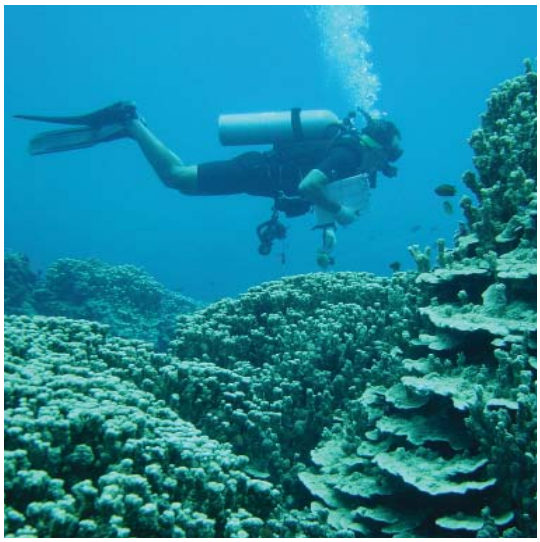
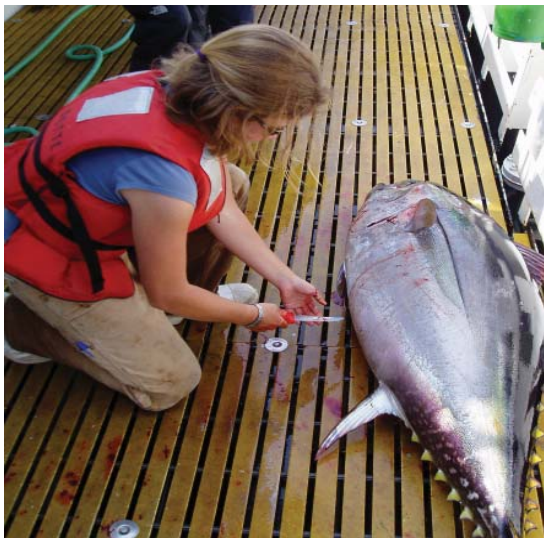
2006 Annual Report

Pacific Islands Fisheries Science Center





NOAA Fisheries

2006 Annual Report

Pacific Islands Fisheries Science Center

NOAA Fisheries

September 2007

PIFSC Mission

To conduct high quality, timely research to support the stewardship of fisheries resources, protected species, and ecosystems in the central and western Pacific Ocean.

Copies of this document may be obtained by contacting:

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An online version is available at http://www.pifsc.noaa.gov/do/index.php

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Contents

Foreword

We are happy to provide you this second annual report of NOAA Fisheries' Pacific Islands Fisheries Science Center. We've now been a full-fledged Science Center for five years and have seen substantial progress in our research programs and directions. At the same time, there is still much to be done.

The Center's research covers a wide range of scientific issues and topics requiring expertise in many disciplines. Our principal areas of research include coral reef ecosystems; ecosystem analysis and oceanography; fish biology and stock assessment; fisheries bycatch monitoring and mitigation; fisheries monitoring and socioeconomics; and protected species population monitoring, ecology, and recovery. Support programs within the Center ensure success of our science endeavors by providing help in administration, information technology and communications, and scientific information services.

This year we conducted an extensive review of the Center by outside experts including NMFS office directors and academic partners. In addition to highlighting our strengths and key successes, the review provided critical insights into areas where we need to improve and where we can develop more fully. We will be conducting regular detailed reviews of our individual research divisions in the years to come.

As you can see from the pictures throughout this report, we have a diverse and energetic staff. Our workforce of 194 includes 86 Federal employees, 101 employees of the University of Hawaii's Joint Institute for Marine and Atmospheric Research, and several external contractors and students. We operate three research facilities on the island of Oahu: our original Honolulu office building located on Dole Street adjacent to the University of Hawaii Manoa campus; our Kewalo Research Facility located on the Honolulu waterfront; and an office complex and laboratory for fish biology in Aiea, west of downtown Honolulu. In addition to our land-based operations, we engage in research expeditions year-around throughout the central and western Pacific on the NOAA Ship *Oscar Elton Sette* and other NOAA vessels and maintain extensive temporary field camps at remote islands and atolls in the Northwestern Hawaiian Islands.

We welcome your comments and thank you for your support.

Samuel G. Pooley, Ph. D.
Science Director

Michael P. Seki, Ph. D.
Deputy Science Director

Support of Partners is Key to PIFSC Success

With primary responsibility for NOAA Fisheries marine ecosystem science in the central and western Pacific, the PIFSC is carrying on a legacy of research in fisheries biology, oceanography, and protected species recovery established by our predecessor, the Honolulu Laboratory, and earlier Federal research entities dating back to The Pacific Oceanic Fishery Investigation in 1948. Through the years, we have helped provide key information needed for science-based management of living marine resources. This has always been, and continues to be, a joint enterprise. The problems we face today are complex, and solutions require the combined efforts and talents of people across the Pacific Islands and beyond. In meeting these challenges, we rely on vital support from our many partners in government agencies (domestic and international), the private sector, universities, and the community at large.

Overview of the Center

Function and Mission

The Pacific Islands Fisheries Science Center (PIFSC) is one of six NOAA Fisheries Science Centers. Established in 2003 with the creation of the new Pacific Islands Region (PIR) within NOAA Fisheries and headquartered in Honolulu, Hawaii, PIFSC is responsible for research on Federally managed marine fisheries, protected species such as the endangered Hawaiian monk seal, and ecosystems in the entire western and central Pacific Ocean, in both near-island (insular) habitats and open ocean (pelagic) environments.

The Center's mission is to conduct timely, high quality applied scientific research to support conservation and management of living marine resources in the central and western Pacific Ocean. The PIFSC mission is linked directly to the NOAA Strategic Plan and, in particular, NOAA's Ecosystem Mission Goal:

"*To protect, restore, and manage the use of coastal and ocean resources through an ecosystem approach to management.*"

In providing the science to support an ecosystems approach to the conservation, management and recovery of living marine resources, the PIFSC has adopted a comprehensive, multidisciplinary strategy. The strategy involves integrated marine resource and environmental monitoring and data collection, including an extensive ecosystem observation system, and scientific research programs with activities focused on near-shore and pelagic fisheries, coral reef species and habitats, marine mammals and sea turtles, and marine ecosystems and oceanography.

The Center's fisheries-oriented research programs monitor U.S. fisheries throughout the Pacific Islands Region and conduct biological, ecological, and economic research in support of five fishery management plans established by the Western Pacific Fishery Management Council and international treaties for the management of tuna and other highly migratory species. Coral reefs research focuses on comprehensive surveys of reef ecosystems in the archipelagoes of the Pacific Islands Region. Protected species research and recovery programs monitor the status of the Hawaiian monk seal and sea turtles in the Pacific and identify the factors affecting their population, health, and recovery. A new component of the Protected Species program is focused on surveys of cetacean populations in the central Pacific. Other PIFSC research investigates the structure and dynamics of central North Pacific marine ecosystems and how marine populations are affected by changes in their predators, prey, and habitat, and by ocean climate.

History

PIFSC has a long and illustrious history. The initial staff and facilities of PIFSC derived from the former Honolulu Laboratory, until 2003 a component of the NOAA Fisheries Southwest Fisheries Science Center in California. Before NOAA's establishment in 1970, the Honolulu Laboratory was part of the U.S. Fish and Wildlife Service, originating in 1948 as the Pacific Oceanic Fishery Investigations (POFI). In almost 6 decades of scientific studies, PIFSC staff and their predecessors have engaged in fishery resource exploration, fisheries development, fisheries biology and ecology, protected species recovery research and conservation, and oceanographic research throughout the Pacific and as far away as the Indian Ocean. More recently, PIFSC has established extensive programs in coral reef ecology through collaboration with NOAA's Coral Reef Conservation Program.

Geographic Area of Responsibility

Bounded by the Hawaiian Archipelago in the north, American Samoa and U. S. Pacific remote island areas in the south, and the Marianas Archipelago in the west, the

The Pacific Islands Fisheries Science Center

Pacific Islands Fisheries Science Center FY 2006

Personnel

Federal	86
JIMAR	101
Other	7
Total	**194**

Budget by NOAA Program

	$ M	%
Ecosystem Observation Program	17.8	78
Corals Program	5.0	22
Total	$ **22.8**	

Pacific Islands Region encompasses the largest geographical area within NOAA Fisheries' jurisdiction. The U.S. Exclusive Economic Zone (EEZ) within the Region includes more than 1.7 million square nautical miles of ocean, roughly equal to the total EEZ of the continental United States and Alaska. PIFSC is also responsible for living marine resource research in the high-seas areas of the central and western Pacific.

Budget and Staffing History

In fiscal year (FY) 2006, the PIFSC budget was $22.8M and supported a staff of 194 researchers, technical personnel, and administrative employees. Almost all the Science Center's budget supports the NOAA "ecosystems" mission and its activities generally fall within the Ecosystems Observation Program and Corals Program. In addition to federal employees, Center programs include a large number of scientists and seasonal technical staff employed by the University of Hawaii (UH) Joint Institute for Marine and Atmospheric Research (JIMAR) and Aquatic Farms. Several UH students also work at the Center or are engaged in graduate research with Center projects.

Facilities and Vessels

The main PIFSC office facility is located on the University of Hawaii at Manoa campus. A smaller research and office facility at Kewalo Basin, on the Honolulu waterfront, has a seawater system enabling research on live, large pelagic fishes, monk seals, and sea turtles. Another research facility, with offices and a wet laboratory supporting fish biology work, is leased in Aiea near Pearl Harbor.

The NOAA Ship *Oscar Elton Sette*, home-ported in Honolulu, is the primary research vessel supporting the Science Center's extensive field activities. Center staff also conduct benthic habitat mapping and other coral reef ecosystems research aboard the NOAA Ship *Hi'ialakai* in partnership with NOAA's National Ocean Service (NOS). PIFSC also retains a fleet of about 29 small boats, ranging from 14 to 25 ft in length, to facilitate nearshore research.

Research Focus

PIFSC research currently focuses on several areas of high priority:

- ❑ Identifying and understanding the effects of ecosystem linkages and environmental processes on fish stocks, protected species, and other marine life and developing the scientific basis for ecosystem oriented management
- ❑ Monitoring and reducing fishery interactions with protected species
- ❑ Monitoring the status of Hawaiian monk seals and finding ways to increase their survival and population sustainability
- ❑ Monitoring the status of Hawaiian green turtles and other marine turtle populations in the Pacific Islands Region

Oscar Elton Sette

- ❑ Assessing cetacean populations and the effects of human activity on them
- ❑ Mitigating fisheries bycatch, particularly in multi-national pelagic longline fisheries
- ❑ Providing scientific advice in support of international and domestic management of fisheries for highly migratory species (HMS)—including tunas, billfishes, and sharks
- ❑ Assessing stocks of tunas, billfishes, and other pelagic fishes in the central and western Pacific
- ❑ Researching the use of barbless hooks by recreational fishers to reduce post-release fish mortality and risks of injury to protected species
- ❑ Expanding the understanding of socioeconomic and cultural aspects of living marine resource use and appreciation throughout the PIR
- ❑ Assessing the physical and biological structure, dynamics, and health of coral reef ecosystems
- ❑ Monitoring and removing derelict fishing gear and other marine debris from reefs and nearshore waters of the Hawaiian Archipelago.

