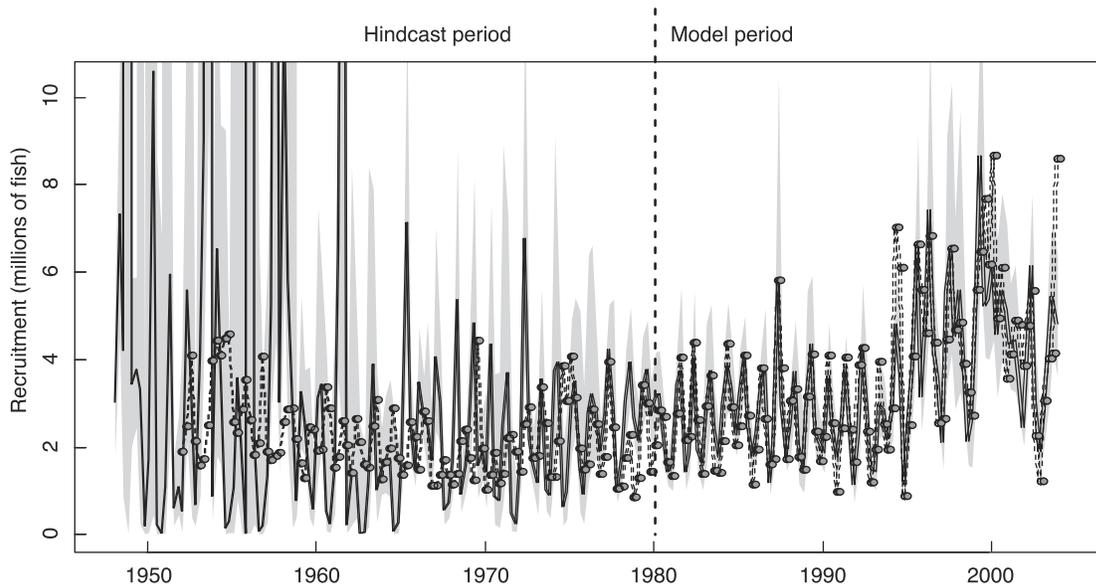
Statistically significant shifts (solid line, dates) in mean values of the two principal component (PC) scores (first two panels) from a multivariate analysis of oceanographic variables selected by the GLM for yellowfin recruitment (third panel)



Statistically significant shifts (solid line, dates) in mean values of the two principal component (PC) scores (first two panels) from a multivariate analysis of oceanographic variables selected by the GLM for bigeye recruitment (third panel)



Recruitment GLM for yellowfin tuna. 'Observed': MULTIFAN-CL recruitment estimate; 'predicted': GLM recruitment estimate



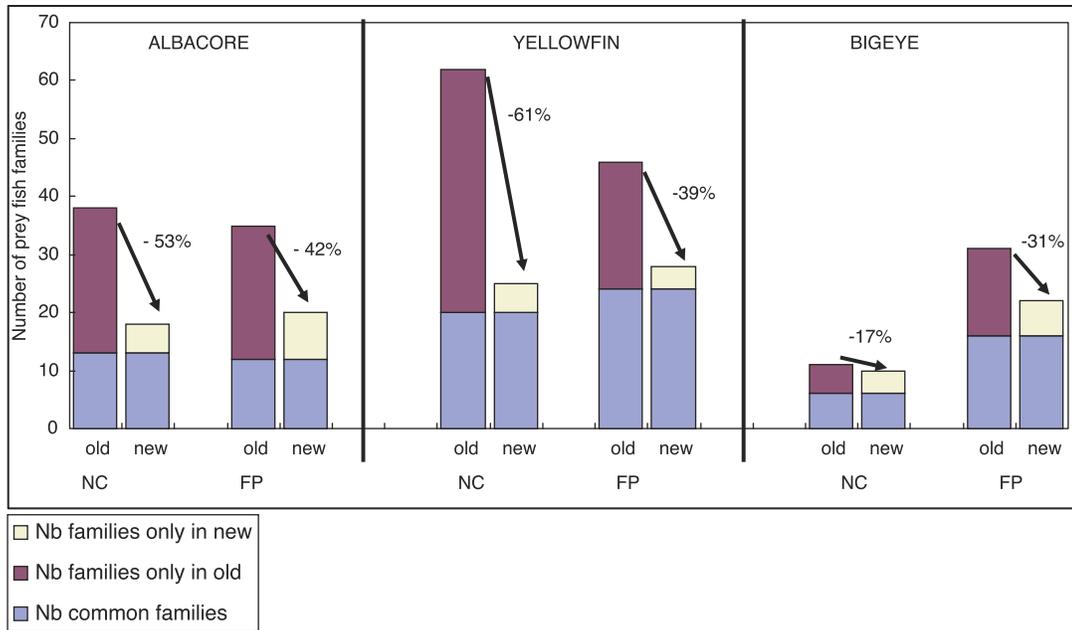
Recruitment GLM for bigeye tuna. 'Observed': MULTIFAN-CL recruitment estimate; 'predicted': GLM recruitment estimate

iii) Stomach contents analysis for data pre- and post the regime shifts of the late 1970s and 1990s (PI: Valerie Allain; RA: Marie-Laure Coudron)

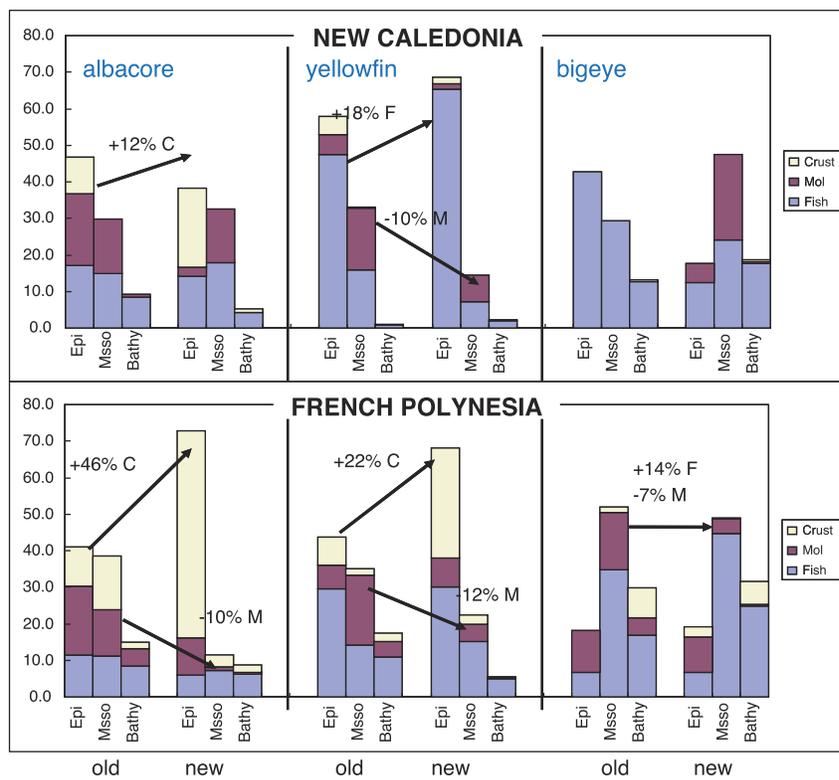
Progress during FY 2007

Component (i)

Quantitative indicators of ecosystem state were derived from multivariate analysis of physical and biological oceanographic variables for the WCPO; statistical tests were then applied to determine the existence of regime shifts in the mean and variance of the indicators. Shifts were found at times that are broadly consistent with other



Diversity of fish prey families in tuna diet studies



Changes in prey proportions by vertical class (% weight). Epi: epipelagic; Meso: mesopelagic; Bathy: bathypelagic; Crust: crustacea; Mol: molluscs; Fish: fish

studies for the north Pacific (1976, 1989, 1998) although earlier shifts (ca. 1964) appear to be just as significant. There is no signal of a regime shift in 1976 in the western equatorial Pacific, although shifts are evident in 1989 and 1998. There is a strong shift in the physical variables of the central equatorial Pacific in 1976, and a strong shift in current direction and primary production in this area in 1998. The methods are sound for the purposes of ecosystem monitoring but are inadequate to build causal or predictive relationships between the ocean environment and tuna recruitment. Other statistical models – Component (ii) – have proved useful in that regard. The best single indicator for monitoring the effect of environmental variability on yellowfin recruitment appears to be the area of the western Pacific warm pool, which accounts for 52% of the variance in GLM predicted recruitment (see below) and which expanded significantly in the 1960s.

Component (ii)

A generalized linear model (GLM) was developed to predict yellowfin recruitment from a range of oceanographic variables, from different areas and spatial/temporal scales. The final model accounted for 68% of observed variation in quarterly recruitment for the period 1980–2003, with the inclusion of 10 different oceanographic variables derived from two zones within the equatorial region of the WCPO. The robustness of the recruitment model was investigated by cross-validation. The model was then applied to hindcast recruitment for the period 1952–1979. Recruitment predictions from the GLM closely followed trends in recruitment estimates from the assessment model through most of this period. The long-term trend in predicted recruitment was largely driven by sea surface temperature in the northwestern area of the equatorial region. This work has direct application to stock assessment for yellowfin tuna in the WCPO. Principally, the GLM enables recent (last 1–2 yr) recruitment to be estimated more precisely, thereby increasing the precision of estimates of current biomass and exploitation rates. Increased precision of the current age structure of the population also improves the accuracy of short-term (next 1–2 yr) stock projections from the assessment model. In a broader context, the recruitment model provides a tool to investigate how yellowfin recruitment may change in response to short- and long-term variation in the oceanographic conditions of the WCPO. The modelling approach was also applied to bigeye tuna, with the final model accounting for 72% of the observed variation in quarterly recruitment. This allows confidence in stock assessment estimates for bigeye recruitment, with similar benefits for estimating recent recruitment and carrying out stock projections as noted for yellowfin.

Component (iii)

Datasets from previous diet studies for tunas (New Caledonia: Grandperrin-IRD 1959-1974; French Polynesia: ECOTAP-IRD 1995-1997) were compared with recent work (Allain: GEF-PFRP 2001-2005) in order to identify any changes in diet that might indicate regime shifts in the pelagic ecosystem.

Table 1. Sample sizes (number of individuals) for comparative diet study

Species	New Caledonia		French Polynesia	
	OLD	NEW	OLD	NEW
Albacore	235	50	82	97
Yellowfin	435	96	90	80
Bigeye	28	59	140	97

For New Caledonia, the diets of all three species seems to have changed between the two studies, although the small sample sizes (Table 1) for albacore and bigeye in the ‘new’ data and for bigeye in the ‘old’ data must limit the extent of our inference. The diversity of fish prey families (Fig. 5) fell 17% (bigeye), 53% (albacore) and 61% (yellowfin) between ‘old’ and ‘new’ studies, with albacore consuming 12% more epipelagic crustacea and yellowfin consuming 18% more epipelagic forage fish and 10% less mesopelagic molluscs.

For French Polynesia, the diets of all three species seem to have changed between the two studies. The diversity of prey families fell 31% (bigeye), 42% (albacore) and 39% (yellowfin) between ‘old’ and ‘new’ studies, with albacore consuming 46% more epipelagic crustacea and 10% less mesopelagic molluscs, yellowfin consuming 22% more epipelagic forage fish and 12% less mesopelagic molluscs, and bigeye consuming 14% more epipelagic forage fish and 7% less mesopelagic molluscs.

Comparing diet studies is a difficult task, especially when working on ‘rescued’ data; this study highlighted the importance of metadata. Taxonomic identification level appears to be a major problem in the comparison process as it highly depends on the identification skills; analysis of the data at the family level is probably a good compromise between accuracy and precision. Environmental variability is highly likely to have played an important role in the

changes apparent in the diet data. However, the lack of continuous monitoring means that it is difficult to discern interannual (ENSO type) variability from that at a decadal scale. Furthermore, the lack of precision in the 'rescued' data makes it difficult to conclude that apparent changes are the result of an ecosystem regime shift.

Trophic Ecology and Structure-Associated Aggregation Behavior in Bigeye and Yellowfin Tuna in Hawaiian Waters

P.I.: Kim N. Holland [Laurent Dagorn and David G. Itano]

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

NOAA Goal(s)

- To protect, restore, and manage the use of coastal and ocean resources through ecosystem-based management

Purpose of the Project

To elucidate the biology (feeding ecology, temporal dynamics, etc.) of FAD associated aggregations of pelagic fishes.

Progress During FY 2007

The private FAD (PFAD) fishery that was a major component of the latter phases of this project has undergone rapid transformation in the past year. Much of the effort has been redirected to other fisheries and some of the key players have moved out of the bigeye-oriented PFAD fishery (including those fishermen that were our key collaborators). In response, we have been working with a new fishery sector that is deploying state approved private FADs on Maui. We will continue to work with this group and also resume our own vessel operations on the Waianae coast.

Trophic Structure and Tuna Movement in the Cold Tongue-Warm Pool Pelagic Ecosystem of the Equatorial Pacific

P.I: John R. Sibert [Valerie Allain, Robert Olson, Felipe Galván-Magaña, Brian Popp]

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

NOAA Goal(s)

- To protect, restore, and manage the use of coastal and ocean resources through ecosystem-based management
- To understand climate variability and change to enhance society's ability to plan and respond

Purpose of the project

Previous modeling suggests that tuna productivity in the western and central Pacific Ocean is tied to upwelling along the equator in the central and eastern Pacific. This project proposes to test this hypothesis by combining diet analysis, stable isotopic analyses, and food-web modeling to study trophic-level variation and tuna movements in the equatorial Pacific. Our hypothesis predicts that tunas that reside near equatorial upwelling regions feed at relatively low trophic levels. Opposite trends are expected in equatorial regions with little upwelling, such as the warm pool of the western Pacific, where tunas are expected to feed at higher trophic levels and move extensively, searching for less-abundant prey. The main objectives of the project are to define the trophic structure, establish an isotope-derived biogeography, and characterize large-scale tuna movements in the pelagic western, central, and eastern tropical Pacific. Results of this study should help define ecosystem linkages leading to tuna production and the effect of climate variability on the systems. This information is important for both fisheries production and ecosystem modeling of the equatorial Pacific Ocean.

Progress during FY 2007

- *Sampling and stomach content analysis*

In the western and central Pacific, since the beginning of the project, 96 sampling trips on tuna fishing vessels

have been completed. Of the 4132 stomachs collected so far from about 67 species, 3158 have been examined in the laboratory.

In the eastern Pacific, fauna from 272 sets made during 64 trips on tuna purse-seine fishing vessels have been sampled since the beginning of the project. Samples of stomachs, muscle, and liver tissues have been collected from more than 10,700 specimens of about 47 taxa. The majority of the stomach samples have been processed in the laboratory, and the stomach contents identified. The diet data from 53 trips have been analyzed by two students at CICIMAR, Mexico, and for 11 trips by students in Manta, Ecuador (all supervised by F. Galván, co-PI of this project).

- *Stable isotope and mercury analyses*

Since the beginning of the project, ~2800 predator, prey, and POM samples have been isotopically analyzed and all the bulk stable isotope analyses planned for the duration of the project have been completed. Overall, our final isotope dataset for the equatorial Pacific confirms our initial hypothesis that there are spatially-coherent patterns in the $\delta^{15}\text{N}$ values of several top predators in the equatorial Pacific Ocean. These spatial patterns will lead to insight into tropical tuna trophic dynamics and movement patterns. Efforts are currently concentrated on writing manuscripts that synthesize these data.

Approximately 30 samples have been analyzed for compound-specific isotope analysis (CSIA) of specific amino acids. Results of CSIA of amino acids from eastern tropical Pacific yellowfin indicated that the ^{15}N enrichment in the north was due to changes in the $\delta^{15}\text{N}$ values at the base of the food web (Popp et al. 2007). We used the difference between the $\delta^{15}\text{N}$ values of trophic (alanine, aspartic acid and glutamic acid) and source (glycine and phenylalanine) amino acids to estimate the trophic level of ETP yellowfin tuna. Assuming the difference between the $\delta^{15}\text{N}$ values of source and trophic amino acids changed by 7‰ per trophic level, we estimated that the trophic level of ETP yellowfin ranges from 4.2 to 4.6. This amino acid-derived estimate matched well the estimate of 4.6 to 4.7 derived from diet analysis (Olson and Watters 2003) and an estimate of 4.1 to 4.9 calculated from a model based on the difference between the $\delta^{15}\text{N}$ values of bulk mesozooplankton and yellowfin tuna in the ETP. The implication of our results is that $\delta^{15}\text{N}$ analyses of individual amino acids in yellowfin can be used to estimate the $\delta^{15}\text{N}$ values at the base of the food web and their trophic level, using a single sample. We propose that differences between the $\delta^{15}\text{N}$ values of source and trophic amino acids can be used to examine possible historical changes in the trophic level of archived samples of fish to investigate potential effects of fisheries removal on the trophic dynamics of pelagic ecosystems. During June to August 2006, samples were analyzed with CSIA to investigate a) the processes producing anomalous high and low ^{15}N enrichment in bulk yellowfin tuna white muscle tissue collected from throughout the equatorial Pacific Ocean, b) the major processes involved in the distinct positive shift in the $\delta^{15}\text{N}$ of Oahu FAD-associated yellowfin tuna documented by Graham *et al.* (2007), and c) the effects of tissue catabolism during fasting on bulk $\delta^{15}\text{N}$ values of Oahu FAD-associated juvenile yellowfin tuna. All three of these objectives have also provided an opportunity to examine the constancy and the mechanisms underlying the 7‰ per trophic level difference between the $\delta^{15}\text{N}$ of ‘trophic’ amino acids and the ‘source’ amino acids. Current efforts are concentrated on writing manuscripts synthesizing these CSIA data.

During FY 2007, we have been exploring the use of generalized linear models (GLMs) and generalized additive models (GAMs) to assess the importance of several environmental variables and sample location in explaining the spatial variation in $\delta^{15}\text{N}$ of mesozooplankton (a proxy for the base of the food web) in the ETP. Samples of zooplankton were collected by bongo net on board the R/V *David Starr Jordan* and R/V *McArthur II*, of the National Oceanic and Atmospheric Administration (NOAA), in the ETP from 5 August to 5 December 2003. This sampling was a component of the *Stenella* Abundance Research (STAR) Project conducted by the Southwest Fisheries Science Center, La Jolla, California, USA. In the laboratory, CICIMAR graduate student Gladis Lopéz-Ibarra sorted the zooplankton samples for copepods, amphipods, euphausiids, and chaetognaths, and bulk carbon and nitrogen isotopic values of these samples were determined. Simultaneous with the zooplankton sampling and from the same ships, oceanographic variables were measured with conductivity-temperature-depth (CTD) instruments. In addition, SeaWiFS turbidity data, bathymetry, altimetry, wind speed and direction, and chlorophyll A concentration were compiled. The mesozooplankton $\delta^{15}\text{N}$ values showed strong non-linear dependence on thermocline depth, SST, and bivariate latitude and longitude, and a weaker linear relationship with SeaWiFS turbidity data. We used a GAM to predict the $\delta^{15}\text{N}$ of the mesozooplankton guild, using the thermocline depth, SST, turbidity, latitude, and longitude at the purse-seine set locations where yellowfin tuna were sampled. The trophic status of the yellowfin tuna was calculated at each sample position based on the GAM-predicted $\delta^{15}\text{N}$ of mesozooplankton, the measured $\delta^{15}\text{N}$ of yellowfin, the trophic fractionation factor between the consumer and its

diet, and an independent estimate of the trophic status of mesozooplankton in the ETP, based on previous work. Spatial variation in yellowfin trophic status is being examined using the stomach contents data in conjunction with the model estimates.

