# *Gary Stauffer, RACE Division Director, Announces Retirement*


Photo by Karna McKinney

Dr. Gary Stauffer, Director of the Center's Resource Assessment and Conservation Engineering (RACE) Division, announced his retirement effective 3 January 2006 after 33 years of service with the National Marine Fisheries Service (NMFS).

Gary is a native of eastern Washington and was born in Wenatchee, Washington. After graduating from Wenatchee High School in 1962, he enrolled at the University of Washington (UW) where he received his bachelor of science degree cum laude in 1966. He continued his education at the UW School of Fisheries, where he completed his master of science degree in fishery biology in 1969 and his doctorate in 1973. His master's research focused on the estimation of population parameters of Chinook salmon in the Green-Duwamish River in Washington State, and his doctoral research was on the development of a growth model for salmonids raised in hatchery environments. During his career, Gary continued to walk the halls of academia , where he held Associate Professorship and Affiliate Faculty status at Oregon State University, the UW, and the University of Alaska Fairbanks.

Gary began his career as a fishery biologist with the Quinault Indian Nation in Taholah, Washington, specializing in salmon culture, clam management, and the effects of logging on local fisheries. Employed as a federal temporary biologist for two summers while attending college, he began his permanent federal career in 1973 with the NMFS Southwest Fisheries Science Center in La Jolla, California, working on the assessment of coastal pelagic fisheries. This work included participation on the Pacific Fishery Management Council's (PFMC) anchovy and jack mackerel Fishery Management Plan Development Teams; working on the State/Federal Bonito Stock Assessment Team; serving as a member of the Mexico/U.S. Subcommittees on Anchovy Fisheries; and working on the NMFS Pacific Saury Preliminary Management Plan and Environmental Impact Statement. Since that time Gary has continued to maintain a strong relationship with the PFMC, serving on its Scientific and Statistical Committee from 1986 to 2003 and as Chair of the Committee from 1990 to 2003.

In 1982, Gary moved to Washington State to serve as a Research Fishery Biologist with the Resource Ecology and Fisheries Management (REFM) Division of the Northwest and Alaska Fisheries Center (NWAFC) in Seattle. With his move to the REFM Division, Gary's research and management activities also changed direction, and he became involved with the groundfish resources of the North Pacific and Bering Sea. In addition to completing annual stock assessments for sablefish, Gary also served as a member of the North Pacific Fishery Management Council's Gulf of Alaska Groundfish Plan Team. In 1985 Gary moved to the NWAFC's (later becoming the AFSC) RACE Division as Deputy Director and in 1986 was promoted to RACE Division Director.

Throughout his career, Gary has been actively involved with the education of future ocean and fisheries scientists and those interested in careers in the maritime industry at both the high school and university levels. He has served on both the University of Alaska School of Fisheries and Ocean Science Advisory Council and the Washington Sea Grant Steering Committee for many years, as well as serving on the graduate committees of a host of graduate students. More recently, Gary became actively involved in the Youth Maritime Training Association and the Ballard Maritime Academy. These institutions work with Seattle area youth to encourage and prepare them for careers in the maritime industry and marine sciences.

During his 20-year tenure as Director of the RACE Division, Gary has been a respected and admired leader in the fisheries science and management communities of the North Pacific and was instrumental in establishing and maintaining important ties between federal fisheries science and

the fishing industry and community. Under Gary's leadership, the RACE Division made significant advances in a full spectrum of research activities including the use of acoustics to survey populations of important pelagic stocks such as Alaska pollock and Pacific whiting; advancements in bottom trawl survey methodology and implementation of instrumentation to better measure survey trawl fishing effort and trawl performance; encouraging and supporting the development and growth of collaborative research with the Pacific Marine Environmental Laboratory and the AFSC on physical and biological factors affecting the recruitment of Alaska pollock and other commercially important fishes in Alaska; the study of fish behavior in relation to recruitment success of Alaska pollock, impacts of the fish catching processes on survival of bycatch, and the factors affecting the selection and use of habitat; and the importance of the standardization, construction, and maintenance of research fishing gear. Gary's leadership created an environment that fostered a high level of scientific achievement by his staff, as evidenced by the publication of more than one thousand per-reviewed papers by RACE scientists during those 20 years.

Gary was awarded the NOAA Administrator's Award in 2001 for his role in the development of a new policy on the use and issuing of scientific research exemptions. In 2005 he was awarded a Department of Commerce Silver Medal for advancing cooperative research with the Bering Sea Fisheries Research Foundation to improve the assessment of Bering Sea crab stocks.

Over his 33-year career with NMFS, Gary has made great contributions to the science and management of fishery resources from California to Alaska. He is a gifted leader with the ability to connect and communicate with scientists, members of the fishing community, and the lay person and is respected by all of them. He has been able to foresee new and emerging issues requiring thought and focus from the Division, the Center, and the agency, and to bring government, industry, and other outside interests together to meet those challenges. His interest in the well-being and personal success of all he worked with and supervised over the years has earned him the love of many. We wish Gary great happiness and success in his retirement. He will be greatly missed.

*By Russ Nelson*

## Dan Twohig Retires From RACE

Daniel J. Twohig, information technology (IT) specialist with the Center's Resource Assessment and Conservation Engineering (RACE) Division, announced his retirement effective 30 November 2005 after a 40-year career with the Federal Government. To ascribe to Dan the moniker "information technology specialist" doesn't begin to describe the work he accomplished during his career.

Dan started with the Coast and Geodetic Survey in 1966 working as an electronics technician on hydrographic vessels. This was the beginning of his fascination with ships at sea. He moved to the Bureau of Commercial Fisheries in 1969 as a member of the Gear Research Program at the Montlake Laboratory in Seattle, where he spent a portion of his time diving in support of the Tuna-Porpoise Program and other bycatch reduction projects. He joined the developing NMFS fisheries acoustics program in 1970 in Seattle and by 1974 was working full-time with this program, which is now known as the Midwater Assessment and Conservation Engineering (MACE) Program .

To document all of Dan's accomplishments during the course of his career would be nearly impossible in the space allotted. Some of his more significant accomplishments are mentioned below.

Beginning in 1970, Dan formed part of a collaborative team that included researchers with the UW's Applied Physics Lab and Fisheries Research Institute, which developed the world's first digital collection and analysis system for quantitative acoustic assessment of fisheries resources.

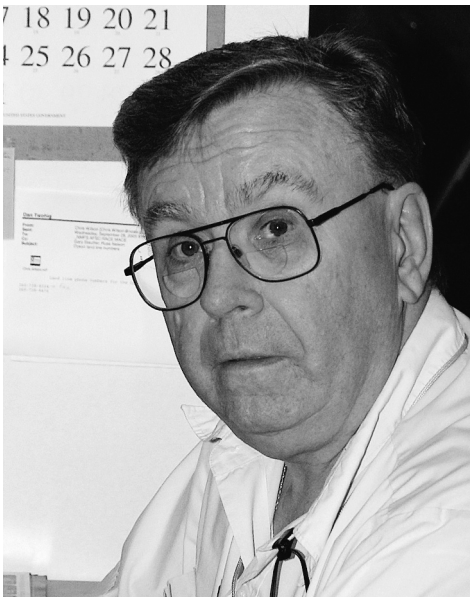


Photo by Paul Walline

In 1976, Dan designed and constructed the first NOAA Acoustic Research Container (ARC-1), which was a portable, self-contained acoustic laboratory housing all of the electronics needed to conduct a fisheries acoustic survey. The ARC I was used aboard research and chartered commercial vessels during the following 6 years. By 1982, Dan had implemented his improved acoustic laboratory design by completing the construction of the next generation laboratory, ARC II. Dan continued to lead the drive during the mid-'90s to redesign and relocate the acoustics laboratory inside the NOAA ship *Miller Freeman* to address safety and performance concerns. His resourcefulness and hard work assured that all three of these temporary homes-at-sea performed flawlessly.

With the acquisition of the Simrad echosounder and processing systems in 1990, Dan rapidly developed his IT skills and built Ingres and Oracle database systems to handle the acoustic and trawl data for the MACE Program. His efforts to understand and operate the echosounding systems earned him the respect of technical experts worldwide, particularly in Norway at Simrad and at the Bergen Institute of Marine Research.

Dan spent 6-8 months at sea each year during much of his career. His extensive knowledge and expertise in acoustics, technology, ships, and virtually anything electrical or mechanical was invaluable to researchers who had the good fortune to work with Dan. His shipboard experience led to his assignment as AFSC liaison with the *Miller Freeman* during its major repair period in winter 1998-99 and more recently to his role as AFSC representative in the design and construction of the NOAA ship *Oscar Dyson*, which is the first in the class of NOAA's state-of-the-art, noise-quieted fisheries research vessels.

Dan was honored early in his career as the 1975 NMFS Outstanding Employee of the Year and the 1976 Seattle Federal Executive Board Employee of the Year in recognition of his substantial contributions to NOAA. He received his first Department of Commerce (DOC) Bronze Medal for his overall contributions to fisheries assessment in the North Pacific in 1993. He received three additional DOC Bronze Medals for his efforts in representing AFSC interests with the NOAA fleet: one for his work with the *Miller Freeman* in 1999, one for his work on the design of a fleet of new Fisheries Survey Vessels (FSV) in 2000, and in 2006 for the completion of the first new NOAA fisheries research vessel *Oscar Dyson*.

Over the course of his career, it is no exaggeration to say that Dan was involved in most - if not all - significant milestones within the MACE Program. He was a respected shipmate and mentor to all who sailed and worked with him. He recently became the proud owner of a new recreational vehicle in which he and his wife Ya Mei plan to tour the country. We extend Dan a heartfelt thanks from all of us who have had the pleasure and good fortune to work with him over the years. We wish him all the best in his retirement. He's earned it!

*By Chris Wilson, Neal Williamson, and Gary Stauffer*

## The End of an Era at the Kodiak Lab

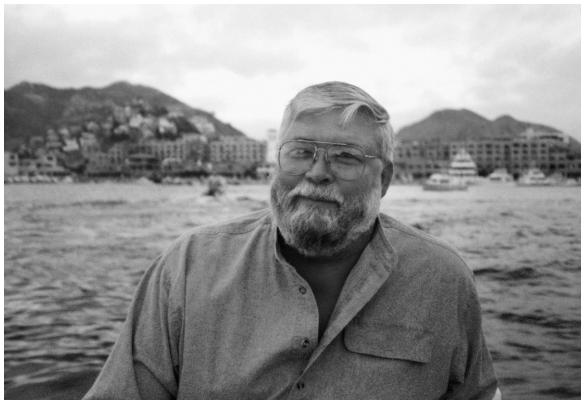

Photo compliments of Bob Otto

The end of an era came to pass with the retirement of Dr. Robert Otto in December 2005 after 32 years of government service. As longtime supervisor of the Kodiak Shellfish Assessment Program and Director of the Kodiak Laboratory, Bob oversaw the program's growth from a small stock assessment group to a multispecies research program. During that time, the program outgrew its location in a derelict WWII barracks and moved into a state-of-the-art marine research facility, the Kodiak Fisheries Research Center (KFRC). Bob was primarily responsible for liaison with architects and engineers during the design and construction of the KFRC.

Bob was born in Trenton, New Jersey, on 4 December 1946. He received primary education at the Newtown Friends School and secondary education at the George School, both in Newtown, Pennsylvania, where Bob lived as a child. He is a birthright member of the Society of Friends (Quakers). He received a B.S. degree in zoology

from Pennsylvania State University (1968), an M.S. degree in zoology (1971) from the University of Maine and a Ph.D. in zoology from the University of Maine (1975). Bob married his wife Gail of Beaver, Pennsylvania, in August 1970.

Bob began work for NMFS as a research specialist in Washington, D.C., in 1974. In 1977 he began work in Kodiak as the leader of the Shellfish Assessment Group and became Director of the NMFS Kodiak Laboratory in 1984. Dr. Otto has served as a member of the International North Pacific Fisheries Commission's King and Tanner crab Sub-Committee (1977-83), The North Pacific Fishery Management Council's Plan Maintenance Team for Bering Sea and Aleutian Islands King and Tanner Crabs (1978-retirement) and the North Pacific Science Organization Working Group on Crabs and Shrimps (Cochairman, 1997-2001).

Published works include papers on population dynamics of Atlantic marlins, biology of king and Tanner crabs, king and Tanner crab fisheries and their management, efficiency of survey trawl nets, biology of Antarctic crabs near South Georgia Island, and chemical composition of forage fishes. Bob is a member of the American Fisheries Society and the American Association for the Advancement of Science.

During his years in Kodiak, Bob rarely missed an opportunity to go out to sea. Never bothered by seasickness, he sought opportunities to go on cruises during seasons (January) and in locations (Antarctica) that most people would prefer to avoid. His curiosity and love of nature kept him out on deck many hours examining strange and interesting creatures. Bob's nearly encyclopedic knowledge of Alaskan marine life could easily overwhelm the casual listener, and everyone who went to sea with him came back much the richer in knowledge.

Friends and family held a retirement party for Bob at the Kodiak Elks Club on 11 December 2005 and presented him with a Sage fly rod. We expect to see him out on the rivers every day next summer and will be looking forward to tasting some of his home-made smoked salmon. Bob will maintain an office at the Kodiak Laboratory as a voluntary NMFS associate and plans to continue scientific work on crab biology and on improving the crab database. For the time being he can be contacted at the KFRC (907.481.1710).

*By Brad Stevens*

## *Eric Brown Retires From RACE*

Photo by Rich MacIntosh

Eric was born 24 March 1944, in Oak Ridge, Tennessee, where his father worked on enriching plutonium for the Manhattan Project. When his parents divorced four years later, his mother moved them west to California, first joining her parents in the Mohave Desert and eventually settling them in San Francisco when Eric began school. His mother remarried and they moved to Berkeley about the time Eric entered junior high school. He graduated from Berkeley High School in 1962. He spent summers with his father who went on to teach at the University of Chicago and the California Institute of Technology in Pasadena. During the 1958 International Geophysical Year, his father traveled to Moscow to attend an International Astronomical Union meeting and took Eric with him.