Science Center Organization

The PIFSC is organized into five research divisions:

- ❑ Coral Reef Ecosystem Division (CRED)
- ❑ Ecosystems and Oceanography Division (EOD)
- ❑ Fishery Biology and Stock Assessment Division (FBSAD)
- ❑ Fisheries Monitoring and Socioeconomics Division (FMSD)
- ❑ Protected Species Division (PSD)

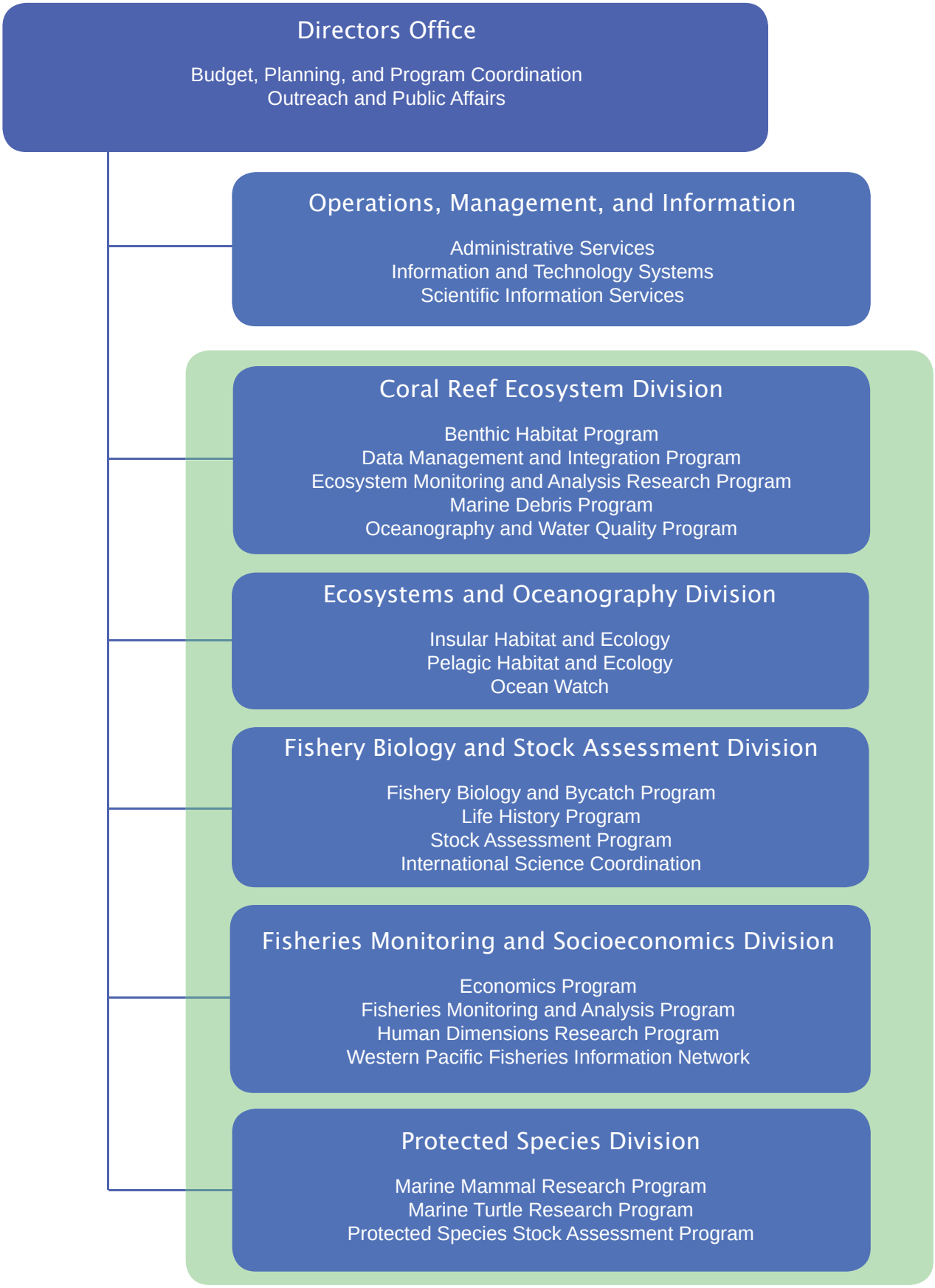
and three programs for operations and research support:

- ❑ Operations, Management, and Information (OMI)
  - Administrative Services
  - Information and Technology Systems
  - Scientific Information Services

Kewalo Research Facility

Aiea Heights Research Facility

Pacific Islands Fisheries Science Center



Directors Office

The Directors Office provides overall scientific leadership, strategic guidance, research direction, program management, and operational policy for the Science Center. In addition, the office is responsible for liaison with our many partnering agencies and offices, including NOAA Fisheries' Pacific Islands Regional Office (PIRO) and other NOAA offices locally and nationally, the Western Pacific Fishery Management Council, the State of Hawaii, the University of Hawaii, the U.S. Fish and Wildlife Service, and Congressional staff offices, among others. The Directors Office provides coordination and leadership for U.S. participation in international scientific committees and commissions in the Pacific. The Directors Office also manages the Center's planning and budget functions, facilities, and outreach and public affairs.

The Center Director also serves on the NMFS Science Board and is the U.S. delegate to PICES, the North Pacific Marine Science Organization

Budget, Planning, and Program Coordination

Many center-wide budget, planning, and program coordination activities are implemented from the Budget and Planning Office to ensure responsiveness to and consistency with the NOAA and NOAA Fisheries Strategic Plans. These activities include:

- Generation of current and projected 'Annual and Program Operating and Spending Plans'
- Center-wide budget formulation, execution, and requests
- Development of guidelines and policies governing the maintenance of budget
- Research program oversight, coordination, and integration
- Strategic planning and input to the NOAA Program Planning and Budget Execution System (PPBES)
- Establishment and tracking of performance measures and milestones
- Ensuring National Environmental Policy Act (NEPA) compliance for PIFSC research
- Coordination of PIFSC efforts to support the Integrated Ocean Observing System (IOOS)
- NOAA research vessel and aircraft operations and scheduling coordination.

Outreach and Public Affairs

The community outreach program serves as the focus for the communication of scientific programs with outside agencies and the public. The objective of the program is to seek and create opportunities to inform and educate the public about the Center's mission and its impact on the economy and environment in the Pacific. This is accomplished by:

- Raising the awareness of the general public to gain support for the programs of the Pacific Islands Fisheries Science Center
- Teaching young people to become stewards of the environment
- Establishing the Pacific Islands Fisheries Science Center as a resource for the community and networking with community groups, schools, and other organizations
- Promoting careers in ocean sciences
- Helping teachers develop a science and conservation curriculum that supports the objectives of the Pacific Islands Fisheries Science Center.

The program also designs educational resources and implements strategies to increase communications and understanding between the agency, our constituents, and the general public.

Directors Office Staff

Operations, Management and Information Programs

Administrative Services

The Office of Administration provides a comprehensive range of services in support of the Center's mission and staff. The office manages Center hiring and personnel issues, grants, procurement and property, safety, facilities, small boats, and staff training.

Administration staff specialists help PIFSC announce and fill federal job vacancies in Center programs, manage the orderly entry and exit of personnel from Center programs, ensure accurate and timely accounting of time and attendance, and handle other personnel issues in cooperation with NOAA's Workforce Management Office. In FY 2006, PIFSC recruited for and filled eight government positions. The NOAA Table of Organization was also audited and corrected.

Members of the Administration staff manage several grants and cooperative agreements supporting research and related activities for protected species, coral reefs, fisheries, oceanography, aquaculture, and other areas of research critical to the NOAA mission. In FY 2006, the Center completed timely processing of 19 grants totaling more than $9 million.

Our procurement specialists help Center staff obtain services, supplies, and equipment they need to meet program requirements and achieve operational goals. We strive to process invoices quickly so contractors and vendors are paid promptly, record transaction accounting data accurately, and make needed adjustments in a timely manner. The procurement staff monitors the Center's equipment inventory to ensure that newly purchased property items are entered and accurately accounted for. In FY 2006, the Center executed 225 contracts and purchase orders totaling more than $4.1 million. We implemented the electronic system for entering requisitions and trained 27 requisitioners and 16 approving officials.

The Facilities Program is responsible for maintaining Center facilities in good order and recording and reporting material deficiencies to NMFS facility program managers. The Administration staff actively monitors the status of PIFSC facilities and coordinates with the Center's Safety Officer and Executive Officer to identify needed repairs or improvements, determine costs, and ensure proper job completion. In FY 2006 we completed several major projects including replacement of the air conditioner in the Dole Street Annex I, air conditioner insulation in the Dole Street main building, carpets, and doors.

The Safety and Environmental Compliance Program is responsible for ensuring that PIFSC research programs and activities abide by federal rules and regulations designed to prevent injury to employees and adverse effects to the environment. The program manages facility compliance inspections and training, and promotes behavioral changes in Center staff to reduce injuries and adverse environmental impacts. In FY 2006, we met or exceeded all NMFS Safety Action Plan milestones.

Administrative Staff

The Small Boat Program is responsible for ensuring PIFSC compliance with NOAA policies related to boats and skiffs. The program maintains an up-to-date PIFSC vessel policy, conducts boat and water safety training for Center staff, and manages the PIFSC small boat fleet. The program coordinates with Center research divisions conducting boating operations and provides assistance and guidance to them on boating and safety issues. In FY 2006, our small boat coordinator was appointed as Line Office representative for the Pacific on the NOAA Small Boat Safety Board.

The Security Program is responsible for the processing of security paperwork for employees, contractors, volunteers, and foreign nationals at the Center. In FY 2006, we processed 57 foreign national visitor submissions and 201 security submissions.

The PIFSC Office of Administration also coordinates and tracks training and professional development activities for Center managers and staff, including guidance and training on EEO matters. The Office of Administration sponsors several activities during the year to encourage diversity in the workplace, including training seminars, brown bag luncheons, internship opportunities, and educational poster displays. In FY 2006, PIFSC conducted training sessions on a range of topics including Prevention of Sexual Harassment, EEO, Prevention of Workplace Violence, Ethics, and more.

Key Activities/Issues

- ❑ Significant resources are being devoted to monitoring of the Center's considerable property inventory. Procedures are being improved to ensure that property

is correctly identified, bar coded, and documented with appropriate forms.

- A comprehensive Facility Condition Survey will be conducted to outline deficiencies which need to be addressed in order to maintain the Dole Street facility until the move to the Pacific Region Center (PRC).
- The PIFSC hosts the most foreign national visitors in NMFS. The process for reporting and monitoring these visitors is cumbersome and time consuming. With ship operations moving to Ford Island, additional security requirements are being imposed.
- Implementation of NOAA-wide small boat safety training program.
- Coordination of PRC boat facility development at Ford Island.
- Processing of an increased number of grants and cooperative agreements, including 5 new Section 404 awards under the PACFIN program and all Cooperative Institute actions with the University of Hawaii, JIMAR.
- Tracking of training expenditures by Center divisions.
- Operational Risk Management Assessments of various small boat operations to reduce risks of injury and property damage.
- Development of Emergency Plans for PIFSC researchers at risk from hurricanes, tsunamis, and large storm wave events in the Northwestern Hawaiian Islands, and for a PIFSC response to influenza pandemic.
- In response to President Bush's executive order requiring federal agencies to be better stewards of environmental and energy resources, the PIFSC responded with a lighting upgrade designed to reduce energy consumption and will continue to incorporate environmental management practices designed to reduce negative effects on the environment.

Scientific Information Services

Scientific Information Services Staff

The Scientific Information Services (SIS) group provides comprehensive support to the Pacific Islands Fisheries Science Center in the management and dissemination of scientific information collected, acquired or produced by Center programs. SIS handles many kinds of information, including fisheries data, scientific publications, educational materials, graphics, and library resources, and also manages the Center's Web presence.

SIS data services staff carefully screen, validate, and archive catch statistics and other information provided to NMFS by commercial fishing vessel captains or collected by the Center's fisheries research programs. SIS strives to provide full access to the data for statistical analyses, stock assessment studies, and fishery reports while meeting legal requirements to protect the confidentiality of commercial fishing enterprises. In FY 2006, SIS launched the PIFSC Metadata Project to compile, organize, and publish information about all data holdings of the Center, including data from fishery monitoring programs and data collected by PIFSC research programs.

SIS publications specialists carefully examine and edit reports, manuscripts, and other documents prepared by Center scientists to ensure they meet NOAA information quality standards before they are released to the public or submitted for publication in peer-reviewed journals. In addition to editing journal articles, in FY 2006 SIS publications staff managed the editing, review and approval of cruise reports for PIFSC expeditions on the NOAA Ships *Oscar Elton Sette* and *Hi'ialakai* and numerous PIFSC internal reports, working papers, conference abstracts, and other documents.

SIS helps Center staff with graphical design and layout, photography, digital image processing, and other graphics needs. In FY 2006, SIS deployed new equipment expanding its capacity to produce large-format posters and banners. The result was better support for outreach projects and conference presentations by PIFSC scientists.

SIS manages a NOAA reference library for use by Center scientists and the public. The library has extensive up-to-date collections of scientific journals and technical books on fisheries science, oceanography, marine ecology, conservation biology, and other subjects with an emphasis on Pacific Island insular and oceanic ecosystems. In FY 2006, the SIS librarian developed a comprehensive Oracle database of PIFSC documents enabling ready public access to the Center's publications via the PIFSC Web site.