Thirty-six samples of pelagic predators were submitted to B. Fry for sulfur isotope ($\delta^{34}\text{S}$) and total mercury (THg) analyses. Preliminary THg data supports the ontogenetic trophic shift observed in juvenile yellowfin tuna collected around Hawaii (Graham *et al.* 2007) and, therefore, could help to distinguish average foraging depth of pelagic predators. On a zonal spatial scale, yellowfin tuna had the highest THg values in the ETP compared to Hawaii or the western tropical Pacific. These spatial variations in THg concentrations could provide a valuable tool to further “source” tuna to specific regions with the equatorial Pacific Ocean. There were no significant differences in the $\delta^{34}\text{S}$ values of these same fish, which indicates that sulfur isotope analysis might have limitations in resolving trophic ecology and movement patterns of top predators in the open ocean.

- *Modeling and diet analyses*

The diet data for skipjack, yellowfin, bigeye tunas and other large predators from the warm pool (equatorial western Pacific) have been partially analyzed. This information has been compiled and included in an Ecosim model of the warm pool pelagic ecosystem. Based on this field work, on other model estimates (biomass and production of forage taxa from SEAPODYM and of the tunas from MULTIFAN-CL; tuna consumption estimates from a bioenergetics model), and on literature information, the model has been developed in collaboration with 6 other scientists experienced in ecosystem modeling during a workshop in Noumea, New Caledonia, 5-9 March 2007. A balanced model describing the ecosystem has been produced, and preliminary Ecosim scenarios were tested. Important facts about the system and the modeling process were highlighted:

- Over-aggregation of species groups, particularly forage, along with diet loops (*i.e.* species 1 eats species 2 which eats species 1) is a major problem that prevents balancing the model. Moreover Ecosim does not manage well high percentages of cannibalism. Consequently despite good quality information from field work (diet data), modifications sometimes very different from field data had to be made to balance the model. Obtaining a balanced model required compromises between simplification and reality.
- Because of its high biomass, production, consumption and cannibalism skipjack occupies a central position in the system. It exerts a very high predation pressure on lower trophic levels and it constitute a major food source, particularly the juvenile stages, for all the top predators. Ecosim scenarios of top-down control showed very strong resilience of this species.
- The Ecosim model challenged the pre-existing models already in use. During the balancing procedure of our Ecosim model, discrepancy between the forage estimates provided by SEAPODYM and the tuna biomass estimates from the stock assessment model MULTIFAN-CL became apparent. We considered stock assessment estimates more reliable and modified the forage estimates to balance the model.

Some Ecosim scenarios were conducted to examine top-down impacts on the ecosystem. Modifications in the fishing pressure do not cascade down to the forage level, while yellowfin and bigeye respond strongly to any modification.

The diet data for 34 species of tunas and associated fauna from the cold tongue (equatorial eastern Pacific) have been analyzed by CICIMAR graduate student, Noemí Bocanegra-Castillo. The majority of the study was focused on pelagic fishes that associate with floating objects. The study represents an important contribution to understanding the nature of the association between pelagic fishes and floating objects in the open ocean, which is an important subject given that the majority of the catches of tunas world-wide originate from purse-seine sets on fish associated with floating objects. Recent studies have found no evidence that large pelagic predators associate with floating objects for feeding. The current study is the first that shows that several small fishes use floating objects as a feeding substrate, feeding on algae, crustaceans, and other invertebrates that live on the objects. Large pelagic fishes, such as sharks, marlins, wahoo, and barracuda, obtain a portion of their diet by eating the small, closely-associated fishes and juvenile tunas, while the tunas do not feed on animals associated with the floating objects. This work is unique in showing that several pelagic fishes have an indirect trophic connection to floating objects.

The Ecosim models from the warm pool and the eastern Pacific were briefly compared. They are structured differently, particularly the forage component, making comparison difficult; however sensitivity analysis reveal an important impact of changes in cephalopod biomass in both system. On the other hand, while a small scombrid *Auxis sp.* has a very important role in the food chain in the eastern Pacific, it is absent from the western Pacific, where skipjack may have a similar role.

The Associative Dynamics of Tropical Tuna to a Large-scale Anchored FAD Array

P.I.: Kim N. Holland [David G. Itano]

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

NOAA Goal(s)

- To protect, restore, and manage the use of coastal and ocean resources through ecosystem-based management

Purpose of the Project

The purpose of this project is to apply sonic tagging and tuna monitoring techniques developed in Hawaii on a small-scale anchored FAD array to a larger system exploited by industrial-scale fisheries. The project was designed as an integral component of a medium-scale tuna tagging/assessment project of the Secretariat of the Pacific Community in conjunction with the National Fisheries Authority of Papua New Guinea. The overall project used a combination of tag types to address several critical issues of tuna movement and behavior in the Papua New Guinea EEZ that is being heavily exploited by domestic purse seine effort on a large-scale array of anchored FADs. The PFRP portion of the PNG Tagging Project funded sonic tagging of skipjack, yellowfin and bigeye tuna to examine fine scale behavior of tuna resources aggregated to this large number of anchored FADs useful for management purposes.



Crew of the Soltai 6 supporting PFRP funded sonic tagging of tuna in Papua New Guinea

Progress during FY 2007

Two tagging cruises totaling six months of sea time were conducted in PNG waters between August 2006–May 2007. Seven groups of FADs were equipped with Vemco VR2 automated fish monitoring receivers as per the funding proposal protocols in the Bismarck and Solomon Seas of PNG. Vemco V9 and V9P sonic tags were surgically implanted and released in association with monitor-equipped FADs (69 skipjack, 135 yellowfin, 18 bigeye tuna). Monitors on five FAD groups were recuperated by the tagging vessel before the end of the tagging charter with data successfully downloaded. Two monitored FAD groups were left to collect additional data and will be recovered in the third quarter of 2007.



A yellowfin tuna about to be tagged for movement and behavior studies around FADs in Papua New Guinea

The overall tag releases were in line with proposed objectives but the project was not able to tag adequate numbers of bigeye tuna in concurrent FAD residence with skipjack and yellowfin tuna. This was a general shortcoming of all tag release types during the overall Project (conventional, archival and sonic) due to an apparent low abundance and realized low availability of bigeye tuna to the project vessel. However, adequate numbers of yellowfin and skipjack were released with sonic tag. In some cases the time span of monitored FADs may not be sufficient for an examination of long-term residence and movement patterns. This could not be avoided due to the logistical considerations of recovering the receivers during the charter period of the vessel.

Synchronous Assessment of Bigeye Tuna (*Thunnus obesus*) and Micronekton Biomass, Distribution, and Movement Patterns at Cross Seamount, and the Effects of the Seamount Environment

P.I.: John R. Sibert [Réka Domokos, Kim N. Holland, Jeffrey J. Polovina]

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

NOAA Goal(s)

- To protect, restore, and manage the use of coastal and ocean resources through ecosystem-based management

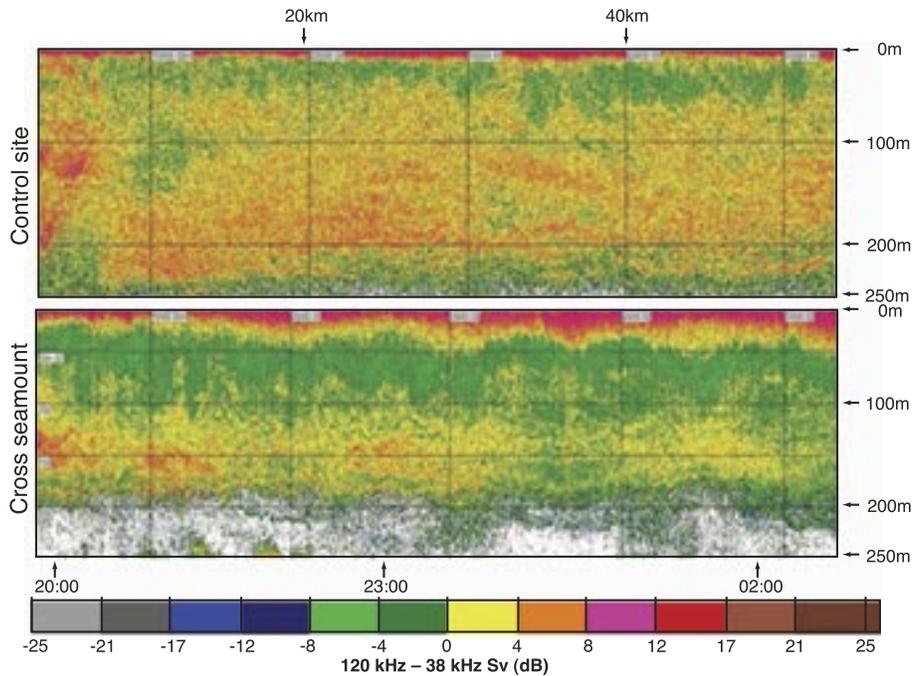
Purpose of the Project

Globally, seamounts play an important role in shaping the distribution of pelagic species, such as tunas and sharks. Cross seamount in the Hawaiian archipelago—a seamount with a 5 nmi diameter 400 m deep plateau, rising from a 5000 m seafloor and lying in the path of the North Equatorial Current and internal tides generated at the Main Hawaiian Islands chain—is known to aggregate economically important fish such as juvenile and subadult bigeye tuna, a population which is heavily targeted by the local fishery. Reported moderate exploitation rates have recently raised concerns that the local fishery removes too many juveniles that could otherwise recruit to adult grounds and help maintain Pacific stocks. Since adult bigeye tuna are an important target species of both local and international fisheries, reducing adult populations of bigeye could have wide ranging negative effects. These concerns call for closely monitoring the biomass of bigeye tuna aggregated at Cross seamount. Since conventional fisheries dependent stock assessment methods are known to be inaccurate and biased, the current research undertakes the development of a fisheries independent method of bigeye tuna biomass estimation using active acoustics. Further, since populations of bigeye tuna depend on the biological and physical environment, the distribution, composition, and movement patterns of bigeye tuna forage, micronekton, as well as the effects of the unique environment at Cross seamount on both bigeye and micronekton, are investigated.

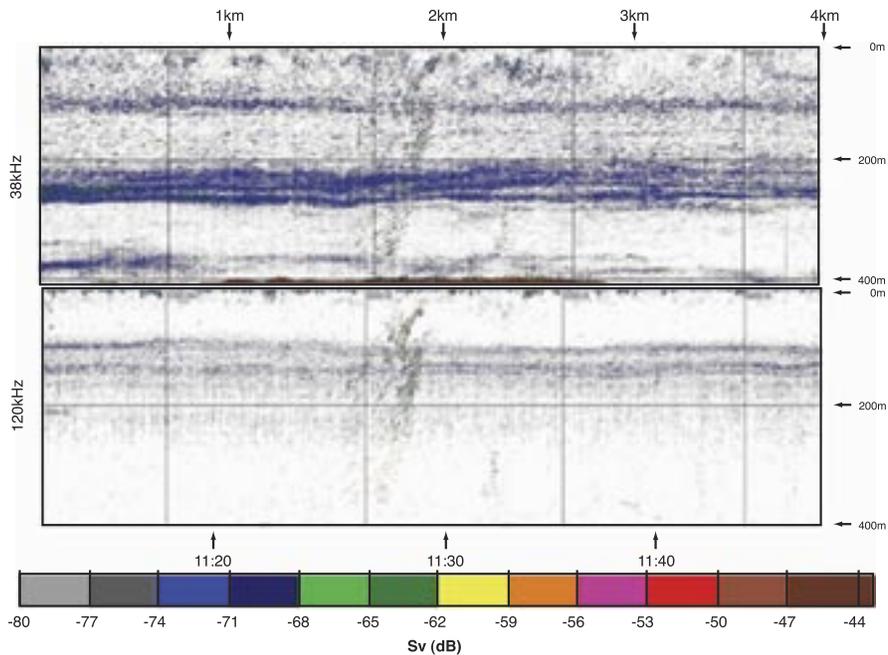
Progress during FY 2007

Data for this project were collected during shipboard surveys, complimented by commercial and experimental fishing records. The *in situ* data include current magnitudes and directions from an Acoustic Doppler Current Profiler (ADCP), temperature, salinity, oxygen, and chlorophylls from Conductivity-Temperature-Depth (CTD) casts, and biological backscatter at 38 and 120 kHz frequencies. Results from the acoustic backscatter are groundtruthed by fishing efforts and Cobb trawl samples for tuna and micronekton, respectively. As the first part of the two year project, an oceanographic survey of Cross seamount was conducted from April 21 through May 13, 2007, aboard the NOAA ship *Oscar Elton Sette*. Preliminary results from this survey, as well as results from a preliminary survey conducted during April, 2005, indicate that the environment at Cross seamount is highly dynamic, with currents changing on time scales as short as 30 minutes. Biomass of both micronekton and tuna at the seamount—as well as that of other fish—were observed to be higher than those away from it. Higher tuna biomass was evident over the shallow plateau, while higher micronekton biomass was seen both over the plateau and at the flanks. The composition of the nighttime shallow scattering layer (SSL), composed mainly of micronekton, differed over the plateau than away from it (Fig. 1), with the differences in backscattering characteristics at the two frequencies indicating relatively high biomass of fish with gas bladder, other gas bubble containing organisms, and possibly squid, at the seamount. Dense micronekton patches, at depths of approximately 700-800 m, were observed at the flanks, predominantly in the up-current directions. Dense, large aggregations (~ 3 km long, 50 m high) of bottom fish were observed directly over the plateau floor only during nighttime, predominantly over the southwestern area of the plateau. Acoustic signatures of bigeye tuna were separated from other nekton, as well as from other tuna species, using their positional, morphological and energetic acoustic descriptors, taking into account previous knowledge of the composition and depth distribution of species fished at Cross seamount. The results of fishing efforts during the surveys, although not numerous enough for statistical significance, collaborated the acoustic identification of bigeye, yellowfin, and skipjack tunas over the plateau.

Two types of acoustic objects, with characteristics consistent with those of bigeye tuna, were observed over the plateau of Cross seamount: single fish described by their Target Strength (TS) values and tuna aggregations.



Differences in the composition of the nighttime shallow scattering layer away from Cross seamount (top panel) and at Cross seamount (bottom panel), as revealed by the differences in the mean volume backscattering strengths (S_v in $\text{dB re } 1 \text{ m}^{-1}$) at 120 and 38 kHz frequencies. x axes show distance and time, while y axes indicate depth. Note that at Cross seamount negative values dominate, indicating relatively higher abundances of fish with swim bladder, other gas bubble containing organisms, and possibly squid.



Echograms showing an aggregation identified as bigeye tuna from the shape, looseness, and depth of the aggregation, as well as from the target strengths of the individuals within. x and y axes are as in Fig. 1. The upper and lower panels display the mean volume backscattering strengths (S_v in $\text{dB re } 1 \text{ m}^{-1}$) at the 38 and 120 kHz frequencies. Note that the aggregation extends vertically from almost the surface to the 400 m deep plateau, indicating that bigeye can shoal during their deep diving behavior.

All tuna aggregations were observed in daytime in the central and southwestern part of the seamount plateau. These aggregations were large (111 m high, 189 m long on average), loose, and deep, with a mean depth of 200 m. The depth distribution of tuna aggregations reasonably matched those of bigeye tuna equipped with archival tags, spending a substantial amount of time at around 400 m near the depth of the seafloor. These results seem to indicate that bigeye tuna shoal during their deep excursions over the seamount plateau (Fig. 2). Generally speaking, most of the tuna targets were aggregated in daytime in the central and southwestern part of the plateau with individuals dispersing at sunset—seemingly leaving the plateau area—then congregating again into large aggregations at sunrise. Besides this diel cycle, daily variability in relative tuna biomass was also observed.

Assessment of the Impacts of Mesoscale Oceanographic Features on the Forage Base for Oceanic Predators

P.I.: Jeffrey C. Drazen [Reka Domokos]

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

NOAA Goal(s)

- To protect, restore, and manage the use of coastal and ocean resources through ecosystem-based management

Purpose of the Project

This project's goal is to investigate the nature and degree of the response of the micronektonic community, an important tuna forage base, to mesoscale oceanographic features using trawl surveys in conjunction with acoustic surveys. Two features of interest are Cross seamount which aggregates yellowfin and bigeye tuna in Hawaiian waters and eddy features from American Samoa which affect albacore catch. The main objectives of this project are:

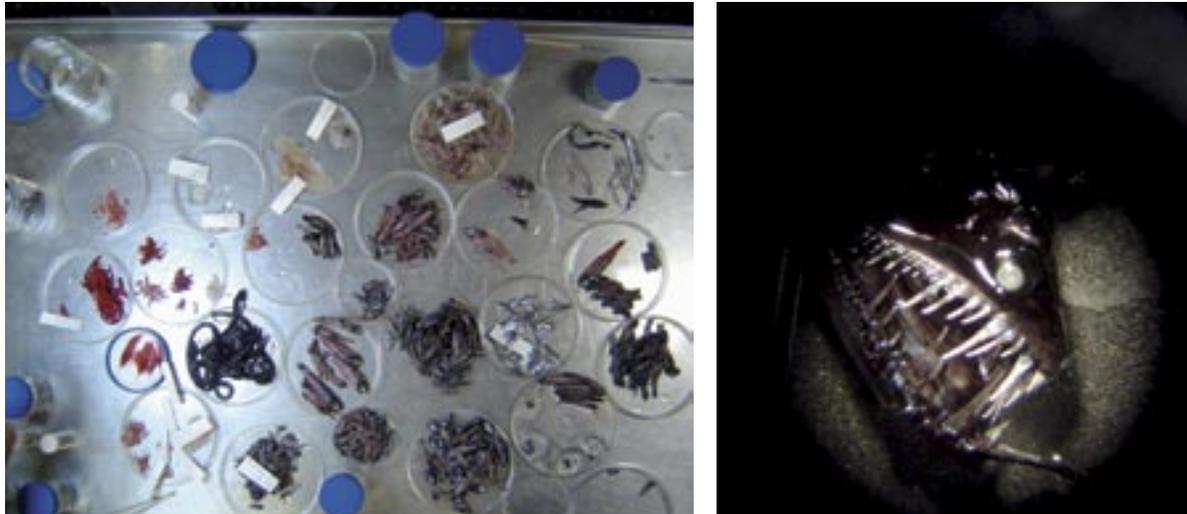
- To assess the impact of each mesoscale feature on the biomass and abundance of the micronekton.
- To assess the impact of Cross seamount on micronekton community composition.
- To characterize the micronekton composition in American Samoa.
- To assess whether each mesoscale feature affects the vertical migration patterns of the micronekton.
- To compare both acoustic and trawl estimates of biomass in each region to provide acoustic "groundtruthing."

Progress during FY 2007

The first year of this project sought to collect samples and complete laboratory sorting. Severe deficiencies in the NOAA corps ability to perform trawling operations from the Oscar Elton Sette severely hampered our abilities to perform the proposed work. A letter of complaint was sent to PIFSC and to PFRP explaining this situation. Nevertheless we made significant progress towards our objectives. In 2005, 34 trawl samples were collected from Keahole Pt., Finch Seamount, and Cross seamount. In 2006, 12 trawls were conducted off of American Samoa but all of them were outside of eddy features. In 2007, we returned to Cross seamount and conducted another 12 successful tows before the winch system failed. Acoustic measurements accompanied all of these trawls. Additional acoustic surveys were done and will be reported by R. Domokos. All of the



Micronektonic squid sorted from a trawl over Cross seamount.



(top, left) The diversity of micronekton, shrimp, squid, and fishes, captured in a Cobb trawl near Cross Seamount, Hawaii.
 (right) Things that go bump in the night! Closeup of the head of a black dragonfish from a trawl near Cross Seamount, Hawaii.

samples from 2005 have been sorted, counted, and weighed to provide estimates of abundance, biomass, and community composition as they relate to seamounts. Samples from 2007 are 50% processed.