In the years following high school, Eric alternately attended San Francisco State University and other colleges and worked in construction jobs. He was drafted into the Navy SeaBees in 1966 and assigned to Port Hueneme and, ultimately, deployed to Vietnam for two tours of duty. Capitalizing on the skills he learned in the SeaBees, he was able to join the carpentry union in San Francisco upon leaving the service in 1968 and worked as an apprentice carpenter for a few years. He met his wife Sybil in 1969 at a New Year's Eve party in Berkeley. For the next 5 years they worked and went to school in Santa Cruz (Cabrillo College) and the Bay Area (UC Davis). Together they moved to Seattle in the summer of 1974, where Eric worked for the Forest Service fighting fires. The following September he enrolled at the UW College of Fisheries to finish his B.S., graduating the following June with a degree in fisheries.

In the spring of 1975 Eric joined what was then the Marine Fish and Shellfish Division of the

Northwest and Alaska Fisheries Center. His first field work was scheduled to begin in May, so he had to make arrangements to finish his finals early. Ultimately, the cruise was postponed and, as he said, he could have kept on schedule and received *much* better grades that last quarter! His first field season prepared him well for what lay ahead, beginning with 30 days in the Gulf of Alaska followed by 63 days in the Bering Sea with the likes of Sue Salveson, Don Gunderson, Terry Sample, Mark Wilkins, and Steve Hughes.

One of the most memorable parts of his career was working with scientists of the Japan Fisheries Agency to collaborate on Gulf of Alaska and Aleutian Islands bottom trawl surveys. He was impressed with the professionalism and cooperation of the Japanese scientists as they helped plan, conduct, and analyze results from cooperative surveys done between 1980 and 1987.

Another milestone in his career occurred in 1980 when he was Chief Scientist aboard the *Miller Freeman* during a winter bottom trawl survey near Kodiak Island. It was during that cruise that he and his fellow scientists discovered immense schools of walleye pollock in Shelikof Strait. The schools, which stretched for hundreds of square miles and from the bottom nearly to the surface, had never been detected before probably because no surveys had been conducted within state waters during that time of year.

An avid hiker and skier, Eric loves to head off into the mountains every chance he gets. Frequently during surveys in the Aleutian Islands, as soon as the skipper dropped anchor in some isolated bay, Eric could be found helping get the skiff into the water, eager to be off and exploring the highest point of land in sight.

Eric was promoted to a supervisory position in charge of conducting the Gulf of Alaska and Aleutian Islands surveys in 1990 and led that group through 2001. He was particularly proud of his close working relationship with many of the stock assessment scientists in the REFM Division, helping them interpret the results of these surveys.

In 2004 Eric, along with other members of the RACE Safety Committee, was awarded a Department of Commerce Group Bronze Medal Award for contributions in developing an At-Sea Safety Plan and Manual that provide essential guidance for harsh fieldwork environments in Alaska waters.

Chief among Eric's talents were his sense of humor, sense of camaraderie, and his knack of getting along with people. We'll all miss having him around and wish him many, many years of active and healthy relaxation. But we won't have to be as cautious about him sneaking up behind and surprising us quite as often!

*By Mark Wilkins*

## Length of Service Awards at ABL

Photo by Dodie Pickle

Bill Heard (above left), program manager for the Auke Bay Laboratory's (ABL) Marine Salmon Interactions Program, received a 45-year length of service award from AFSC Deputy Director Jim Coe (above right) at a special meeting for ABL staff at the University of Alaska Southeast campus. Other longevity award recipients from ABL were: Cheri Hendren (35 years); Jeff Fujioka and Paula Johnson (30 years); Mark Carls, Steve Ignell, and Scott Johnson (25 years); Ron Heintz, Christine Kondzela, Bonita Nelson, Robert Stone, and Brad Weinlander (20 years); Sharon Hawkins, Larry Holland, and Marie Larsen (15 years); and Ed Farley (10 years)

# AUKE BAY LABORATORY (ABL)

## MARINE SALMON INTERACTIONS PROGRAM

### Gamete Incompatibility in Salmonids

Scientists at the Auke Bay Laboratory's (ABL) Little Port Walter Marine Station designed and implemented a study to describe gamete incompatibility in Pacific salmon. Gamete incompatibility refers to the differential survival during fertilization and initial embryo development of progeny from specific female-male mating combinations. Gamete incompatibility is important because it can define speciation and may be an indication of inbreeding depression. The study will provide valuable insight into the genetic process within and between stocks of steelhead and Chinook salmon and will address fundamental issues that can drive conservation biology management decisions.

In May and August 2005, experiments were initiated using steelhead and Chinook salmon gametes in separate studies. In each experiment, 75 single-pair matings of all possible crosses were made in a 5×5 factorial design with three replicate cells representing each female-male combination. Three blocks were completed using 5 different males and females for each block representing a total 15 different males and females, and after replications, 225 parings for each species. Families were assigned to incubator cells in a stratified random manner and incubated in vertical incubators. Survival data to eyed-egg stage and to hatch was collected and analyzed using an ANOVA (analysis of variance)package in SAS (data analysis software).

Initial statistical analysis for percent survival to the eyed-egg stage and hatch indicated that both steelhead and Chinook salmon showed significant female-male interactions. These results indicate that certain female-male combinations either inhibit fertilization or depress survival of early embryos. Further statistical analyses and analysis of biological samples taken during the experiment will help determine factors that are responsible for this interaction.

*By Andy Gray and John Joyce*

### Report to Purse Seine Task Force

Joe Orsi of ABL's Marine Salmon Interactions Program reported on ABL's Southeast Coastal Monitoring (SECM) project to the Southeast Alaska Purse Seine Task Force in Ketchikan, Alaska, on 30 November 2005. This was a joint meeting of managers, researchers, and users of the pink salmon resource in southeastern Alaska. The purpose of the meeting was to review the 2005 purse seine fishery in the region with respect to seasonal commercial harvest, adult escapements, and processing capacity, and to discuss expectations for the 2006 season. The Purse Seine Task Force invited Orsi to present data from epipelagic ichthyofauna trawl surveys conducted by SECM that provide reliable forecast of pink salmon adult returns based on juvenile salmon indices.

The overview of the SECM project included preliminary results on forecasting chum salmon and a discussion of the possible ecological consequences of localized warming in the Southeast Alaska region of the Gulf of Alaska ecosystem. In 2004-05, SECM research documented anomalous warm waters in the area that appeared to trigger an earlier seaward migration of juvenile salmon; additional research in the region in late August in 2005 showed a northward range expansion of southern species such as Pacific sardine and Humboldt squid. There were additional corroborative reports at the meeting from purse seine fishers who also experienced warmer water temperatures than normal and had large catches of Pacific sardine throughout southeastern Alaska in July and August.

Documenting unusual and anomalous oceanographic conditions from commercial fishers in the region raises the prospect of utilizing this untapped source of data in the newly developing Southeast Alaska Ocean Observation System (SEAOOS). Integrating relevant data from research findings and the commercial fishing industry can help develop a better understanding of how ecosystems fluctuate.

*By Joe Orsi and Alex Wertheimer*

### Joint NPAFC-PICES Symposium on Pacific Salmon

A symposium on "The Status of Pacific Salmon and their Role in North Pacific Ecosystems" was held on 30 October through 1 November 2005 in Seogwipo, Jeju Island, Republic of Korea, immediately following the annual meeting of the North Pacific Anadromous Fish Commission (NPAFC). The symposium, jointly sponsored by the NPAFC and the North Pacific Marine Science Organization (PICES), featured a 3-day series of technical papers and posters on a broad range of issues by scientists

from Korea, Japan, Russia, Canada, and the United States. Key themes of the symposium included 1) trends in abundance and biological characteristics of Pacific salmon, 2) how ocean conditions can be observed using Pacific salmon, 3) migration routes, migration timing, and resident areas for populations of Pacific salmon and what they can tell us about environmental conditions on small to mid-scales, 4) spatial scales of salmon and environmental variability, and over what spatial scales salmon act as indicators of environmental variability, 5) which observations of Pacific salmon indicate climate variability most clearly, and 6) how climate variability is transmitted to variability in Pacific salmon populations. A total of 31 oral presentations and 20 posters addressed these theme areas.

Scientists from ABL presented several papers including "Chinook salmon-trends in abundance and biological characteristics" by Bill Heard and others, "Biological characteristics of Pacific salmon as indicators of ocean conditions" by Jack Helle, Ellen Martinson and others, "*I*nterannual variation in water mass properties, phytoplankton, nutrients, and juvenile salmon, age-0 pollock and herring distributions during fall in the eastern Bering Sea" by Lisa Eisner, Ed Farley, Jr., James Murphy, John Pohl, Jack Helle, and others (presented by Ed Farley), and "A review of the critical size, critical period hypothesis for juvenile Pacific salmon" by Ed Farley, Jr., Jamal Moss, and others.

Additionally, Jack Helle was coauthor on "Trends in abundance in chum salmon and biological characteristics," Richard Wilmot and Charles Guthrie were co-authors on "DNA markers track the distribution and migration of sockeye salmon in the Bering Sea," and Joe Orsi was coauthor on "Translating climate variability into salmon production; potential mechanisms for Chinook and coho salmon in southeastern Alaska, U.S.A."

Posters presented by AFSC scientists included "Spatial variations in feeding conditions of juvenile Bristol Bay sockeye salmon in relation to ocean conditions along the Bering Sea shelf" by Ed Farley, Jr., James Murphy, and others, and "Stock-specific abundance estimates of Bristol Bay juvenile sockeye salmon" by James Murphy, Ed Farley, Jr., and others. Many of these papers and presentations, following peer review, are scheduled for publication in NPAFC Bulletin No. 4.

*By Bill Heard*

### NPAFC Annual Meeting

Representatives of Canada, Japan, the Republic of Korea, Russia, and the United States, the primary states of origin for salmon stocks in the North Pacific Ocean, met in the Republic of Korea on 24-25 October 2005 for the Thirteenth Annual Meeting of the North Pacific Anadromous Fish Commission (NPAFC). The meeting was chaired by Koji Imamura, president of the NPAFC. The NPAFC promotes the conservation of salmonids in the North Pacific Ocean and its adjacent seas, and serves as a venue for cooperation and coordination of enforcement activities and scientific research.

The Committee on Scientific Research and Statistics (CSRS) reviewed current research activities of member parties including reports of Working Groups on Stock Assessment, Salmon Marking, Stock Identification, and the Bering-Aleutian Salmon International Survey (BASIS) Program. Loh-Lee Low from the AFSC served as chairman of the CSRS, and Jack Helle of ABL was head of the CSRS science delegation for the United States. One of the more important events of the annual meeting was finalizing development of a new 5-year NPAFC Science Plan by CSRS and acceptance of the plan by the NPAFC.

The overarching hypotheses related to this plan are that 1) anadromous stocks play an important role in North Pacific marine ecosystems, and 2) there is a close relation between climate and climate change and subsequent changes in marine productivity and survival of anadromous stocks and associated fishes. Key elements of the new plan include a focus on status and trends in production of anadromous stocks in ocean ecosystems, juvenile anadromous stocks in ocean ecosystems, anadromous stocks in the Bering Sea Ecosystem and anadromous stocks in the Western Subarctic Gyre and Gulf of Alaska Ecosystems. Details of the new science plan are available at *http://www.npafc.org/*.

*By Bill Heard*

## HABITAT PROGRAM

### Innovative Passive Samplers Assess Source and Origin of Hydrocarbons

Conventional passive sampling devices for monitoring pollution input often prove cost prohibitive when the spatial and temporal scales being assessed are very large. The Kenai River, a major salmon

producing river in Alaska, served as the perfect laboratory to test the utility of polyethylene membrane devices (PEMD) developed at the AFSC to determine the spatial and temporal fluctuations in chronic nonpoint source inputs to fisheries habitat. Comparison of the relative levels of polycyclic aromatic hydrocarbons (PAH) at 71 locations over a 3-year period allowed us to assess the significance and potential source of these compounds in the river. Concentrations of PAH were greatest near urban areas and peaked during the late winter when streams flows and attendant dilution were low. Vessel activity and PAH levels on the river peaked in July and were heaviest in the lower 16 km of the river where fishing activity was concentrated. Nearly one-third of the engines observed on the river were two-stroke engines, which release a higher proportion of unburned fuel into the water than the cleaner burning four-stroke engines. The low concentrations of hydrocarbons upriver of the boat traffic suggest very little remote delivery of these contaminants to the watershed. These devices proved to be an excellent low-cost tool for determining the patterns of PAH in large fisheries watersheds.

*By Adam Moles*

## FISHERIES MONITORING & ANALYSIS (FMA) DIVISION

The last quarter of the year is especially busy for Fisheries Monitoring and Analysis Division (FMA) staff as they debrief the last of the returning observers for the current year and prepare for the new fishing year which starts on 1 January.

### Observer Services

The Observer Manual is updated every year to keep pace with changes in fisheries management and data collection requirements. This process continues throughout the year, with intensified activity August through November in order to meet a 1 December deadline for printing. Observer Services staff have also been preparing training materials and training observers for the winter fishing season.

In a typical year, we have a rush of observers returning for debriefing in October and November with a few final debriefings occurring in December. This year, however, 35 observers were still deployed on longline vessels in early December, and this fishery closed unusually late on 12 December when the catch quota was reached. The additional debriefing workload in December occurred when staff were already engaged in training tasks.

Another important fourth quarter activity is the annual inspection of observer sampling stations. Vessels engaged in some fisheries are required by regulation to provide these sampling stations, and staff members inspect vessels each year for compliance.

*By Allison Barns*

### Information and Monitoring Technologies

Several vessels participated in Community Development Quota (CDQ) fisheries during the fourth quarter and continued to fish after most of the open access fisheries had closed. Observers onboard CDQ vessels enter and transmit catch information daily through the use of an at-sea data entry and communications program. The Information and Monitoring Technologies (IMT) staff ensure that these transmissions are received and that all of the incoming data are complete and free of critical errors. The IMT staff also work closely with other FMA staff to finalize observer data. This process involves additional checks for errors and missing data to ensure that complete, accurate, and timely data are available to our end users.

In preparation for the upcoming year, staff verify that the at-sea data entry and communication software is working onboard all vessels that use this system. This is a high priority task because almost 85% of observer data are transmitted electronically through use of this software. Changes currently are being made to improve the database error checking scripts used to verify the accuracy of incoming observer data. Through development of improved error checking and continued work with the fishing industry to facilitate digital transmission of observer data, the Information and Monitoring Technologies task contributes directly to the provision of high quality data to promote stewardship of North Pacific living marine resources for the benefit of the nation.