SIS is responsible for developing and maintaining the PIFSC web site. The PIFSC webmaster disseminates the Center's scientific reports, public data products, news about current research activities and other information over the Internet. Web content is produced by subject matter experts in the Center's research divisions. Several

improvements were made in FY 2006, including redesign of web page templates, timely creation of web articles about current research cruises and other events, and greater use of database-driven methods to enable dynamic updating of web page contents.

SIS also manages the PIFSC Intranet, providing Center staff with comprehensive information about administrative support resources; policies and procedures; reports of current Center research activities; NOAA and NMFS corporate news; announcements of upcoming meetings, seminars, and other events; and more. Improvements in FY 2006 include posting of the new PIFSC Fisheries Data Catalog.

As a diverse information support group, SIS aims to ensure that marine resource managers, research colleagues, and the public have ready and timely access to important data products and the research findings of Center scientists.

SIS has established several milestones for FY 2007:

- ❑ Install a web-based system for managing PIFSC data service requests
- ❑ Design a web-based system for managing PIFSC digital image resources
- ❑ Configure, test, and launch a web-based manuscript processing system
- ❑ Implement Phase II of PIFSC web development plan: improve web site content and design
- ❑ Revamp PIFSC Intranet: improve contents, accessibility, user features.

PIFSC Metadata Project Launched

Timely access to data for agency research and decision making is vital to the NOAA mission of marine ecosystem stewardship. Accordingly, PIFSC strives to make data collected by Center research and monitoring programs readily available to scientists and the public while protecting sensitive and confidential data.

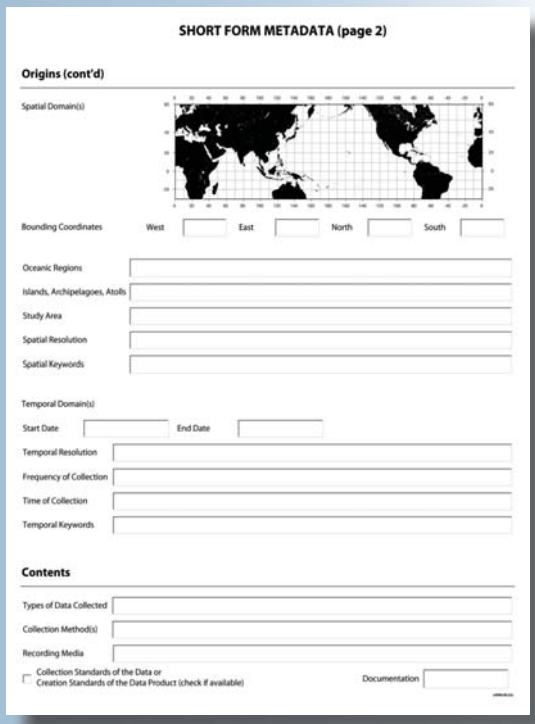
To improve data accessibility, SIS Data Services recently launched a project to identify and describe all data in the Center's archives and data currently being collected by researchers. Hundreds of PIFSC data collections are involved, going back to the late 1940's. Gathering and organizing this "metadata" – information about the data – is central to making the data themselves more accessible and useful to PIFSC scientists and clients. A PIFSC Metadata Team is executing the project in three phases:

Discovery—Completing an inventory of data collections within each Research Division.

Registration—Entering basic metadata for each data collection into the NOAA Fisheries InPort metadata registry and adding more detailed metadata as time and resources allow.

Publication—Providing tools to search the metadata and organizing metadata into Data Catalogs tailored to needs of particular data user groups and research themes.

Once the metadata are collected, registered, and organized PIFSC plans to make them available to scientists and other clients online, along with guidance on access and use of the data.


SHORT FORM METADATA (page 2)

Origins (cont'd)

Spatial Domain(s)

Bounding Coordinates West East North South

Oceanic Regions

Islands, Archipelagoes, Atolls

Study Area

Spatial Resolution

Spatial Keywords

Temporal Domain(s)

Start Date End Date

Temporal Resolution

Frequency of Collection

Time of Collection

Temporal Keywords

Contents

Types of Data Collected

Collection Method(s)

Recording Media

Collection Standards of the Data or Creation Standards of the Data Product (check if available) Documentation

Information and Technology Systems

Systems Design Team

Information and Technology Systems Staff

The Information and Technology Systems (ITS) group provides IT support to PIFSC staff, including staff located at the Kewalo Research Facility and Aiea. ITS system administrators maintain, monitor, and upgrade computer hardware, software, and infrastructure and ensure compliance with IT security requirements. The ITS system design team assists with the design and development of data systems to meet the needs of users in all Center divisions and programs.

System Administrators

During FY 2006, ITS system administrators upgraded the Center's statistical processing server with a faster processor, more memory and more disk space; purchased and installed a faster, higher capacity tape backup system for our UNIX servers to accommodate increased data storage requirements and reduce downtime during backups; installed a BBS server for PSD to permit open communications among scientists in remote field camps and staff at Center offices by allowing the scientists to post e-mails from the field; completed security and performance upgrades of the Dole Street network by centralizing communications switches and routers in a secured room and provided 100 mbps bandwidth to each desktop; upgraded power and battery backup capacity in the ITS computer room including a centralized UPS; installed an emergency power down switch near the computer room exit; installed e-Policy Orchestrator enabling ITS to push virus protection to each desktop; installed a new Tandberg video gateway allowing the Center to set up a video conference from any network outlet; and encrypted all PIFSC laptops.

Systems Design Team

The ITS Systems Design Team (SDT) assists PIFSC and PIRO data managers and administrators in designing cost effective, time-saving information management solutions. The SDT provides database design and management expertise, application development services, and project management support both within the Pacific Islands Region and on a cross-regional basis through partnerships with NOAA Fisheries' national Fisheries Information System (FIS).

In spring 2006, the SDT-designed, FIS-funded InPort metadata catalog system was adopted by FIS federal and state fisheries partners as the standard tool for gathering and publishing detailed metadata on fisheries-dependent data collections. Currently, there are ten partner metadata libraries within the InPort catalog, with nearly 1000 items cataloged. The SDT continues development of the next version of InPort which will include additional metadata modules and enhancements requested by the growing InPort user base. Other FIS-funded work includes the development of an electronic logbook application certification process that is needed in our region to expand electronic data reporting. This certification process will then be used as a model in other Fisheries regions.

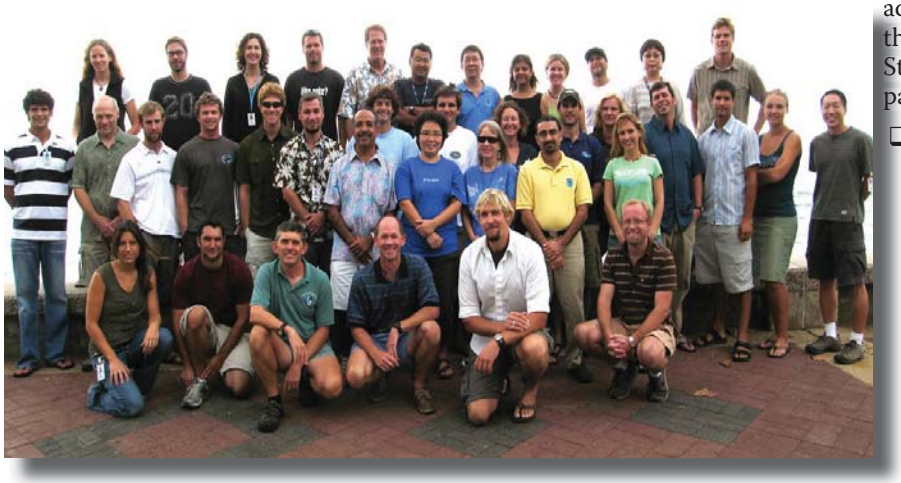
In FY 2006, SDT helped PIFSC OMI optimize and streamline procurement requests and property management. The SDT also continued to work closely with PIFSC and PIRO data managers and scientists to support the Longline Observer Data System (LODS). Major accomplishments included the establishment of a LODS steering committee and the adoption of a formal process for managing LODS change requests. A major focus in the upcoming year will be to assist PIFSC data management groups in enhancing their data systems to transition toward an integrated PIFSC Information Management System in support of ecosystems management.

Coral Reef Ecosystem Division

The Coral Reef Ecosystem Division (CRED) conducts integrated, multidisciplinary, ecosystem research, habitat mapping, and long-term monitoring of coral reef ecosystems in the U.S.-affiliated Pacific Islands. CRED's work is a key component of NOAA's Coral Reef Conservation Program (CRCP). Working closely with numerous federal, state, and territorial agencies and nongovernmental organizations, CRED scientists describe, map, and monitor coral reef ecosystems in the main Hawaiian Islands, the Northwestern Hawaiian Islands (NWHI), the Territories of Guam and American Samoa, the Commonwealth of the Northern Mariana Islands (CNMI), and the Pacific Remote Island Areas (PRIAs). The program's approach is to apply a suite of standardized methods—including ecological assessments, oceanographic and water quality measurements, and benthic habitat mapping, to improve understanding of the spatial and temporal processes influencing the health of coral reef ecosystems throughout the region. The knowledge gained is shared with resource managers and various public stakeholders to improve decision-making for the long-term conservation and management of coral reef resources. In addition, CRED conducts applied research and conservation activities, such as marine debris removal, to directly address key threats to reef ecosystems.

The CRED is organized into four thematic program areas:

- The *Oceanography and Water Quality Program* observes and monitors key oceanographic processes, environmental parameters, and water quality conditions using in situ observations collected from NOAA ships and small boats, surface and subsurface moored instrument arrays, and satellite-tracked drifter buoys; data collected by satellite-borne remote sensors; and oceanographic models. The program also provides applied research, instrumentation development, and technical support to the Division, including Ecological Acoustic Recorders (EAR) to acoustically monitor ambient biological and vessel sounds; Autonomous Reef Monitoring Structures (ARMS) to assess invertebrate biodiversity; bottomfish camera baitstations (BotCam) to assess relative abundance of bottomfish; and environmental sensors supporting Coral Reef Ecosystem Integrated Observing System (CREIOS).
- The *Ecosystem Monitoring and Analysis Research Program* conducts Rapid Ecological Assessments (REAs) and towed-diver surveys, which quantitatively and qualitatively document the spatial distribution, density, species composition, and sizes of corals, other macroinvertebrates, fish, and algae observed during sample surveys. The REAs employ a suite of complementary and overlapping methods: stationary point counts, roving diver surveys, belt transects, photoquadrats, video transects, and specimen sample collection. Towed-diver surveys using digital video or still cameras provide broad spatial coverage of benthic composition and the abundance and distribution of ecologically important fish and macroinvertebrates. As part of the International Census of Marine Life's Census of Coral Reef Ecosystems (CReefs), CRED leads comprehensive biodiversity assessments of reef habitats using a diverse array of sampling methods.
- The *Benthic Habitat Program* uses multibeam echo sounders deployed on NOAA research vessels to map the depth and character of the sea bottom. Towed cameras, remotely operated vehicles, and laser-line scan systems are used to collect video and photographic data that validate the interpretations of the seafloor character derived from the acoustic data.
- *The Marine Debris Program,* which also receives support from the NOAA Marine Debris Program, uses both towed diver and swim surveys to assess distributions and accumulations of derelict fishing gear and other marine debris in the main and Northwestern Hawaiian Islands. CRED divers manually remove marine debris from the reefs and shorelines and collect data on the type, distribution and density of debris. Marine debris removal activities are conducted in cooperation with the U.S. Coast Guard and other Federal, State, local, academic, NGO, and industry partners.
- In addition, the *Data Management and Integration Program* collects, formats, documents, synthesizes, integrates, distributes, and archives data collected by CRED and its partners. The program implements a second tier of data quality control, produces metadata compliant with NOAA's Coral Reef Information System (CORIS) , and enters the data into an Oracle database and/or an ArcSDE geodatabase. These databases are designed to facilitate access to the data and enable spatial and temporal



Coral Reef Ecosystem Division Staff

Coral Reef Ecosystem Division
FY 2006

Personnel	
Federal	8
JIMAR	47
Total	**55**

Budget	$	%
Salaries and benefits	776,345	15.5
Grants	2,871,073	57.4
Contracts	626,198	12.5
Equipment	47,758	1.0
Supplies	318,122	6.4
Travel & transportation	97,454	1.9
Rent, vessel charters, and communication	263,500	5.3
Printing	1,300	< 0.1
Total	**$5,001,760**	

analysis and integration of CRED's multidisciplinary ecosystem data sets. The program is also developing OceanEye, an online tool designed to enable interactive WWW access to a wide range of oceanographic data from a variety of sources.