Investigation of Shark Bycatch in the Hawaii-based Longline Fishery, and an Extension of Analyses of Catch Data from Widely Separated Areas in the Pacific Ocean

P.I.: John R. Sibert [William A. Walsh, Keith A. Bigelow]

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

NOAA Goal(s)

- To protect, restore, and manage the use of coastal and ocean resources through ecosystem-based management

Purpose of the Project

This project entails biometrical research with two overall goals. The first is to improve understanding of shark bycatch in the Hawaii-based longline fishery. The second is to elucidate variation across broad spatial scales in catch per unit effort (CPUE) for several highly migratory Pacific fishes as a contribution to the development of ecosystem-based fishery management. Improved understanding of the composition of shark bycatch may permit use of the diversity of these species as an indicator of ecosystem status, while an improved understanding of the magnitude of shark bycatch, in the aggregate and by species, is fundamental background information required to evaluate the efficacy of bycatch reduction efforts. Comparisons of catch trends across broad spatial scales may contribute to the definition of the functional sizes of Pacific Ocean ecosystems and improved ecosystem monitoring because such trends may vary both within and among species and fisheries. This second aspect represents a request for an extension of the PFRP project “Comparisons of Catch Rates for Target and Incidentally Taken Fishes in Widely Separated Areas of the Pacific Ocean”, originally submitted by William Walsh and Samuel Pooley (subsequently replaced by Keith Bigelow as the collaborating investigator), in order to resume uncompleted activities.

Progress during FY 2007

Substantial progress was achieved toward project goals in FY 2006. The species composition of shark bycatch was evaluated with catch data reported by the Hawaii Longline Observer Program. The evaluations were performed by checking identifications on a species-specific basis, using a suite of objective criteria and starting with the infrequently reported species (e.g., white shark, tiger shark). The criteria for reliability included photograph(s),

confirmation by a NMFS fishery biologist or Bishop Museum ichthyologist, or prior sightings of the species by the particular observer in question. The expectation in this regard was that the number of species listed in the observer database would exceed the number of reliably identified species, with misidentifications among the infrequently caught species possibly giving rise to spurious inferences regarding occurrences in the catch of this fishery. This expectation proved correct; results demonstrated that newly hired observers were responsible for a substantial (and highly disproportionate) fraction of the reported catches of rare and uncommon shark species. This finding is expected to be useful because it should lessen the possibility that rarity or absence of such species could be perceived as adverse effects of the Hawaii-based longline fishery rather than normal conditions. Results from this aspect of the project were presented as a PowerPoint presentation at the PFRP semiannual meeting in November 2006 ("Preliminary Results from Analyses of Shark Catches in the Hawaii-based Longline Fishery as Reported by Fishery Observers" by William A. Walsh and Keith A. Bigelow).

The basis for comparisons of catch rates of pelagic species in widely separated areas of the Pacific Ocean was also established in FY 2006. Observer catch data with wahoo and mahimahi from the Hawaii-based longline fishery were assessed in terms of catch rates, the magnitude and condition of bycatch, the sizes of caught fish, and data accuracy. The most surprising result was an apparent biennial cycle in wahoo, with catch rates and fish sizes varying inversely with a significant negative correlation. Results from this aspect of the project were presented as a PowerPoint presentation at the 58th International Tuna Conference in May 2007 ("Exploratory Analyses of Mahimahi and Wahoo Catch Rates in the Hawaii-based Longline Fishery", by William A. Walsh and Keith A. Bigelow).

Examining Latitudinal Variation in Food Webs Leading to Top Predators in the Pacific Ocean

P.I.: John R. Sibert [Jock Young, Robert Olson, Valerie Allain, Jeffrey Dambacher]

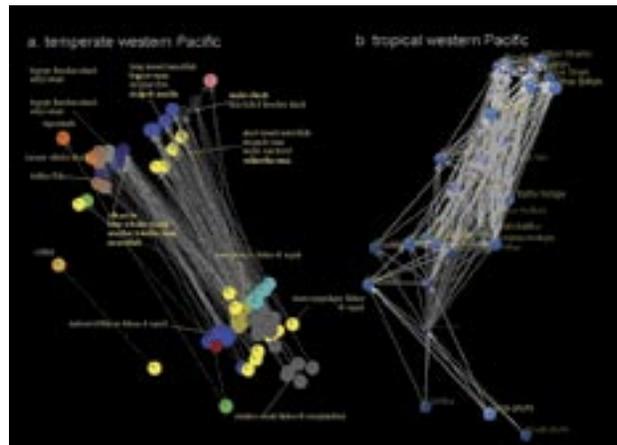
NOAA Office (of the primary technical contact): National Marine Fisheries Service/Pacific Islands Fisheries Science Center

NOAA Goal(s)

- To protect, restore, and manage the use of coastal and ocean resources through ecosystem-based management

Purpose of the Project

A previous trophodynamics study funded by PFRP has demonstrated significant heterogeneity in trophic pathways across the tropical Pacific, associated with either the prevailing mesoscale oceanography or the seabed topography. These results have the potential to not only identify shifts in ecosystem structure (climate change), but also may help to define stock structure of widely distributed tropical tunas. A similar, but more localized study off eastern Australia (Young et al. 2004) is also beginning to reveal differences not only within the region but also in comparison with the study in the tropical Pacific (Olson et al. 2005). Given the proximity of the two studies geographically and the potential migration of tunas between the regions, project researchers will conduct a study that compares the trophodynamics of the pelagic ecosystems of these regions using largely existing data sets. The analysis would combine statistical comparisons with qualitative models to determine similarities or otherwise of the two regions. Such comparisons may offer insight into the ecosystem impacts of potential climate change expressed as ocean warming. This project will compare stomach



Structure of pelagic foodwebs for a) temperate western Pacific, and b) tropical western Pacific Ocean. Plot of species with relative distances in a 3-D non-metric multidimensional scaling space based on regular role equivalence. The equivalence of species is a function of the similarity of their predator and prey linkages throughout the entire trophic network. In a) closely clustered species with nodes of the same color are members of an equivalent group, while in b) the groups are represented by a single node.

contents of top predators from tropical and temperate waters of the western, central, and eastern Pacific Ocean to examine latitudinal differences in the trophic pathways of these regions. The results will be used to develop and compare qualitative models (Dambacher et al. 2002) of the trophic flows within each region.

Progress during FY 2007

An Access database has been established to incorporate dietary data previously held by Australia, Noumea and the United States. This database has all details necessary to select predator prey diet matrices of varying spatial and temporal resolution. At present, we have all data from Noumea and Australia entered resulting in a data set of approximately 7000 stomachs from ~25 predators. The United States data set is nearly completed and will be incorporated into the database soon. A meeting was held in Hobart in September 2006 where the four investigators agreed to use the existing CSIRO database as the holding port for all the data to be used in the analyses. This required a number of alterations to the existing database and to the format of the SPC data which has now been achieved.

As part of the process of integrating the data sets, Jeffrey Dambacher attended a meeting of Ecosystem modelers in Noumea in March 2007 where he demonstrated the qualitative approach. Preliminary analyses of the data sets have been used to explore the basic structure of the food webs from different regions (Figure 1). These network structures will provide the basis for the development of qualitative models that will be used to explore perturbation scenarios in each of the regions considered in the project.

Performance of Longline Catchability Models in Assessments of Pacific Highly Migratory Species

P.I.: John R. Sibert [Keith A. Bigelow, Mark Maunder, Adam Langley, Pascal Bach]

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

NOAA Goal(s)

- To protect, restore, and manage the use of coastal and ocean resources through ecosystem-based management

Purpose of the Project

The project will provide improved models of tuna and billfish resource abundance to the regional fisheries agencies (IATTC, NOAA Fisheries, NRIFSF, SPC) or committees providing scientific advice to management bodies (ISC, Scientific Committee of the WCPFC). Standardized CPUE trends are highly influential in Pacific HMS assessments because the standardized trends represent the only indication of resource abundance in the absence of fishery independent indices. The removal of catchability and vulnerability effects will continue to be an important consideration in future Pacific HMS assessments. The project will develop improved longline catchability models for use in population assessments.

Progress during FY 2007

Year 1 funding was received in October 2006. A Pelagic Longline Catch Rate Standardization meeting was held at the University of Hawaii, Manoa, from February 12–16 2007. The meeting was jointly hosted by this PFRP funded project and the Secretariat of the Pacific Community (SPC). The objectives of the meeting were to formulate a research plan to meet the objectives of the PFRP longline catchability project and provide a technical review of current and alternative longline CPUE standardization techniques used for the yellowfin and bigeye stock assessments in the Western and Central Pacific Ocean (WCPO).

Rescue, Compilation, and Statistical Characterization of Historic Longline Data, Pacific Oceanic Fisheries Investigation 1951-73

P.I.: John R. Sibert [Bert Kikkawa]

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

NOAA Goal(s)

- To protect, restore, and manage the use of coastal and ocean resources through ecosystem-based management

Purpose of the Project

The four major objectives are:

- a) Electronically capture detailed individual hook information and anecdotal fishery related observations recorded during the POFI research cruises from 1951 through 1973.
- b) Integrate the “recovered” data into the PIFSC data holdings.
- c) Develop database tables of metadata, GIS plots of the cruises, distribution of the major pelagic species, and possibly other key resulting information.
- d) Provide some electronic access to metadata tables (item c) through a webpage portal.

Progress during FY 2007

- Data Entry Institute of Hawaii (DEIH) was awarded the data entry contract and work began on 6/11/07. To date DEIH have approximately 34,228 lines of data rescued. By the past experiences with DEIH no contretemps are expected.
- Integration will commence upon the completion of the first data entry batch.
- With the retirement and resignation from the project by Robert Skillman, co-principal investigator at the start of the year, efforts to find a suitable replacement have thus far been unsuccessful.

Intra Guild Predation and Cannibalism in Pelagic Predators: Implications for the Dynamics, Assessment and Management of Pacific Tuna Populations

P.I.: John R. Sibert [Tim Essington, Mark Maunder, Robert Olson]

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

NOAA Goal(s)

- To protect, restore, and manage the use of coastal and ocean resources through ecosystem-based management

Purpose of the Project

Pelagic longline fisheries for tunas, sharks and marlins are unique compared to other fisheries in the world in that they catch a relatively narrow component of the food web. Although these piscivorous fishes constitute the apex predators in these ecosystems, many of these species also prey upon members of their own guild. The work on this project seeks to quantify the magnitude and nature of these “intra-guild” predation and cannibalism interactions and to explore their implications for tuna population dynamics and for the fisheries targeting them. Our approach combines a research synthesis of the extensive historical and contemporary studies that describe food habits of these fishes, with simulation modeling to quantify biologically plausible responses of skipjack, yellowfin, and bigeye tuna to fishery-induced depletion of their predators. The latter will include an explicit emphasis of the policy implications of alternative plausible representations of tuna population dynamics. Our project fits within the framework of the GLOBEC regional program CLIOTOP, trophic studies and modeling working groups. Moreover, our work addresses the third topic of PFRP’s RFP of January 2006, and focuses on the highest ranking individual topic of the Ecosystem Integration session of the November 2005 PFRP Research Priorities Workshop.

Progress during FY 2007

This project consists of two linked components: a synthesis of food habits data and a modeling effort that can be used to estimate the impacts of predation on tuna production. We describe our progress on each of these, in turn.

Food Habits Data: To date, we have compiled food habits data from twenty-nine published studies, which contain diet information for fifteen large-bodied predators, including tunas, marlins, and sharks (Table 1). The published data have been digitized by manual entry into an Access database. The data sources, at a minimum, contain information on the sampling time periods and ocean regions, the range of predator body sizes sampled, and the proportional contribution of tuna species to predator diets. When available, we recorded detailed information on individual samples such as predator body size, the precise location and date of collection and the size of tuna that was consumed. The sampling periods for the published studies span nearly 50 years, ranging from 1949–1996, and the study regions encompass the western, central, and eastern tropical Pacific Ocean (Table 1). The published data range from highly aggregated summaries to diet contents summarized by sampling region, season, and predator body size. Yellowfin and skipjack tuna are commonly identified to species level and thus these two species will be the focus of this project.

Modeling: We have developed a novel computational framework that allows us to simulate the impact of predators on juvenile fishes by calculating predation mortality on pre-recruited individuals. This framework has initially been developed based upon demographic data and feeding habits data of western Pacific Ocean skipjack tuna (where very high rates of cannibalism are common). Our initial model results suggest that only between 0.1% and 10% of individuals survive the period during which time their body lengths are 5 – 15 cm.

Scaling Up: Linking FAD-associated Local Behavior of Tuna to Regional Scale Movements and Distribution

P.I.: Kim N. Holland [Laurent Dagorn]

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

NOAA Goal(s)

- To protect, restore, and manage the use of coastal and ocean resources through ecosystem-based management

Purpose of the Project

To determine the “catchment area” of coastal Hawaiian FADs. That is, does the abundance of fish aggregated around FADs reflect the size of the population from which they are drawn and, if so, what is the geographical range of that population?

Progress during FY 2007

FAD-associated yellowfin tuna aggregations peak in fall and winter in Hawaii and therefore the fieldwork phase of this project has not yet begun. However, the tags have been purchased and new tag anchors developed and tested prior to being deployed in this research.

Distribution and Use of Seafood in the Context of the Community: A Case Study of the Main Hawaiian Islands

P.I.: John R. Sibert [Edward W. Glazier and Stewart Allen]

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

NOAA Goal(s)

- To protect, restore, and manage the use of coastal and ocean resources through ecosystem-based management

Purpose of the Project

The purpose of the project is to describe the ways in which pelagic fishing fleets in the Main Hawaiian Islands function in terms of typical processes of harvest, distribution, and consumption of seafood, and to enable explanation of variation in those processes within and across groups of fishery participants. The project will identify "at-sea" communities or social networks of interacting or cooperating fishermen. It will also expand the understanding

of the social and economic dynamics of marine fisheries in Hawaii while providing insight into efforts to define and identify “fishing communities” here and elsewhere.

Progress during FY 2007

The following objectives have been met during 2007: (1) compilation and review of existing data and reports regarding the fisheries in question, (2) conduct of in-depth discussions with vessel operators, crew, and their extended families; fish buyers and purveyors; regional fisheries managers; and others highly knowledgeable of pelagic fisheries in the MHI, and (3) observation of cases and contexts indicative of the flow of seafood products from point of harvest to point of consumption per the fisheries, markets, and consuming populations in question. This work will be finalized prior to the end of 2007.



Long-time Ika-Shibi Fisherman Setting Chute, Hilo Side, Winter 2007

Development of Business Card Tags: Inter-Individual Data Transfer

P.I.: John R. Sibert [Laurent Dagorn and Kim N. Holland]

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

NOAA Goal(s)

- To protect, restore, and manage the use of coastal and ocean resources through ecosystem-based management

Purpose of the Project

The Business Card Tag (BCT) is aimed at increasing knowledge regarding schooling cohesion and inter-species association. The overall objective of the project is to assess the feasibility of a two-way receiver tag (called ‘business card’ tag), through:

- (1) The development of a two-way ‘receiver tag’ prototype. The receiver tag prototype should be able to identify and store acoustic signals sent by other acoustic tags. The receiver tag should be small enough to be mounted on/in tunas or similar sized animals
- (2) Tests of these prototype tags. The prototype tags will be tested on captive fish (controlled situation) and in situ.

Progress during FY 2007

As stated in the project time table, the 1st year of the project (July 1, 2006 – June 30, 2007) was devoted to the development (by Vemco, Canada, www.vemco.com) of a first receiver tag prototype.

The BCT is a tag-sized VR2 (Vemco acoustic receiver) which can be implanted in or attached to a fish. The BCT also behaves as a normal VEMCO transmitter and can be detected by other Vemco receivers. The miniature receiver will be able to detect other tagged fish in its presence and thus provide increased knowledge on schooling behavior or inter-species interaction. Other objects such as FADs could be equipped with a conventional VEMCO pinger and the BCT would detect and store these data thereby revealing the length of time spent near that object. Presently, prototype BCTs have been built and tested in Shad Bay, NS, Canada. They are 22 mm in diameter by 130 mm long. They transmit at 158 dB with a 60 second average inter-transmission delay. The BCT can have a battery life up to 1 year, when using a receiver duty cycle of ~20%.

Climate and Fishing Impacts on the Spatial Population Dynamics of Tunas

P.I.: John R. Sibert [Patrick Lehodey, Olivier Maury]

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

NOAA Goal(s)

- To protect, restore, and manage the use of coastal and ocean resources through ecosystem-based management
- To understand climate variability and change to enhance society's ability to plan and respond

Purpose of the Project

A high priority for effective management of large pelagic fishes is the capability to discriminate between the effects of exploitation and climate dynamics on the sustainability of tuna populations. Climate related changes are believed to strongly influence the pelagic habitats of tuna, and thus movement and migration patterns. High frequency ENSO recruitment response appears to play out into low frequency decadal variations of tuna population biomass. Large changes in Pacific tuna catch rates in the 1950s–1960s were associated with natural climatic fluctuations. But not all tuna respond the same way to climate cycles, thus there should be demonstrable differences in survivorship during recruitment and responses to exploitation patterns. Empirical and analytical evidence are needed to explain the relative importance of environmental and fishing variability in structuring pelagic ecosystems. There is need to determine the mechanisms involved in observed variability across species, trophic connections, and oceanic regions. In this proposal, two spatial bio-physical models are proposed to be run for several tuna species concurrently with 6-8 long-term (up to 50 years) climate regime datasets. It is anticipated that the models will enable researchers to evaluate potential alternative system states due to physical and anthropogenic forcing and to help determine if the impacts of natural climate variability could be anticipated in such a way as to help establish a management regime that accommodates exploitation pressures and natural variability to build sustainable tuna fisheries.

Progress during FY 2007

The planned activities for year 1 were:

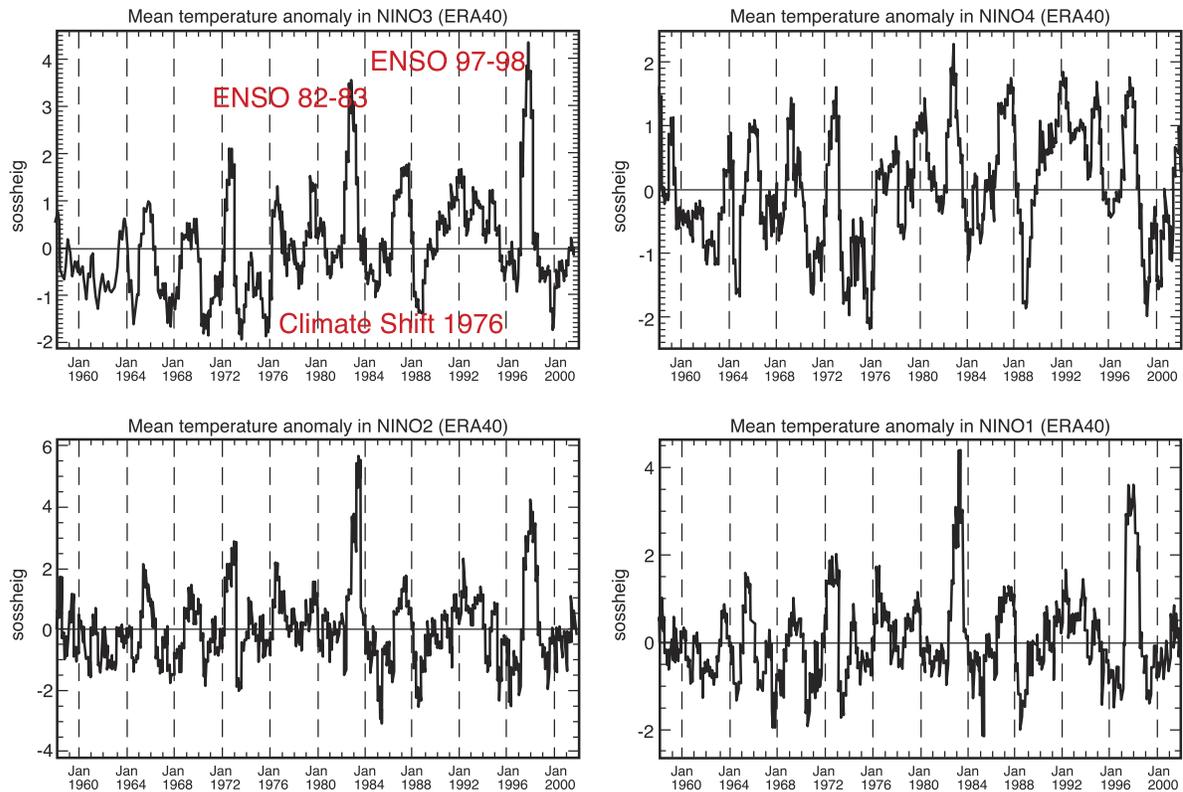
- The recruitment of a post-doctoral researcher (based in Noumea for the first 12 months) to prepare physical fields and to run online/offline coupling with the biogeochemical model PISCES
- An audit of project requirements in term of 2D/3D data visualization software
- The recruitment of an engineer (based in IRD Sète, France) who will be in charge of the global fishing tuna database (supervisors: O. Maury / A. Fonteneau / G. Watters).
- Continuous progress in SEAPODYM/APECOSM models code and parameterization
- Participation to meetings: CLIOTOP WG4 Synthesis and modelling and PFRP PI or Tuna Conference meetings.