*By Shane Leach*

### Field Operations

Field Operations (FO) staff and staff from the Sustainable Fisheries Division of the Alaska Regional Office participated in a cooperative research project to evaluate the functionality of new technology and the effectiveness of current sampling protocols in October 2005. NOAA's National Marine

Fisheries Service, the International Pacific Halibut Commission, the Marine Conservation Alliance Foundation, and Cascade Fishing Incorporated collaborated on this project. The principle objectives for this project, which was conducted onboard the F/V *Seafisher* in the eastern Bering Sea were to

1) Test the software, hardware, and operation of an automated catch sampling system designed to select weighed random samples from the catch and deliver them to the observer's sampling station.

2) Evaluate the accuracy of observer sampling for estimating haul-specific catches of selected target species (yellowfin sole), prohibited species (Pacific halibut), moderately abundant bycatch species (arrowtooth and Kamchatka flounder), and a rare bycatch species group (eelpouts). Composition data from six subsamples per haul were compared against a full catch census of these five species groups to evaluate the accuracy and precision of haul-specific sampling.

3) Evaluate the use of video technology for monitoring fish handling and discard practices in the yellowfin sole and arrowtooth flounder fisheries. The scientific party placed tagged halibut into the catch and collected data on sorting and discard events to track the detectability of these fish. Data collected in this experiment will be compared with video records to determine the potential application of video for monitoring catch handling and discard.

Results from this project will be useful for improving observer catch sampling methods and providing an analytical basis for designing future catch monitoring programs.

During the last 3 months, FO staff spent considerable time preparing for the January fishery openings. Remaining fish, bird, and marine mammal specimens that had been collected during the year by observers and placed in storage at the field offices were shipped to the scientists who had requested the samples. FO staff also participated in the annual inspection of sampling stations by visiting vessels located in Alaskan ports. FO staff also participated in year-end debriefing to help ensure that observers who had completed their deployments and were able to get home for the holidays.

*By Allison Barns and Todd Loomis*

#### Operations and Administration

Operations and Administration (OA) gear room staff have been preparing sampling and safety gear which will be issued to observers in 2006. Each year we deploy approximately 400 observers on fishing vessels; many of these observers are deployed more than once during the year so staff must equip observers for about 800 trips. Approximately half of this gear is shipped to Anchorage to be issued to observers who are trained at the University of Alaska Anchorage Observer Training Center. At the end of the year, in preparation for the initial fishery openings, approximately 250 sets of gear were prepared for issue to observers.

Each year we solicit requests for special observer sampling or data collection projects. Some of the requests we receive are also considered for possible addition to regular observer sampling duties. OA and training staff work with the requestors to develop forms and instructions to be provided to observers. Depending on the nature of the project, sample collection materials may be distributed directly to observers or distributed to the appropriate vessels or processing plants. Fourteen special sampling or data collection projects will be conducted in 2006.

The North Pacific Fishery Management Council is scheduled to conduct initial review of alternatives for changes in the design and administration of the North Pacific Groundfish Observer Program at its February 2006 meeting. Information on this analysis is available on the Council web site at *www.fakr.noaa.gov/npfmc/current_issues/observer/observer.htm*.

*By Allison Barns*

## NATIONAL MARINE MAMMAL LABORATORY (NMML)

### ALASKA ECOSYSTEMS PROGRAM

#### Winter Migrations of Adult Female and Newly Weaned Northern Fur Seals

In October/November 2005 the Alaska Ecosystems Program of the National Marine Mammal Laboratory (NMML) began a yearlong study tracking the winter movements of newly weaned northern fur seal pups (*Callorhinus ursinus*). Currently the Eastern Pacific stock of the northern fur seal Alaskan population is declining at a rate of

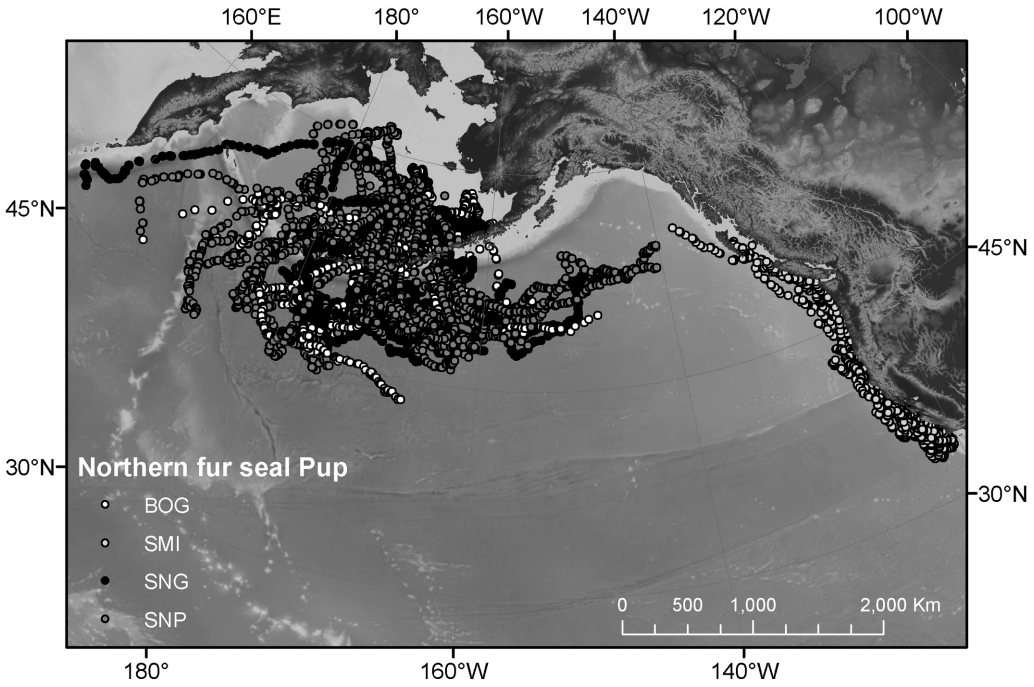


Figure 1. Winter movement patterns of northern fur seal pups from St. Paul Island (dark gray), St. George Island (black), Bogoslof Island (white) and San Miguel Island (light gray) from Ocober-November 2005 until 31 December 2005.

6% per annum and is listed as depleted under the Marine Mammal Protection Act. Approximately 60% of the global northern fur seal population, estimated at 1.2 million, resides on the Pribilof Islands in western Alaska (57˚N, 170˚W). Reasons for the decline are not fully understood and may include anthropogenic factors such as disturbance, entanglement, pollution, and indirect or direct fisheries interactions, and environmental factors, such as regime shifts in the North Pacific Ocean and Bering Sea, possibly affecting prey availability.

The movement and distribution of newly weaned pups is poorly understood as yearlings are rarely seen, and survival of pups in their first year away from the rookeries is thought to be less than 50%. Pups are weaned and begin their migration from the rookeries in November. During migration, pups must navigate for the first time in the open ocean to reach suitable winter habitat and must consume enough prey to sustain themselves. Documenting the winter migrations of newly weaned fur seals will provide crucial information on winter foraging habitat preferences and the potential importance of oceanographic features to the foraging behavior and survival of this age group. This project aims specifically to determine 1) the migratory movements and winter destinations of northern fur seals in their first year at sea; 2) the foraging activity of this age group as inferred from diving data, when available, or with less certainty, from the amount of time spent in an area; and 3) the environmental factors influencing the spatial and temporal distributions of migration and foraging within and between years.

Research is being conducted at long-term study sites at seven breeding colonies on St Paul (SNP) and St George Islands (SNG), Pribilof Islands, and at the newer growing breeding colonies on Bogoslof Island (BOG, 54˚N, 168˚W) and, in cooperation with NNML's California Current Ecosystem Program, at San Miguel Island (SMI, 34˚N, 120˚W), California. In October/November 2005, 99 satellite transmitters were deployed on 48 female (F) and 51 male (M) pups at the various breeding sites (SNP (21F/23M); SNG (10F/10M); SMI (7F/8M); BOG (10F/10M)). All 99 pups are being tracked while at sea, and dive data are also being collected for 40 of the pups.

A cooperative study program was initiated on St. Paul Island with the local school where students are also involved in the study. A talk about the project was given to the students in November, and a web page is being developed to enable the students to track the pups (with their newly appointed Aleut names) in real time from their classroom.

*By Mary-Anne Lea and Tom Gelatt*

## CALIFORNIA CURRENT ECOSYSTEM PROGRAM

### San Miguel Island Research Program

In collaboration with the Alaska Ecosystem Program (see previous article), the California Current Ecosystem Program deployed satellite telemetry instruments on 10 adult female northern fur seals at San Miguel Island, California, in November 2005. The Alaska Ecosystem Program simultaneously deployed instruments on 20 adult females each at St. Paul Island in the Pribilof Islands and Bogoslof Island in the Aleutian Islands. The goal of the study is to describe migration and movements of northern fur seals throughout the Northeast Pacific. All the females departed the breeding colonies in late November. The females from San Miguel Island traveled northwest from the colony along the central and northern California coast, and by January females had reached the California-Oregon border (40° N). Females from the Alaska breeding colonies traveled south through the Aleutian passes and into the Gulf of Alaska, California Current, and other areas of the Northeast Pacific. By January some females were reaching the transition zone off the Canadian-U.S. border, while others were traveling southward offshore along the Pacific coast. Northern fur seals utilize multiple ecosystems during the annual life history cycle. During the summer reproductive season, northern fur seals feed in ecosystems near their breeding colonies in Alaska, Russia, and California. During the winter, they travel long distances to ecosystems with different oceanographic dynamics and prey communities in search of food to support the energetic demands of pregnancy and the pup rearing through the next reproductive season. The results of this study will provide an ecosystem-based foundation for understanding the role of seasonal oceanographic features and prey distribution in population trends of northern fur seals throughout their range.

Adult female northern fur seal at San Miguel Island, California, with satellite instrument attached in November 2005. Photo by Tony Orr.

The California Current Ecosystem Program deployed 10 satellite telemetry and three global positioning system (GPS) FastLoc instruments on adult female California sea lions at San Miguel Island in November 2005. The study is a collaboration with the University of California, Santa Cruz, Tagging of Pacific Pelagics (TOPP) program. Researchers at the University of California instrumented 10 adult females at San Nicolas Island, California, 60 miles southeast of San Miguel Island during the same time period. The focus of the study is to describe winter dispersal and foraging behavior of adult females from the two populations. Food habits data and previous foraging distribution studies suggest that adult females from the two populations feed in

FastLoc global positioning system instrument attached to adult female California sea lion at San Miguel Island, California, November 2005. Photos by Tony Orr.

different feeding areas along the central California coast. The GPS FastLoc instruments are prototypes produced by Wildlife Computers. When the instruments are recovered in late January, they will provide detailed movements and diving data at a higher resolution than that available through satellite telemetry instruments currently available. Such information will allow a finer scale to interpret habitat requirements for the species and will assist management agencies in evaluation of potential resource conflicts between fisheries and California sea lions in California.

*By Sharon Melin*

## CETACEAN ASSESSMENT AND ECOLOGY PROGRAM

### Southeast Alaska Offshore Killer Whales

Since 1991, Southeast Alaska killer whales (*Orcinus orcas*) have been the focus of long-term investigations by NMML staff. Two to three trips are conducted annually aboard the NOAA ship *John N. Cobb* to survey throughout the inland waterways of Southeast Alaska. Killer whale abundance, trends, and short- and long-range movements have been documented through photo-identification methodology. Stock structure has been determined through biopsy sampling and genetic analysis. We have established that three, distinct ecotypes of killer whales inhabit the study area termed: resident, transient, and offshore. Although considerable data exist on the resident and transient form of killer whale, little is known about the offshore type.

Offshore killer whales were first seen in Southeast Alaska in 1989. It was assumed these whales entered inland waters from pelagic areas, thus the name "offshores." As more sightings of offshore killer whales became available, the following characteristics appeared to be consistent among this ecotype. It was clear that morphologically, offshore whales more closely resembled resident whales than transient whales. However, the overall size of offshore whales appeared to be smaller than that of resident and transient whales. Given the smaller overall size of an adult offshore male, less sexual dimorphism was observed between adult males and females. In the offshore form, the tip of the dorsal fin is rounded, similar to those of resident whales, however, unlike the resident form, the offshore dorsal fin is round over the entire tip with many whales having multiple nicks on the trailing edge. Nicks are obtained at a rapid rate; the cause of this is unknown. Saddle shape of offshore whales is similar in size to that of resident whales and is typically closed (i.e., no intrusion of black pigmentation into the gray saddle); however, saddle shape does vary. Offshore group size can range from several members up to 200 whales.

Although the ranges of the three ecotypes overlap, offshore whales have not been seen to intermix with resident or transient ecotypes. Unlike the movements of residents and transients, the movements of offshore whales appear to be long-range. Many of the whales we see in Southeast Alaska have also been seen in the Bering Sea and off Washington State and central California. (Photographic matches among regions are based on cooperative studies with several independent researchers). The high percentage of resightings of the same individual whales in various regions indicates that the overall population size may be relatively small. Considerable group mixing exists within the offshore ecotype, suggesting a more fluid association than that described for residents or transients.

The preferred diets of the three different ecotypes vary considerably. Resident whales are known fish eaters, whereas transient whales primarily prey on other marine mammals. Recently feeding ecology of killer whales has received much attention, with transient killer whale predation being linked to population declines of pinnipeds and sea otters in western Alaska. Little is known about the diet of offshore whales, but it is assumed they target fish as their primary prey. To verify food preferences of offshore whales, skin and blubber samples have been analyzed for both contaminant levels and stable isotope/fatty acid profiles by our colleagues at the Northwest Fisheries Science Center (Montlake Laboratory; contact M. Krahn). Results of these analyses suggest that offshore killer whales are consuming prey species that are distinctly different from the resident or transient ecotype.

*By Marilyn E. Dahlheim*

### Assessing Humpback Whale Populations Across the North Pacific: The SPLASH Project

Humpback whales (*Megaptera novaeangliae*) are distributed throughout the world's oceans. They are great wanderers and travel what is probably the longest migration of any mammal, going distances

A humpback whale surfaces in the midst of a sea of birds. Dozens of humpbacks join hundreds of thousands of sooty shearwaters to feed on krill off Unalaska Island. Photo by Erin Falcone, Cascadia Research.

that can exceed 5,000 miles between the cold, productive waters of high latitudes and warm seas in tropical climes. In summer, humpback whales fatten up on krill and small fish and in late autumn begin their long migration to winter breeding and calving grounds in low latitudes. During this time, calves are born, males sing complex songs and compete for females, and the whales fast for weeks or even a few months.