CRED has a total of 55 staff members, including 8 federal employees and 47 employees of the NOAA University of Hawaii's Joint Institute for Marine and Atmospheric Research (JIMAR). Grants—primarily to JIMAR—accounted for the largest CRED expenditures in FY 2006.

Key FY 2006 Accomplishments

- CRED scientists drafted the *Coral Reef Ecosystem Monitoring Report for American Samoa*, including mapping information and summary analyses of fish, coral, invertebrates, algae, and oceanography for each island in American Samoa from survey cruises in 2002, 2004, and 2006. The draft was presented to the marine resource managers of the American Samoa Coral Reef Advisory Group.
- The Marine Debris Team removed 19 tons of derelict fishing gear from the NWHI. This was the first year of reduced scale removal operations that targeted high-priority areas and accumulation rate zones. Since 1996, the Marine Debris Team and its many partners have removed 511 metric tons of marine debris from the NWHI.
- The Marine Debris Team completed the first ever, comprehensive aerial marine debris survey of the main Hawaiian Islands, recording more than 700 debris sites on the shorelines of Oahu, Molokai, Lanai, Maui, Big Island, and Kauai. In two pilot projects, more than 15 tons and 13 tons of debris were removed from Oahu and Lanai, respectively.
- Benthic habitat mapping operations continued with a full schedule of 145 days aboard the NOAA Ship *Hi'ialakai* and 102 operational days on the R/V *AHI*. About 8100 km^2 of seafloor were surveyed and significant progress was made in processing and analyzing benthic habitat mapping data around the PRIAs, American Samoa, main Hawaiian Islands, and NWHI. Multibeam bathymetry and backscatter data, optical validation data, and high-resolution benthic habitat mapping products are available for download at http://www.soest.hawaii.edu/pibhmc.
- CRED led Reef Assessment and Monitoring Program (RAMP) cruises on the NOAA Ships *Sette* and *Hi'ialakai* to the CNMI and Guam (including the first ever PIFSC survey at Wake Atoll), American Samoa, PRIAs, main Hawaiian Islands, and the NWHI, and conducted REA surveys at 78, 62, 22, 56, and 64 sites, respectively. Cruises were accomplished in partnership with the University of Guam, CNMI Division of Fish and Wildlife, CNMI Division of Environmental Quality, CNMI Coastal Resources Management, U.S. Army, Guam Division of Aquatic and Wildlife Resources, American Samoa Department of Marine and Wildlife Resources, U.S. Fish and Wildlife Service, Hawaii Institute of Marine Biology, Hawaii Division of Aquatic Resources, Bishop Museum, University of Hawaii, and other NOAA agency partners.
- The Oceanography and Instrumentation Program currently monitors oceanographic and water quality conditions at 54 islands, atolls, and banks throughout the U.S. Pacific Islands by using 26 telemetered surface buoys and more than 188 subsurface data recorders.
- In a pilot study, Ecological Acoustic Recorders (EARs) equipped with vessel detection capability were deployed at sites in American Samoa, NWHI, and the main Hawaiian Islands for passive acoustic monitoring of coral reef habitats. Vessel activity data from a site in the National Park of American Samoa reveal greater vessel traffic than local managers anticipated.
- In partnership with the NOAA's Pacific Marine Environmental Laboratory (PMEL), dissolved inorganic carbon (DIC) in coral reef waters around American Samoa was sampled as part of an ongoing effort to document and understand the potential effects of climate change-induced ocean acidification on coral reef ecosystems.

- During October 2006, a pilot study was conducted using the BotCam as a non-extractive method to collect data on bottomfish populations in the NWHI. BotCam was deployed 20 times at St. Rogatien/Brooks Banks and 16 times on the West Bank of Nihoa Island at depths ranging from about 73 to 330 m. In partnership with the Hawaii Undersea Research Laboratory, the BotCam was also used to collect data on bottomfish populations in and around Restricted Fishing Areas (RFAs) in the main Hawaiian Islands.
- CRED led the first Census of Marine Life, Census of Coral Reefs (CReefs) expedition to French Frigate Shoals in the Northwestern Hawaiian Islands Marine National Monument aboard the NOAA Ship *Oscar Elton Sette*. The objective of the unprecedented survey was to document the biodiversity of understudied reef-associated invertebrates, turf and coralline algae, and microbial communities. During the 21-day expedition, an international team of taxonomists used 14 different sampling methods designed to have minimal ecological impacts to survey a diverse range of habitats. Preliminary analyses indicate that ~ 1611–2151 unique morphospecies were documented, including the discovery of more than 100 probable new species records.
- CRED scientists delivered 14 oral and poster presentations at the AGU/ASLO 2006 Ocean Sciences Meeting held during February 20–24 in Honolulu. The presentations highlighted CRED's coral reef assessment, monitoring, and mapping activities at U.S.-affiliated islands throughout the Pacific Ocean.
- CRED published 26 manuscripts in 2006 on scientific topics ranging from fisheries to algal communities and coral bleaching.

Challenges, Problems, Limitations

The success of CRED's field programs depends on access to NOAA ships and other research vessels equipped for the work. CRED projects required more than 250 vessel days, totaling more than 4000 scientist-days at sea, in FY 2006 on a variety of vessels traveling to very remote areas. The logistics of obtaining vessel time, scheduling cruises, and organizing staff and crew are significant. In addition, the CRED needs to acquire specialist staff with expertise in data management and integration, ecosystem and oceanographic modeling, spatial statistics, and invertebrate biology.

Future Focus and Direction

After receiving positive feedback on the American Samoa Monitoring Report drafted in 2006, CRED initiated work on the Coral Reef Ecosystem Monitoring Report of the Hawaiian Archipelago. Similar reports will be created for each of the U.S. Pacific areas, including CNMI, Guam, and the PRIAs. These reports will present integrated ecosystem assessments for resource managers in each region. Future efforts will focus on ecosystem integration and development of quantitative indicators of ecosystem change.

The Marine Debris Program plans to continue an ongoing study of debris accumulation rates and to monitor derelict fishing gear in the NWHI. Current analyses indicate that the annual accumulation rate is more than 52 tons. In FY 2006, the Program shifted from large-scale removal operations to smaller-scale removal efforts and removed 19 tons of debris from the NWHI. CRED is working with the NOAA Marine Debris Program and the NOAA Coral Reef Conservation Program to address the gap in debris removal capacity.

In FY 2007 CRED will continue to:

- produce comprehensive, high-resolution digital maps of shallow (< 30 m deep) coral reef ecosystems in the U.S. Pacific Islands, with a focus on characterizing priority moderate-depth reef systems by 2009
- provide leadership of the CReefs biodiversity project of the international Census of Marine Life
- integrate CREIOS with the larger Global Earth Observing System of Systems (GEOSS)
- collaborate with PMEL to understand the role of climate change-induced ocean acidification on reef ecosystems
- make greater use of CRED's extensive environmental and ecological data collections to improve understanding of the ecological impacts of climate change.

Cooperative Surveys Assess Status of Coral Reef Ecosystems in American Samoa and Remote Equatorial Islands

As governments in many parts of the world strive to protect and restore their depleted coral reef resources, scientists at PIFSC are working to survey and assess the relatively healthy coral reef ecosystems in the Pacific Islands Region. As part of the national Coral Reef Conservation Program, in 2006 CRED researchers joined with local government partners to study coral reefs in American Samoa and several remote U.S. islands and atolls in the equatorial region. In surveys of American Samoa, Johnston Atoll, Howland and Baker Islands, Jarvis Island, Palmyra Atoll, and Kingman Reef scientists collected data to assess the status of fishes, corals, algae and marine invertebrates and used multibeam sonar to map benthic habitat. In some locales, they collected data on ocean temperature and the concentration of chlorophyll and various nutrients important to biological production and deployed moored instruments that will continue to monitor and record oceanographic conditions. The extensive data collections from the survey are being analyzed and compiled into several reports that will aid marine resource mangers responsible for coral reef ecosystem conservation.

Fishery Biology and Stock Assessment Division

The Fishery Biology and Stock Assessment Division (FBSAD) conducts fundamental biological and ecological research on fish and crustaceans caught in federally managed fisheries to enable improved understanding of the mechanisms that influence their distribution and abundance. Life history studies on age and growth, reproduction and fecundity, migration and movement, and mortality are conducted to provide vital rates statistics for stock assessments and ecosystem approaches to management. Research is focused on tunas, billfishes and other pelagic species; bottomfish; and NWHI lobster. Attention is also being directed toward coral reef species. The research involves field surveys using a variety of sampling gears, laboratory studies of biological specimens, and analysis of data from experiments using conventional and electronic tags and tracking methods. New fishing technologies are developed, tested, and promoted internationally to reduce fisheries bycatch and the effects of pelagic longline and other fisheries on populations of sea turtles, seabirds, sharks, and other species caught incidentally. The ecology of exploited stocks and the effects of stock levels, harvests, bycatch, and conservation measures on the broader ecosystem are explored through food web analyses and ecosystem models. Stock assessments are currently conducted for tunas, billfishes, pelagic sharks, bottomfishes, and lobsters. These assessments, along with estimates of the bycatch of sea turtles, seabirds, and marine mammals are provided to support informed decisions by the NOAA Fisheries Pacific Islands Regional Office (PIRO), the Western Pacific Fishery Management Council (WPFMC), and international organizations such as the Western and Central Pacific Fisheries Commission (WCPFC), the International Scientific Committee for Tuna and Tuna-Like Species in the North Pacific Ocean (ISC) and the Inter-American Tropical Tuna Commission (IATTC).

Fishery Biology & Stock Assessment Division Staff

The FBSAD is organized into three programs:

- The *Fishery Biology and Bycatch Program* primarily focuses on identifying methods to minimize incidental capture of sea turtles and other bycatch species in pelagic longline and other fisheries, including modifications to fishing gear and bait and associated outreach and education programs,. The program also conducts research on habitats, movements, distribution, and post-release survivorship of animals released from pelagic fishing gear, and on factors affecting vulnerability to fishing for use in standardization of catch-per-unit-effort (CPUE) data for pelagic stock assessments. Leadership of the Council's Pelagic FMP Team resides in this program.
- The *Life History Program* conducts basic research on the age, growth, and reproductive strategies of managed fish species and bycatch species. The program also collaborates in studies of coral reef fish community structure and responses to anthropogenic effects.
- The *Stock Assessment Program* conducts population assessments of pelagic species, including yellowfin and bigeye tunas in the western and central Pacific and swordfish, striped marlin, and blue shark in the North Pacific. Assessments are also produced for insular species including Hawaiian Archipelago bottomfish and NWHI lobster. The program also estimates incidental takes of sea turtles, seabirds, and marine mammals in the Hawaii longline fishery. Leadership of the Council's Crustaceans and Bottomfish FMP Teams resides in this program.

The FBSAD Chief serves as International Science Advisor to the Directors Office, providing critical support on scientific issues arising with respect to tunas, billfishes, and ecologically associated species in the Pacific. The International Science Advisor is responsible for: providing scientific advice, technical reports, and informed opinion on scientific matters at meetings of the WCPFC, the ISC, and other regional fisheries organizations (RFOs); providing similar scientific support to PIRO, the U.S. State Department, and other members of official U.S. delegations to such meetings so that they may best represent the interests of the Pacific Islands Region; and leading the U.S. delegation to meetings of the WCPFC Scientific Committee. The International Science Advisor also oversees compilation of official statistics for U.S. fisheries harvesting tunas and billfishes in the Pacific Islands Region and, as the U.S. data correspondent, submits such statistics to the WCPFC, ISC, and other RFOs. FBSAD staff also provides support to the Directors Office in overseeing NOAA Grants to the Oceanic Institute, advising the State of Hawaii

Fishery Biology & Stock Asseessment Divison FY 2006

Personnel	
Federal	19
JIMAR	9
Total	**28**

Budget	$	%
Salaries and benefits	1,880,695	52.2
Grants	676,446	18.8
Contracts	313,978	8.7
Equipment	46,982	1.3
Supplies	180,226	5.0
Travel & transportation	173,040	4.8
Rent, vessel charters, and communication	333,480	9.2
Printing	676	< 0.1
Total	**$3,605,522**	

on introduced and invasive species, and organizing and maintaining PIFSC's research vessel schedule.

FBSAD has a staff of 28 people including 19 federal employees and 9 employees of JIMAR or other nonfederal entities. Staff salaries and benefits made up the largest share of expenditures in FY 2006.