Though the fiscal year for this PFRP project started on July 1, 2006, the sub-contract agreement was officially signed in December. For administrative reasons, it was not possible to start postdoc and engineer recruitment procedure before this date. The priority was to recruit the post-doc researcher. Dr. Vincent Faure has been selected for this position. He was recruited and started his work in Noumea the 1st March 2007. Under the supervision of Drs. C. Menkes and O. Aumont, he is in charge of preparing physical fields and to run online/offline coupling with the biogeochemical model PISCES. Recruitment of fishing database engineer has been postponed to September 2007. He/she will be recruited together with the computer engineer for code parallelization.

The chosen coupled physical-biogeochemical models for our study are embedded in the NEMO modelling framework (<http://www.lodyc.jussieu.fr/opa/>). NEMO allows several ocean related components of the earth system to work together or separately. We use two different configurations:

- ORCA2: a coupled ocean / sea-ice configuration based on the ORCA tripolar grid at 2° horizontal resolution with climatological forcing.
- ORCA05: the same as ORCA2 but based on grid at 0.5° horizontal resolution.

ORCA2 horizontal grid is based on a 2 degrees Mercator mesh, (i.e. variation of meridian scale factor as cosinus of the latitude). In the northern hemisphere the mesh has two poles so that the ratio of anisotropy is nearly one everywhere. Besides, the ocean model includes 30 vertical levels, with 20 of these in the upper 500 meters.



Mean temperature anomaly over 1958-2001 from ORCA2-ERA40 simulation for the Nino boxes, showing interannual and multi-decadal variability. Nino4 = [160°E-150°W; 5°S - 5°N]; Nino3 = [150°W-90°W; 5°S-5°N]; Nino2 = [90°W-80°W; 5°S-0°]; nino1 = [90°W-80°W; 10°S-5°S].

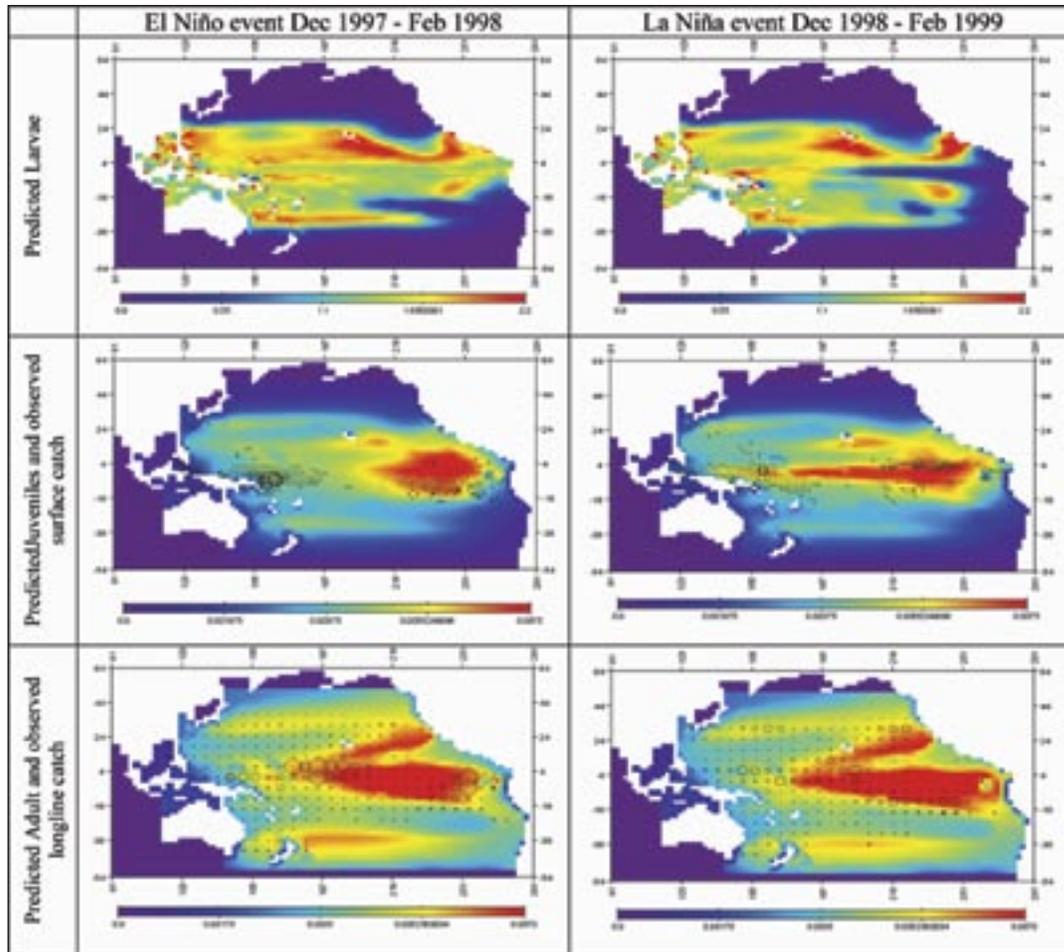
ORCA05 uses the same vertical grid, but grid spacing is 0.5°lon x 0.5°lat on the Mercator grid. The forcing fields, corresponding to the needed input fields, are basically the wind stress, heat and freshwater fluxes, and temperature/salinity data to initialize the domain configuration.

For the project, several physical simulations have been performed (or are in progress), using two configurations of the physical model and two kind of forcing: NCEP-1 and ERA-40. The product called NECP-1 is a Reanalysis performed by NCEP/NCAR over the period 1948-2003 (<http://dss.ucar.edu/pub/reanalysis/>). ERA-40 is a Reanalysis performed by ECMWF over the period 1958-2001 (<http://www.ecmwf.int/research/era/>). However, only the surface windstresses of ERA-40 was used. Thus the forcing fields between simulations with NCEP-1 and ERA-40 differ only in their specification of the surface windstresses.

We realized interannual simulations with reanalysis data products NCEP-1 and ERA-40. The two model configurations are ORCA2 and ORCA05. As previous results showed that ERA-40 simulations were superior, we chose not to achieve the ORCA05 with NCEP-1 product. These 3 different ocean reanalyses will be coupled to the biogeochemical model PISCES and provided to R. Murtugudde (Univ. Maryland, for offline coupling to the biogeochemical model ESSIC).

The parameterization of SEAPODYM for its application to Pacific skipjack and bigeye tunas has been achieved using optimization approach based on fishing catch and length frequency data. Overall fishing impact is estimated to be 3% and 40% for adult stocks of skipjack and bigeye respectively. Besides, SSAP (Skipjack Survey Assessment Program) tagging dataset was used for one-cohort version of SEAPODYM and proved applicability of the model to description of movement of tagged tunas. The latter makes it possible in the further research to incorporate tagging data besides catch and LF series into SEAPODYM for the purpose of more accurate estimation of tuna preferred habitat and movement parameters.

A meeting was held in CLS, Toulouse on Jan. 12, 2006 with participants involved in the "Climate and Tuna" project, in the French ANR-REMIGE project, and in the IRD-SARDARA project to organise the PFRP project activities linked to the global tuna fishing database and the definition of needs for visualization software. The



Biomass distribution (background colour) of bigeye tuna larvae, juveniles and adults predicted with SEAPODYM during El Niño event (top) in Dec 1997 - Jan 1998 and La Niña event (bottom) in Dec 1998 - Jan 1999. Surface and sub-surface observed catch (proportional to circles) are superimposed

development of the fishing database SARDARA was presented. This database is technically operational but now requires downloading the data in appropriate form. A definition of stratification of fishing data was discussed, i.e. sufficient for the models but also acceptable for entering in the public domain. Existing tools for visualization and new developments are currently reviewed and synthesized in a report.

OM, PL and GW participated to the CLIOTOP WG4 workshop in Shimizu, Japan, May 2007 using external funding.

Long-Term Deployment of Satellite Tags on Swordfish using the California Harpoon Fleet

P.I.: John R. Sibert [Heidi Dewar and Jeffrey J. Polovina]

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

NOAA Goal(s)

- To protect, restore, and manage the use of coastal and ocean resources through ecosystem-based management
- To understand climate variability and change to enhance society’s ability to plan and respond

Purpose of the Project

The objectives of this project are four-fold. The management of swordfish in the Pacific is hampered by the lack of data on stock structure and essential habitat in part because of the difficulties associated with studying these large, active and aggressive fish. The goals of this project were 4 fold. First, to determine the feasibility of using the California harpoon fleet to deploy pop-up satellite tags over long time periods. To do this, tags were to be deployed over periods of up to 10 months. The second was to test the retention rates with two different dart types. The third to use any data obtained to determine whether the region off California is in fact a region of mixed as suggested previously and examine essential habitat is different oceanographic regions. Finally, given the diving patterns of swordfish and associated difficulty of using light to determine latitude and longitude efforts will focus on using hydrographic features to estimate locations between tag and pop-up.

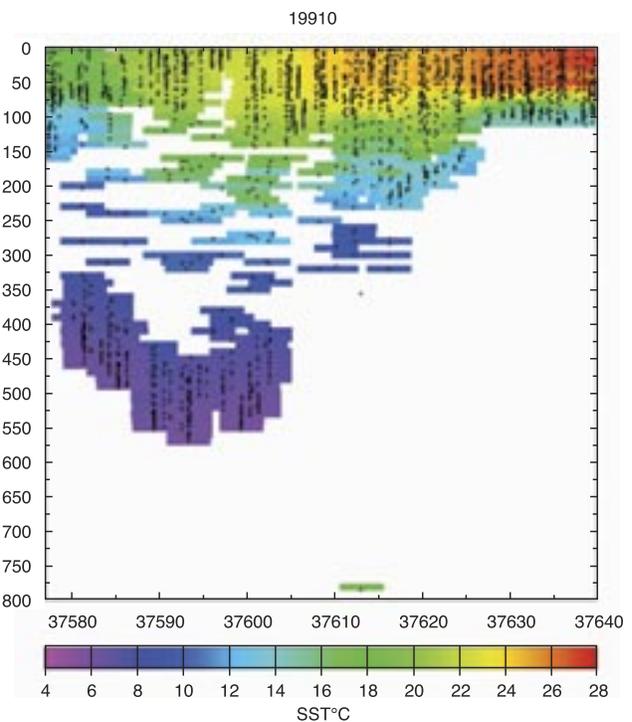
Progress During FY 2007

In the first year of the program nearly 50% of the satellite tags deployed did not report which represents a high rate of failure especially in comparison to previous studies using the same methods. Consequently the PI's were reluctant to place more tags in the water before trying to resolve the issue of low recovery rates. Low recovery rates have also been noted in other species who regularly dive into cold, deep waters such as thresher sharks and bigeye tuna. The low recovery rates for these species, including swordfish, may be associated with either the time spent in cold temperatures at high pressure or with the number of temperature and pressure fluctuations that the tags must endure.

To address the potential for technological limitations of the PAT tags due to the behavior of swordfish (descending at dawn and returning to the surface at dusk) the PI's worked with Wildlife Computers and Dan Costa at the University of Santa Cruz, a scientist specializing in tagging elephant seals. Elephant seals spend long periods of time at depth in the cold waters of the North Pacific on their annual migrations. This was considered to be a good proxy for swordfish behavior. In the winter of 2005-2006 three tags provided gratis by Wildlife Computers were deployed on 2 elephant seals. The two tags that were recovered after 5 months functioned perfectly unfortunately providing no insight into our high failure rates. Another potential problem may be recapture of tagged fish by the local driftgillnet fleet although with the \$500 reward in place this is unlikely. This year we plan to try shorter deployments to reduce the non-reporting rates. It was the longer deployments where the problems were apparent.



(above) Picture showing a swordfish basking on the surface just before being harpooned. (below) The depth and temperature record through out the course of a track. Note the dramatic reduction in depth and increase in temperature when the fish enters waters conducive to spawning.



Sustainable Fisheries Initiative (SFI)

P.I.: Thomas A. Schroeder [Alvin Katekaru]

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

NOAA Goal(s)

- To protect, restore, and manage the use of coastal and ocean resources through ecosystem-based management

Purpose of the Project

The purpose of the Sustainable Fisheries Initiative (SFI) is to foster sustained optimal use of fishery resources and to provide maximum protection to marine endangered and threatened species in the Pacific islands region. Project activities are authorized under the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) and are consistent with other applicable laws, such as the Endangered Species Act, Marine Mammal Protection Act, and National Environmental Policy Act. These activities are based on the best scientific information available, and commensurately, SFI collects and analyzes scientific data, including socio-economic information, and as appropriate, applies these data for fisheries management and conservation actions. SFI also evaluates biological, environmental, and economic issues such as, protected species interaction mitigation, including fishermen education and data collection/monitoring in U.S. domestic fisheries in the western Pacific Ocean. The desired outcome is to increase food supply, enhance the economy, maintain and foster island culture, and maximize commercial and non-commercial (recreational, subsistence) fishing opportunities in the U.S. flag island areas in the Pacific Ocean.

Progress During FY 2007

Education and Outreach

The Sustainable Fisheries Division (SFD) provides outreach and education for U.S. fishermen for commercial longline and bottomfish vessels, primarily through its protected species workshops and daily contact with fishermen. In addition to the classroom format, electronic interactive protected species workshops are being developed with initial rollout to commercial fishermen in August, 2007. The intent of the workshops is to provide fishermen, with information and instruction on protected species mitigation and deterrent methods involving sea turtles, seabirds, and marine mammal. The program received JIMAR support in 2007 and will rely on continued support in 2008.

Sustainable Fishery Regulations

JIMAR personnel were responsible for facilitating the internal NOAA Fisheries' evaluation of two fishery management plans prepared by the Western Pacific Fishery Management Council: crustaceans (deep water shrimp) and bottomfish management in U.S. Exclusive Economic Zone waters around the Northern Mariana Islands. Also, staff prepared a final rule and supporting policy documentation for the optional use of NOAA Fisheries approved electronic logbook forms in lieu of paper logbooks. The data collection rule was published in the Federal Register on April 11, 2007. Staff assisted in the development of supporting documentation for the following federal actions which were published in the Federal Register: Advance Notice of Proposed Rulemaking to establish a control date for the Hawaii pelagic charter fishery, interim rule to temporarily close commercial and non-commercial fishing in the main Hawaiian Island for 7 deepwater bottomfish species, and partial approval of Amendment 14 to the Pelagics Fishery Management Plan. JIMAR support will continue in FY 2008 to facilitate the promulgation of regulations addressing overfishing of bottomfish complexes in the main Hawaiian Islands and implementation of a fishery ecosystem plan for the Hawaiian archipelago.

Socio-Economic Assessments

JIMAR personnel collaborated with NOAA Fisheries partners by participating in the Human Dimensions Research Program of PIFSC. Staff was a co-lead on the project entitled: the "Socioeconomic Assessment and MPA Monitoring Training" project in American Samoa. From April 30th -May 10th, JIMAR personnel conducted training on socioeconomic assessment and monitoring for resource agencies in American Samoa. The goal was to improve NOAA Fisheries' capacity to integrate socioeconomic analysis into the design, management, and monitoring of marine protected areas (MPAs), community-based fisheries programs, and other natural resource management programs in American Samoa. This collaborative effort will continue in 2008.

Sustainable Fisheries Permits

The JIMAR permit associate assisted with processing and issuing 131 Hawaii longline limited entry permits, six Western Pacific longline general permits, seven NWHI bottomfish permits, and 2,072 shallow-set certificates. In addition, she provided support to other Sustainable Fisheries Division staff and helped design a new website for the division.

National Environmental Policy Actions

In FY2007, three major environmental impact statements (EISs) were completed under SFI and filed with the Environmental Protection Agency. These were: a Draft Supplemental EIS (DSEIS) for measures to end bottomfish overfishing in the Hawaiian Archipelago and a Revised DSEIS, and a Draft Programmatic EIS on an ecosystem approach shifting from species-based fishery management plans to place-based fishery ecosystem plans in the western Pacific. These documents enabled the Western Pacific Fishery Management Council and NOAA Fisheries to consider all reasonably foreseeable environmental effects of alternative resource management actions and to involve and inform the public in the decision making process. In FY2008, SFI will complete the preparation and filing of the Final EISs for the bottomfish measures and fishery ecosystem plans to implement NOAA Fisheries' preferred alternatives under the Magnuson-Stevens Act.

Sustainable Fisheries and International Fisheries Program

The PIRO International Fisheries Program (IFP) has implemented sea turtle conservation, management and fisheries related mitigation activities within the Sustainable Fisheries Initiative (SFI). IFD SF sea turtle projects include a subcontract in Papua New Guinea (PNG), work within the Marshall Islands and continuing work in Yap State, Federated States of Micronesia. *The Papua New Guinea Sea Turtle Interaction Mitigation and Outreach Program Phase II* continued during FY06 and consisted of one remaining subcontract with the Papua New Guinea National Fisheries Authority (NFA). This project will remain active through a no-cost extension until June, 30, 2008, to enable NFA to obtain supplies for future turtle excluder device (TED) implementation and observer training activities. Attempts at finding materials and suitable machine shops to build TEDs within Papua New Guinea have not proven successful and the NFA has requested more time to work closely with an Australian company familiar with TED technology to obtain supplies and build TEDs.

The Marshall Islands Outer Island Sea Turtle Genetic Sampling and Data Collection

The Women United in the Marshall Islands (WUTMI) data collection project was initiated in November 2005 and completed by the end of FY 2006; however, final results were not compiled until the beginning of FY07 so they are presented here. The primary focus of WUTMI is on projects which prepare the younger generation of women to take their role in society as healthy mothers, educators, health professionals, leaders and business women. WUTMI actively seeks resources for projects such as empowerment, life skills development, research into areas such as child abuse and training in areas of the greatest need. WUTMI was selected for a pilot sea turtle project because of its extensive network of members involved in community activities and their standing as a well-managed, reputable organization capable of dealing with technical and administrative tasks required for this project. From November 2005–June 2006, eight data collectors from the atolls of Ailuk, Likiep, Wotje, and Majuro collected 141 turtle skin samples from turtles originating at 11 different atolls. These tissues are being analyzed by the NOAA Fisheries, Southwest Fisheries Science Center (SWFSC) to determine mitochondrial DNA haplotypes of these turtles. Information obtained from these samples will establish which turtle haplotype(s) are found in turtles nesting on Marshall Islands beaches and will provide insight into the natal beaches of juvenile turtles captured by fishermen in the nearshore territorial waters. This information in turn, will lead to a better understanding of turtle migrations and areas of potential interaction with fisheries. In addition to skin sampling, the WUTMI data collectors have worked to further characterize the marine turtle aggregations in the Marshall Islands by taking measurements and photographs of turtles, and writing reports on turtle utilization for sustenance and cultural practices.