Whaling reduced nearly every humpback whale population to a fraction of its original size, and in some areas (such as South Georgia in the South Atlantic) stocks were completely destroyed. The North Pacific was once host to many humpbacks; we don't have a precise population estimate, but we do know that their population exceeded (perhaps greatly) 10,000 animals. Humpbacks are found across the entire North Pacific Basin, from California and Central America to Alaska and west to Hawaii, Russia, Japan, and the Philippines. In the 1970s, biologists recognized that each humpback whale had a unique pattern of black and white markings on the underside of its tail, similar to a human fingerprint in that no two patterns are alike. As a result, photographs of the tail (usually raised in the air when a whale dives) can be used reliably to identify individual whales. This technique has been widely applied to long-term investigations of living whales in many places in the North Pacific, and some of these studies have entered their fourth decade; indeed, some whales observed at the beginning of these projects are still being photographed today. Tracking individuals over time in this way has proved immensely useful. Most knowledge today about the biology and behavior of humpback whales is a direct result of these long-term studies.

A few years ago, scientists working on humpback whales in the North Pacific joined forces to plan a comprehensive study of the species across the ocean basin. This large-scale project goes by the acronym SPLASH (Structure of Populations, Levels of Abundance and Status of Humpback whales) and involves scores of scientists from many countries. The primary objectives of the SPLASH study are to determine the number of humpback whales in the North Pacific and gather information about their population structure.

SPLASH uses a combination of established photo-identification methods (recognizing individual whales from their tail patterns) and molecular genetics to meet SPLASH objectives. Skin samples are obtained from whales by use of harmless biopsy darts that extract small plugs of skin and blubber. These samples can be used for hundreds of genetic experiments as well as sophisticated analyses relating to diet and pollutants.

In collaboraton with scientists from other institutions in California, Washington, Alaska, Canada, and Russia, NMML researchers conducted work on humpbacks during the summer of 2005, the second feeding season sampled for the SPLASH project. NMML's task was to sample whales off Kodiak Island, along the eastern Aleutian Islands, and in the Bering Sea, from early August to mid-September, aboard the NOAA ship *Oscar Dyson*. The cruise was plagued with bad weather and mechanical problems which forced the cancellation of the third leg in late September; despite this, sam-

A humpback whale dives off Dutch Harbor with the NOAA Ship *Oscar Dyson* in the background. Photo by Phil Clapham.

pling was remarkably successful. Several large aggregations of humpbacks were encountered, and the cruise obtained 360 biopsy samples of humpback whales and close to 500 tail photos for individual identification. Along the way, skin samples were also obtained from killer whales, fin whales, gray whales, and Baird's beaked whales.

The second leg of the cruise in late August visited the remains of two commercial whaling stations: Port Hobron on Kodiak Island and Akutan on Akutan Island. These stations operated from 1926 to 1937 and from 1912 to 1939, respectively; they caught many humpback whales as well as other species, including the now extremely rare right whale. NMML scientists were pleased to find whale bones still present at Akutan and collected some for DNA analysis.

Skin samples from the summer cruise will go to the Southwest Fisheries Science Center in La Jolla, California, for genetic analysis which will help to determine population structure as well as sex and genotype of all sampled whales. Photographs go to the central SPLASH archive at Cascadia Research in Olympia, Washington, where they will be compared to thousands of other photos taken throughout the North Pacific. Photographic and genetic matches of the same whale observed in more than one location will provide important insights into population structure and migratory movements. It will be some time before the results of this huge study are fully analyzed, but when they are we expect to have a much more thorough picture of the status and biology of humpback whales in the North Pacific.

*By Phil Clapham, Paul Wade, and Tony Martinez*

### Cook Inlet Beluga Habitat Analysis

More than half of Alaska's residents live in the area immediately surrounding Cook Inlet**,** a semi-confined body of water which is home to a small, isolated population of beluga whales. With less than 300 animals remaining, the Cook Inlet beluga population is susceptible to local physical, ecological, and anthropogenic stressors. Current plans to further develop portions of Cook Inlet make identifying habitat requirements particularly timely for this beluga population.

Geographic information systems (GIS) and various statistical techniques are powerful tools that have helped elucidate the relationship between several environmental parameters and the summer distribution of beluga whales. Classification and regression tree (CART) and resource selection function (RSF) models were used to determine the ecological importance of bathymetry as well as the distance from river inlets (categorized as low, medium, or high according to rate of river flow) and proximity to mudflats. The CART model provided insight on the underlying structure of the data while the RSF model allowed environmental variables to be assessed individually based on the level of significance. The importance of the rate of river flow varied slightly between the models, but in general belugas preferred to be near higher flow rivers and proximate to mudflats. Using GIS to map the results from the RSF model resulted in a spatial depiction of available beluga habitat (Fig. 1).

In addition to the environmental factors already being examined, proposals are underway to examine biological factors (such as prey availability) as well as

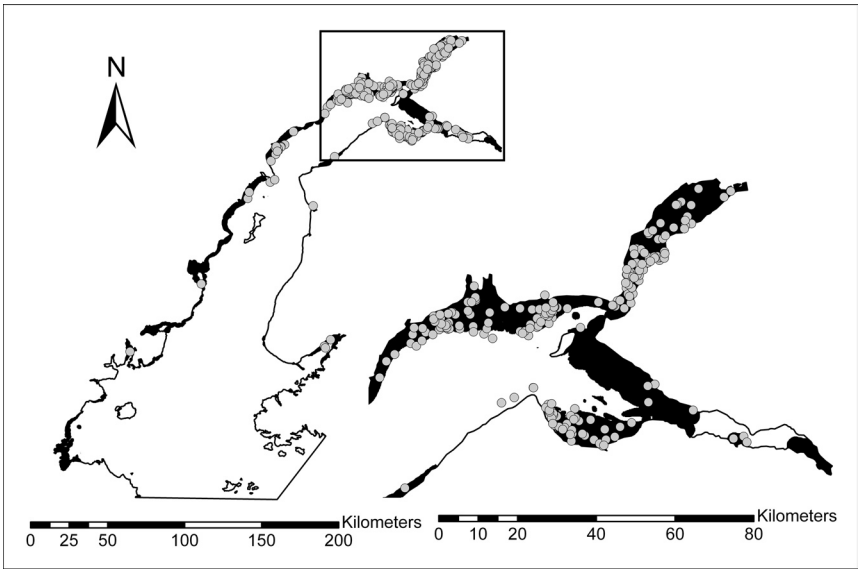


Figure 1. Cook Inlet beluga habitat (black) predicted by the Resource Selection Function model with beluga sightings shown in gray. The right side of this figure shows a magnification of the boxed area.

anthropogenic factors that may be influencing the distribution of belugas in Cook Inlet. In the future, we hope to increase the predictive power of habitat models by accounting for activities such as fishing, oil and gas activity, military action, and transportation. Overall, the current and future work involved in determining beluga habitat provides an example of how the interdisciplinary integration of GIS and statistical modeling can reveal important aspects of the habitat requirements of this depleted stock of whales.

*By Kim Goetz*

# RESOURCE ASSESSMENT & CONSERVATION ENGINEERING (RACE) DIVISION

## GROUNDFISH ASSESSMENT

### Groundfish Systematics

James Orr, Duane Stevenson, and Elaina Jorgensen are continuing work on the taxonomy and systematics of several families of fishes, most recently skates, snailfishes, rockfishes, and eelpouts, and cephalopods. Orr and Stevenson with Jerry Hoff and John McEachran (Texas A&M University) are preparing the description of a new species of skate from the Aleutian Islands, as well as participating in a study with Ingrid Spies and Mike Canino in their genetic analysis of skates of Alaska. Orr's research on snailfishes has expanded with descriptions of four new species of *Allocareproctus* with Morgan Busby, two new species of *Careproctus* with Katherine Maslenikov of the University of Washington Fish Collection, and several new species of *Paraliparis* with Zachary Baldwin, an undergraduate intern from the University of Washington. Orr's work with Sharon Hawkins of Auke Bay Laboratory on the recognition, identification, and nomenclature of species of the rougheye rockfish complex is continuing. Stevenson's description (with M. E. Anderson) of the new species *Bothrocara nyx* has now been published, and Stevenson and Orr's description of a new species of eelpout of *Lycodes* is in press. Stevenson's most recent research is focused on the systematics of eelpouts, including a revision of the genus *Bothrocara* (with Anderson and G. Shinohara), during which he has recognized the presence of at least three additional species in the eastern Bering Sea. He is also conducting an examination of morphological variation in *Lycodes diapterus* from across its entire range in the North Pacific in an effort to better understand its taxonomy. Both Orr and Stevenson have recently published notes on the distribution of fishes in the Bering Sea, including two species of deep sea skates, *Bathyraja abyssicola* and *Amblyraja badia*, the slickhead *Roulenia attrita* (with Chris Kenaley, University of Washington), as well as the snailfish *Paraliparis paucidens* and the deep-sea cuskeel *Bassozetus zenkevitchi* (with Beth Sinclair and Bill Walker of the National Marine Mammal Laboratory). Cephalopod taxonomic research is being conducted by Elaina Jorgensen. She is preparing guides to the both the adults and early life history

stages of cephalopods of the North Pacific and, with Louise Allcock of Queen's University Belfast, is working on the redescription of a small, very common octopus found on the Bering Sea slope.

*By Mark Wilkins*

### Juvenile Rockfish Distribution and Habitat

During the fall quarter Chris Rooper continued to analyze sidescan and multibeam sonar and video data collected at the Islands of Four Mountains rockfish habitat study sites. A method for characterizing and mapping seafloor habitat using these data was developed and described in a manuscript that is currently undergoing internal review. Analysis of juvenile rockfish distribution and habitat use in the study area has also continued during the fall. A web site documenting the progress and results of this project has been launched on the AFSC web site at *http://www.afsc.noaa.gov/race/groundfish/habitat/POP/pop_intro.htm*.

*By Mark Wilkins*

Figure 1. Free-fall cone penetrometer (FFCPT) being deployed with free-fall winch. Photo by Robert McConnaughey.

### Free-Fall Cone Penetrometer Tested Near Halifax

The RACE Division participated in sea trials of a free-fall cone penetrometer (FFCPT) (Fig 1). This technology is being developed for groundtruthing of Alaska fish habitat from an underway vessel. The 26-28 November cruise aboard the Canadian Forces Auxiliary Vessel *Quest* was conducted by scientists and engineers with Defence R&D Canada (DRDC), a research arm of the Canadian Navy, and Brooke Ocean Technologies Ltd. (BOT), manufacturer of the FFCPT. *Quest* is a 76-m general-purpose research vessel with responsibility for evaluating prototype ocean systems with potential military applications. Chief Scientist for the cruise was Dr. John Osler, Group Leader, Ocean Sensing and Modeling, DRDC Atlantic in Dartmouth, Nova Scotia.

The FFCPT is a free-falling probe designed to measure in situ sediment properties. It is a 1.6-m long, 9-cm diameter cylinder with modular sections for sensors, batteries, ballast, and data storage. The basic FFCPT weighs approximately 40 kg, with the option of adding additional ballast for harder bottoms in deeper waters. The geotechnical sensors measure deceleration and dynamic sediment pore pressure during penetration into the seabed, providing two independent means of calculating undrained shear strength (a measure of resistance to deformation). During each drop of the probe, these data are recorded at a rate of 2,000 measurements per second. These same measurements can also be used to interpret the dominant sediment texture. A combined sound velocity and pressure sensor is located above the stabilizing tail fin, and an optical backscatter sensor in the nose cone senses the mud-water interface.

This leg of the *Quest* cruise left Halifax harbor on 26 November, after waiting for Hurricane Rita to pass through the area, and proceeded along the south shore of Nova Scotia to the study area in St. Margaret's Bay. The overall objective was to evaluate feasibility of underway geophysical sampling by integrating the FFCPT with a free-fall winch system. This capability would enable more rapid environmental assessments than are possible with static on-station sampling and is a requirement for NOAA deployments in Alaska because of the enormous area involved. For the first time, multiple-drop underway sampling was accomplished in sand, silty sand, and silty bottoms at speeds of 3.5-6.0 kts. Maximum penetration of the probe exceeded 2.5 m in the softest areas. Interestingly, the pull-out loads (kg) required to extract the FFCPT from the seabed generally decreased as vessel speed increased.

The RACE Division, in cooperation with other NOAA line offices has already installed a free-fall winch on NOAA ship *Fairweather* enabling underway sound velocity measurements during acoustic survey operations. A FFCPT will be added to the system in Spring 2006, to aid interpretation of seabed characteristics in support of fish habitat research.

*By Robert McConnaughey*

## NEWPORT LABORATORY: FISHERIES BEHAVIORAL ECOLOGY PROGRAM

### Density-Dependent Habitat Selection In Juvenile Flatfishes

The distribution of juvenile fishes in nursery grounds is determined by behavioral responses to environment variables (sediment type, structure, prey availability). Therefore, the distributions are assumed to reflect habitat preference and used to determine which habitats are deemed "essential" or "critical" to the population. However, the relationships between fish distribution and habitats are complicated by density-dependent responses. The reasons for density-dependent responses are not known but are generally assumed to be related to competition for food or conspicuousness to predators. As a result, habitats that are not preferred when populations are at low densities are used to a greater degree when density in the preferred habitat rises. The principles of density-dependent habitat selection were first outlined for birds, but these models have subsequently been adapted to fisheries science with the "basin hypothesis." In general, these models predict how motile animals should distribute themselves as high-quality habitats become saturated with conspecifics. The effects of density on habitat use by juvenile flatfishes are the subject of several related projects being conducted in the Fisheries Behavioral Ecology Program (FBEP).