Key FY 2006 Accomplishments

- The performance of large circle hooks with fish bait, as mandated for the Hawaii swordfish fishery, was reviewed and presented at the Sea Turtle Symposium to counter claims that failure of the new measures was responsible for the fishery's temporary closure in March 2006.
- Tests showed that bigeye tuna fishing success with large circle hooks in the Hawaii tuna longline fishery was equal to or better than with traditional tuna hooks. Results were presented at the annual Tuna Conference sponsored by NOAA and IATTC.
- Test results showing barbless circle hooks performed at least as well as traditional barbed hooks in Hawaii shore fisheries were presented at the American Fisheries Society Annual Meeting.
- Started an experiment in the Hawaii tuna longline fishery comparing deep gear with no shallow hooks (> 100 m) to normal deep gear. Preliminary results indicate higher catches of bigeye tuna and greatly reduced catches of marlins and other incidental species.
- Completed experiments in Peru and Ecuador showing that hooks with appendages designed to reduce ingestion by sea turtles do so. Associated reductions of target catch are less than when using larger circle hooks without appendages.
- FBSAD staff convened and chaired the inaugural meeting of the ISC Bycatch Working Group (WG) and meetings of the ISC Swordfish WG and ISC Marlin WG. Meeting reports on the web at http://isc.ac.affrc.go.jp/.
- Published peer-reviewed articles on post-release survivorship of pelagic fishes and sea turtles.
- Completed decade-long effort to describe age and growth of broadbill swordfish in the Pacific. Submitted a paper on the results indicating faster growth of swordfish caught in the Hawaii and Chile fisheries compared with those caught in the Taiwan fishery.
- Completed fieldwork on billfish eggs and larvae in Hawaiian waters and presented results at the 4th International Billfish Symposium.
- Computed estimates of the incidental takes of sea turtles, seabirds, and marine mammals in the 2005 Hawaii longline fishery using longline logbook and observer data. Provided PIRO with protocols and guidelines for observer sampling in 2006.
- Convened the 9th NMFS National Stock Assessment Workshop (NSAW).
- Collaborated to update stock assessments of yellowfin and bigeye tuna, NWHI slipper and spiny lobsters,

FBSAD biologist identifies a fish specimen collected during a research cruise.

and Hawaii bottomfish. Submitted the yellowfin tuna assessment for review by the Center of Independent Experts. Completed and reported to the ISC new assessments of striped marlin and blue shark.

- Made important scientific contributions to the 2nd Meeting of the WCPFC's Scientific Committee and Northern Committee regarding fish stock assessments, CPUE standardization, and bycatch mitigation.
- Completed the annual lobster resource survey with the NOAA Ship *Oscar Elton Sette* and two NMFS-Industry cooperative lobster tagging cruises in the NWHI. Over a span of 5 years, the latter have resulted in tagging of 26,400 spiny and 4,000 slipper lobsters for growth and mortality estimation.

Challenges, Problems, Limitations

Expanding staff to meet new mandates requires creativity in providing office space. The situation is much improved since acquisition of the Aiea facility, where laboratory renovations will soon be completed. Adequate funding of sea turtle bycatch work may continue, but the budget for fish bycatch research has been dwindling and funding for other fish and ecosystem research is very limited. Core fish stock assessment tasks are substantially funded, but mandates to assess additional species and meet new MSFMA requirements are unfunded. FBSAD scientists actively solicit funding for fish research from external sources such as the State's Fisheries Disaster Relief Program (FDRP) and the University of Hawaii-JIMAR Pelagic Fisheries Research Program. To accommodate the Division Chief's new role as International Science Advisor, substantial leadership of the three FBSAD research programs has been delegated to subordinates. Problems may arise in the transfer of responsibilities during FY 2007. On a related matter, PIFSC has never received adequate funding for its new PIR responsibilities in support of international agreements. The program is also challenged with developing and coordinating the integrated research programs needed to support ecosystem approaches to management of living marine resources. In particular, FBSAD scientists need to collaborate more with the EOD in using oceanographic data in stock assessments. Among new challenges, FBSAD has been asked to help assess coral reef fisheries and provide scientific advice to the State of Hawaii regarding main Hawaiian Islands fisheries management through closed areas and other means. Information is often lacking to adequately address these issues, which have traditionally been outside Federal jurisdiction.

Future Focus and Direction

Collaborative testing of improved fishing gear to reduce turtle bycatch will continue. It will also be evaluated at a national review meeting. Products of this review will include a synthesis of recommendations for international fisheries conservation measures, and for future research directions. Bycatch estimation will be broadened to include all fish species in observed fisheries, and observer data will be used to explore factors affecting shark and other bycatch. New research will be focused on Hawaiian bottomfish life history, distribution, and stock dynamics, with major new projects and staff funded by FDRP. Another new focus will be research on marlin life history, in collaboration with several other institutions. The rigorous new process for peer-review of stock assessments may require further improvements. New bottomfish assessments will be completed for Guam, the Northern Marianas, and American Samoa. Significant effort will be devoted to standardizing data processing and reporting schedules and formats to meet the increasing demands of international agreements for information and advice.

Research on Bottomfish Biology and Stock Assessment Geared to Improved Scientific Advice for Fishery and Ecosystem Managers

Sound management of Hawaii's bottomfish complex depends on a good understanding of biological factors that govern bottomfish population dynamics. It also requires methods of stock assessment that make full use of the biological information and take into account uncertainties in the data. FBSAD scientists are actively pursuing research in both areas. In cooperation with commercial bottomfish vessels, researchers are collecting biological data from specimens of bottomfish caught in Hawaii waters and delivered to the Honolulu waterfront for sale. Scientists are using fish measurements and samples of organs and tissues for studies of bottomfish growth, ageing, reproduction, and genetics. Other researchers are developing stock assessment methods that use the new biological data in population models and incorporate probabilities associated with prior knowledge of the population model inputs. The combination of expanded biological research and more realistic stock assessment models will improve the quality and utility of the Center's scientific advice for managers.

Onaga (Red Snapper)

Ecosystems and Oceanography Division

The Ecosystems and Oceanography Division (EOD) conducts research to advance our understanding of the structure and dynamics of Pacific basin marine ecosystems. In particular, EOD seeks to understand how marine populations change directly in response to changes in their predators and prey and indirectly as a result of broader habitat-based changes in the ocean climate, including El Niño, La Niña, and other interannual or decadal events.

EOD research covers topics on many different spatial scales ranging from fine-scale habitat characterization to basin-scale oceanography, and various temporal scales from short-term individual foraging behavior to long-term ecosystem changes and population trends. Accordingly, a variety of approaches are necessary, including interdivisional, multiagency, academic, industry, NGO, and multinational collaborations.

The EOD has three major research themes:

- *Insular Habitat and Ecology* focuses on understanding the dynamics of island-associated species and processes.
- *Pelagic Habitat and Ecology* considers the ocean from the perspective of large pelagic animals.
- *Ecosystem Oceanography* identifies changes in the ocean that may affect the marine ecosystem.

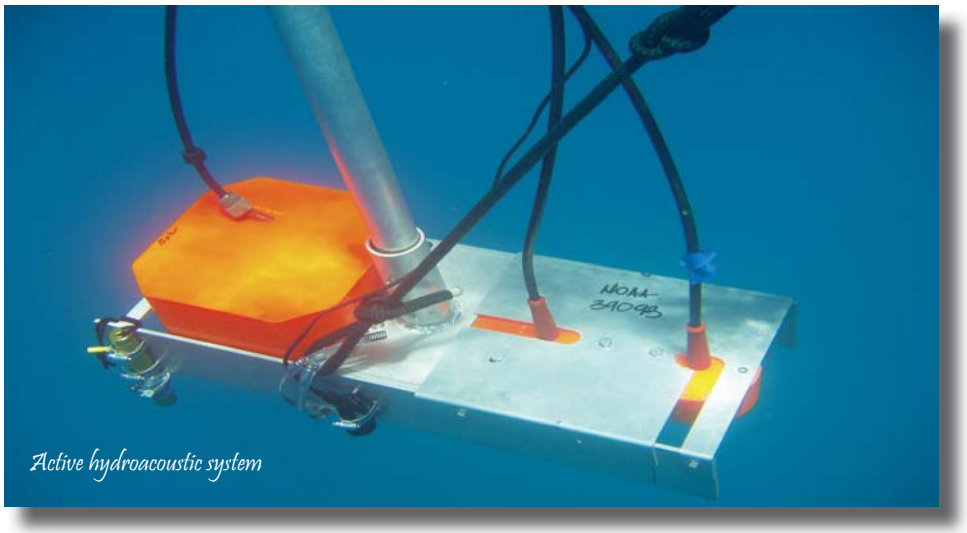
EOD provides scientific advice in support of improved stock assessment and fisheries management, develops indicators of ecosystem changes, and publishes scientific findings related to effects of habitat and environment on individuals, populations, ecosystems, and fisheries. To accomplish these goals, EOD researchers use a variety of platforms including deep diving submersibles, remotely operated vehicles, and SCUBA, both small and large research vessels and commercial vessels. EOD employs a broad spectrum of advanced technologies and tools, including pop-up satellite archival tags, animal-borne instruments such as CRITTER-CAM, shipboard and moored echo sounders, satellite remotely sensed oceanographic and atmospheric data products, ocean circulation models, and ecosystem models.

EOD has 11 staff, including 6 federal employees and 5 JIMAR employees. During FY 2006, salaries and benefits made up the largest share of expenditures in the EOD budget.

The EOD Chief also serves as Principal Investigator for the NESDIS-funded Central Pacific OceanWatch Node (http://oceanwatch.pifsc.noaa.gov/) managed by a JIMAR oceanographer. This program archives and distributes a suite of satellite remotely sensed oceanographic data to a diverse group of users in government agencies and the private sector.

Key FY 2006 Accomplishments

- Completed a paper on the vertical habitat of deepwater moonfish (opah) with data collected from pop-up archival tags.
- Completed a paper on the oceanography of the American Samoa longline fishery for tuna that identified the strength of the South Equatorial Counter Current as key to dynamics of the fishery.
- Completed a paper on the ecosystem dynamics of northern atolls in the Hawaiian Archipelago located at the boundary between two biomes.
- Published a coauthored paper on approaches to reduce seabird bycatch in longline fisheries and completed two papers (one in press, one in review) on protected species interaction/mitigation in the Hawaii-based longline fishery.
- Completed paper on top-down impacts of Hawaiian monk seals on their prey community.
- Completed a paper on the density and habitat of three deep sea corals in the main Hawaiian Islands.
- Improved instrumentation and methodology for estimating the distribution and abundance of juvenile opakapaka using hydroacoustics and launched an acoustic survey for pre-recruits of the deepwater snapper.



Active hydroacoustic system

- Published two manuscripts on larval transport and the connectivity between populations of marine fauna, one addressing a larval transport corridor between Johnston Atoll and the Hawaiian Archipelago and the other examining larval transport dynamics in the Northwestern Hawaiian Islands.

Challenges, Problems, Limitations

In 2005, EOD began conducting acoustic surveys of tunas and their forage and encountered a problem with noise contamination in the acoustic data collected onboard the NOAA Ship *Oscar Elton Sette*. EOD identified the likely cause of this problem but due to funding limitations at the Pacific Marine Center (NOAA) the problem has yet to be fixed. Another emerging issue is that our extensive use of passive and active acoustic tools, satellite remotely sensed data, and coupled physical-biological ocean models all result in very large data sets. Storing and handling these large data sets are significant challenges.

Future Focus and Direction

The EOD expects to expand research on deep sea corals. The Division is already studying precious coral and black coral throughout the Hawaiian Archipelago and exploring their distributions in the Line Islands. EOD will likely extend deep sea coral surveys to the western Pacific and expand research on coral distribution, growth, and ecology. The Division also plans to expand studies to determine whether active acoustics can be used to obtain a fishery independent estimate of adult snapper abundance. We will expand our use of coupled ocean and ecosystem models to advance our understanding of ecosystem dynamics and develop ecosystem forecasts. Lastly, EOD recently acquired a long time-series of bottomfish tag-recapture data from the State of Hawaii Division of Aquatic Resources for use in collaborative studies. This unique and valuable dataset will be useful for estimating the short- and long-term movement patterns, growth rate, mortality rate, and possibly biomass of opakapaka.