Yap State Marine Turtle Research Project

A marine turtle nesting beach monitoring project on Gielop and Iar Islands, Ulithi Atoll, Yap State, Federated States of Micronesia, was conducted in 2005 (June to August) and included tagging, measuring, health assessments and tissue sample collection of nesting sea turtles. This project was repeated in the summer of 2006 and focused on Gielop Island alone for logistical reasons, including boat and staff availability. Two Peace Corps Volunteers (one of which acted as the Project Leader) were retained from the 2005 project and as in the previous nesting season, 10 people from Falalop and Ulithi were field assistants. Administrative support of the project was

provided by Yap Community Action Program (YapCAP) and permitting by Yap State Marine Resources and Management Division (MRMD). Funding was provided by PIRO and JIMAR with flipper tagging equipment provided by SPREP. Between 2 June and 20 August 2006, 330 green turtles were tagged and measured with 272 of those receiving passive integrated transponder (PIT) tags in addition to titanium flipper tags. PIT tags are being used to ensure individual turtle recognition in the long term. Skin samples were collected from 282 turtles for future mitochondrial DNA sequence analysis by the SWFSC. Carapace lesions were observed on 4.8% of tagged turtles. Biopsy samples were collected from 10 turtles for lesion histological analysis. In August 2006, Dr. Steve Kolinski, PIRO Coral Reef Ecologist, provided technical assistance with satellite transmitter deployment on six post-nesting green turtles. The Philippines appears to be an important foraging area for post nesting Gielop turtles based on four turtle tracks from the 2006 season and one from 2005 (Kamdidi), one turtle's transmitter discontinued transmitting within the boundaries of Yap State and another appears to have foraging grounds in Malaysia. Tracking services and expertise are provided by Denise Parker, JIMAR/PIFSC Marine Turtle Research Specialist and George Balazs, Leader, Marine Turtle Research Program PIFSC.

JIMAR and PIRO IFP continue supporting this project for a third year and as of 1 June 2007, the non-governmental organization The Oceanic Society has taken over administration with the now former Peace Corps volunteers and the locally based field crew remaining intact. Through the end of the JIMAR fiscal year 2007, this group had tagged 145 turtles. Tagging will continue through August and a final round of transmitters will be deployed with additional funding from PIRO and continued partnership with PIFSC.

Protected Resources Environmental Compliance Initiative

P.I.: Thomas A. Schroeder [Chris Yates]

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

NOAA Goal(s)

- To protect, restore, and manage the use of coastal and ocean resources through ecosystem-based management

Purpose of the Project

Develop and implement strategies to further recover marine species protected under the Endangered Species Act (ESA) and /or the Marine Mammal Protection Act (MMPA). Conduct section 7 consultations under the ESA. Revise and maintain the marine mammal stranding program to fulfill mandates of the MMPA. Assist in the analysis and procedural requirements to manage federal fisheries in compliance with the ESA and the MMPA. Develop and deliver outreach and education campaigns for the public concerning protected resources issues. Project provides supplementary staff to augment federal employees assigned to this mission.

Progress During FY 2007

The objectives established for this period included: 1) sea turtle conservation, management and fisheries related mitigation activities within the PRECI; 2) draft informal section 7 consultation responses to other federal agencies in response to their submissions of project plans and permit applications; 3) draft ESA biological opinions and MMPA negligible impact determinations to analyze the specific actions on marine mammals; 4) research and review species for the NOAA Fisheries Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES) Task Force; 5) prepare, review and analyze scientific and policy documents concerning management of marine mammals in the Pacific Island Region; 6) provide marine mammal biological expertise during the preparation and review of management and policy documents; 7) assist in outreach and education mission by developing outreach materials, coordinating volunteer groups and creating partnerships with other federal and state agencies and non-profit organizations involved in protected resource issues; 8) provide administrative support to federal and JIMAR project staff in the Protected Resources Division.

- Project hired Kim Maison as the division Turtle Biologist in August 2006. Kim spent the last year visiting sea turtle project sites and establishing working relationships with project coordinators in Guam, Saipan and on the island of Hawaii. As the designated division Hawksbill recovery coordinator, Kim also organized the 2007 Hawaii Hawksbill Recovery Group meeting; worked with partners to develop outreach materials aimed at Hawaii's Hawksbills; and initiated a communication network for the hawksbill community in Hawaii.

Kim has also supported other programs by creating and maintaining a Sea Turtle reference database and assisting with Sect. 7 consultations.

- JIMAR Marine Mammal Biologist, Michelle Yuen, worked with the Monk Seal Recovery Team to complete the first five-year status review for the Hawaiian monk seal as required by the Endangered Species Act. Michelle also assisted with the revisions of the Monk Seal Recovery Plan by updating scientific data and references, and thoroughly evaluating all of the comments received from the public and independent peer-reviewers. Michelle is also a part of the PRD Spinner Dolphin team. She assisted with the five October/November 2006 scoping meetings which were held to solicit comments from interested individuals, government agencies, and public interest organizations regarding the Spinner Dolphin-Human Interaction Environmental Impact Statement. Michelle also helped to coordinate the first semi-annual Hawaiian Monk Seal Count, a program aimed to generate awareness about the Hawaiian Monk Seal and encourage more volunteers to join the Monk Seal Response Teams across the main Hawaiian Islands.
- JIMAR Resource Specialist, Krista Graham, continued to represent the project on the CITES Task force and directing the ESA Section 4 Pacific Islands Region Species of Concern Program. She collaborated with a variety of stakeholders to promote species conservation, including recommending funding for conservation and research projects for each species. She also worked with the PRD Endangered Species Act team, drafting informal section 7 consultation responses to other federal agencies in response to their submissions of project plans and permit applications. Krista is also a member of the PRD Spinner Dolphin team. She assisted this group in coordinating the five October/November 2006 public scoping meetings and public comment periods; and helped draft recommendations for the preferred and additional alternatives for the Spinner Dolphin-Human Interaction EIS and Proposal Rulemaking.
- JIMAR International Turtle Conservation and Management Liaison, Karen Frutchy, made site visits to JIMAR/NOAA supported sea turtle projects in the Marshall Islands, Guam, Indonesia and Solomon Islands. While in Solomon Islands, the Karen visited several study areas and met with non-profit organizations, local and national government officials to lay the groundwork for large scale aerial surveys for counting leatherback nests and for the deployment of satellite transmitters on leatherbacks. She was commended for her role in this activity which resulted in a large area of Solomon Islands coastline being surveyed and in ten transmitters deployed on leatherbacks, most of which migrated south towards Papua New Guinea, southern Australia and New Zealand. In addition to reporting to PIRO regarding the progress of projects, Karen provided administrative and technical support together with training in field sampling and data collection techniques. Other continuing IFD PRECI sea turtle projects include the Marshall Islands Sea Turtle-Fisheries Interaction Outreach Education Project Phase 2 and Population Dynamics of Sea Turtles at the Commonwealth of the Northern Mariana Islands (CNMI).
- JIMAR Outreach and Education Specialist, Jen Metz, continued to coordinate the Honu Guardian Program at Laniakea Beach on Oahu, where green sea turtles haul-out to bask. The number of volunteers doubled this fiscal year and Jen established a core “Team” of volunteers to assist her with the scheduling and recruiting of volunteers. She also worked with partners to develop “Honu Basking Area” informational signs to use at Laniakea and other beaches in the islands where the green sea turtles tend to bask to help mitigate human-sea turtle interactions. Jen worked closely with the Marine Mammal Response Coordinator on various outreach efforts aimed at the Hawaiian monk seal. These included informational fact sheets, a community flier, an



Jen Metz (left) and a few Honu Guardian volunteers with a late afternoon basking turtle. This volunteer program has doubled in size under Jen's guidance, and serves a vital role in protecting basking turtles and educating the public.

informational sign for seal pupping areas and a natural history card to be used by volunteers out in the field. She also assisted the Spinner Dolphin Team and their public scoping meeting outreach efforts by initiating a listserv and helping with the development of the posters used at the scoping meetings and the newspaper advertisements used to publicize the meetings. Jen also drafted an Outreach Strategy for the project, created the web pages for the website, and presented information about marine protected species at teacher workshops and various outreach events including E Malama I Ke Kai at Kapiolani Park and the Marine Educator Evening at the Aquarium.

- JIMAR Administrative Assistant, Naomi Yamamoto, continued to provide excellent support in areas of travel authorizations and vouchers, procurement, and inventory. Naomi expanded her responsibilities this year to include assisting in the formulation, execution, and tracking of spending plans, and as the custodian for property. She also serves in a quality control role for documents originating in the project.

Marine Turtle Conservation and Management Initiative

P.I.: Thomas A. Schroeder [Charles Karnella]

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

NOAA Goal(s)

- To protect, restore, and manage the use of coastal and ocean resources through ecosystem-based management

Purpose of the Project

In many communities in the Pacific, marine turtles have long been known as a food source and can play important cultural roles in the lives of the inhabitants. Six marine turtles species: green, hawksbill, olive ridley, leatherback, loggerhead and flatback turtles inhabit the Pacific, especially the marine areas of Melanesia. Additionally this is an area of growing commercial fishing fleets, specifically using longline and purse seine gear types. The purpose of this project is to introduce fishermen, fishery administrators, policy makers and other relevant stakeholders to information and materials designed to increase the opportunities for survival by marine turtles that might be captured during the course of pelagic fishing operations in the exclusive economic zone (EEZ) of New Caledonia (this action will augment NOAA Fisheries supported marine turtle conservation activities already underway in Papua New Guinea, Indonesia and future activities possibly in Solomon Islands).

Progress During FY 2007

Solomon Islands Marine Turtle-Fisheries Interaction Outreach Education Project

Along with NOAA Fisheries, project continues to monitor the Solomon Islands government and fisheries situation and has investigated opportunities to implement the marine turtle-fisheries interaction mitigation observer training project when appropriate in the future. During September 2006, a site visit was conducted in Honiara, Solomon Islands. In meetings with fisheries officials, it was learned that the fisheries based in Honiara are still recovering from the destruction of many vessels in a cyclone in February 2006. The government was also attempting to stabilize after much of the capital city was burned during civil unrest in March 2006. The Solomon Islands Fisheries Department is also undergoing restructuring and the Director did not know when stabilization in their department would be achieved and when the proposed observer training could occur. However, they remain interested in this activity and will notify the project when implementation is feasible. In the meantime, funds for this portion of the Initiative have been transferred to New Caledonia.

New Caledonia Marine Turtle-Fisheries Interaction Outreach Education Project

A NOAA Fisheries PIRO-sponsored project was undertaken in New Caledonia in March, 2007. The primary objectives were: to heighten awareness of marine turtle interactions with fishing gear by familiarizing commercial fishing operators, fishery observers, and staff of Marine Marchande with techniques for handling marine turtles caught incidentally to fishing operations; to provide appropriate equipment and instructions to the fishing industry on how to address specific marine turtle interactions with fishing gear; to collect baseline data on interactions between marine turtles and tuna-fishing gear in New Caledonia; to integrate appropriate topics in marine turtle interaction with commercial fishing into the ongoing work programs of Marine Marchande and the Secretariat of

the Pacific Communities (SPC) Training Section; and to enhance cooperation among the different government and non-government organizations involved in fisheries management and turtle conservation, locally and regionally.

An initial workshop was held at SPC for master fishermen, observers, and staff involved with training or support activities. Three other workshops were held with fishing industry participants in Noumea, and one at the northern port of Koumac. Participants at industry workshops included captains, deck bosses, crewmen and fleet managers. The project achieved its objectives with support from the SPC's Training and Nearshore Development Section and the New Caledonia government's Service de la Marine Marchande et des Pêches.

Loggerhead Turtle Conservation-Education and Outreach Program

This project supports a recently appointed (June 2007), public outreach educator at Aquarium de Nouméa. The educator's responsibilities include development of educational materials, hosting visiting schools and conducting one day workshops on turtle biology and conservation. Workshops will be given off-site at up to 120 schools within 33 townships of New Caledonia. It is anticipated that over 3,000 children will participate.

Basic turtle biology and population dynamics will be covered to provide necessary background to the conservation program and stress the need to combine efforts at local and regional levels. In particular, programs will focus on raising public awareness regarding the following issues: reduction of dog predation on loggerhead nests; minimizing disturbance to nesting turtles; remediation for habitat loss; and the impact of plastic bag pollution. The project will be carried out over an 18 month period from May 2007. However, the education program will continue on beyond this time-frame using remaining tools and materials and based on loggerhead research conducted in the New Caledonian region during the project's duration.

Pacific Islands Regional Observer Program

P.I.: Thomas A. Schroeder [Kevin Busscher]

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

NOAA Goal(s)

- To protect, restore, and manage the use of coastal and ocean resources through ecosystem-based management

Purpose of the Project

The Pacific Islands Regional Observer Program is managed through a fishery Management Plan developed by the Western Pacific Regional Fishery Management Council and approved by the National Marine Fisheries Service with the authority of the Magnuson-Stevens Fishery Conservation and Management Act, and the Endangered Species Act. The observer program provides high quality data on protected species interactions (sea turtles, marine mammals, and sea birds), catch composition, fishing effort, and selected fisheries research projects from commercial longline vessels based in Hawaii and American Samoa. The data are collected at sea by fisheries observers. The debriefers/data surveyors primary purpose is to train observers and ensure the quality and integrity of data collected by the observers



JIMAR employee Lesley Jantz with a bigeye tuna during a research cruise.

through debriefing observers and data editing.

Progress During FY 2007

From July 2006 through June 2007, 339 observer trips were debriefed. Of the 339 observed trips, 199 were completed through the final data editing stage. In addition the program has completed the final data editing for 200 trips from the previous year. This puts the observer program approximately 140 trips behind in the final data editing stage for observer data. Despite having a deficit of 140 trips, this year the observer program has made progress in the deficit of trips that need the final data editing completed from the previous year. A shortage in the debriefing staff is the major reason for not meeting our objectives this year. However, we have since hired a full compliment of staff and we expect to meet our objectives for 2007.



JIMAR employee Eric Siemer with a mahi mahi during a research cruise.

Coastal Research

The JIMAR Administrative Board approved the addition of Coastal Research as the sixth JIMAR research theme at its November, 2000 meeting. To date, JIMAR research has been directed at issues related to coral reefs, a major component of the coastal zones of Hawaii and U.S.-affiliated Pacific Islands.

Coral Reef Management Initiative

P.I.: Thomas A. Schroeder [Alan Everson, John Naughton]

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

NOAA Goal(s)

- To protect, restore, and manage the use of coastal and ocean resources through ecosystem-based management

Purpose of the Project

To enhance the management of coral reef habitat throughout the US Pacific Islands. The goal of Coral Reef Management Initiative (CRMI) is to establish an enhanced coral reef management presence within the existing NMFS, Pacific Islands Regional Office (PIRO), Habitat Conservation Division (HCD). The CRMI relates directly to the JIMAR Coastal Research theme of achieving sustainable balance between the forces of coastal development and preservation. Information obtained as a result of CRMI assists resource managers in attaining this goal. It also enhances interagency cooperation and information exchange as well as develop new technologies for coastal resource management. A major focus of this initiative is to investigate approaches to develop appropriate compensatory mitigation for coastal construction related loss of coral reef habitat, including but not limited to conducting follow-up studies of several coral reef mitigation projects. A coral reef classification system will be developed for use in habitat management decisions made by the HCD. The initiative will also enhance our capacity to address coral reef conservation issues in Guam, CNMI and American Samoa., as well as aid in the development of an integrated GIS-based system to evaluate anthropogenic impacts to corals reef

Progress During FY 2007

Coral reef management initiative can be divided up into four sub-projects: Coral reef mitigation/restoration; Guam/CNMI/American Samoa Coral coordinators; Hawaii Local Action Strategy Coordinator; and Fishery Extension Agent

Coral reef mitigation/restoration staff continued to participate with EPA, US Fish and Wildlife Service (USFWS), Army Corps of Engineers, the State of Hawai'i and the Government of Guam in the Pacific Region Interagency Coral Reef Mitigation Working Group (PRIWG) as part of the process of standardizing mitigation plans for marine projects. Honolulu and Guam staff continued restoration work associated with the *Cape Flattery* ship grounding that occurred in 2005. Completed pre-assessment report detailing damage to reef resources off Barbers Point following the grounding of the Cape Flattery. Development of potential compensatory restoration projects involving underwater cable debris removal, restoration of orphan vessel grounding sites, and removal of invasive algae. Staff also assisted the Department of Defense in conducting an assessment of a former munitions disposal site off Pokai Bay, Oahu, Hawaii which included analysis of fish tissue data for final report. Kuhio Beach Nourishment Project: collected samples pre and post dredging of sand for sand infaunal analysis. Due to lack of funding, only the nematode component of the samples has been separated to date. Nematodes show no differences between pre and post samples, suggesting that the magnitude of the dredging was not significant or that recovery of this group occurred rapidly. Barbers Point/Kalaeloa Harbor Expansion Project: worked with USFWS to collect data for HEA on reef resources that will be lost or damaged during the proposed jetty construction and channel dredging. Continuing to work on developing possible mitigation projects for this construction. All goals and objectives of this project were met for FY07.

Guam/CNMI/American Samoa Coral coordinators: Staff in Guam continued to coordinate mitigation efforts with EPA, US Fish and Wildlife Service (USFWS), Army Corps of Engineers, and the Government of Guam in the as part of the process of standardizing mitigation plans for marine projects. Staff continued to provide support for the HEA model that is currently being used as a pilot project for determining mitigation for the expansion of an ammunition wharf on a Navy base in Guam (Honolulu and Guam staff participated in intensive field work to support the assessment.) Guam staff facilitated the development of a comprehensive island-wide



Young fishers at Kakaako



Fisheries Extension Agent (right) with retired fisherman/ net makers at Ala Moana Beach Park

long term coral reef monitoring strategy for the local resource agencies. Guam staff also continued a marine debris education campaign to increase public awareness of marine debris impacts and promoting stewardship for coastal and marine resources. Activities included presentations at educator workshops and community group meetings, radio interviews, a booth at the annual Earth Day event, and an underwater and beach clean-up. Staff in CNMI conducted interviews with fishermen in Saipan, Tinian and Rota on their perception and attitudes towards marine conservation and resource management issues. A coral reef brochure, marine debris brochure, marine protected areas brochure, 6 marine protected areas posters, a turtle poster and reef fish of the CNMI 2007 calendar have been developed and distributed to fishermen, students and the general public. Voice of the Pacific Ocean radio program was conducted whereby scientists, administrators, government officers, non-governmental organizations, students, educators, attorneys, traditional leaders and fishermen were interviewed. Discussions were held on different marine environmental issues. Fishermens' Workshop was held on Traditional Fishing Practices and 2 youth conferences on Traditional Marine Conservation Practices were also held. Staff in American Samoa continued planning for additional Participatory, Learning, and Action workshops for local villages to engage community members in information gathering, developing, and implementation of coral reef resource management. American Samoa staff coordinated and participated in a socio-economic study of village marine resource users and continued to work closely with the Coral Reef advisory group as well as staff of the American Samoa Marine and Wildlife Resources. Also participated in several outreach/education initiatives and planning for the upcoming coral reef task force meeting to be held in American Samoa. In addition, staff located in all three jurisdictions coordinated Local Action Strategies for inshore coral reef fisheries management. These activities included revising the action plans, presiding over planning meetings and ensuring the goals and objectives of the various plans are met. All goals of this sub-project have been met for 2007.

Hawaii Local Action Strategy Coordinator: Updated and revised the Hawaii Fishery Local Action Strategy (FLASH); FLASH funded 4 projects, Maunalua Bay Creel Survey, Effectiveness of Seasonal Closures, Primary Nursery Habitats of Important Resource Species, and Life History Characteristics of Selected Coral Reef Fisheries. Grant funding totaled \$80,000; assisted in the coordination of the Reef Fish Life History workshop in Hilo bringing together scientists and resources managers, attended by approx. 35 people; assisted in the hiring of and coordination of priority issues for the Hawaii Fisheries Extension Agent. All goals for 2007 were met.