In one series of experiments, Thomas Hurst and intern Clara Lampi examined how density of northern rock sole affected the frequency of nighttime swimming behavior. In this experiment, fish were initially stocked onto one side of a 3-m diameter tank at densities from 1.2 to 12 fish $m^{-2}$. The fish were allowed to swim over a barrier to move to the other side of the tank which was not stocked with fish. Nighttime swimming of flatfishes in the water column and at the surface is a widely observed but poorly understood aspect of the behavior of juvenile flatfishes. The use of nighttime swimming by northern rock sole was described in a recent paper (Hurst and Duffy 2005) and is believed to be an important mechanism of redistribution in heterogeneous environments. Per-capita rates of redistribution (into empty habitat) increased from approximately 18% at the lower stocking densities to 30% at the highest stocking density (Fig. 1). Additional trials indicated that nighttime redistribution was not sensitive to the presence of epibenthic structure. Hence, structured habitats that fish congregate in during the day may "leak" fish into surrounding habitats at night when densities reach certain levels.

In separate experiments, Ben Laurel is comparing the density-dependent habitat selection of juvenile northern rock sole and Pacific halibut. Both species are known to strongly prefer sandy sediment over coarser gravels. In this experiment, the preference of fish for sand substrate is tested at varying fish densities and sizes to determine if increased fish

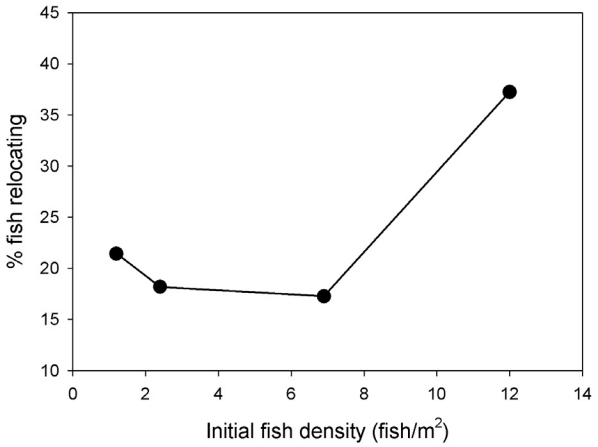


Figure 1. Net rates of redistribution of northern rock sole by nighttime water column swimming as a function of fish density. Inset: the rate of nighttime redistribution was not affected by the presence of benthic structure (sponges) in either side of the experimental arenas.

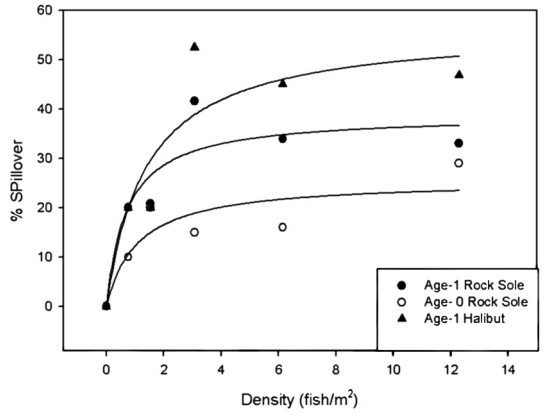


Figure 2. Percentage spillover (fraction of fish) from a preferred substrate (sand) to the non-preferred substrate (gravel) as a function of fish density. Data is for age-0 northern rock sole, age-1 northern rock sole and age-1 Pacific halibut.

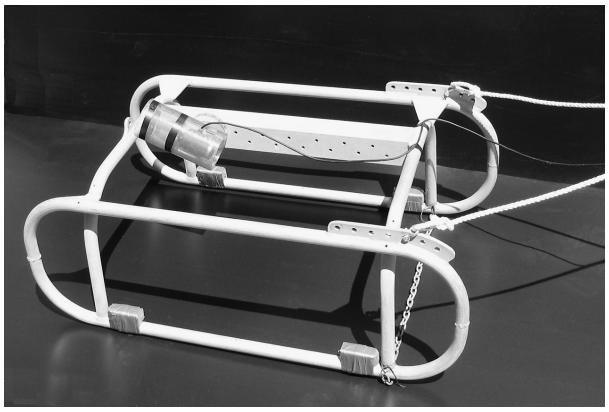

Figure 3. Photograph of camera sled developed by FBEP researchers and used to examine the habitat characteristics and distribution of juvenile flatfishes in nearshore Kodiak Island nursery areas.

densities result in greater usage of the less preferred substrate. Preliminary results (Fig. 2) indicate that habitat selection of age-0 rock sole is less sensitive to fish density than that of age-1 rock sole or age-1 halibut. Age-0 rock sole were less likely to leave the preferred substrate as fish density increased.

Examination of the interaction between fish density and habitat selection is also being conducted in the field. FBEP researchers have developed a towed camera sled for the examination of juvenile flatfish distributions and habitat associations (Fig. 3). The benefit of this camera system is that it provides continuous and spatially-explicit (through navigation linkage) sampling of fish, benthic bedform, water temperature, and biological components of habitat not effectively sampled with trawls. This camera system has been used to survey flatfishes and their habitats in several Kodiak Island nursery areas over the last 4 years. Data from these surveys, analyzed at multiple spatial scales with generalized additive models (GAM), demonstrate a strong nonlinear effect of worm tubes and other structural features on flatfish density, in addition to effects of sediment type and bedform.

In an extension of this project, Ben Laurel is using data on the fine-scale distribution of juvenile flatfishes in Kodiak Island nursery areas to examine the patchiness of fish and habitats. Patchiness measures are often used to describe the variable spatial and temporal patterns in the distribution of marine fish. Such measures are particularly useful during early life stages as they describe the points where passive contributions (i.e., larval drift) weaken and behavioral processes begin. Although several studies have measured patchiness in the field, none have explicitly linked active habitat selection with patchiness estimates. Successfully linking patchiness measures to process-derived measures of habitat selectivity will provide a powerful tool in categorizing essential fish habitat for exploited marine species.

*By Thomas Hurst*

# RESOURCE ECOLOGY & FISHERIES MANAGEMENT (REFM) DIVISION

## RESOURCE ECOLOGY AND ECOSYSTEM MODELING PROGRAM

### Fish Stomach Collection and Lab Analysis

Laboratory analysis was performed on 2,760 groundfish stomachs from the eastern Bering Sea and 618 stomachs from the Aleutian Islands and Gulf of Alaska. During this quarter, no stomachs were returned by Observers. In total, 9,720 records were added to the groundfish food habits database.

*By Troy Buckley, Geoff Lang, and Mei-Sun Yang*

### Ecosystem Considerations

The Ecosystem Considerations section of the Stock Assessment and Fishery Evaluation (SAFE) document was updated again in 2005 and includes an ecosystem assessment, updated status and trend indices, and ecosystem-based management indices and information. This report is made available to stock assessment scientists and the North Pacific Fisheries Management Council (NPFMC) and the public in the fall of each year, and the information in this report is used in scientific evaluations in stock assessments and the Environmental Assessment that are also provided to management. One of the additions and improvements to the report this year is an executive summary which highlights important and recent trends in climate, biology, and fishing impacts. Also, a new web site has been developed that provides access to the contributions as well as to data time series summarized in the report (online availability is planned for mid-2006).

Notable trends include recent warm conditions in the eastern Bering Sea (EBS) and a long-term warming trend in shallow waters of the Gulf of Alaska (GOA). This year, there were two apparent "red flags" in the EBS. First, there was a persistent decline of summer net zooplankton (e.g., large copepods such as *Calanus marshallae*), which are important prey for fish, including walleye pollock, seabirds, and baleen whales. If the low abundances

of these prey items continue, there may be declines in consumer populations or range shifts northward to areas where these copepods might be expected to remain abundant. The second flag was less certain. Declines in annual surplus production (ASP) in the EBS were observed, in spite of relatively stable abundances and exploitation levels. Excluding the most abundant groundfish species that dominate observed trends, annual surplus production trends also showed strong and significant declines in all nonpollock species from 1978 to 2004 in the Bering Sea and declines in stocks, excluding pollock and arrowtooth flounder, in the GOA over this same period. These declines may be a reflection of changes in either annual primary production or changes in food web structure. If these declines in annual surplus production are the result of climate change and if the current climate conditions persist, future fish production in the EBS is expected to be lower than in previous decades. However, if the declines in surplus production are a function of density-dependent factors resulting from moderate to high biomass levels, then the declines are not a "red flag" but rather a natural response to changes in stock size.

*By Jennifer Boldt*

### Ecosystem Modeling

Ecosystem modeling and food habits analyses were used extensively in the 2005 North Pacific Fishery Management Council's (NPFMC) Gulf of Alaska pollock stock assessment. In particular, trends in predator consumption of pollock (based on stomach sampling and survey estimates of predator bioamass) were examined in light of concerns of decreasing pollock biomass coupled with rising populations of arrowtooth flounder, a major predator of pollock. Consumption rates of four groundfish predators: arrowtooth flounder, Pacific cod, Pacific halibut, and walleye pollock were compared to numbers-at-age of juvenile pollock estimated by the stock assessment. During years of low age-2 recruitment, consumption of juvenile pollock by predators was uniformly low (Fig. 1). With increasing pollock abundance, consumption of pollock increased, but seemed to level off or even decline in high recruitment years, perhaps indicating predator satiation or a separation of pollock from predators in high recruitment years. In order to include changing natural mortality rates directly in stock assessments, more consideration of the bioenergetics of predators, particularly arrowtooth flounder, will be required.

*By Kerim Aydin*

### Stable Isotope Analysis of Albatross Diets

The impact on North Pacific seabirds of provisioning (i.e., food availability through discards and offal) by the Alaskan groundfish fishery continues on two fronts: a quantitative analysis of fish and fish parts returned to the sea and a stable isotope (delta-15N) study investigating the use of fisheries discards and offal by Laysan and black-footed albatrosses (Fig. 2). In consultation with fishing industry representatives, we are estimating at-sea offal discharge rates based on product recovery rates and total retained catch estimates. An important component of this investigation is a comparison of discharge rates between at-sea and shore-based processors, with particular emphasis on the presence or absence of fish meal plants at the processing facilities.

The delta-15N value of an animal's tissue is indicative of the level at which that animal feeds in the food chain. Higher values correspond to higher trophic levels. Preliminary data from the delta-15N values of feathers clearly show that the diets of Laysan and black-footed albatrosses have shifted over the last 80 years, a period corresponding to the rise of large-scale commercial fisheries in the

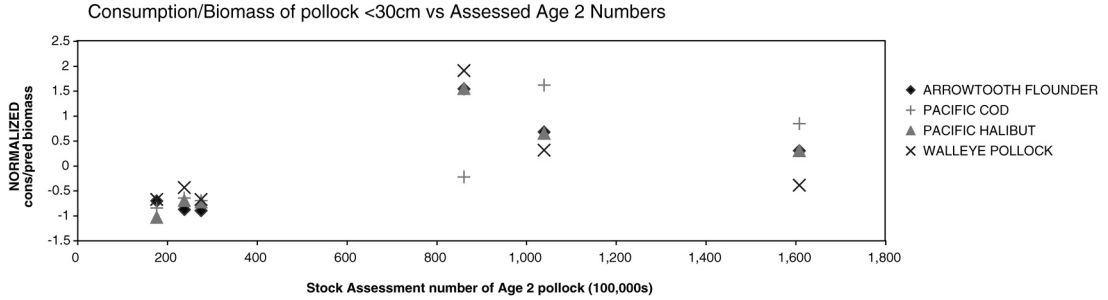


Figure 1. Normalized consumption per unit biomass (g/g wet weight) of pollock <30cm fork length, plotted against age-2 pollock numbers calculated from the 2005 pollock stock assessment.

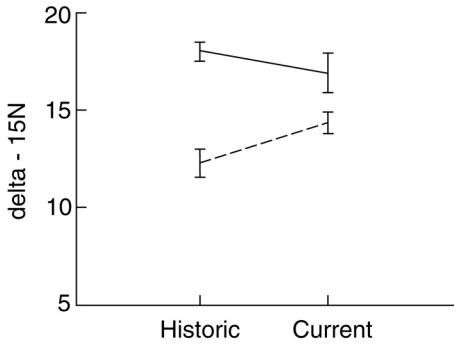


Figure 2. Delta-15N values (mean ± standard error) of Laysan albatross (dotted line) and black-footed albatross (solid line) feathers. Values are indicative of diets in July. Historic birds were collected on the breeding colonies before 1925. Current birds were collected predominantly behind fishing vessels since 1995. *n* = 15 for each category.

North Pacific. Historically (before 1925), the diets of Laysan and black-footed albatrosses during the nonbreeding season differed by an average of almost two trophic levels. Currently (after 1995), the diets of Laysan and black-footed albatrosses collected mostly behind fishing vessels differed on average by less than one trophic level. Thus, the dietary overlap of these two closely related but distinct species has increased with the advent of commercial fishing. The shift in delta-15N values from a "natural" diet before 1925 to a fisheries-enhanced diet today produces a quantifiable, stable isotope "fisheries signal" (most notable in Laysan albatrosses). This signal provides a tool for investigating the population-level effects of fisheries on albatrosses.

*By Ann Edwards*

### Seabird Interactions

The REEM Seabird Program focused on addressing requirements in the short-tailed albatross Biological Opinion (BiOp) published in 2003 (available from the Alaska Regional Office web site at *http://www.fakr.noaa.gov/protectedresources/seabirds.html*). In coordination with the AFSC's new Fisheries Monitoring and Assessment Division, several at-sea fishery observer projects have been implemented to begin addressing the BiOp's nondiscretionary requirements. Several other BiOp requirements are being addressed, including an assessment of how important trawl sonar (third wire) technology is to the Alaskan fleet and analyzing trawl and third wire effort among the fleet. Another requirement was met by summarizing observer checks of seabird avoidance gear on longline vessels during 2004 (see Table 1). Observer data are also being used along with catch information from the NMFS Alaska Regional Office to provide estimates of seabird incidental takes through the 2004 fishing season. Analysis was completed by Michael Perez of the National Marine Mammal Laboratory, and REEM Program staff are preparing summary tables and graphs for public distribution. This information will be available on the AFSC's web site at *http://www.afsc.noaa.gov/refm/reem/Seabirds/Default.htm*. A large component of the freezer longliner fleet started using paired streamer lines at the start of 2002, before regulations were implemented. The average annual seabird incidental takes for demersal longline (all fisheries combined) for the years before and after paired streamer lines were being used is 15,888 from 1993 through 2001 and 4,910 from 2002 through 2004 -- a 70% reduction.

REEM Program staff are also coordinating with the Migratory Bird Management Division of the U.S. Fish and Wildlife Service, Anchorage, Alaska, to implement a seabird sighting survey program that takes advantage of current research, charter, and possibly fishing vessels while in transit or on station. Funds were applied for through the North Pacific Research Board that would support materials, travel costs, and data management for dedicated seabird observers on vessels of opportunity.