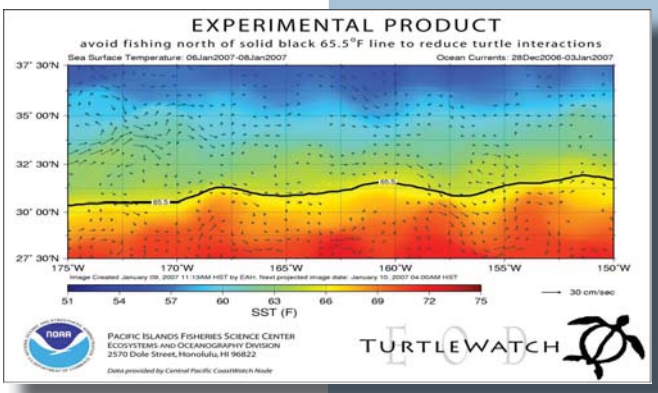
Ecosystems & Oceanography Division FY 2006

Personnel	
Federal	6
JIMAR	5
Total	**11**

Budget	$	%
Salaries and benefits	659,629	72.1
Grants	0	0.0
Contracts	39,899	4.4
Equipment	50,101	5.5
Supplies	115,420	12.6
Travel & transportation	47,037	5.1
Rent, vessel charters, and communication	664	0.1
Printing	1,742	0.2
Total	**$914,492**	

Ecosystems and Oceanography Division Staff

Real-time Information on Center's Web Site Helps Longline Fishers Avoid Interactions with Protected Sea Turtles



TurtleWatch can be accessed at :www.pifsc.noaa.gov/eod/turtlewatch.php

Knowing the location of loggerhead sea turtles can help Hawaii swordfish longline fishers avoid incidental interactions with these protected marine reptiles. Scientists in the Ecosystems and Oceanography Division regularly publish a map on the Center's Web site indicating the current location of the loggerhead's preferred habitat in waters north of Hawaii. Based on data collected by NOAA and NASA satellites, these TurtleWatch maps provide spatial information about sea surface temperature and the direction and strength of ocean surface currents. The maps show the predicted location of the temperature boundary separating preferred loggerhead habitat, waters colder than 18.5°C (65.5°F), from warmer waters farther south where the species is less likely to be found. The Web site maps are updated every few days when new satellite data become available to EOD scientists. In helping decrease the likelihood of longline-loggerhead interactions, the TurtleWatch project provides benefits not only to the turtles, but also to fishers, who operate under a strict federal limit on the number of turtle interactions allowed each year and are subject to a fishery closure and loss of catch revenue when the limit is reached.

Protected Species Division

The Protected Species Division (PSD) conducts research supporting the recovery and sustainability of protected species populations in the Pacific Islands Region (PIR), notably the Hawaiian monk seal and Pacific sea turtles. The division is expanding a new research endeavor to address growing needs for information on cetacean populations in the PIR. Current activities by the PSD include studies using advanced technologies such as passive acoustic monitoring systems, satellite-linked Geographic Positioning System (GPS) tags; archival electronic tags; analysis of fatty acid profiles for diet studies; studies of sea turtle ecology and migration; stock assessments and demographic models for turtles and marine mammals; and health and disease research.

The Division is organized into three programs:

- *Marine Mammal Research Program* (MMRP). This program conducts research on topics concerning Hawaiian monk seal foraging ecology, and health and disease in an effort to identify and understand natural and human factors that may limit the recovery of this critically endangered species.
- *Marine Turtle Research Program* (MTRP). This program conducts comprehensive research on the Hawaii green turtle population, including: field studies of growth rates, mortality, and movements; long-term monitoring of abundance trends including annual surveys of the nesting colony at East Island, French Frigate Shoals; and the biology, etiology, and effects of fibropapilloma disease. The program also trains Pacific islanders and fishery observers in sea turtle biology and handling, collects data on fishery interactions with sea turtles, and studies the pelagic biology of sea turtles in the Pacific.
- *Protected Species Stock Assessment Program* (PSSAP). This program studies the population biology and stock status of Hawaiian monk seals and central and western Pacific cetaceans (whales and dolphins). Studies of sea turtles are also included in this program. Current focal areas of research include demographic modeling and skeletochronology.

Protected Species Division FY 2006

Personnel	
Federal	11
JIMAR	17
Other	2
Total	**30**

Budget	$	%
Salaries and benefits	949,963	27.7
Grants	812,500	23.7
Contracts	1,124,523	32.8
Equipment	73,139	2.1
Supplies	335,881	9.8
Travel & transportation	105,094	3.1
Rent, vessel charters, and communication	21,181	0.6
Printing	1,415	< 0.1
Total	**$3,423,696**	

The PSD staff of 43 includes 10 federal employees, 20 JIMAR staff, and 13 others including multiyear contractors. Contracts to veterinarians and other specialists accounted for the largest share of PSD expenditures in FY 2006.

Key FY 2006 Accomplishments

- Published (or in press) peer-reviewed publications on Hawaiian monk seal abundance estimation methods, survival rates patterns, reproductive rate patterns, sea level rise threats, foraging behavior, and potential exposure to pollutants in the main Hawaiian Islands.
- Conducted first cetacean survey of American Samoa and first PIFSC-led cetacean survey using visual and acoustic detection aboard the NOAA Ship *Oscar Elton Sette*.
- Completed preliminary analysis of data from a moored passive acoustic recorder at Cross Seamount yielded promising results regarding detection of large and small whales, dolphins, and anthropogenic noise.
- Greatly expanded volunteer network for reporting monk seal sightings in the main Hawaiian Islands (MHI), improved the MHI monk seal database and obtained a new minimum abundance estimate for the area. The estimate was included in the draft 2007 monk seal Stock Assessment Report.
- Initiated 'captive care' program to develop methods for improving juvenile monk seal survival.
- Developed and tested of a cellular phone-based GPS tag for tracking marine mammals in the USA in collaboration with Sea Mammal Research Unit, St. Andrews, Scotland.
- Drafted manuscript on methodology for population viability analyses for marine turtles to assist managers in

making decisions regarding status (IUCN listing criteria) and population-level impact of fisheries bycatch.

- Initiated a collaborative project with researchers in New Caledonia to investigate the pelagic ecology of genetically discrete loggerhead turtles interacting with longline and other fisheries in the South Pacific.
- Coauthored peer-reviewed publications on geographic variation in the marine turtle disease fibropapillomatosis, and on pelagic ecology of juvenile loggerhead sea turtles.
- Convened an international workshop on sea turtle stranding research in Taiwan involving 60 participants.


Protected Species Division Staff

Challenges, Problems, Limitations

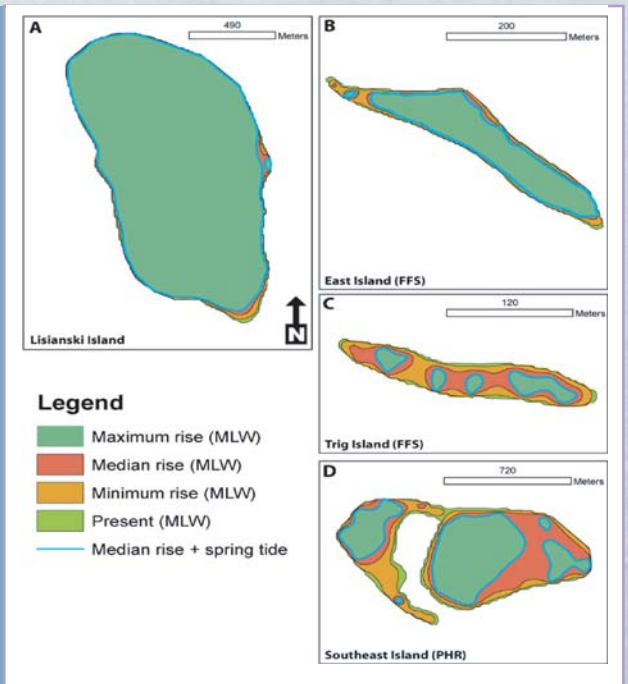
While PSD has achieved excellent results monitoring the endangered Hawaiian monk seal in the NWHI, we continue to document a population decline in this imperiled species. An ongoing challenge is to diagnose the root causes of the decline and develop tools for enhancing the species recovery. As PSD has broadened its sea turtle and cetacean research activities, substantial progress has been made in identifying research priorities and methods for filling information gaps. The greatest impediment to the expansion of these new programs is a lack of resources (funding, personnel, office space) needed to carry out new mandates.

Future Focus and Direction

FY 2007 will see an emphasis on diagnosing the decline in Hawaiian monk seals in part by studying the habitat needs and foraging behavior of juvenile seals. At the same time, PSD will build partnerships with other agencies and nongovernmental organizations to develop "captive care" methods for improving the survival of juvenile monk seals. PSD will also endeavor to continue NWHI field camps, during which long-term monk seal demographic data is collected, mortality is mitigated (e.g., through disentanglement and reduction of shark predation), and specimens for foraging and health studies are obtained. We hope to further expand the monitoring program into the main Hawaiian Islands, where the monk seal population is increasing and human contact with seals is becoming more frequent. Another key goal will be to continue to develop and implement the cetacean stock assessment research program. This will include analyzing cetacean sound data from acoustic recorders, modeling spinner dolphin resting habitat characteristics, and establishing a community-based photographic identification catalog for Hawaiian spinner dolphins. In addition, PSD will develop a research plan to address stock assessment of marine turtles in American Samoa, Guam, and the Commonwealth of the Northern Mariana Islands while continuing to assess the status of marine turtle populations that forage in the central North Pacific but nest outside the United States (e.g., leatherbacks, loggerheads, and olive ridleys).

Local Effects of Global Climate Change: Rise in Sea Levels Expected to Reduce Habitat for Hawaiian Monk Seals and Green Sea Turtles

Higher sea levels, a predicted outcome of global climate change, would cause a substantial reduction of beach habitat needed by monk seals and green turtles in the Northwestern Hawaiian Islands. This was a key finding of recent research by PIFSC scientists Jason Baker and Charles Littnan and their JIMAR colleague David Johnston. The trio surveyed emergent land in the island chain and developed topographic models of several islands important to the seals and turtles, and also to nesting seabirds. With this information in hand, they estimated how much beach habitat would be flooded in the year 2100 given sea level rise scenarios predicted by the Intergovernmental Panel on Climate Change. They projected a 3–65% loss of habitat under the median predicted sea level rise of 48 cm and 5–75% loss under the maximum predicted rise of 88 cm. The wide range of projected losses reflects topographic variation among islands. Spring tides would result in even greater periodic inundation of seal and turtle habitat.



Fisheries Monitoring and Socioeconomics Division

The Fisheries Monitoring and Socioeconomics Division (FMSD) specializes in the collection, management, and analysis of data from U.S. fisheries in the Pacific Islands Region. The FMSD monitors and reports on U.S. fisheries in the Pacific Islands Region; provides technical support to PIFSC partner agencies in Hawaii, American Samoa, Guam, and the Northern Mariana Islands (CNMI) in developing and administering local fishery monitoring programs; and conducts social and economic research on marine resource use in the Pacific Islands Region. Fishery-dependent data collected, processed, and analyzed by FMSD, and products derived from them, comprise most of the information requests received by FMSD from fishery scientists and managers and are the foundation of many fisheries management decisions. FMSD provides fishery statistics to fulfill U.S. obligations for data exchange and reporting under several international agreements. FMSD socioeconomic data collection and research provide valuable insights into the effects of those decisions on fishery participants.

The FMSD is organized into four programs:

- The *Western Pacific Fisheries Information Network* (WPacFIN) is a cooperative program involving the WPacFIN central office at PIFSC and fisheries agencies of American Samoa, CNMI, Guam, and Hawaii. WPacFIN compiles fisheries information collected by these agencies and provides technical expertise and tools to help them collect fishery-dependent data needed for local, federal, and international fishery management decisions.
- The *Fisheries Monitoring and Analysis Program* (FMAP) collects, processes, compiles, interprets, and disseminates federally mandated logbook data. FMAP also provides information on federally regulated fisheries to fishers and industry constituents and makes nonconfidential data available to fishers to improve PIFSC communication and working relationships with them.
- The *Economics Program* (EP) contributes to Pacific Islands Region fisheries management by collecting cost-earnings data, assessing the economic health and capacity of fishing fleets, studying fish markets, examining economic effects of fisheries regulations, and evaluating nonmarket values of living marine resources.
- The *Human Dimensions Research Program* (HDRP) studies the "people" side of fishing and other uses of marine ecosystems in the Pacific Islands Region. HDRP research complements biophysical and economic studies by exploring social and cultural benefits and values associated with marine resources.