New for FY07 is the Hawaii Fishery Extension Agent. This project's main focus is to foster favorable relationships with the local recreational shoreline fishing community throughout the Hawaiian Islands using a variety of approaches to gain the trust and confidence of fishermen and women and other resource users. The fishery extension agent acts as a liaison between resource users and resource managers for state, federal and private organizations in order to improve communication, relationships and information exchange. The objective of this project has been met by conducting outreach with approximately 200 fisher men and women and developing several positive relationships at different fishing areas on the south and western shores of O'ahu. (Efforts will be focused on O'ahu for the first year). Questions and concerns are communicated to resource managers, supervisors and colleagues during monthly meetings. All goals for this year were met.

National Environmental Policy Act (NEPA) Initiative

P.I.: Thomas A. Schroeder [Charles Karnella]

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

NOAA Goal(s)

- To protect, restore, and manage the use of coastal and ocean resources through ecosystem-based management

Purpose of the Project

Under the Federal National Environmental Policy Act (NEPA), federal agencies must insure that environmental information is made available to public officials and citizens before decisions are made and actions are taken. The purpose is to promote management and policy decisions that will prevent or eliminate damage to the environment, stimulate health and welfare of man and enrich understanding of ecological systems and natural resources important to the Nation. The major focus of this initiative is to obtain technical assistance on an activity- and project-specific basis to ensure timely and legally sufficient agency compliance with applicable NEPA requirements. The initiative addresses NOAA Fisheries Service's NEPA compliance with international treaties as well as fosters international marine resource conservation measures. While NOAA Fisheries Service has addressed NEPA compliance associated with Federal activities (i.e., development of fishery management plans) in the past, this NEPA Initiative represents a holistic effort to foster compliance with NEPA in international projects. Information and lessons learned from this NEPA Initiative will be evaluated and applied to future NEPA actions. NEPA-focused hires under this initiative will closely coordinate and collaborate with several existing organizations with marine resource protection mandates. These include, but are not limited to: NOAA Pacific Islands Region Fisheries Science Center, NOAA National Ocean Service, NOAA and NOAA Fisheries Service headquarters components, and the Western Pacific Fishery Management Council.

The primary purpose of the NEPA Initiative is the development of NEPA analyses to implement the Western and Central Pacific Fisheries Convention (WCPFC) and decisions of the WCPF Commission.

Progress During FY 2007

The WCPFC Implementation Act became law in January 2007 and the United States deposited its instrument of ratification with the Convention depositary in June 2007, so NMFS now has the authority to take the regulatory and other actions needed to implement the Convention, as well as the need to complete the necessary NEPA analyses for such actions.

Implementation of the Convention involves complexities related to, among other things, whether and how to analyze environmental effects abroad, determinations of whether the agency has any discretion in the needed actions, and the scope of analysis required. These factors have resulted in the need for extensive research and strategy development. A NEPA strategy that recognizes the need for a broad programmatic NEPA analysis has been prepared. Research to establish the baseline condition has progressed substantially and a description of the affected environment has been prepared.

For the initial round of implementing regulations, a notice of intent to prepare an Environmental Assessment was published in the Federal Register (February 2007) and public comments accepted. Preparation of the Environmental Assessment is underway: alternative actions have been crafted and analyses of the impacts of the alternatives have been initiated.

To support the Environmental Assessment and the longer-term NEPA needs for implementation of the Convention, administrative record-keeping and documentation schemes have been constructed.

Sustaining Healthy Coastal Ecosystems

P.I.: Thomas A. Schroeder [Russell E. Brainard]

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

NOAA Goal(s)

- To protect, restore, and manage the use of coastal and ocean resources through ecosystem-based management

Purpose of the Project

To address concerns about the deterioration of coral reef ecosystems around the globe, this project supports multi-disciplinary efforts to assess, monitor, map, restore, and protect coral reef ecosystems of the U.S. Pacific Islands. The goals of this project are to:

- improve understanding of coral reef ecosystems through assessment, long-term monitoring, and applied research;
- evaluate and reduce adverse impacts to coral reef ecosystems with particular emphasis on those related to fishing activities;
- enhance coral reef fisheries management and conservation by providing scientific support for implementation of the Coral Reef Ecosystem Fishery Management Plan, and archipelagic-based ecosystem management plans; and
- provide the scientific basis to expand, strengthen, and establish marine protected areas (MPAs) to conserve coral reef resources of the U.S. Pacific Islands.

Progress During FY 2007

Program Progress Overview

The JIMAR Sustaining Healthy Coastal Ecosystems project is funded by the NOAA Coral Reef Conservation Program and is staffed by over 60 researchers, support personnel, and students. This includes 48 full-time personnel, a post-doctoral fellow, 2 UH graduate students, and 5 undergraduate students. The research accomplishments and success of the program has been critically dependent on the expertise and efforts of JIMAR scientists and staff in the Coral Reef Ecosystem Division (CRED) and the Pacific Islands Fisheries Science Center (PIFSC).

In order to support the objectives of the JIMAR Sustaining Healthy Coastal Ecosystems project plans for FY2007 include:

- to continue long-term monitoring and assessment of fish, corals, algae and macro-invertebrates in coral reef ecosystems of U.S. Pacific Islands
- to continue long-term monitoring of the oceanographic environment of coral reef ecosystems of U.S. Pacific Islands
- to complete mapping of coral reef habitats in U.S. Pacific Islands
- to continue long-term marine debris removal in the Northwestern Hawaiian Islands (NWHI)
- to initiate a marine debris removal program in the Main Hawaiian Islands (MHI) based on aerial surveys

During FY2007, the Sustaining Healthy Coastal Ecosystems project conducted multi-disciplinary research cruises aboard the NOAA Ships *Oscar Elton Sette* and *Hi'ialakai* in U.S. Pacific Islands. These research cruises conducted assessments and monitoring of the fish, corals, other invertebrates, and algae in the context of their benthic and oceanographic habitats of the coral reef ecosystems of the MHI, NWHI, Wake Atoll, Guam, and the CNMI. These research cruises also conducted benthic habitat mapping activities consisting of multi-beam acoustic surveys and towed diver and towed camera optical validation surveys. This multi-disciplinary approach to research provides an improved understanding of coral reef ecosystems, which will serve as the scientific basis for management plans and conservation efforts. Project activities that evaluate and reduce adverse impacts to coral reef ecosystems included marine debris removal efforts in the NWHI and MHI.

Ecological Assessment—Fish

Ecological assessments of reef fish were conducted in the main MHI and NWHI (July-September 2006), at Wake Atoll (April-May 2007), and in the Marianas Archipelago (CNMI and Guam) (May-June 2007). These

assessments were conducted by scientists from the project, CRED, and its partner agencies, from the NOAA Ship *Hi'ialakai*.

In the Hawaiian Archipelago, ecosystem monitoring of the species composition, size, and density of all fishes was conducted on shallow-water (<35 m) coral reefs around these islands. 120 REA survey sites for all fishes and 225 towed-diver surveys (for large fishes) were completed in the MHI and NWHI. A cumulative record of all fish species observed to be present anywhere at the site was made. Photographic documentation of fish-habitat associations was taken on an opportunistic basis. Generally, fish stocks continued to appear to occur in low densities around most of these MHI, with a few exceptions. Large fish, predators, and other commonly fished species were particularly rare at most sites, in comparison to the predator-rich NWHI. At REA sites in the NWHI, permanent stakes were installed to facilitate future monitoring surveys at the same exact sites.

At Wake Atoll, fish communities were monitored following their initial assessment in late 2005 for species composition, size, and density along the reef slope. Twelve REA sites and 19 towed-diver fish surveys were completed during four days of operations. Wake's reefs continue to support a healthy abundance of reef fishes, in spite of a major typhoon since our last surveys. Parrotfish of several species were exceptionally large, and the rare bumphead parrotfish, *Bolbometopon muricatum*, was commonly encountered. Also encountered commonly was the endangered Napoleon wrasse, *Cheilinus undulatus*. In addition, a cumulative record of all fish species observed to be present in the area around the site was made. Photographic documentation of fish-habitat association was taken on an opportunistic basis.

In the Marianas Archipelago (Guam and CNMI), 66 fish REA monitoring sites (established during CRED cruises in 2003 and 2005) were resurveyed around 13 islands for species composition, size, and density of all coral reef fishes. A total of 114 towed-diver fish surveys were also completed around these islands. In addition, a cumulative record of all fish species observed to be present anywhere at the site was made, and photographic documentation of fish-habitat association was taken on an opportunistic basis. Overall, fish assemblages around the CNMI were similar to that found during our previous two biennial surveys. The general trend still indicated a greater abundance of larger fish in the northernmost islands compared to the southern islands, where human population density is the greatest. A few Napoleon wrasses (*Cheilinus undulatus*) were seen at some islands, including some large ones.



NOAA Ship *Hi'ialakai* at Uracas, CNMI on RAMP cruise HI-07-03 in May-Jun, 2007



Towed-diver surveys over coral reefs at Pagan, CNMI on RAMP cruise HI-07-03 in May-Jun, 2007

No bumphead parrotfish (*Bolbometopon muricatum*) were seen, while several were seen in the archipelago in 2003. Around Guam, large fish were again not abundant at any of the sites surveyed. Guam supports a large human population including a sizeable fishing community.

All coral reef fishery independent monitoring data from belt-transect, stationary point count (SPC), and towed-diver large fish surveys were migrated from spreadsheet format to a full relational database format, which allowed for a more efficient entry of data in the field with full error-checking capabilities. Analysis of fish data from these, previous years' cruises, and subsequent manuscript preparation were also conducted during the year. Several manuscripts and reports were completed and submitted. Preliminary analyses of fish data indicate that the population status of targeted reef fish species across U.S. Pacific island



JIMAR coral biologist conducting REA survey at Lisianski on NWHI RAMP cruise in Aug-Sep, 2006

reefs is strongly correlated with local human densities. Highest fish biomass was found around the uninhabited, or sparsely populated, isolated islands and atolls of the central Pacific, such as Howland, Baker, Jarvis, Wake, Palmyra and Kingman. Fish biomass on these reefs ranged from two to six metric tons per hectare. Conversely, lowest fish densities (~0.5 mt/ha) were found around heavily populated islands, such as Oahu, in the Hawaiian Archipelago, and Guam, in the Marianas Archipelago. Preliminary data also suggest that reef fish biomass around the more remote/uninhabited islands is dominated by large apex predators, such as sharks (>60% of total biomass), while biomass on reefs suspected to be heavily fished is primarily comprised of herbivorous fish (>40% of total biomass).

Ecological Assessment—Corals

Rapid Ecological Assessments (REAs) examining coral population parameters (percent cover, diversity, abundance, density, and size class distribution) and characterizing the nature and prevalence of coral disease were conducted throughout the length of the Hawaiian Archipelago (Big Island of Hawaii to Kure Atoll) onboard the NOAA Ship *Hi'ialakai* from July through September 2006. JIMAR Marine Ecologist Dr. Jean Kenyon and JIMAR Coral Disease Specialist Dr. Bernardo Vargas-Angel conducted the majority of the surveys, with personnel from the State of Hawaii's Department of Land and Natural Resources and the University of Hawaii's Institute of Marine Biology assisting in the main Hawaiian Island surveys. A total of 120 sites were surveyed using standard protocols applied since 2002 throughout all U.S. Pacific regions monitored by the project and CRED. In the NWHI, permanent transect markers were installed at most of the sites so that researchers might return to the same survey area in future years and thereby minimize the effect of spatial heterogeneity in sampling benthic



Crown of Thorns at Asuncion, CNMI on RAMP cruise HI-07-03 in May-Jun, 2007

communities. No substantial coral bleaching was observed during these surveys, unlike the years 2002 and 2004 when mass coral bleaching was seen in September (when sea surface temperatures are near their maximum) at northerly-latitude locations in the NWHI. The surveys in the NWHI were the first to be conducted since this area was designated a Marine National Monument by President G.W. Bush on June 15, 2006. A number of new procedures that were required in the wake of newly-developed Monument regulations (e.g., a prohibition against the dive launches anchoring on hard bottom, and the *Hi`ialakai* transiting at least 50 nautical miles outside Monument boundaries to pump waste water), challenged both crew and scientists in being able to conduct the same number of quality surveys as in previous years.

Similar surveys were conducted at Wake Atoll (12 sites), Guam (10 sites), and throughout the CNMI (56 sites) by Dr. Kenyon and Dr. Vargas-Angel in April and May 2007, from the NOAA Ship *Hi`ialakai*, with personnel from the Division of Environmental Quality taking over Dr. Kenyon's duties in the northern islands of CNMI. These constituted the second round of such surveys to be conducted by the project and CRED at Wake Atoll, and the third round at Guam and CNMI. In August 2006 a category-five typhoon swept across Wake Atoll, necessitating the evacuation of all personnel. Despite the severity of the storm, measured coral community parameters (percent cover, diversity, relative abundance, and size class distribution) did not reveal any statistically significant changes to the coral communities at the depths surveyed.

Two manuscripts on which Dr. Kenyon is the lead author have been published since summer of 2006, and an additional manuscript describing coral community structure at Pearl and Hermes Atoll has been accepted for publication, and a similar manuscript focusing on the coral communities at Laysan and Lisianski is currently in review. The latter manuscript was facilitated by benthic image analyses conducted by a NOAA Hollings Scholar under Dr. Kenyon's mentorship, whose work also merited the Best Presentation Award of all 100 Hollings Scholars selected by NOAA in 2006. Analysis of imagery collected during towed-diver surveys (a methodology unique to CRED) in the MHI was facilitated through a grant from the Hawaii Department of Land and Natural Resources, Division of Aquatic Resources.

Since July of 2006, Dr. Bernardo Vargas-Angel has embarked three times on the NOAA Ship *Hi`ialakai* and conducted a total of 196 coral disease and health surveys at: the MHI (54 sites), the NWHI (64 sites), Wake Atoll (12 sites), Guam (10 sites), and the CNMI (56 sites). Dr. Jean Kenyon participated in coral surveys in the Hawaiian Archipelago, Wake, Guam, and CNMI; additional collaborative assistance with coral surveys in the MHI was provided by Benjamin Wheeler (Hawaii Institute for Marine Biology) and by Dr. Peter Houk (CNMI Department of Environmental Quality) in the Northern Mariana islands. The 2006 quantitative assessments indicate that the mean overall prevalence of coral disease in the Main and Northwest Hawaiian Islands is relatively low, affecting less than 3.4% of colonies. These values are comparable to the levels observed by Dr. Greta Aeby in prior visits between 2003 and 2005. In addition, baseline appraisals of disease distribution and occurrence at Wake Atoll, and the islands of Tinian, Rota, Aguihan, Alamagan, Agrihan, Maug, Pagan, Guguan, Asuncion, Uracas, Saipan, and Sarigan (CNMI) have now been attained, and therefore, a better understanding of disease occurrence and potential impacts for the U.S. Pacific coral reefs is emerging.

Products that incorporated data collected by CRED's Coral Disease Project included: (1) a manuscript in peer-reviewed scientific literature pertaining to the coral disease distribution and prevalence in the American Samoan Archipelago; (2) oral presentations; (3) inclusion of 2006 coral disease distribution maps and prevalence metrics into NOAA's 2002-2006 Pacific RAMP American Samoa Monitoring Report, a multidisciplinary report that is near completion, with plans to incorporate coral disease data for similar monitoring reports to be generated for other U.S. Pacific jurisdictions; and (3) all unpublished data sets are available to partners through the NOAA Coral Reef Conservation Program's Coral Reef Information System (CoRIS).

Finally, the 80 or some coral tissue samples collected in 2006, at multiple locations in the Equatorial Pacific Cruise and the NWHI Cruise, have been processed, and histopathological characterization of different disease states is underway.

Ecological Assessment—Algae

During 2006-2007, ecological assessment of marine algae were conducted at 53 sites in the Main Hawaiian Islands (July–August 2006), 64 sites in the Northwestern Hawaiian Islands (August–October 2006), and at 76 sites at Wake Island, Guam, and the Commonwealth of the Northern Mariana Islands (April–June 2007). Quantitative relative abundance data of macroalgal populations was collected in the field together with photoquadrat images that will be used for percent cover analyses. Voucher specimens of algae associated with each photoquadrat/site were collected and are slated for eventual deposition at the *Herbarium Pacificum* in the Bishop Museum,

Honolulu, Hawaii after taxonomic analysis is complete. Five manuscripts that incorporate data collected by the phycology laboratory have been published since summer 2006.

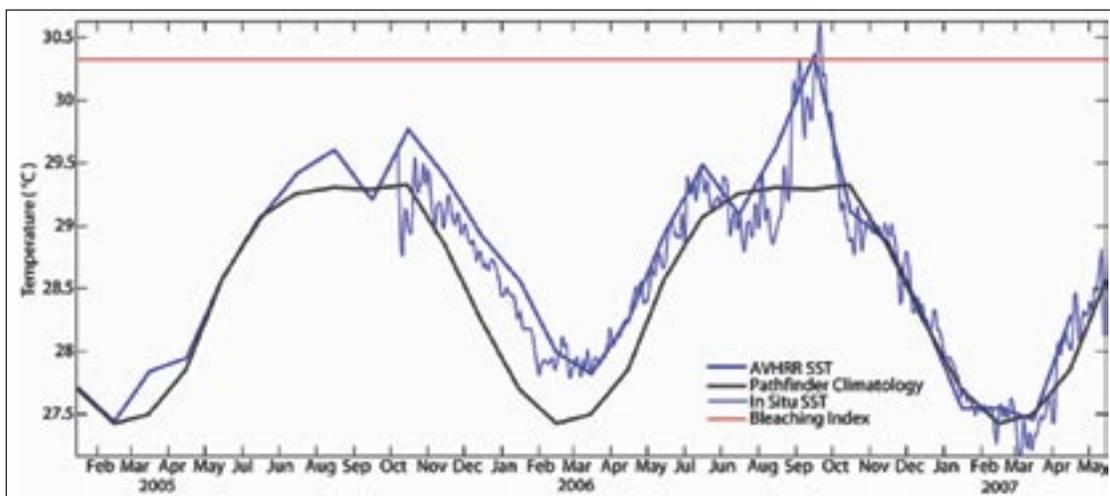
Recently completed research projects or projects that are still underway include: (1) An ecosystem-based analysis of Howland and Baker Islands, US Phoenix Islands; (2) A spatial analysis of benthic communities at Pearl and Hermes Atoll, Northwestern Hawaiian Islands; (3) Analysis of the diversity and abundance of marine algae at Gardner Pinnacles, Northwestern Hawaiian Islands; (4) Algal species lists are being completed for Howland and Baker Islands; (5) A Pacific-wide study of the relative abundance of macroalgae based on rapid ecological assessment data; (6) An analysis of the relative abundance of macroalgae in the islands of American Samoa; (7) Description of a new brown algal species, *Sporochnus longiramosum*, from Maro Reef, Northwestern Hawaiian Islands; and (8) Analysis of benthic communities at Rose Atoll based on species-level percent cover data.