*By Shannon Fitzgerald*

## ECONOMICS AND SOCIAL SCIENCES RESEARCH PROGRAM

### Protected Marine Species Economic Valuation Survey

Estimates of the economic benefits of protecting threatened and endangered marine species are often needed by resource managers and policy makers to assess the impacts of alternative management measures and policies that may affect these species. However, few estimates of the benefits of protecting marine species exist, and none exist for many species protected by NOAA's National Marine Fisheries Service (NMFS). To begin filling this information gap, Dan Lew has begun working with several other NMFS economists on a nonmarket valuation survey research project to estimate the value of protecting several protected marine species.

Numerous cetacean, pinniped, sea turtle, and fish species have been selected for inclusion in the study, and preliminary survey materials are being

Table 1. Summary of seabird avoidance measures used in 2004 by demersal groundfish longline catcher-processor (CP) and catcher (CV) vessels in the Bering Sea (BS), Aleutian Islands (AI), and Gulf of Alaska (GOA) Regions of Alaskan waters while NMFS-certified groundfish observers were on board. Vessels 60 feet length overall and larger have 100% or 30% observer coverage of fishing days depending on vessel size. Observers spot-checked for avoidance gear during the set but did not monitor the entire setting process.

| Period[1] | Region | Vessel Type | Total Sets | Sets not Checked | Sets Checked | % Sets Checked | Paired Steamer | Single Streamers | No Streamers | % Paired or Single |
|---|---|---|---|---|---|---|---|---|---|---|
| Prior to Regulations | BS | CV | 0 | - | - | - | - | - | - | - |
| | BS | CP | 2,885 | 979 | 1,906 | 66.1 | 1,732 | 96 | 78 | 95.9 |
| | AI | CV | 0 | - | - | - | - | - | - | - |
| | AI | CP | 0 | - | - | - | - | - | - | - |
| | GOA | CV | 61 | 9 | 52 | 85.3 | 14 | 14 | 24 | 46.2 |
| | GOA | CP | 318 | 51 | 267 | 84.0 | 263 | 4 | 0 | 100.0 |
| | Subtotal | | 3,264 | 1,039 | 2,225 | 68.2 | 2,009 | 114 | 102 | 95.4 |
| After Regulations | BS | CV | 79 | 0 | 79 | 100.0 | 79 | 0 | 0 | 100.0 |
| | BS | CP | 13,945 | 4,496 | 9,449 | 67.8 | 8,116 | 1,034 | 299 | 96.8 |
| | AI | CV | 38 | 5 | 33 | 86.8 | 17 | 16 | 0 | 100.0 |
| | AI | CP | 1,455 | 785 | 670 | 46.1 | 512 | 39 | 119 | 82.2 |
| | GOA | CV | 871 | 127 | 744 | 85.4 | 654 | 72 | 18 | 97.6 |
| | GOA | CP | 1,261 | 391 | 870 | 69.0 | 797 | 30 | 43 | 95.1 |
| | Subtotal | | 17,649 | 5,804 | 11,845 | 67.1 | 10,175 | 1,191 | 479 | 96.0 |
| Total | | | 20,913 | 6,843 | 14,070 | 67.3 | 12.184 | 1,305 | 581 | 95.9 |

[1] New regulations requiring the use of streamer lines for vessels greater than 55 feet length overall became effective February 12, 2004. See *http://www.fakr.noaa.gov/protectedresources/seabirds/regulations.htm* for full text.

developed. The survey will employ stated preference questions to gather information on public preferences for protecting these species. The first set of focus groups to test a preliminary set of materials was held in early November. Changes were made based on the results of these groups, and a second set of focus groups is scheduled for early January 2006 to test the new versions and further develop materials. Due to the complexity of the issues and the number of species covered in the survey, it is anticipated that focus group groups and other qualitative pretest activities will continue through 2006 before the survey is ready to be field tested.

*By Dan Lew*

### Groundfish Market Data Collection and Translation

There is a need to improve our ability to conduct market studies on Alaskan groundfish fisheries in order to better understand the effects of changes in total allowable catches (TACs) on prices and revenue. Most of the empirical market studies of fish and/or fish products concentrate on market demand estimation. There are two likely reasons that demand studies tend to dominate this field. First, the supply of fish is often assumed to be an exogenously determined fixed variable. The second is that cost data for suppliers at various stages of the market chain is not available, making it difficult to impossible to estimate theoretically consistent supply functions derived from a model based on profit maximization. Therefore, in many cases the data required for market analysis is price and quantity data for various species and products.

During the past quarter we have worked with individuals within NMFS, the University of Alaska, and Japan in order to identify new sources of price and quantity data for seafood exported from Alaska to foreign countries. Unfortunately, in many cases the available data are not in an electronic format and must be converted in order to facilitate data analysis. In other cases, the data are in another language and must be translated in order to be utilized. At present we are working with a translator and data entry personnel in order to catalog these new additional data sources and put them in useable, interpretable, electronic formats. The goal will be to collect data on groundfish species and products, as well as price and quantity data for other species which may be useful when modeling the roles of substitute products. The availability of new data will improve the type and caliber of models that can be estimated and will improve our ability to answer policy-relevant questions.

*By Ron Felthoven and Harrison Fell*

### Collaboration With Southwest Region Economic Data Collection Project

The Manguson Stevens Act, National Environmental Policy Act, and other laws require economic analysis of proposed management actions, including an assessment of the local and regional economic impacts of such actions. For example, regional economic impact assessments are critical in meeting the requirements of National Standard 8. Published regional economic data for Alaska fisheries are highly aggregated, and do not provide detailed and reliable information needed for regional economic analysis of Alaska fisheries. Therefore, there is an ongoing need to improve the regional economic models by collecting primary data. For this project, contractors at the University of Alaska, Fairbanks (UAF) met with AFSC economist Chang Seung to discuss important issues associated with implementing the project. Specifically, the participants in the meetings discussed the availability of existing federal and state government fisheries data, discussed how to disaggregate the harvesting sector, and agreed that mail surveys and interviews with focus groups from industry will be major methods of obtaining regional economic information (such as expenditure and costs). After the meetings, the contractors examined the harvesting sector data that are available from the Commercial Fisheries Entry Commission files in order to develop a method to disaggregate these data. The contractors and Dr. Seung also discussed ways to validate survey results using some statistical procedures such as stratified sampling methods and associated estimators. The goal of this project is to undertake those tasks in order to improve our ability to conduct the requisite regional economic analyses. A similar data collection project will be conducted for the Gulf Coast region when the Southwest region project is completed.

*By Chang Seung*

### First Phase of Integrated Economic-Ecosystem Modeling Project Completed

Commercially valuable fish species are dependent on many other species and organisms dispersed throughout their habitat. Therefore, when formu-

lating renewable fishery resource policies, it is important to understand the ecological relationships between these species. It is also important to understand how these fishery resource policies affect human activity and the economy, and how human activity affects these species in a marine ecosystem.

The objective of our project is to develop an integrated ecological/economic model for Alaska fisheries that can track both ecological relationships and human activities. The ecosystem model to be developed will be combined with a computable general equilibrium (CGE) model. Such an integrated ecosystem approach will provide more useful information to policy-makers than stand-alone regional economic or ecological models for fisheries, and better satisfy the National Standard 8. The resulting integrated model from this research will serve as a decision-making tool for fishery management actions.

The first phase of the project has been completed. The principal investigators (PIs) prepared a report for the first phase of the project in which the PIs, for the second phase of the project identified the breadths of the ecosystem and regional economic models to be developed, determined the data needs, and identified the data sources. A workshop will be scheduled for February, in which the issues and areas of improvements for the integrated modeling will be discussed. During the second phase of the project, the PIs have developed a social accounting matrix (SAM) for the Alaskan economic CGE model, based on IMPLAN data (a commercially available set of data for conducting regional economic analyses). The base IMPLAN dataset necessarily underwent substantial modification due to deficiencies of the dataset. The 509 IMPLAN industry sectors were aggregated into four sectors, which include fish harvesting, fish processing, miscellaneous (a catchall for all other productive sectors in the state), and recreation and tourism. During 2006, once the SAM is satisfactorily completed, the work will shift to refining the economic and ecological system models.

*By Chang Seung*

### Stakeholder Concerns and Spinner Dolphin Management

Jennifer Sepez completed a NOAA rotational assignment at the Pacific Islands Regional Office. The region is concerned about the effects of "swim-with-wild-dolphins" tourism activity that has increased in recent years. NMFS is considering whether to propose regulations to protect wild spinner dolphins in the main Hawaiian Islands from "take," as defined in the Marine Mammal Protection Act (MMPA) and its implementing regulations, or from actions that otherwise adversely affect the dolphins (see *http://www.regulations.gov*). NMFS encourages members of the public to view and enjoy spinner dolphins in the main Hawaiian Islands in ways that are consistent with the provisions of the MMPA, and supports responsible wildlife viewing as articulated in agency guidelines *(http://www.nmfs.noaa.gov/prot_res/MMWatch/hawaii.htm)*.

Viewing wild marine mammals in Hawaii is a popular recreational activity for both tourists and residents alike. In the past, most recreational viewing focused on humpback whales *(Megaptera novaeangliae)* during the winter months when the whales migrate from their feeding grounds off the coast of Alaska to Hawaii's warm and protected waters to breed and calve. However, in recent years, recreational activities have increasingly focused on viewing small cetaceans, with a particular emphasis on spinner dolphins, which are routinely found close to shore in shallow coves and bays and other areas throughout the main Hawaiian Islands. These dolphins feed offshore at night, and return to the nearshore during the day to rest and socialize. NMFS is concerned that some nearshore human activities cause unauthorized taking of dolphins, diminish the value to the dolphins of habitat routinely used by them for resting, and cause detrimental individual- and population-level impacts.

Dr. Sepez interviewed stakeholders in the main locations where spinner dolphin tourism takes place. She met with a broad array of individuals with an interest in the issue, from residents who engage in swimming with dolphins on a regular basis, to opponents of the activity, to other ocean users who may encounter dolphins. She is currently drafting a report on her findings which will include a description of the types of interactions between humans and spinner dolphins at various locations, and a preliminary analysis of the impacts of different policy choices articulated by NOAA in the Advanced Notice of Proposed Rulemaking published in the Federal Register on 12 December 2005 (on the web at *http://www.gpoaccess.gov/fr/)*.

*By Jennifer Sepez*

### Two New Economists Join the Group

Two new economists were hired by the Economics and Social Sciences Research Program: Dr. Brian Garber-Yonts and Dr. Michael Dalton. Dr. Garber-Yonts was formerly a research economist with the Pacific Northwest Research Station in Corvallis, Oregon. He completed his M.S. in Resource and Environmental Economics in 1996 and his Ph.D. in Forest Policy in 2001, both at Oregon State University. Dr. Dalton received his Ph.D. in economics from the University of Minnesota in 1995 and was a postdoctoral research associate at Stanford University from 1995-1998 before joining the faculty at California State University at Monterey Bay in the fall of 1998. He is an economist (chair, economics subcommittee) on the Scientific and Statistical Committee of the Pacific Fishery Management Council and a recent Visiting Scholar in the Population and Climate Change program at the International Institute for Applied Systems Analysis (IIASA) in Laxenburg, Austria.

*By Ron Felthoven*

## STATUS OF STOCKS AND MULTISPECIES ASSESSMENT PROGRAM

### Groundfish Stock Assessments for 2006

#### Fishery Quota Recommendations

The Alaska groundfish management system is based on extensive data available from the NMFS Observer Program and dedicated research cruises. Catch of target and prohibited species (e.g., salmon, crab, herring, and Pacific halibut) are estimated at sea or in processing plants to provide real time information to ensure that fisheries do not exceed total allowable catches (TACs) or violate other fishery restrictions (like time-area closures). Dedicated research cruises coupled with observer data make it possible to build detailed population dynamics models. Results of these modeling activities are used to determine the status of individual species.

Establishing TACs involves annual evaluation of the best available scientific information through a series of documents and public meetings. The first step begins with the preparation of stock assessment and fishery evaluation (SAFE) reports. These reports contain analyses summarizing the information about the individual stocks and groups, and include acceptable biological catch (ABC) and overfishing level (OFL) recommendations for future years. The authors of these reports, generally NMFS scientists, present their findings to the North Pacific Fishery Management Council's (NPFMC) groundfish Plan Teams in September and November. At these meetings, the reports are reviewed, and recommendations for ABC levels are compiled into two SAFE report volumes (one each for the Bering Sea/Aleutian Islands (BSAI) and Gulf of Alaska (GOA) regions) along with Plan Team recommendations for ABC, which may differ from author recommendations. The compiled reports are then submitted to the NPFMC Scientific and Statistical Committee (SSC) for further review. The SSC makes the final ABC recommendation to the Council and the Council's Advisory Panel of industry representatives makes TAC recommendations. Finally, the recommended TAC levels are adjusted (for some species) by the Council to ensure that other constraints (e.g., limiting the sum of all TACs in the Bering Sea and Aleutian Islands to be less than 2 million t) are met. The following rule applies for all federally managed groundfish species in a given year: Catch $\leq$ TAC $\leq$ ABC $<$ OFL

In practice, catch is often much less than TAC and TAC is often much less than ABC. The multispecies management system is, therefore, based on the premise that no individual components are overfished or below stock sizes that are considered detrimental to the ecosystem. Stock assessments can be obtained at: *http://www.afsc.noaa.gov/refm/stocks/assessments.htm*.

In 2005 the Resource Assessment and Conservation Engineering (RACE) Divison's groundfish assessment group conducted a summer bottom trawl survey in the Gulf of Alaska (the previous such survey was in 2003). This survey, together with past estimates, indicate that groundfish biomass levels have increased from below 5 million t total in 1984 and 1987 to over 7 million t in 2003 and 2005. The main species groups to increase over this period were rockfish and arrowtooth flounder whereas other flatfish, Pacific cod, and walleye pollock show general declines. RACE's Midwater Assessment and Conservation Engineering (MACE) group conducted three major surveys in 2005: the winter echo integration-trawl survey in the Shelikof Strait and nearby areas, the winter Bogoslof Island region survey of spawning pollock from the Aleutian

Basin, and preliminary summer work developing a broader-scale echo integration-trawl survey within the GOA. Auke Bay Laboratory (ABL) scientists conducted the annual longline survey which is designed primarily for sablefish but also produces data used in Greenland turbot and some rockfish assessments. This survey covers the slope regions of the GOA along with segments of the Bering Sea and Aleutian Islands regions. The RACE Division's groundfish assessment group also conducted the standard summer-trawl survey for the EBS shelf area. Data from these main survey efforts are critical for groundfish stock assessments.