FMSD has a staff of 27, including 11 federal employees and 16 JIMAR employees. Salaries and benefits made up the largest fraction of expenditures in FY 2006.

Fisheries Monitoring and Socioeconomics Division FY 2006

Personnel	
Federal	11
JIMAR	16
Total	**27**

Budget	$	%
Salaries and benefits	1,074,532	63.3
Grants	456,000	26.9
Contracts	6,953	0.4
Equipment	15,518	0.9
Supplies	26,911	1.6
Travel & transportation	99,072	5.8
Rent, vessel charters, and communication	13,539	0.8
Printing	3,872	0.2
Total	**$1,696,397**	

Key FY 2006 Accomplishments

Many products provided by FMSD are recurrent. Examples are quarterly and annual summaries of logbook statistics for longline fisheries in Hawaii and American Samoa, sections of annual reports for Fishery Management Plans, and annual inputs to *Fisheries of the United States*. Some of the Division's new initiatives in FY 2006 were the following:

- Provided local fishery offices with technical support and software to improve data collection and reporting in American Samoa, CNMI, and Guam.

Fisheries Monitoring and Socioeconomics Division Staff

- Provided data and analysis for monitoring the U.S. Pacific longline fishery catch of bigeye tuna east of 150° W longitude, fulfilling U.S. responsibilities to track and report the U.S. catch against the annual quota for the U.S. fleet established by the Inter-American Tropical Tuna Commission (IATTC).
- Provided data and analysis for monitoring and reporting the U.S. Pacific longline fishery catch and effort to the Western and Central Pacific Fishery Commission (WCPFC).
- Continued to support the recently developed long-term economic data collection program in the Hawaii longline fishery.
- Continued and broadened an outreach project with recreational fishers throughout the main Hawaiian Islands to encourage the use of barbless circle hooks, enabling fishers to reduce mortality of released catch, including target fish species, fish bycatch, and protected species.
- Produced logbooks to enable monitoring of catch and fishing effort by U.S. fishing fleets in the Pacific Remote Island Areas (PRIAs).
- Published results of a cost-earnings study of bottomfish vessels in NWHI analyzing the economic health of the fleet and the valuation and motivation of the fishers.
- Studied technological changes in the Hawaii-based longline fishery and their effects on the fleet's capacity and productivity.
- Participated in a study involving NOAA Fisheries and the Western Pacific Fishery Management Council (WPFMC) to assess overcapacity in federally managed commercial fisheries.
- Studied economic losses of the Hawaii longline swordfish fishery caused by the 2006 closure of the fishery.
- Used a spatial bioeconomic model to evaluate tradeoffs between economic return and sea turtle interactions under alternative management scenarios subject to limits on turtle take.
- Trained Department of Marine and Wildlife Resources staff in American Samoa to collect socioeconomic information and apply it to marine protected area management.
- Used funds from the Fisheries Disaster Relief Program to develop case studies on successful implementation of bycatch reduction techniques by Hawaii-based longline fishers.
- Collaborated with other economists, including NOAA Fisheries headquarters staff, to survey economic values associated with recreational fishing for blue marlin in Hawaii.
- Published article on the Filipino crew community in the Hawaii-based longline industry.
- Published paper on the social and cultural effects of the swordfish closure on Vietnamese-American longline fishermen.
- Improved and standardized methods for American Samoa shore-based data collection.

Commercial catch on display at a fish auction.

- Revised and improved automated production of Bottomfish and Pelagic Plan Team annual reports for American Samoa and Hawaii (automation of Guam and CNMI reports completed in 2005).
- Improved production of *Fishery Statistics of the Western Pacific* and published Vol. 21 of this report covering 2004.
- Improved inputs for Fisheries of the United States and produced data summaries for this report covering 2005.

Challenges, Problems, Limitations

The FMSD must meet increasing demand for more and better fisheries data to help the agency comply with statutory and regulatory provisions of the Magnuson-Stevens Fishery Conservation and Management Act (MSA), Marine Mammal Protection Act, and Endangered Species Act. New mandates under the MSA with respect to permits, reporting, and management of Total Allowable Catch (TAC) will provide challenges in the Pacific Islands where regulations governing such management measures are absent. Accordingly, the FMSD must invest in expanding and training PIFSC personnel, build greater technical capacity of WPacFIN partners, increase the efficiency of data operations, and improve the timeliness of reporting. Staff will also complete comprehensive metadata and documentation for fishery data collections and reports.

Future Focus and Direction

WPacFIN will continue to improve long-term data collection programs and address new developments. We will work closely with partner offices throughout the Pacific Islands Region to identify ways to improve data collection and coverage and help local fishery offices implement new monitoring programs. WPacFIN will continue to develop database applications to support several projects, including integration of Hawaii Division of Aquatic Resources fish catch data with fish dealer sales data; and collection of data on local fishing fleets and fish imports in CNMI and American Samoa. WPacFIN also plans to improve its Web site content, data request service protocols, and documentation for data collection programs and database applications.

The Fisheries Monitoring and Analysis Program (FMAP) plans to provide scientific and technical support to help implement regulations allowing simpler and more efficient alternatives for reporting logbook data, such as electronic longline logbooks. FMAP also intends to move towards real-time data collection. FMAP also plans to develop applications that integrate data from different data sets, generate outputs needed to fulfill U.S. data reporting obligations to international fisheries management bodies, and automate report generation. FMAP will also improve its section of the PIFSC Web site so that the public can have ready access to current nonconfidential fishery statistics, fishery reports, and other information.

The Economics Program will continue to seek support to expand research in American Samoa, Guam, and the Commonwealth of the Northern Mariana Islands. EP would like to expand its research on the economics of coral reef resources, protected species, and ecotourism.

Human Dimensions Research Program plans to complete profiles of fishing communities in Hawaii and American Samoa as required by National Standard 8 of the Magnuson-Stevens Act, complete a framework for long-term monitoring of the human dimensions of coral reef ecosystems in the main Hawaiian Islands, and further develop its GIS capability to support analysis of fishing impacts at the sub-island scale in the main Hawaiian Islands.

WPacFIN Partnerships Improve Management of Fisheries Data Across the Pacific Islands Region

The Western Pacific Fisheries Information Network (WPacFIN) enables effective coordination of fisheries data collection and better management of fisheries data in the Pacific Islands Region. FMSD provides central support for WPacFIN, assisting fisheries department staff in all island areas with the design of data collection programs, management of databases, and compilation and reporting of fishery statistics. In 2006, FMSD helped WPacFIN partners in American Samoa, Commonwealth of the Northern Mariana Islands, Guam, and Hawaii prepare reports on local fisheries for bottomfish and pelagic species for delivery to the Western Pacific Regional Fishery Management Council. FMSD also lent a hand with design of shore-based creel surveys to monitor fishing effort and catch, development of fishing vessel registration systems, upgrading of computer systems, and technical training. By working together, WPacFIN partners help ensure sound management of fishery resources and ecosystems across the region.

Pair of alias used for commercial fishing in American Samoa.

Notable Milestones

Hosted intersessional meeting of the North Pacific Marine Science Organization (PICES) Governing Council
Completed first formal submission of U.S. fishery statistics to Western Central Pacific Fisheries Commission
Built and managed a positive and proactive public profile for the Pacific Islands Fisheries Science Center
Completed comprehensive PIFSC Metadata Survey
Developed database and web-based search and retrieval system for PIFSC publications
Implemented PIFSC web development plan
Provided web access to PIFSC catalog of fisheries and research data and key summary data products
Estimated protected species bycatch by Hawaii-based fisheries
Initiated sea turtle bycatch reduction experiments and handling workshops in additional Pacific fishing nations
Convened first meeting of the Bycatch Working Group of the International Scientific Committee for research on tuna and tuna-like species in the North Pacific (ISC)
Initiated new stock assessment and review process, beginning with western Pacific bottomfish
Convened the 9th NMFS National Stock Assessment Workshop (NSAW) in April 2006
Updated stock assessments for bigeye and yellowfin tuna, NWHI slipper and spiny lobsters, and 4 bottomfish complexes
Provided education to the international fisheries community and public on methods for reducing the impact of longlines on sea turtles
Conducted Workshop on Human Dimensions of Coral Reef Ecosystems
Conducted field survey on impacts of technological changes in the Hawaii longline fishery
Completed report on longline economic data collection
Completed report on Cetacean Research Workshop
Conducted American Samoa cetacean survey
Began characterization of spinner dolphin habitat in the main Hawaiian Islands
Created monk seal photo identification database for the main Hawaiian Islands
Conducted small cetacean and false killer whale photo identification field studies
Conducted NWHI monk seal population assessment
Completed draft Hawaiian Monk Seal Foraging Research Plan
Completed fatty acid modeling in eastern portion of monk seal range
Assessed green sea turtle nesting population at East Island, French Frigate Shoals
Completed Center for Independent Experts (CIE) reviews of green turtle research program and yellowfin tuna stock assessment
Expanded CREIOS Ocean Observing System instrumentation array
Completed first beta version of Ocean Atlas system
Conducted Pacific Reef Assessment and Monitoring Program (RAMP) surveys
Used multibeam sonar to map the 50-fathom isobath at Maro Reef, Northwestern Hawaiian Islands
Conducted multibeam mapping surveys of American Samoa and the U.S. Pacific remote island areas (PRIAs)
Prepared web-host grids of multibeam bathymetry and backscatter data for American Samoa archipelago (Tutuilla and Manua Islands; Rose and Swains Atolls) and the PRIAs (Jarvis, Howland, and Baker Islands; Palmyra, Kingman, and Johnston Atolls)
Conducted aerial surveys of marine debris in main Hawaiian Islands at Islands of Hawaii and Kauai
Completed annual marine debris removal project in NWHI with the removal of 19 tons of debris, bringing cumulative removals from NWHI to 511 tons
Reported on marine debris accumulation rates in the NWHI
Published 54 papers in peer-reviewed scientific journals and conference proceedings (see publications)

2006 Publications

Articles in Peer-Reviewed Journals

Antonelis, G. A., J. D. Baker, T. C. Johanos, R. C. Braun, and A. L. Harting.
2006. Hawaiian monk seal (*Monachus schauinslandi*): status and conservation issues. Atoll Res. Bull. 543:75-101.

Baker, J. D., and P. M. Thompson.
2006. Temporal and spatial variation in age-specific survival rates of a long-lived mammal, the Hawaiian monk seal. Proc. R. Soc. Ser. B, 274:407-415 (published online at http://dx.doi.org/10.1098/rspb.2006.3737)

Baker, J. D., A. L. Harting, and T. C. Johanos.
2006. Use of discovery curves to assess abundance of Hawaiian monk seals. Mar. Mamm. Sci. 22(4):847-861.

Baker, J. D., C. L. Littnan, and D. W. Johnston.
2006. Potential effects of sea level rise on the terrestrial habitats of endangered and endemic megafauna in the Northwestern Hawaiian Islands. Endang. Species Res. 4:1-10.

Balazs, G. H., and M. Chaloupka.
2006. Recovery trend over 32 years at the Hawaiian green turtle rookery of French Frigate Shoals. Atoll Res. Bull. 543:147-158.

Bigelow, K., M. K. Musyl, F. Poisson, and P. Kleiber.
2006. Pelagic longline gear depth and shoaling. Fish. Res. 77:173-183.

Boland, R., B. Zgliczynski, J. Asher, A. Hall, K. Hogrefe, and M. Timmers.
2006. Dynamics of debris densities and removal at Northwestern Hawaiian Islands coral reefs. Atoll Res. Bull. 543:461-170.

DeMartini, E. E.
2006. Compensatory reproduction in Northwestern Hawaiian Islands lobsters. Atoll Res. Bull. 543:203-215.

DeMartini, E. E., and A. M. Friedlander.
2006. Predation, endemism and related processes structuring shallow-water reef fish assemblages of the NWHI. Atoll Res. Bull. 543:237-256.

DeMartini, E. E., A. M. Friedlander, and S. R. Holzwarth.
2006. Size at sex change in protogynous labroids, prey body size distributions, and apex predator densities at NW Hawaiian atolls. Mar. Ecol. Prog. Ser. 297:259-271.

Firing, J., and R. E. Brainard.
2006. Ten years of shipboard ADCP measurements along the Northwestern Hawaiian Islands. Atoll Res. Bull. 543:347-363.