Oceanography

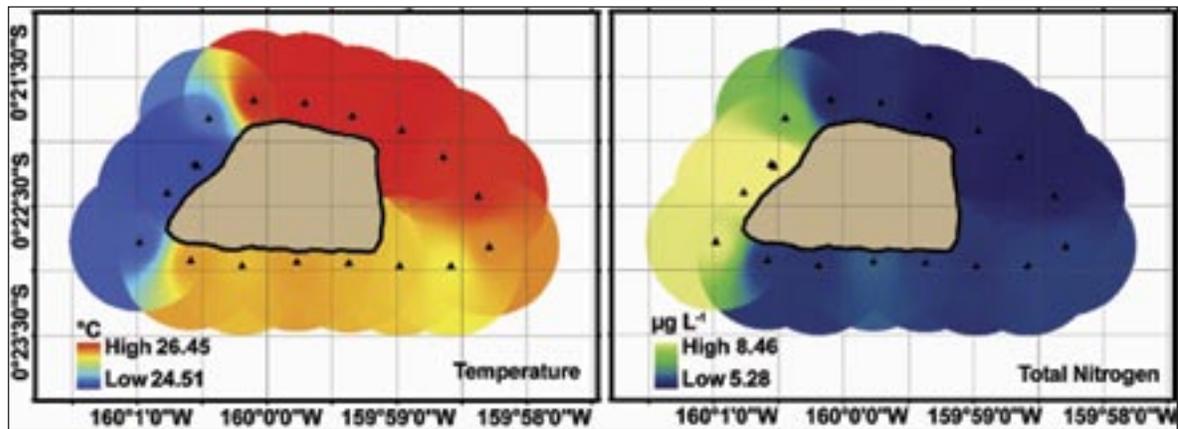
Oceanographic monitoring and assessment continued throughout the NWHI, Guam, CNMI, American Samoa, and the Pacific Remote Island Areas (PRIA). As of July 2007, there are 238 instruments currently deployed and 292 datasets available from past deployments. Datasets include various oceanographic and meteorological parameters, including sea surface and subsurface water temperature, salinity, current profiles, wave and tide data, photosynthetic active radiation, UV-B, air temperature, barometric pressure, and wind velocity at ~50 islands and banks around the Pacific Ocean. Remotely sensed and modeled products, including sea surface temperature, ocean color, and open ocean wave heights, are used in tandem with *in situ* data to increase the spatial coverage and extend the temporal coverage of oceanographic monitoring conducted around the Pacific.

Over 750 closely spaced shallow water (30 m) conductivity, temperature, depth (CTDs) casts were performed this past year at study sites throughout the Pacific Region, adding to the cumulative total of 3751 casts. High-resolution nearshore CTD profiles allow for a detailed vertical and horizontal description of the spatial structure around each of the atolls and islands. Deepwater (500 m) CTDs and shipboard acoustic Doppler current profiler (ADCP) transects were also conducted during research cruises providing important information about the large scale oceanographic conditions influencing the nearshore waters of island ecosystems.

Physical oceanographic data are complimented with in-situ water samples of chlorophyll (chlorophyll a, pheopigments) and dissolved nutrient concentrations (phosphate, silicate, nitrate, nitrite), with approximately 1500 and 1700 chlorophyll and nutrient samples collected during the past year, respectively. Other variables, such as dissolved inorganic carbon are being measured at certain locations as part of a collaborative effort with NOAA's Pacific Marine Environmental Laboratory. These data are important for determining water masses and identifying unique oceanographic phenomena, and when compared with concurrently collected biological data, aids in the understanding of the interactions between the physical environment and biological processes.



Time series of in situ sea surface temperature (SST), remotely sensed AVHRR SST, and Pathfinder SST Climatology from Guam. In late September, 2007, SST around Guam was far above the climatological mean, reaching and surpassing the bleaching threshold for a 10 day period. The combination of remotely sensed and in situ data products allow for regional and site specific oceanographic conditions to be monitored concurrently.



Temperature (left panel) and total Nitrogen (right panel) at 30 m depth at Jarvis derived from nearest neighbor interpolation of near shore CTD and water sample casts (locations indicated by triangles). Physical and chemical oceanographic data are key components in the understanding of coral reef ecosystem dynamics.

In collaboration with the Hawaii Institute of Marine Biology (University of Hawaii), the program has developed and deployed a number of Ecological Acoustic Recorders (EAR), passive acoustic listening devices used to monitor the temporal and spatial patterns of changes in the ambient sound field at remote coral reef ecosystem locations. This past year, EARs were deployed at sites in American Samoa, Wake Atoll, Guam, and CNMI. These time-series of passive acoustic datasets will provide researchers with another tool to investigate ecological activity and will provide coastal resource managers with the ability to monitor anthropogenic activity at remote sites of ecological significance. Initial results from data collected from a remote area within the National Park of American Samoa reveal that the pattern of small boat activity was much greater than park managers expected. A diver-held acoustic/video data acquisition unit was fielded in Wake Atoll and used to collect information on the Napoleon Wrasse, a species of concern.

The Bottomfish Camera (BotCam) station, currently under development by the program, is a non-extractive method to monitor exploited bottomfish populations and other important deep-water species, visually assess habitat, and study ecological linkages to more shallow water ecosystems. Optical measurement tools represent an underutilized non-extractive method for collecting ecosystem observations of habitat and population parameters. In collaboration with SOEST, University of Hawaii, a series of BotCam surveys (~80 sea days) of Restricted Fishing Areas in the MHI has been initiated this past year and is on going.

Benthic Habitat Mapping

Benthic habitat mapping of coral reefs is an important part of the JIMAR Sustaining Healthy Coastal Ecosystems work. Since 2001, surveys have been conducted in U.S.-affiliated Pacific Islands using bottom cameras, towed diver surveys, and single-beam echosounders. In FY2003, mapping capabilities were significantly enhanced with the acquisition of the 25-ft survey launch, R/V AHI, which is equipped with a 240-kHz multi-beam sonar, followed by the start of operations in 2005 of the NOAA Ship *Hi'ialakai* with two multibeam sonars (30 and 300 kHz). Since the commencement of mapping operations with these systems, extensive multibeam mapping has been conducted. Total areas of multibeam coverage to date, square kilometers, are shown in the table below.

Main Hawaiian Islands	Northwestern Hawaiian Islands	Commonwealth of the Northern Mariana Islands	American Samoa	Pacific Remote Island Areas
3,018	42,077	13,095	1,385	4,461

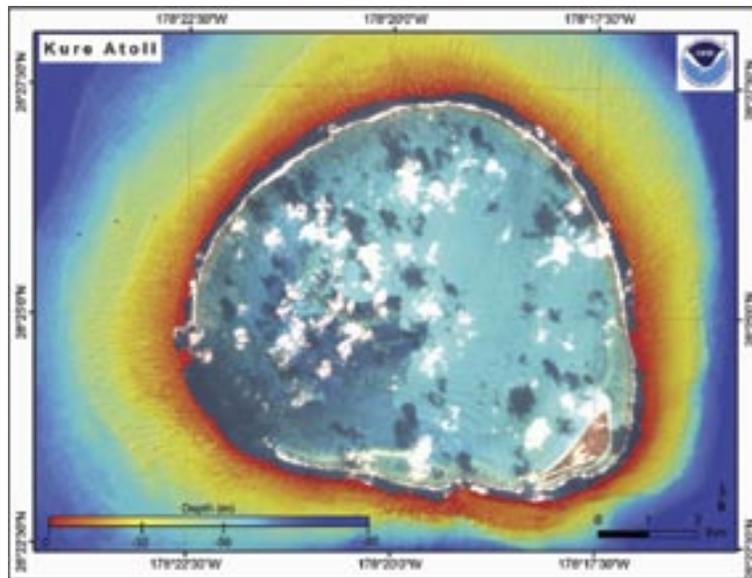
Multibeam bathymetric datasets and metadata have been submitted to the National Geophysical Data Center, and metadata are submitted to CoRIS. Multibeam bathymetric grids, backscatter imagery, and corresponding metadata are also made available to the public via a web site (<http://www.soest.hawaii.edu/pibhmc>) for the Pacific Islands Benthic Habitat Mapping Center, a group that conducts mapping activities with Sustaining Healthy Ecosystems and Center for Excellence in Ocean Sciences (CEROS) funding through JIMAR.

Optical seafloor imagery are also collected, to validate the apportionment of the seafloor into biologically significant classes using acoustically-derived data, and to provide additional information that acoustic techniques are unable to. The project currently owns and operates two camera sleds that can be deployed from a small vessel such as the R/V AHI, or NOAA ships. Those systems were enhanced over the past year with the ability to run two camera systems simultaneously, improved lighting, and a dedicated winch with 300+ m of custom cable and a remote controller to enable the camera system operator to directly control the position of the sled above the seafloor. Optical data including results of their classification are publicly available on the web site listed above, and metadata are submitted to CoRIS.

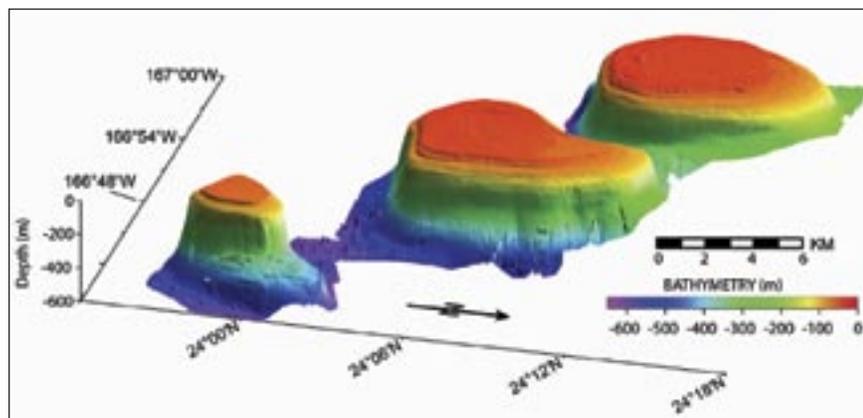
Mapping data were collected on several cruises aboard the NOAA Ship *Hi'ialakai* over the past year including at Kure and Pearl and Hermes Atolls during a dedicated mapping cruise (HI0609) in June and July 2006. Additional multibeam data were also collected to fill holes in the existing bathymetric coverage for Hanalei Bay on Kauai. The work at Kure, in conjunction with existing pseudo-bathymetry extracted from satellite imagery, represents the first island or atoll in the Hawaiian Archipelago for which a complete set of high-resolution bathymetric data exists from the ocean surface to a depth of greater than 500 m. Another dedicated mapping cruise (HI0612) in October 2006 finished the collection of multibeam data at Brooks Banks and collected additional multibeam data at St. Rogatien Bank and West Nihoa.

In November 2006, the mapping group conducted cruise (HI0614) to test the applicability of a commercially available laser line scan (LLS) system to address benthic habitat mapping needs in coral reef ecosystems, which included a team of 6 operators in addition to the normal scientific complement. Approximately 24 hours of LLS data were collected before the system struck the seafloor. Unfortunately, a shear pin system designed to release the towfish from its cable in the event of a bottom strike failed to operate as designed. The instrument was recovered the following week with a submersible operated by the Hawaii Undersea Research Laboratory, and for the remainder of the cruise, multibeam data were collected off the western coast of the island of Hawaii.

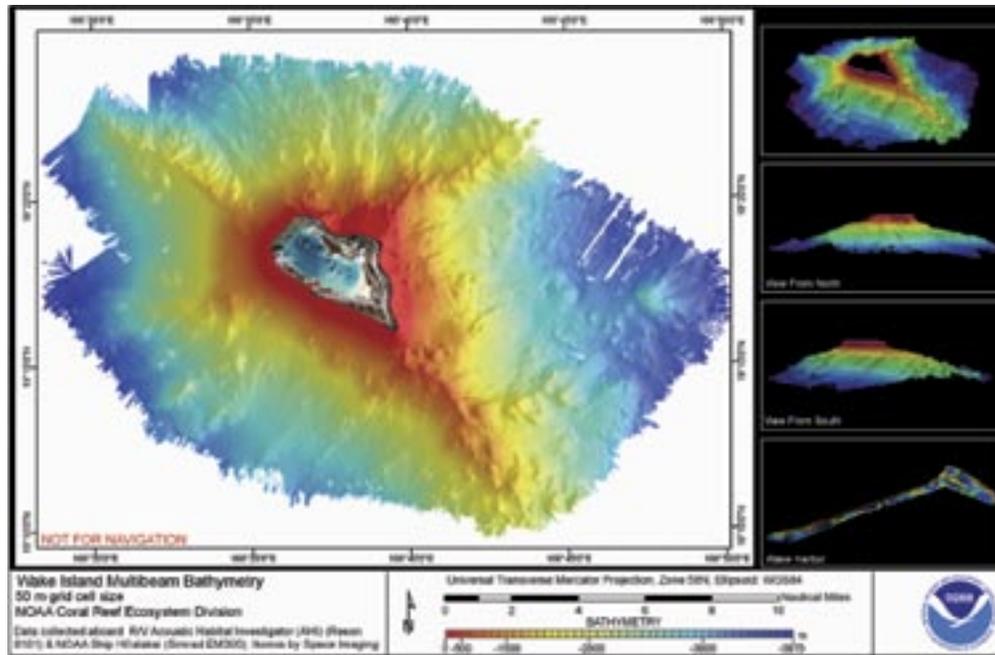
A final cruise with a mapping component (HI0701–HI0703) was conducted from April–June 2007. A complete set of multibeam data were collected between depths of approximately 10 and 3000 m at Wake Island. Multibeam data were collected to hydrographic standards in conjunction with the NOAA Office of Coast Surveys at Saipan, Tinian



Multibeam bathymetry color-coded by depth, from Kure Atoll, and an Ikonos satellite image of the lagoon and islands there. Survey conducted on NWHI mapping cruise in June–July, 2006.



Perspective view of multibeam bathymetry from Brooks Banks in the Northwestern Hawaiian Islands.



Multibeam bathymetry collected at Wake Island on RAMP cruise HI-07-01 in April, 2007.

and Rota Harbors in the CNMI. Additionally, multibeam data were collected around all islands in both Guam and CNMI, resulting in complete coverage at depths between approximately 20 and 1000 m for all islands except Guam, Aguijan, and Rota.

Marine Debris Removal

The Marine Debris Team leads a successful multi-agency effort to remove derelict fishing gear from the reefs and beaches of the Hawaiian Archipelago. Since the inception of marine debris removal efforts in 1996, over 511 metric tons (MT) of derelict fishing gear have been removed from the NWHI and over 35 MT removed from the MHI. All derelict fishing gear removed since 2002 has been incinerated for Oahu energy production. The primary goals of this project are as follows: assess, document, and remove derelict fishing gear from the coral reef environments and islets of the NWHI and MHI; and monitor debris accumulation at specified NWHI reef sites to identify rates and patterns of ongoing accumulation.

This year, the Marine Debris team continued its successful survey and targeted removal effort in the MHI. After completing helicopter surveys assessing patterns of distribution and abundance of marine debris and conducting a pilot removal effort on Oahu, the team conducted a removal effort on the shores of Lana'i using helicopter slingloads to transport debris from remote areas.

In the NWHI, the Marine Debris team removed over 19 metric tons of derelict fishing gear in 2006. This was the first year of the maintenance mode effort, and the field season consisted of three parts:

- A 28-day effort aboard the NOAA Ship *Oscar Elton Sette* targeting high density areas of debris and



CREC Marine Debris team haul derelict fishing nets from the beaches of the main Hawaiian Islands.

- accumulation rate study regions at Kure and Pearl and Hermes Atolls;
- A smaller, land-based removal effort in conjunction with PIFSC’s Protected Species Division and Layson and Lisianski; and
- A five-day, shore based survey and removal effort at Midway Atoll National Wildlife Refuge in partnership with the United States Coast Guard.

A newly released study suggests that the accumulation rate is higher than originally anticipated, and is now estimated to be over 52 tons annually.

Hawaii Regional Coastwatch

P.I.: Thomas A. Schroeder [Samuel G. Pooley and Jeffrey J. Polovina]

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

NOAA Goal(s)

- To protect, restore, and manage the use of coastal and ocean resources through ecosystem-based management
- To understand climate variability and change to enhance society’s ability to plan and respond
- To serve society’s needs for weather and water information
- To support the nation’s commerce with information for safe, efficient, and environmentally sound transportation

Purpose of the Project

This project in collaboration with 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. The satellite-derived products include ocean surface temperature, ocean color, ocean surface topography, ocean surface wind fields, environmental indicators (Empirical Orthogonal Functions [EOFs]), and high-resolution (1.1 km) thermal infrared High Resolution Picture Transmission (HRPT) imagery from the NOAA AVHRR satellites. The HRPT data is collected daily by the AVHRR receiving station located in Ewa Beach, Oahu (Hawaii).

Progress During FY 2007

During FY 2007, OWCP conducted the reformatting of the entire satellite remote sensing data for the creation of a multi-dimensional netCDF file architecture. Once this was accomplished, OWCP installed a THREDDS/OPeNDAP data server, as well as the Live Access Server (LAS) web client. The new THREDDS/OPeNDAP infrastructure provides an unprecedented access and flexibility to the user for obtaining the datasets they are interested in, and allows them to conduct on-the-fly spatial and temporal sub-settings of the dataset of interest. Datasets include sea-surface temperature, sea-surface height, ocean color, and ocean surface winds. In addition, OWCP also provided users with customized data support, as well as conducting oceanographic cruise support during at-sea deployments.

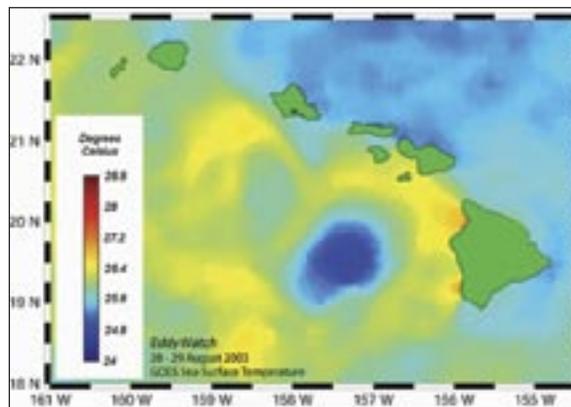


Image generated by the EddyWatch monitoring program available at OceanWatch—Central Pacific. The image shows the spin-up of a mesoscale oceanographic eddy off the Big Island, resulting in the upwelling of cool nutrient-rich deep water into the surface. Image was collected by the Geostationary Operational Environmental Satellite (GOES) during 28-29 August 2003.