Ecosystem considerations sections were enhanced within individual assessment sections in addition to the 314 page document detailing an overall picture of the ecosystem status, available on the web at http://*www.afsc.noaa.gov/refm/docs/2005/EcoChpt.pdf.*

Presently, projections of 2006 spawning biomass for the main groundfish stocks are estimated to be above their target stock size ($B_{msy}$) and the 2005 catch levels were below $F_{msy}$ levels for both the BSAI and GOA regions (Figs. 1 and 2). Combined spawning biomass estimates for the main species in these regions appear to be stable overall (Fig. 3). Fisheries for these groundfish species during 2004 yielded 2.0 million metric tons (t) valued at approximately $1.7 billion after primary processing. The main pollock stock remains high and again yielded catches just over 1.5 million t. Virtually all flatfish resources (e.g., rock sole, yellowfin sole, Alaska plaice, and arrowtooth flounder) are at high and healthy levels but catches remain relatively low. Atka mackerel abundance is stable and at above-average levels. Rockfish species comprise 5%-8% of the groundfish complex biomass and are generally increasing based on recent surveys. For the main stocks with age-structured analyses, the spawning biomass trends compared with the average levels since 1977 are shown in Figure 4 for the GOA and BSAI. These figures suggest that stock conditions are fairly evenly split between those that are above average and below in the past few years.

### Gulf of Alaska (GOA)

In the GOA, full assessments were presented for 17 stocks and assemblages and an appendix on the status of forage fish was also prepared. The sum of the recommended ABCs for 2006 is 501,366 t which represents an 8% decrease from the 2005 total. The largest component of the decrease was from arrowtooth flounder (which dropped 18% from the 2005 ABC), followed by flathead sole (down 16%), and pollock (down 6%). These declines in ABCs were offset by increases in Pacific cod (+19%), deepwater flatfish (+27%) and Atka mackerel. Pacific ocean perch and shortraker and rougheye rockfish ABC levels increased slightly (~5%) while pelagic shelf rockfish increased substantively (+19%). Northern rockfish ABCs were the same as last year as further refinements to the model were requested prior to increasing the level as preliminary results indicate. Brief summaries of each GOA species or species group follows.

***GOA Pollock:*** The 2005 summer bottom trawl survey pollock biomass estimate was down 11% from the 2003 level while the winter Shelikof Strait EIT survey indicated a 2% increase from the 2004 estimate. The model estimate of spawning biomass in 2006 is 193,092 t, which is 35% of unfished spawning biomass and below $B_{40\%}$ (224,000 t). Estimates of stock status in 2006 are similar to 2005 and are consistent with survey trend estimates. Projections incorporating uncertainty in the stock assessment indicate that there is very low probability that the pollock stock will drop below critical levels in the near future.

The ecosystem considerations section for pollock was also substantially updated. This analysis confirmed that pollock are an important prey species in the GOA, especially for Pacific halibut, Steller sea lions, arrowtooth flounder, and Pacific cod. Analyses of food habits collections from 1990 through 2005 combined with estimates of predator consumption rates suggest that consumption of pollock by arrowtooth flounder is substantial, and consumption by arrowtooth, halibut, and cod combined accounted for the majority of pollock consumption in the ecosystem. While arrowtooth flounder cause the highest proportion of pollock mortality, they are less dependent on pollock than halibut and sea lions because pollock represent a relatively small proportion of the arrowtooth diet. Therefore, while a pollock decline might influence biomass trends for halibut, it is unlikely to do so for arrowtooth. Model simulations indicate that increased pollock mortality had stronger effects on halibut (and the halibut fishery) and sea lions than on arrowtooth flounder or other predators. Currently under way, the management strategy evaluation (MSE) analyses linked with

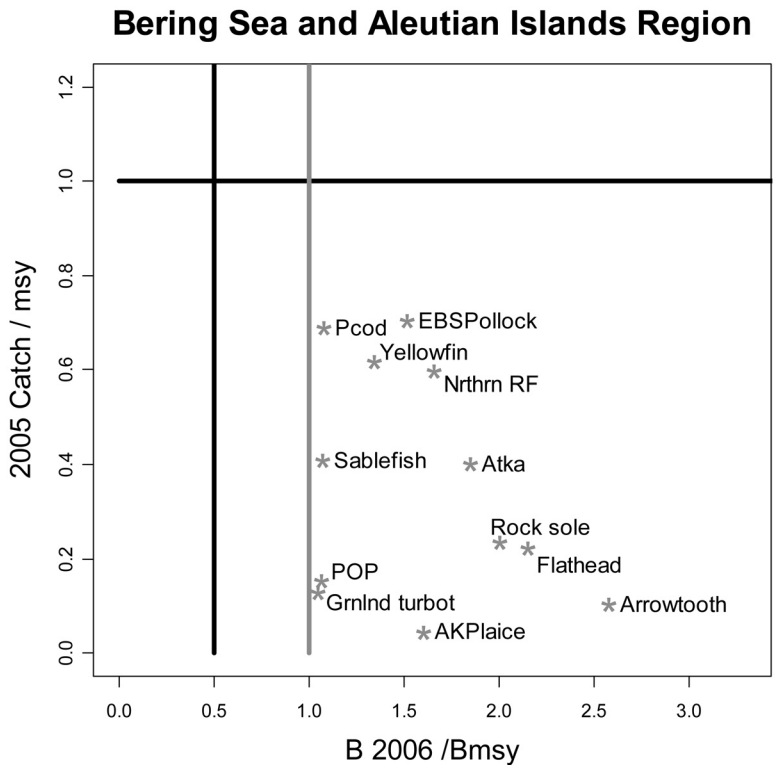


Figure 1. Relative 2006 spawning stock size compared to $B_{msy}$ (taken to be $B_{35\%}$ for all species except EBS pollock) versus relative 2005 catch levels compared to 2005 $F_{msy}$ levels for BSAI stocks.

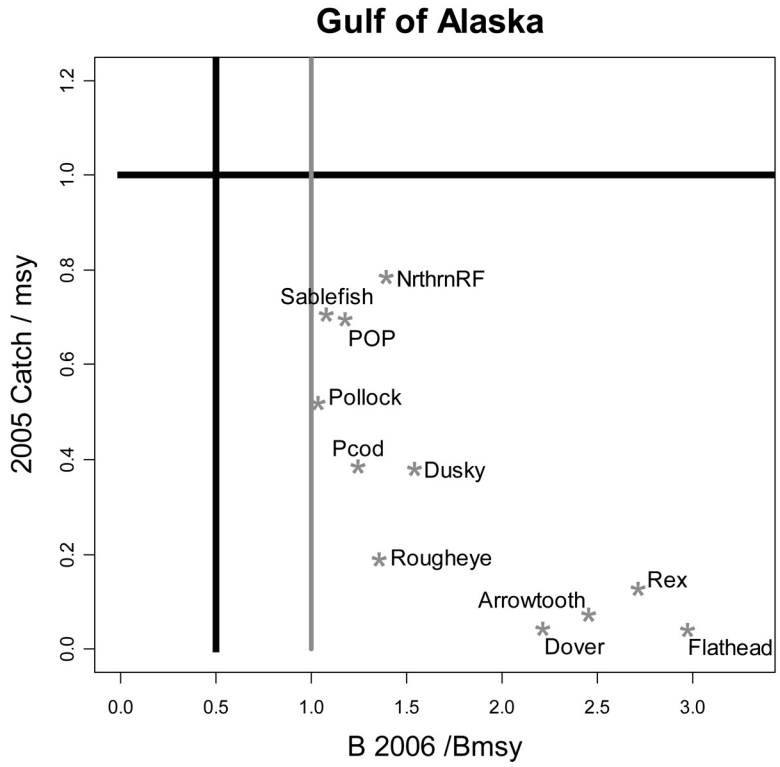


Figure 2. Relative 2006 spawning stock size compared to $B_{msy}$ (taken to be $B_{35\%}$ for GOA stocks) versus relative 2005 catch levels compared to 2005 $F_{msy}$ levels for GOA stocks.

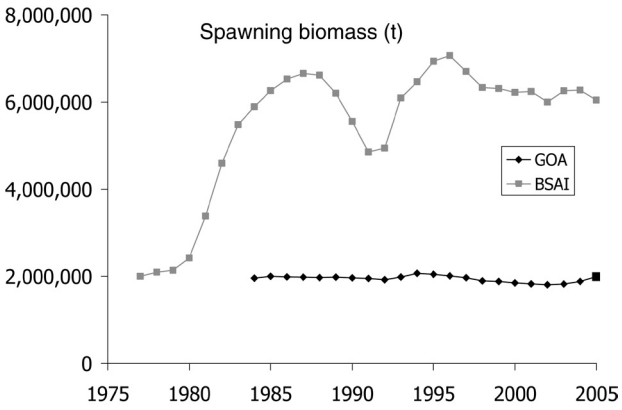


Figure 3. Spawning biomass trends for Bering Sea and Aleutian Islands (BSAI) and Gulf of Alaska (GOA) for all groundfish stocks combined (sablefish spawning biomass is included in the GOA total).

ecosystem modeling may provide advice on whether additional adjustments to ABC recommendations are needed.

***GOA Pacific Cod:*** The 2005 summer bottom trawl survey Pacific cod biomass estimate was up about 4% from the 2003 level to 308,000 t. The model estimate of spawning biomass in 2006 is 116,600 t, which is above the $B_{40\%}$ (106,800 t). The assessment was done using new software that allowed a number of enhancements over previous analyses. More significantly, revised estimates of maturity-at-age were used based on recent studies completed by James Stark (RACE Division). These new estimates resulted in substantially higher estimates of spawning biomass compared to previous years. Hence, the recommended ABC level is up 19% from last year to 68,859 t.

***GOA/BSAI Sablefish:*** The longline survey abundance index decreased 3% from 2004 level but is about 6% higher than the value for 2000. Spawning biomass is currently about 38% of the estimated unfished level and is projected to decrease to 34% by 2008 given current estimates of recruitment. The Council-recommended 2006 ABC was level compared to 2005 at 21,000 t. However, due to apparent changes in the relative densities of sablefish between areas, the ABC allocated to the GOA dropped by 7% while the ABC for the EBS and Aleutian Islands regions increased by 25% and 18%, respectively.

***GOA Flatfish:*** The 2005 survey estimate of arrowtooth flounder biomass (for the western and central GOA) was 1.65 million t compared to the 1984-2005 average of 1.4 million t. This compares with a value of 479,000 t for Pacific halibut and 661,000 t for all other flatfish species in this region. However, compared with the 2003 survey estimates the 2005 values are lower. For arrowtooth flounder the assessment model results in a 2006 ABC recommendation that drops by 18% to a value of 177,844 t (compared to a 2005 catch level of only 18,000 t). The other flatfish management groups and 2006 ABCs were deep water flatfish—8,665 t (compared to 2005 catch of 404 t); shallow water flatfish—51,450 t (compared to 2005 catch of 4,600 t); flathead sole—37,820 t (compared to 2005 catch level of 2,400 t); and rex sole—9,200 t (compared to 2005 catch level of 2,200 t). Enhancements to this year's group of flatfish assessments included greater consideration of ecosystem effects within each section and the adoption of a full age-structured model for Dover sole (included in the "deep water flatfish" group).

***GOA Rockfish:*** Total rockfish biomass as estimated from the 2005 NMFS bottom trawl survey was nearly double the average value since 1984 with 707,000 t for the western and central GOA and 123,000 t in the eastern GOA. The largest increases from the 2005 survey were due to Pacific ocean perch (up 61% relative to the average) and northern rockfish (up 116% relative to the average). Since most rockfish species are very patchily distributed, the survey estimates are very imprecise. Hence model estimates leading to ABC recommendations were significantly moderated. For Pacific ocean perch, the 2006 ABC increased by 5% to 14,261 t. For northern rockfish, the Council was presented with an array of models implementing a variety of new data. Further analyses were recommended and for precautionary reasons, the Council opted to keep the ABC the same as the 2005 level (5,091 t). For rougheye rockfish using a model introduced last year, the 2006 ABC dropped 2% to 983 t while the shortraker rockfish ABC was up 12% from last year to 843 t. Other slope rockfish (an assemblage of which 92% are silvergrey, sharpchin, redstripe, and harlequin rockfish) 2006 ABC increased 6% to 4,152 t. The pelagic shelf rockfish assemblage, 90% of which comprises dusky rockfish, 2006 ABC increased 19% to 5,436 t. Demersal shelf rockfish (comprising mainly yelloweye rockfish) 2006 ABC remained the same at 410 t. Shortspine thornyheads

biomass levels are stable or increasing slightly. The 2005 survey estimate dropped by 7% for shortspine thornyheads but the overall biomass is still 55% higher than the average level since 1984. This results in a 14% increase for the 2006 ABC (based on the average of the two most recent surveys) to 2,209 t. This compares to a 2005 shortspine thornyhead catch level of 720 t.

***GOA Atka Mackerel:*** The 2005 bottom trawl survey had a number of stations that contained significant quantities of Atka mackerel and the highly uncertain (CV = 50%) biomass estimate was up 65,500 t in 2003 to 100,900 t. Currently no directed fishing for Atka mackerel is allowed in the GOA due to Steller sea lion protection measures. The Council set the 2006 ABC to 4,700 and the TAC to 1,500 t (sufficient for bycatch needs in other fisheries).

***GOA Skates:*** The updated assessment used the most recent survey data for ABC and OFL recommendations. Other significant findings in this year's analysis were that skate catch estimates from the halibut fishery are larger than had previously been estimated. This heightened the concern of fishery development potentials for these stocks, particularly given that survey estimates suggest stable to slightly declining trends. The Plan Team and the Council continued to support conservation measures where "big" and "longnose" skate species are managed separately from the aggregate complex known as "skates" since these have been the target of developing fisheries in recent years. The less sought-after "other" skates (combined *Bathyraja* spp.) complex is managed separately as a third category within this assemblage.