Goldstein, T., F. M. D. Gulland, R. C. Braun, G. A. Antonelis, L. Kashinsky, T. K. Rowles, J. A. K. Mazet, L. M. Dalton, B. M. Aldridge, and J. L. Stott.
2006. Molecular identification of a novel gamma herpesvirus in the endangered Hawaiian monk seal (*Monachus schauinslandi*). Mar. Mammal Sci. 22(2):465-471.

Hoeke, R., R. Brainard, R. Moffitt, and M. Merrifield.
2006. The role of oceanographic conditions and reef morphology in the 2002 coral bleaching event in the Northwestern Hawaiian Islands. Atoll Res. Bull. 543:489-503.

Holzwarth, S. R., E. E. DeMartini, R. E. Schroeder, B. J. Zgliczynski, and J. L. Laughlin.
2006. Sharks and jacks in the Northwestern Hawaiian Islands from towed-diver surveys 2000-2003. Atoll Res. Bull. 543:257-279.

Howell, E. A., and D. R. Kobayashi.
2006. El Niño effects in the Palmyra Atoll region: oceanographic changes and bigeye tuna (*Thunnus obesus*) catch rate variability. Fish. Oceanogr. 15:6, 477-489.

Johnston, D.
2006. A hard day's night: spinner dolphins also need their rest. Ka Pili Kai 28(2):9-11.

Keenan, E. E., R. E. Brainard, and L. V. Basch.
2006. Historical and present status of the pearl oyster at Pearl and Hermes Atoll, Northwestern Hawaiian Islands. Atoll Res. Bull. 543:333-344.

Kelley C., R. Moffitt, and J. R. Smith.
2006. Mega- to micro-scale classification and description of bottomfish essential fish habitat on four banks in the Northwestern Hawaiian Islands. Atoll Res. Bull. 543:319-332.

Kenyon, J., and R. E. Brainard.
2006. Second recorded episode of mass coral bleaching in the Northwestern Hawaiian Islands. Atoll Res. Bull. 543:505-523.

Kenyon, J. C., R. E. Brainard, R. K. Hoeke, F. A. Parrish, and C. B. Wilkinson.
2006. Towed-diver surveys, a method for mesoscale spatial assessment of benthic reef habitat: a case study at Midway Atoll in the Hawaiian Archipelago. Coastal Management, 34:339-349.

Kenyon, J. C., P. S. Vroom, K. N. Page, M. J. Dunlap, C. B. Wilkinson, and G. S. Aeby.
2006. Community structure of hermatypic corals at French Frigate Shoals, Northwestern Hawaiian Islands: capacity for resistance and resilience to selective stressors. Pac. Sci. vol. 60, no. 2:153-175.

Kobayashi, D.
2006. Colonization of the Hawaiian Archipelago via Johnston Atoll: A characterization of oceanographic transport corridors for pelagic larvae using computer simulation. Coral Reefs 25:407-417.

Kobayashi, D. R., and J. J. Polovina.
2006. Simulated seasonal and interannual variability in larval transport and oceanography in the Northwestern Hawaiian Islands using satellite remotely sensed data and computer modeling. Atoll Res. Bull. 543:365-390.

Kolinski, S. P., R. K. Hoeke, S. R. Holzwarth, L. I. Ilo, E. F. Cox, R. C. O'Conner, and P. S. Vroom.
2006. Nearshore distribution and an abundance estimate for green sea turtles, *Chelonia mydas*, at Rota Island, Commonwealth of the Northern Mariana Islands. Pac. Sci., vol. 60, no. 4:509-522.

Lammers, M. O., R. E. Brainard, and W. W. L. Au.
2006. Diel trends in the mesopelagic biomass community of the Northwestern Hawaiian Islands observed acoustically. Atoll Res. Bull. 543:391-407.

Littnan, C. L., B. S. Stewart, P. K. Yochem, and R. Braun.
2006. Survey for selected pathogens and evaluation of disease risk factors for endangered Hawaiian monk seals in the main Hawaiian Islands. EcoHealth DOI: 10.1007/S10393-006-0059-z, 13 p.

Longenecker K., R. A. Dollar, and M. K. Cahoon.
2006. Increasing taxonomic resolution in dietary analysis of the Hawaiian monk seal. Atoll Res. Bull. 543:103-113.

Lundblad, E. R., D. J. Wright, J. Miller, E. M. Larkin, R. Rinehart, D. F. Naar, B. T. Donahue, S. M. Anderson, and T. Battista.
2006. A benthic terrain classification scheme for American Samoa. Marine Geodesy 29(2):89-111.

Miller, J. E., S. Vogt, R. Hoeke, S. Ferguson, B. Applegate, J. R. Smith, and M. Parke.
2006. Bathymetric atlas and website for the Northwestern Hawaiian Islands. Atoll Res. Bull. 543:309-422.

Moffitt, R. B., J. Johnson, and G. DiNardo.
2006. Spatiotemporal analysis of lobster trap catches: impacts of trap fishing on community structure. Atoll Res. Bull. 543:217-236.

Moyes, C. D., N. Fragoso, M. K. Musyl, and R. W. Brill.
2006. Predicting postrelease survival in large pelagic fish. Trans. Am. Fish. Soc. Sep 2006, 135(5):1389-1397.

Nielsen, A., K. A. Bigelow, M. K. Musyl, and J. R. Sibert.
2006. Improving light-based geolocation by including sea surface temperature. Fish. Oceanogr. 15:4, 314-325.

Parrish, F. A.
2006. Precious corals and subphotic fish assemblages. Atoll Res. Bull. 543:425-438.

Parrish, F. A., and K. Abernathy.
2006. Movements of monk seals relative to ecological depth zones in the lower Northwestern Hawaiian Islands. Atoll Res. Bull. 543:115-130.

Parry, M.
2006. Feeding behavior of two ommastrephid squids Ommastrephes bartramii and Sthenoteuthis oualaniensis off Hawaii. Mar. Ecol. Prog. Ser. 318:229-235.

Polovina, J., I. Uchida, G. Balazs, E. A. Howell, D. Parker, and P. Dutton.
2006. The Kuroshio extension bifurcation region: a pelagic hotspot for juvenile loggerhead sea turtles. Deep-sea Res. II, 53:326-339.

Pooley, S. G., and M. Pan.
2006. Economic research on the NWHI – a historical perspective. Atoll Res. Bull. 543:33-50.

Reif, J., M. M. Kliks, A. A. Aguirre, D. L. Borjesson, L. Kashinsky, R. C. Braun, and G. A. Antonelis.
2006. Gastrointestinal helminths in the Hawaiian monk seal (*Monachus schauinslandi*): Associations with body size, hematology, and serum chemistry. Aquat. Mamm. 32(2), 157-167.

Schroeder, R. E., and J. D. Parrish.
2006. Ecological characteristics of coral patch reefs at Midway Atoll, Northwestern Hawaiian Islands. Atoll Res. Bull. 543:439-460.

Sibert, J., J. Hampton, P. Kleiber, and M. Maunder.
2006. Biomass, size, and trophic status of top predators in the Pacific ocean. Science, Vol. 314. no. 5806, pp. 1773-1776.

Snover, M. L., G. M. Watters, and M. Mangel.
2006. Top-down and bottom-up control of life-history strategies in coho salmon (*Oncorhynchus kisutch*). Am. Nat., Vol. 167, No. 5, pp. E140-E157.*

Stewart, B. S., G. A. Antonelis, J. D. Baker, and P. K. Yochem.
2006. Foraging biogeography of Hawaiian monk seals in the Northwestern Hawaiian Islands. Atoll Res. Bull. 543:131-145.

Swimmer, Y., R. Arauz, M. McCracken, L. McNaughton, J. Ballestero, M. Musyl, K. Bigelow, and R. Brill.
2006. Diving behavior and delayed mortality of olive ridley sea turtles *Lepidochelys olivacea* after their release from longline fishing gear. Mar. Ecol. Prog. Ser. 323:253-261.

Vargas Ángel, B., S. B. Colley, S. M. Hoke, and J. D. Thomas.
2006. The reproductive seasonality and gametogenic cycle of *Acropora cervicornis* off Broward County, Florida, USA. Coral Reefs 25:110-122.

Verbruggen, H., O. De Clerck, A. D. R. N'Yeurt, H. Spalding, and P. S. Vroom.
2006. Phylogeny and taxonomy of *Halimeda incrassata*, including descriptions of *H. kanaloana* and *H. heteromorpha* spp. nov. (*Bryopsidales, Chlorophyta*). Eur. J. Phycol., 41(3):337-362.

Vroom, P. S., and K. N. Page.
2006. Relative abundance of macroalgae (RAM) on Northwestern Hawaiian Islands reefs. Atoll Res. Bull. 543:533-548.

Vroom, P. S., K. N. Page, K. A. Peyton, and J. K. Kukea-Shultz.
2006. Marine algae of French Frigate Shoals, Northwestern Hawaiian Islands: species list and biogeographic comparisons. Pacific Science, Vol. 60, no. 1:81-95.

Vroom, P. S., K. N. Page, J. C. Kenyon, and R. E. Brainard.
2006. Algae-dominated Reefs. Am. Sci. 94 (Sep-Oct):430-437.

Walsh, W. A., E. A. Howell, K. A. Bigelow, and M. L. McCracken.
2006. Analyses of observed longline catches of blue marlin, Makaira nigricans, using generalized additive models with operational and environmental predictors.
Bull. Mar. Sci. 79(3):607-622.

Articles in Conference Proceedings

Hoeke, R., R. Brainard, R. Moffitt, and J. Kenyon.
2006. Oceanographic conditions implicated in the 2002 Northwestern Hawaiian Islands bleaching event. Proceedings of 10th International Coral Reef Symposium, Okinawa, Japan.

Holzwarth, S., B. Zgliczynski, and R. E. Schroeder.
2006. Spatial distribution of large mobile predators in the Northwestern Hawaiian Islands. Proceedings of the 10th International Coral Reef Symposium, June 28 to July 2, 2004, Okinawa, Japan:1131-1137.

Kenyon, J. C., G. S. Aeby, R. E. Brainard, J. D. Chojnacki, M. J. Dunlap, and C. B. Wilkinson.
2006. Mass coral bleaching on high-altitude reefs in the Hawaiian Archipelago. Proceedings of 10th International Coral Reef Symposium, June 28 to July 2, 2004, Okiniawa, Japan:631-643.

Schroeder, R. E., M. S. Trianni, K. A. Moots, J. L. Laughlin, B. J. Zgliczynski, and R. B. Tibbetts.
2006. Status of fishery target species on coral reefs of the Marianas Archipelago. Proceedings of the 10th International Coral Reef Symposium, June 28 to July 2, 2004, Okinawa, Japan:1016-1027.

Vargas Angel, B., B. Riegl, D. Gilliam, and R. Dodge.
2006. An experimental histopathological rating scale of sedeimentation stress in the Caribbean coral Montastraea cavernosa. Proceedings of the 10th International Coral Reef Symposium, June 28 to July 2, 2004, Okinawa, Japan:1168-1173.

Book Chapters

DeMartini, E. E., and P. C. Sikkel.
2006. Reproduction. In: L. G. Allen, D. J. Pondella II, and M. H. Horn (eds.), The Ecology of Marine Fishes: California and Adjacent Waters, p. 483-523 (Chapter 19), University of California Press, 660 p.

Theses and Dissertations

Baker, J. D.
2006. The Hawaiian monk seal: abundance estimation, patterns in survival, and habitat issues. Thesis (Ph.D.). University of Aberdeen.

Reports

Hamm, D. C., N. T. S. Chan, and C. J. Graham.
2006. Fishery Statistics of the Western Pacific, Volume 21. Pacific Islands Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, Honolulu, HI 96822-2396. Pacific Islands Fish. Sci. Cent. Admin. Rep. H-06-02, 196 p.

Moffitt, R. B., D. R. Kobayashi, and G. T. DiNardo.
2006. Status of the Hawaiian bottomfish stocks, 2004. Pacific Islands Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, Honolulu, HI 96822-2396. Pacific Islands Fish. Sci. Cent. Admin. Rep. H-06-01, 45 p.

Pan, M., and A. Griesemer.
2006. Economic analysis of bottomfish fishing vessels operating in the Northwestern Hawaiian Islands in 2003. Pacific Islands Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, Honolulu, HI 96822-2396. Pacific Islands Fish. Sci. Cent. Admin. Rep. H-06-03, 35 p.

Schultz, J., J. O'Malley, A. Griesemer, D. Curran, and P. Dalzell.
2006. Pelagic fishing tournaments and clubs in Hawaii. SOEST 06-02, JIMAR Contribution 06-361, 38 p.