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Appendix I List of Acronyms

ADMB	AD Model Builder
ADCP	Acoustic Doppler Current Profiler
ADPC	Asian Disaster Preparedness Center
AIM	Ambient Ion Monitor
AIR	All-India Rainfall
AMOC	Atlantic Meridional Overturning Circulation
AMSR-E	Advanced Microwave Scanning Radiometer
AOML	Atlantic Oceanic and Meteorological Lab
APDRC	Asia-Pacific Data-Research Center
APECOSM	Apex Predators Ecosystem Model
AR4	Fourth Assessment Report
ARSHSL	The Archive of Rapidly-Sampled Hawaiian Sea Level
ASM	Asian Summer Monsoon
AVHRR	Advanced Very High Resolution Radiometer
BET	Bigeye Tuna
BCT	Business Card Tag
BotCam	Bottomfish Camera
BFAL	Black-footed Albatross
CEROS	Center for Excellence in Ocean Sciences
CICIMAR	Centro Interdisciplinario De Ciencias Marinas
CITES	Convention on International Trade in Endangered Species of Wild Flora and Fauna
CLIOTOP	Climate Impacts on Oceanic Top Predators
CLS	Collecte Localisation Satellite
CNMI	Commonwealth of the Northern Mariana Islands
CPUE	Catch Per Unit Effort
CO ₂	Carbon Dioxide
CoRIS	Coral Reef Information System
CRED	Coral Reef Ecosystem Division
CRMI	Coral Reef Management Initiative
CSIA	Compound-Specific Isotope Analysis
CSIRO	Commonwealth Scientific and Industrial Research Organization
CTD	Conductivity, Temperature, Depth Casts
dN	Dentrification
DEIH	Data Entry Institute of Hawaii
DNA	Deoxyribonucleic Acid
DSEIS	Draft Supplemental EIS
DSS	Data Server System
EAR	Ecological Acoustic Recorder
ECMWF	European Centre for Medium-Range Weather Forecasts
EEZ	Exclusive Economic Zone
EISs	Environmental Impact Statements
ENSO	El Niño/Southern Oscillation
EOF	Empirical Orthogonal Functions
EPA	Environmental Protection Agency
ERA	ECMWF Re-Analysis
ESA	Endangered Species Act
ESSIC	Earth System Science Interdisciplinary Center
ESRL	Earth System Research Laboratory
ETP	Eastern Tropical Pacific
EURING	European Union for Bird Ringing
FAD	Fish Aggregation Device
FLASH	Hawaii Fishery Local Action Strategy

FY	Fiscal Year
GAM	Generalized Additive Model
GCM	General Circulation Model
GCOS	Global Climate Observing System
GEM	Global Environmental Multi-scale
GEV	Generalized Extreme Value
GIS	Geographic Information System
GLMs	Generalized Linear Models
GLMMs	General Linear Mixed Models
GLOBEC	Global Ocean Ecosystems Dynamics
GLOSS	Global Sea Level Observing System
GODAE	Global Ocean Data Assimilation Experiment
GOES	Geostationary Operational Environmental Satellites
GOOS	Global Ocean Observing System
GPS	Global Positioning System
HARP	High Frequency Acoustic Recording Package
HEA	Habitat Expansion Agreement
HCD	Habitat Conservation Division
HFP2	Second Historical Forecasting Project
HI-POOIS	Hawaii-Pacific Ocean Observing and Information System
HMS	Highly Migratory Species
HNLC	GPS site located at the Honolulu tidegauge site
HPLC	High Performance Liquid Chromatography
HRPT	High Resolution Picture Transmission
HSCO	Hawaii State Climate Office
IATTC	Inter-American Tropical Tuna Commission
IBMs	Individual Based Models
IFP	International Fisheries Program
IGBP	International Geosphere-Biosphere Programme
InSAR	Interferometric Synthetic Aperture Radar
IOTWS	Indian Ocean Tsunami Warning System
IPCC	Intergovernmental Panel on Climate Change
IPRC	International Pacific Research Center
IPWV	Integrated Precipitable Water Vapor
IRD	L'Institut de recherche pour le developpement
ISC	International Scientific Committee
ITCZ	Intertropical Convergence Zone
JASMINE	Joint Air-Sea Monsoon Interaction Experiment: Upper Ocean Survey
JIMAR	Joint Institute for Marine & Atmospheric Research
kfSST	Kalman Filter Sea Surface Temperature
LAS	Live Access Server
LF	Low Frequency
LHR	Latent Heat Release
LIHU	GPS site located at the Lihue NWS office
LLS	Laser Line Scan
LODS	Longline Observer Data System
MARDAP	Marine Resource Dynamics and Assessment Program
MARS	Micronesia Archaeological Research Services
MFCL	MULTIFAN-CL
MHI	Main Hawaiian Islands
MJO	Madden-Julian Oscillation
MLO	Mauna Loa Observatory
MMPA	Marine Mammal Protection Act
MMRP	Marine Mammal Research Program

MODIS	Moderate Resolution Imaging Spectroradiometer
MPA	Marine Protected Areas
MRMD	Marine Resources and Management Division
MT	Metric Tons
MTAP	Marine Turtle Assessment Program
MTRP	Marine Turtle Research Program
MULTIFAN-CL	a length-based, age and spatially-structured statistical model for fisheries stock assessment
MSY	Maximum Sustainable Yield
NASC	Nautical Area Scattering Coefficients
NCDC	National Climate Data Center
NCEP	National Centers for Environmental Prediction
NCAR	National Center for Atmospheric Research
NCOM	Navy Coastal Ocean Model
NEMO	Nucleus for European Modelling of the Ocean
NEPA	National Environmental Policy Act
NESDIS	National Environmental Satellite and Data Information Service
NFA	National Fisheries Authority
NLOM	Navy Layered Ocean Model
NLPCA	Non-linear Principal Component Analysis
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NORI	National Oceanographic Research Institute
NOS	National Ocean Service
NRIFSF	National Research Institute of Far Seas Fisheries
NRL	Navy Research Laboratory
NWHI	Northwestern Hawaiian Islands
NWS	National Weather Service
OCO	Office of Climate Observations
OWCP	Ocean Watch Central Pacific
PASTA	Pacific-Atlantic Sea Turtle Assessment
PAT	Pop-up Archival Transmitter
PC	Principal Component
PEAC	Pacific ENSO Applications Center
PFAD	Private Fish Aggregation Device
PFEL	Pacific Fisheries Environmental Laboratory
PFRP	Pelagic Fisheries Research Program
PI	Principle Investigator
PICTs	Pacific Island Countries and Territories
PIFSC	Pacific Islands Fisheries Science Center
PIR	Pacific Islands Region
PIRO	Pacific Islands Regional Office
PISCES	Pelagic Interaction Scheme for Carbon Ecosystem Studies
PIT	Passive Integrated Transponder
PMEL	Pacific Marine Environmental Laboratory
PNG	Papua New Guinea
POFI	Pacific Ocean Fisheries Investigation
POM	Particulate Organic Matter
PRECI	Protected Resources Environmental Compliance Initiative
PRD	Protected Resources Division
PRIA	Pacific Remote Island Areas
PRIDE	Pacific Region Integrated Data Enterprise
PRIWG	Pacific Region Interagency Coral Reef Mitigation Working Group
PSAT	Pop-up Satellite Archival Tags
PSMSL	Permanent Service for Mean Sea Level

PTTs	Platform Terminal Transmitters
QB	Quasi-Biennial
QBO	Quasi-Biennial Oscillation
QQ	Quasi-Quadrennial
RA	Research Assistant
RAMP	Reef Assessment and Monitoring Program
REA	Rapid Ecological Assessment
RCUH	Research Corporation of the University of Hawaii
RFP	Request for Proposal
RGM	Reactive Gaseous Mercury
ROAM	Regional Ocean-Atmosphere
R/V AHI	Research Vessel Acoustic Habitat Investigator
SEAPODYM	Spatial Ecosystem and Populations Dynamics Model
SEC	South Equatorial Current
SECC	South Equatorial Counter Current
SFD	Sustainable Fisheries Division
SFI	Sustainable Fisheries Initiative
SFPS	Sequential Fine Particle Sampler
SOEST	School of Ocean & Earth Science & Technology
SPC	Secretariat of the Pacific Community
SPC	Stationary Point Count
SPREP	Secretariat of the Pacific Regional Environment Programme
SSAP	Skipjack Survey Assessment Program
SSH	Sea Surface Height
SSL	Shallow Scattering Layer
SST	Sea Surface Temperature
STAR	Stenella Abundance Research
STCZ	Subtropical Convergence Zone
SWFSC	Southwest Fisheries Science Center
SWSC	Southwest Fisheries Science Center
TED	Turtle Excluder Device
TDRs	Time-Depth-Temperature Recorders
THg	Total Mercury
THREDDS/ OPeNDAP	Thematic Real-Time Environmental Distributed Data Services/ Open-Source Project for a Network Data Access Protocol
TS	Target Strength
TZCF	Transition Zone Chlorophyll Front
UH	University of Hawaii
UHSLC	University of Hawaii Sea Level Center
ULT	Ultra Low Temperature
USAID	U.S. Agency for International Development
USFWS	US Fish and Wildlife Service
VIMS	Virginia Institute of Marine Science
VR2	Vemco acoustic receiver
WCPFC	Western and Central Pacific Fisheries Commission
WCPO	Western and Central Pacific Ocean
WGNE	Working Group on Numerical Experimentation
WOCE/JGOFS	World Ocean Circulation Experiment/Joint Global Ocean Flux Study
WPacFIN	Western Pacific Fisheries Information Network Project
WPRFMC	Western Pacific Regional Fishery Management Council
WPSARP	Western Pacific Stock Assessment Review Process
WUTMI	Women United in the Marshall Islands
XBT	Expendable Bathythermograph
YapCAP	Yap Community Action Program

Appendix II Visiting Scientists

DATE	NAME/AFFILIATION	PURPOSE OF VISIT
09/09/06-09/12/06	Richard Johnson Department of Atmospheric Sciences Colorado State University	Provide perspective of contributions of the Department to the fields of tropical meteorology climate. Participant in the “Tropical Meteorology and Climatology in the 20th and 21st centuries” symposium on 09/11/06
09/09/06-09/13/06	Colin Ramage Professor Emeritus and JIMAR Senior Fellow Emeritus University of Hawaii	Provide perspective of contributions of the Department to the fields of tropical meteorology climate. Participant in the “Tropical Meteorology and Climatology in the 20th and 21st centuries” symposium on 09/11/06
9/10/06-09/19/06	Timothy Todd Jones Zoology University of British Columbia Wachapreague, VA	Presentation at the Pelagic Fish and Sea Turtle workshop at ESLs (VIMS) in
10/07/06	Joel Martin National History Museum of Los Angeles County	Participant on the CoML cruise 10/08/06 to 10/29/06
10/31/06-11/07/06	Arielle Levine Dept. of Environmental Science, Policy & Management University of California-Berkley	Consult on future project in American Samoa and other fisheries’ issues
11/13/06-11/19/06	Yasunori Sakurai Graduate School of Fisheries Sciences Hokkaido University Hokkaido, JAPAN	Invited speaker at the joint PFRP and GLOBEC-CLIOTOP workshops 11/14/06 to 11/17/06
11/13/06-11/19/06	Unai Marcaida Aburto El Colegio de La Frontera Sur Ecosur Campeche, MEXICO	Invited speaker at the joint PFRP and GLOBEC-CLIOTOP workshops 11/14/06 to 11/17/06
11/13/06-11/20/06	Graham Pierce School of Biological Sciences University of Aberdeen Aberdeen, UK	Invited speaker at the joint PFRP and GLOBEC-CLIOTOP workshops 11/14/06 to 11/17/06
11/12/06-11/23/06	Hugo Arancibia Department of Oceanography University of Concepcion Concepcion, CHILE	Invited speaker at the joint PFRP and GLOBEC-CLIOTOP workshops 11/14/06 to 11/17/06

12/10/06-12/12/06	Kim Urian Duke University Marine Laboratory	Presentation at the PIPIN (Pacific Islands Photo-Identification Network) workshop 12/11/06 to 12/12/06
12/10/06-12/12/06	Jan Ostman-Lind Kula Nai'a Foundation	Attend the PIPIN (Pacific Islands Photo-Identification Network) workshop 12/11/06 to 12/12/06
01/03/07-01/27/07	George Boer University of Victoria Victoria, B.C., CANADA	Collaborate with Kevin Hamilton and other IPRC members on analysis of seasonal hindcasts
01/15/07-02/22/07	Jin-Song Von Storch Max-Plank Institute for Meteorology Hamburg, GERMANY	Collaborate with the Department of Meteorology and the IPRC on issues of climate predictability
01/21/07-01/31/07	James O'Brien Oceanography and Meteorology Florida State University	Collaborate with JIMAR, Department of Meteorology, Oceanography, and IPRC. Meet with campus-wide young investigators.
01/27/07-02/11/07	Jong-Ghap Jhun School of Earth and Environmental Sciences Seoul National University Seoul, SOUTH KOREA	Collaborate with the Department of Meteorology and IPRC on the study of East Asian monsoon using long-term historical rainfall data
02/09/07-02/18/07	Kotaro Yokawa National Research Institute of Far Seas Fisheries Shizuoka, JAPAN	Collaborate with Dr. Keith Bigelow on issues and projects of mutual interests 02/09/07 to 02/10/07 and participant in the "Pelagic Longline Catch Rate Standardizations" workshop 02/12/07 to 02/16/07
02/11/07-02/18/07	Minoru Kanaiwa Tokyo University of Agriculture Hokkaido, JAPAN	Collaborate with Dr. Keith Bigelow on issues and projects of mutual interests 02/09/07 to 02/10/07 and attend the "Pelagic Longline Catch Rate Standardizations" workshop 02/12/07 to 02/16/07
02/09/07-02/20/07	Pascal Bach Centre de Recherches Halieutiques (IRD) Le Port, FRANCE	Participant in the "Pelagic Longline Catch Rate Standardizations" workshop 02/12/07 to 02/16/07
02/10/07-02/17/07	Daniel Gaertner Centre de Recherches Halieutiques (IRD) Sete Cedex, FRANCE	Participant in the "Pelagic Longline Catch Rate Standardizations" workshop 02/12/07 to 02/16/07
02/10/07-02/14/07	Mark Maunder Inter-American Tropical Tuna Commission	Collaborate with Dr. Keith Bigelow on 02/11/07 to finalize the agenda and coordinate rapporteurs for and to attend the "Pelagic Longline Catch Rate Standardizations" workshop 02/12/07 to 02/16/07

02/11/07-02/17/07	Adam Langley Secretariat of the Pacific Community Noumea, NEW CALEDONIA	Attend the “Pelagic Longline Catch Rate Standardizations” workshop 02/12/07 to 02/16/07
02/15/07-02/16/07	Charles Jones ICESS University of California, Santa Barbara	Collaborate with Yi-Leng Chen on MM5 output and fire weather modeling for FARSITE
02/22/07-03/04/07	Maria Angela Marcovaldi Projeto Tamar Salvador, Bahia, BRAZIL	Participant in the International Sea Turtle Symposium in Myrtle Beach, SC and to collaborate on sea turtle publication and the requirements for the Fulbright Fellowship Program
02/26/07-02/27/07	Stuart Sandin Scripps Institution of Oceanography University of California, San Diego	Present seminar and Coral Reef workshop, “Setting an Ecological Baseline for Coral Reefs: Community Structure Across a Large Gradient of Human Impacts” 02/26/07 to 02/27/07
03/05/07-03/09/07	R. Ian Perry Fisheries & Oceans Canada Pacific Biological Station Nanaimo, B.C., Canada	Chair the NOAA PIFSC External Program Review 03/06/07 to 03/08/07 and collaborate with PIFSC Director and Deputy Director on logistics and preparation for the review 03/05/07
03/08/07-03/09/07	Gary Mitchum University of South Florida	Collaborate with UH Sea Level Center personnel to provide input on various aspects of the program and give a departmental seminar on sea level rise
03/20/07-03/24/07	Susanne Pridoehl Photographer	Provide photographic documentation of experimental methods and assist in retrieving and re-deploying instruments in Guam
03/21/07-03/23/07	Mary Silver Ocean Sciences Department University of California, Santa Cruz	Invited speaker of the Oceanography Graduate Students Lecture Series 03/21/07 to 03/23/07
04/03/07-04/12/07	Alexandre Ganachaud Institut de Recherche pour le Developpment	Collaborate with Bo Qui of the Department of Oceanography and Axel Timmerman of the IPRC
05/14/07	Allan Ligon Kaho’olawe Island Reserve Commission	Participant in the PIPIN (Pacific Islands Photo-Identification Network) Steering Committee meeting 05/14/07
05/14/07	Cheryl King Kaho’olawe Island Reserve Commission	Participant in the PIPIN (Pacific Islands Photo-Identification Network) Steering Committee meeting 05/14/07

05/14/07-05/15/07	Susan Rickards Hawaii Marine Mammal Consortium	Participant in the PIPIN (Pacific Islands Photo-Identification Network) Steering Committee meeting 05/14/07
05/21/07-05/24/07	Robert Ahrens Fisheries Center University of British Columbia	Invited presenter on ongoing fishery modeling research at the 58th Tuna Conference 05/21/07 to 05/24/07

Appendix III Workshops and Meetings Hosted by JIMAR

Pelagic Fisheries Research Program Principal Investigators Workshop November 14-15, 2006

GLOBEC-CLIOTOP WG3 Workshop November 16-17, 2006 Asia Room, Imin Conference Center

Enzo Acuña	Rusyan Jill Mamiit
Valerie Allain	Unai Markaida
Hugo Arancibia	Timothy Ming
Alexander Arkhipkin	Enrique Morales Bojorquez
Ken Baltz	Andy Myers
Keith Bigelow	Anders Nielsen
William Boecklen	Ron O'Dor
Susana Camarillo Coop	Robert Olson
Milani Chaloupka	Minling Pan
Anela Choy	Matthew Parry
Lisa De Forest	Graham Pierce
Heidi Dewar	Sam Pooley
Jeff Drazen	Brian Popp
Reka Domokos	Naresh Pradhan
Bridget Ferriss	Alison Rieser
John Field	Rui Rosa
Felipe Galván-Magaña	Iliana Ruiz-Cooley
William Gilly	Yasunori Sakurai
Eric Gilman	Cesar A. Salinas-Zavala
Ed Glazier	Michael Seki
Brittany Graham	Inna Senina
Adam Griesemer	John Sibert
David Hamm	Yonat Swimmer
F.L. Hochberg	Bill Walsh
Justin Hospital	John Wang
Evan Howell	Jock Young
Mary Hunsicker	Richard Young
Taro Ichii	Johnoel Ancheta
David Itano	Dodie Lau
George Jackson	
Francis Juanes	
Marco Kienzle	
David Kirby	
Hidetada Kiyofuji	
Pierre Kleiber	
Michael Laurs	
Patrick Lehodey	
Shichao Li	
Molly Lutcavage	

Appendix IV JIMAR Personnel

Information as of June 30, 2007

Category	Number	Unknown	High School	Associates	Bachelors	Masters	Ph.D.
Research Scientist	20	0	0	0	0	0	20
Visiting Scientist	1	0	0	0	0	0	1
Postdoctoral Fellow	6	0	0	0	0	0	6
Research Support Staff	103	0	3	3	58	32	7
Administrative	15	0	2	0	12	1	0
Undergraduate Students	22	0	21	0	1	0	0
Graduate Students	13	0	0	0	6	7	0
Received less than 50% NOAA support	9	0	0	0	4	1	4
Total	189	0	26	3	81	41	38
Located at Lab (include name of lab)	ESRL = 4 NWS = 1 PFEL = 7 PIFSC = 96 PIRO = 19 PMEL = 2						
Obtained NOAA employment within the last year	3						
Postdoctoral Fellows and Students from Subgrantees	Postdocs = 2 Students = 11						

Appendix V 2007 Awards

2007 Awards

Kevin Higaki

NOAA Team Member of the Month for June 2007

Bernard Kilonsky

2006 RCUH Outstanding Employee of the Year

Sun Bak

Nominated for 2006 RCUH Outstanding Employee of the Year

Andrew Burnell

Nominated for 2006 RCUH Outstanding Employee of the Year

Oliver Dameron

Nominated for 2006 RCUH Outstanding Employee of the Year

David Johnston

Nominated for 2006 RCUH Outstanding Employee of the Year

Trevor Kaplan

Nominated for 2006 RCUH Outstanding Employee of the Year

Walter Machado

Nominated for 2006 RCUH Outstanding Employee of the Year

Daniel Merritt

Nominated for 2006 RCUH Outstanding Employee of the Year

Joyce Miller

Nominated for 2006 RCUH Outstanding Employee of the Year

David Nardini

Nominated for 2006 RCUH Outstanding Employee of the Year

Daniel Palacios

Nominated for 2006 RCUH Outstanding Employee of the Year

Fatima Sauafea-Le'au

Nominated for 2006 RCUH Outstanding Employee of the Year

Elizabeth Steffen

Nominated for 2006 RCUH Outstanding Employee of the Year

Joseph O'Malley

Best Paper Award at the 32nd Testor Symposium

CRED's Marine Debris Team

Winner of the Hawaii's Living Reefs Award in the Government Agency Category of Non-Commercial Division, awarded on September 20, 2006.

Appendix VI Publication Summary

The table below shows the total count of publications for the reporting period and previous periods categorized by NOAA lead author or institute (or subgrantee) lead author and whether it was peer-reviewed or non-peer-reviewed.

	JI Lead Author						NOAA Lead Author						Other Lead Author					
	FY02	FY03	FY04	FY05	FY06	FY07	FY02	FY03	FY04	FY05	FY06	FY07	FY02	FY03	FY04	FY05	FY06	FY07
Peer - Reviewed	19	18	36	50	36	32	7	33	22	26	20	26	17	20	30	26	28	43
Non-Peer-Reviewed	15	16	39	31	24	11	15	10	17	14	16	18	10	14	21	17	17	20