#### Bering Sea/Aleutian Islands (BSAI)

The sum of the ABCs for 2006, as recommended by the North Pacific Fishery Management Council's Scientific and Statistical Committee, is just over 3 million t, approximately 32,000 t less than the sum of the 2005 ABCs representing a difference of about 1%. In 2006, the biennial summer bottom-trawl survey of the Aleutian Islands region is planned, as is the EBS slope area. Additionally, the biennial summer EIT survey of the EBS shelf region will be conducted along with the winter Bogoslof region EIT survey. The standard summer bottom trawl survey is also planned. These surveys will provide critical information for developing 2006 assessments and further management recommendations. Summaries of each stock/assemblage group are presented as follows.

***EBS Pollock:*** The 2005 bottom-trawl survey estimate of the pollock stock in this region is 37% higher than the 2004 estimate but only 5% higher than the long-term average estimate since 1982. Other new data in this year's assessment includes revised age composition estimates from the 2004 EIT survey, new age composition estimates from the 2004 fishery, and age composition estimates from the 2005 survey. Maturity data from a study completed by Jennifer Stahl (UAF Juneau) were evaluated in this year's assessment. The current state of the population (as projected to 2006) is estimated to consist mainly of the 2000 year class (estimated biomass at about 2.6 million t or 28% of the total) whereas 31% of the 2006 pollock biomass is estimated to be aged 1-3 years (Fig. 5). The Council recommended a 2006 ABC of 1.93 million t while the 2006 TAC for this management stock was set at 1,485,000 t. Projections for 2007 suggest population declines but these will be revised when the planned 2006 EIT and bottom-trawl surveys are complete and analyzed.

***Aleutian Islands Pollock:*** The Council accepted the age-structured analysis but for precautionary reasons, recommended ABC and TAC levels of 29,400 t and 19,000 t, respectively, which is well below the maximum permissible ABC level of 43,200. They reiterated the need for more comprehensive surveys during the time when pollock fishing traditionally occurred in this region. To this end, NMFS is preparing a proposal for industry-cooperative research to develop alternative management measures that might allow for directed pollock fishing while also minimizing the potential interaction effects with Steller sea lions.

***Bogoslof Island Pollock:*** A new age-structured assessment was presented for pollock in this region in 2005. The motivation for developing this model was partly due to the fact that the spawning-ground survey data extends over 16 years and that even though this area has been closed to pollock fishing since 1992, the stock has remained at stable but low

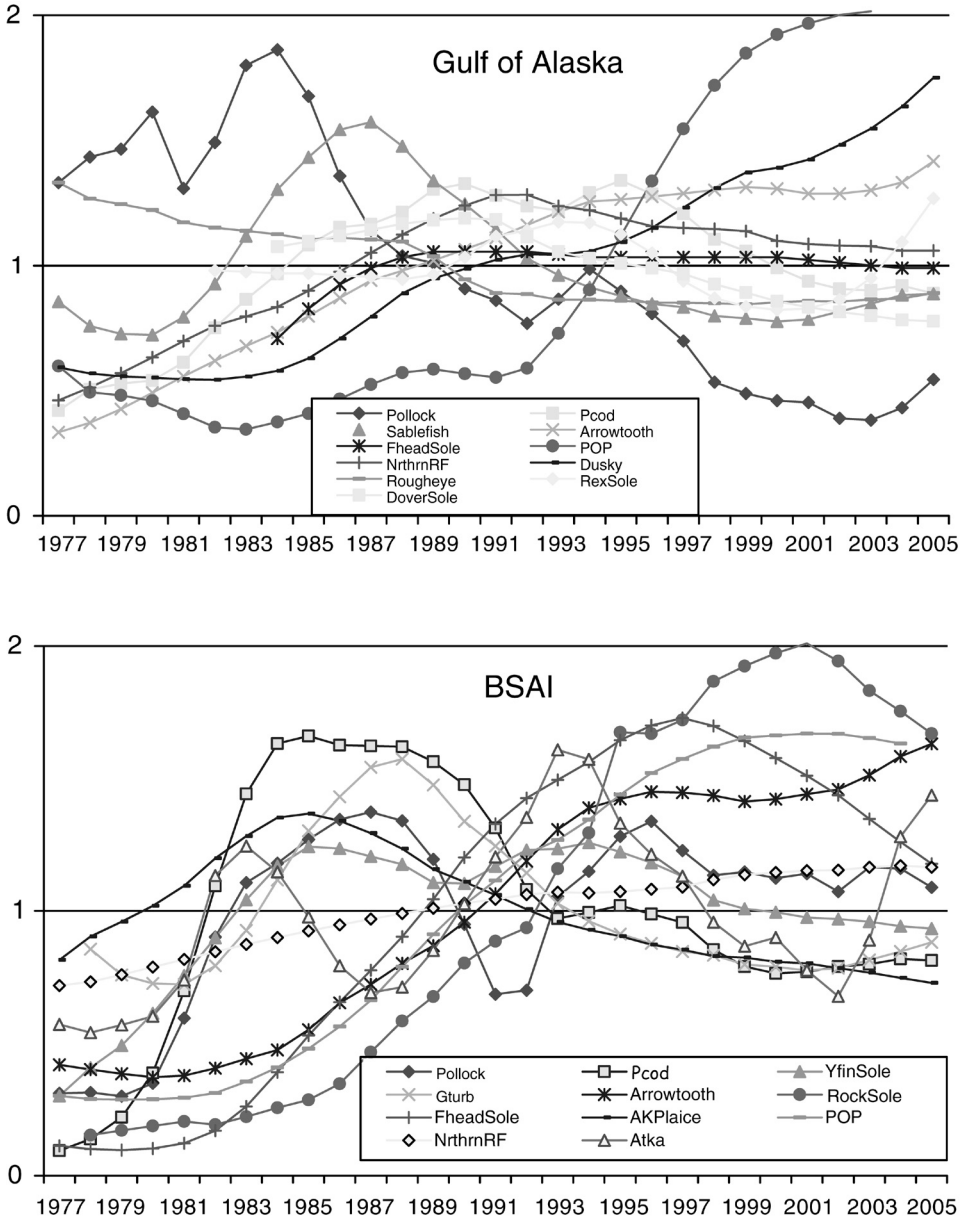


Figure 4. Biomass trends for Gulf of Alaska (GOA) and Bering Sea and Aleutian Islands (BSAI) stocks relative to their mean level, 1978-2004.

abundances compared to peaks observed during the late 1980s. The Council encouraged this study and requested that further analyses be conducted relative to fisheries on "Aleutian Basin" pollock (e.g., those caught in the international zone of the Central Bering Sea). The 2006 ABC was specified as in previous years which (based on the most recent survey estimate) results in a value of 5,500 t. The Council set the TAC for this area at 10 t to allow for bycatch in other fisheries.

***BSAI Pacific Cod:*** The 2005 EBS shelf bottom-trawl survey estimate (603,800 t) for Pacific cod is up by 1% compared to the 2004 estimate but is 26% below the average of all survey biomass estimates since 1982. The assessment was done using new software that allowed a number of enhancements over previous analyses. More significantly, revised estimates of maturity-at-age were used based on recent studies completed by James Stark (RACE Division). These new estimates resulted in substantially higher estimates of spawning biomass for a given population numbers-at-age estimate, but other factors in tuning the model resulted in biomass levels that were generally lower than previously estimated. The Council-selected model resulted in an ABC (and

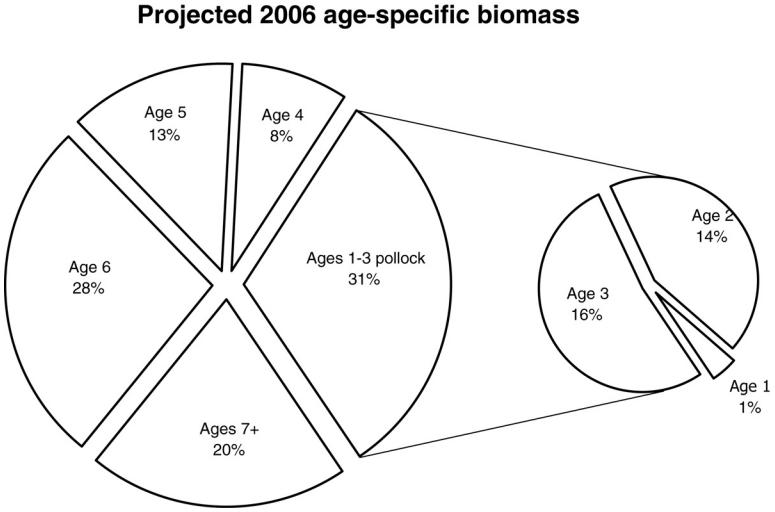


Figure 5. EBS pollock biomass by age groups as projected for 2006.

TAC) of 194,000 t compared to the 2005 level of 206,000 t.

***BSAI Flatfish:*** Combined, the five main species groups of flatfish have continued to trend upwards with a 6% increase from the 2005 level to 6.87 million t. This level is 23% higher than the average of the biomass estimates for all EBS shelf surveys since 1982. The *yellowfin sole* 2006 ABC dropped 2% from last year to 121,000 t, which led to a TAC of 95,701 t. The *arrowtooth flounder* 2006 ABC increased 26% to 136,000 t, which led to a TAC of 13,000 t. *Northern rock sole* 2006 ABC declined by 5% to 126,000 t and a TAC of 41,500 t. The *flathead sole* ABC increased by 2% to 59,800 t while the Council set the TAC at 19,500 t. *Alaska plaice* 2006 ABC was stable (decline of 1%) at a value of 188,000 t and a 2006 TAC of 8,000 t. The *other flatfish* assemblage 2006 ABC dropped 15% to 18,100 t, but the TAC was set to 3,500 t.

***BSAI Greenland Turbot:*** This stock continues to decline, perhaps reflecting generally warmer conditions. This species tends to be distributed in more northerly regions and the degree of mixing between other regions (e.g., north of the US convention line) is unknown. Assessment uncertainties and stock structure issues has led the Council to recommend conservative ABC levels, which for 2006 is 2,740 t, well below the maximum permissible value of 11,400 t.

***BSAI Rockfish:*** Since these species are generally long-lived and less common on the EBS shelf (where annual surveys occur) the Council has approved of a biennial cycle for conducting full assessments of these species to coincide with the timing of surveys. A bottom-trawl survey in the Aleutian Islands is planned for 2006 and when these data are available, a full assessment will be undertaken. Projected stock trends for *Pacific ocean perch* in the BSAI resulted in a 2006 ABC recommendation of 14,800 t compared to the 2005 level of 14,600 t. For *northern rockfish* the 2006 ABC increased by 3% relative to the 2005 value to 8,530 t. *Shortraker rockfish* 2005 ABC recommendations decreased by 3% from last year's levels giving 580 t, while the ABC for *rougheye rockfish* and *other rockfish* remained the same at 224 t.

***BSAI Atka Mackerel:*** New information on fishery and survey age composition resulted in slightly different model results compared to the 2004 assessment. In particular, the revised estimates of age structure resulted in 2005 model estimates of age 3+ biomass that were 10% higher compared to the assessment prepared in 2004, but still with a declining biomass trend through 2006 and 2007. This resulted in 2006 ABC recommendations that were down by 11% (to 110,000 t) compared to the 2005 ABC. The Council's 2006 TAC recommendation for Atka mackerel is 63,000 t, which is the same as the TAC for 2005. The Council and AFSC scientists are interested in exploring the extent that Atka

mackerel occurring in the GOA may be related to the BSAI stock.

***BSAI Other Species:*** The authors presented comprehensive assessments and recommendations for setting group-specific ABCs and OFLs within this larger category of "other species." The Council supported this idea but noted an FMP amendment needs to be developed for management. For *squid,* a reliable biomass estimate is lacking although the stock size relative to the catch is thought to be orders of magnitude greater. Ecosystem model calculations suggest that about one million t of squid are consumed as prey annually. While highly uncertain, this tends to confirm that squid stock size is likely to be relatively large. For *BSAI skates* area-specific ABCs were recommended based on different species composition and relative abundances between the Bering Sea and Aleutian Islands, and the presence of endemic skate species found only in the Aleutian Islands. Studies by Jerry Hoff (RACE) on skate nurseries may also play an important role in future management recommendations for this group. For *BSAI sculpins*, the biomass is second highest in this group following skates based on the EBS shelf bottom-trawl survey data. For *BSAI octopus*, biomass estimates based on trawl surveys suffer from high levels of sampling variability, seasonal differences in distribution, and gear selectivity. For the *BSAI shark complex* issues related to highly imprecise biomass estimates pose problems for deriving ABC recommendations. The set of documents presented to the Council provides useful documentation for developing the needed FMP amendments. These issues will be discussed in greater detail during the February 2006 Council meeting to be held in Seattle.

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## AGE AND GROWTH PROGRAM

Estimated production figures for 1 January through 31 December 2005

| Species | Number Aged |
|---|---|
| Flathead sole | 1,474 |
| Dover sole | 507 |
| Northern rock sole | 934 |
| Yellowfin sole | 1,268 |
| Arrowtooth flounder | 2,037 |
| Walleye pollock | 11,744 |
| Pacific cod | 2,273 |
| Sablefish | 2,392 |
| Atka mackerel | 4,254 |
| Pacific ocean perch | 3,209 |
| Northern rockfish | 1,467 |
| Sharpchin rockfish | 569 |
| Rougheye rockfish | 1,495 |
| Dusky rockfish | 651 |

Total production figures were 34,274 with 8,897 test ages and 271 examined and determined to be unageable. This is the second highest annual production total over the past 15 years.

The Age and Growth Program has unveiled a new interactive web site. This Age Reading Demonstration (ARD) web site allows site visitors to place marks on otolith images, which essentially assigns an age to the otolith. ARD then automatically marks the otolith image with marks from an experienced age reader and compares the visitor's age with the experienced age reader's age. ARD presents otoliths from various species and of varying levels of ageing difficulty, which demonstrates that otoliths from different species often require completely different ageing strategies, and that otoliths from even an easy species can present difficult challenges. The purpose of the ARD web site is not to "teach" age reading. An age reader typically must view thousands of otoliths through a binocular microscope in order to understand growth patterns before acquiring proficiency on a species. Instead, the purpose of the ARD web site is to give scientists and the general public a better appreciation of how difficult age reading really is. A future goal will be to allow the comparison of ageing criteria, between labs, on a real-time basis using similar software.

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