AUKE BAY LABORATORIES (ABL)

HABITAT ASSESSMENT & MARINE CHEMISTRY PROGRAM

Energetic Changes in Coho Smolts Induced by the Presence of the Nematode Parasite *Philonema agubernaculum*

A recent article by Lawrence Schaufler, Johanna Vollenweider, and Adam Moles from the Habitat & Marine Chemistry Program at Auke Bay Laboratories (ABL) examines the lipid storage effects of a severe parasitic worm infection of coho smolts in Juneau, Alaska. Fifty-five percent of the coho salmon collected from Auke Creek in 2003 for this study were significantly parasitized by one or more *Philonema agubernaculum* helminths. The most heavily parasitized smolts examined contained 11 individual nematodes, an average parasite length of 108 mm, a total combined parasite mass of 848 mg, and a resulting body/parasite mass ratio of 13:1. No significant difference was observed in the length or weight of the parasitized versus unparasitized smolts, but parasitized coho had 36% less total lipid than unparasitized fish. The types of lipids (storage, structural, etc.) also varied between the two groups. None of the nematode-infected fish examined contained detectable amounts of the storage lipid triacylglycerol (TAG), in contrast to the uninfected fish. Parasitized fish also had significantly higher levels of free fatty acids (which can be a sign of lipid metabolism) than did the unparasitized fish. The observed differences suggest that the parasites are either harvesting energy directly from the hosts or are placing additional energetic demands on the smolts in order to cope with the infection.

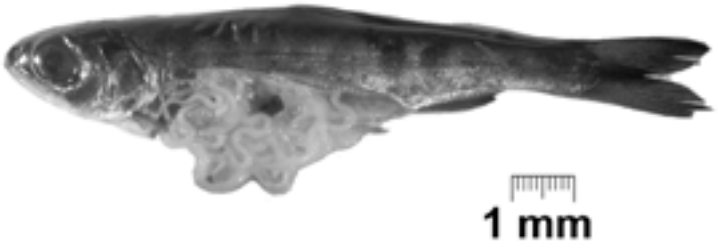


Figure 1. Coho salmon smolt heavily parasitized by the nematode *Philonema agubernaculum*. It was caught in Auke Creek, Juneau, Alaska in 2003. Photo by Mark Carls.

The article appears in the January 2008 issue of *Comparative Biochemistry and Physiology*, Part B, published by Elsevier.

By Lawrence Schaufler

MARINE SALMON INTERACTIONS PROGRAM

North Pacific Anadromous Fish Commission 15th Annual Meeting

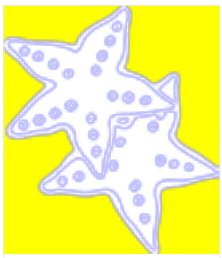
The 15th Annual Meeting of the North Pacific Anadromous Fish Commission (NPAFC) was held in Vladivostok, Russia, 8-12 October 2007. Representatives of Canada, Japan, the Republic of Korea, Russia, and the United States met to review important scientific and high-seas fishery enforcement issues concerning salmon stocks in the North Pacific Ocean. The meeting was chaired by Guy Beaupré of Canada, current President of the NPAFC. Doug Mecum, NMFS Alaska Regional Office, was head of the U.S. delegation supported by fellow U.S. Commissioners Gary Smith from Washington State and Rowland Maw from Alaska.

In recent years, NPAFC Parties have documented an increased activity by vessels suspected of high-seas driftnet fishing in the western portion of the North Pacific, although overall high-seas driftnet activity continues to be low. Coast Guard vessels from the United States, Russia, and Japan conducted joint patrols in the NPAFC Convention Area during 2007 in coordination with long-range patrol aircraft from Canada, Japan, Russia, and the United States. Patrol aircraft and surface vessels sighted multiple vessels suspected of high-seas driftnet fishing in Convention Area waters, and a total of seven vessels were apprehended. Some vessels had several kilometers of driftnet on board. An Indonesian vessel apprehended by Russian officials had 90 metric tons (t) of frozen salmon on board. Six vessels intercepted by the U. S. Coast Guard and turned over to Chinese officials are still in ongoing investigations.

A new development in NPAFC enforcement is refinement of the Integrated Information System (IIS). The IIS, which links all enforcement agencies associated with the Commission, provides real-time data to all Parties when high-seas driftnet

activity is detected. The system enables member countries to share observed illegal activity, including photos, allowing better coordination in efforts to deal with ongoing threats of illegal, unreported, and unregulated fishing in the North Pacific.

The Committee on Scientific Research and Statistics (CSRS) met to review current research activities of member parties including reports of working groups on stock assessment, salmon marking, stock identification, the Bering-Aleutian Salmon International Survey (BASIS) Program, and a newly formed working group on salmon tagging. Vladimir Karpenko of Russia served as chairman of the CSRS, and Loh-Lee Low of the Alaska Fisheries Science Center (AFSC) was head of the CSRS delegation of nine scientists from the United States. Other AFSC scientists participating in CSRS deliberations included Ed Farley, Jamal Moss, and Bill Heard of Auke Bay Laboratories.



The total harvest of Pacific salmon by all NPAFC countries in 2006 was 863,000 t. This level was 12% below the 2005 catch, due mainly to the unexpectedly poor pink salmon harvest in North America. Pink salmon still represented 58% of the total 2006 Pacific salmon catch, followed by chum, sockeye, coho, Chinook, and cherry (masu) salmon. Based on preliminary reports, Russian catches for 2007 are the highest on record, particularly for pink salmon from Sakhalin, and sockeye and Chinook salmon from Kamchatka. On Sakhalin Island many new modern hatcheries are contributing to these increased harvest levels. The 2007 catches in the United States (Alaska) and Japan were also high; however, trends for Canada, the northwest United States, and the Republic of Korea were not as strong.

Studies by NPAFC scientists on regional fluctuations in abundance indicated these fluctuations may be related to ongoing impacts of climate change on salmon production. For example, oceanographic conditions in the Bering Sea have undergone dramatic changes in recent years as documented by the BASIS Program and other research programs in this region.

Reviews and defense of AFSC research by CSRS included an overview of salmon bycatch in U.S. Bering Sea-Aleutian Islands and Gulf of Alaska groundfish fisheries by Low-Lee Low, a review of U.S. BASIS cruises by Ed Farley and Jamal Moss, a review of Southeast Coastal Monitoring cruises on the NOAA ship *John N.Cobb* and a review of high-seas coded wire tag recoveries by Bill Heard.

The summary by Ed Farley on trawl and oceanographic sampling in the Chukchi Sea during September 2007 on the NOAA ship *Oscar Dyson* generated much interest and discussion due to the large number of juvenile salmon caught in this area in relation to established salmon-producing areas along the coastline of the eastern Bering Sea and anomalously high ocean temperatures recorded in that area. Jamal Moss described archival and disc tagging efforts for Pacific salmon on board the NOAA ship *Miller Freeman* using a pelagic trawl fitted with a live box in the codend of the trawl. Numerous marine fishes and salmon suitable for tagging or laboratory studies of live fishes were captured in good condition with minimal-to-no scale loss.

The new working group on salmon tagging will work closely with the NPAFC Secretariat in coordinating future international high-seas tagging research among the Parties to clarify stock-specific marine distribution and migration behavior patterns of salmon. A new disc tag will carry the NPAFC logo on one side and instructions for returning tags on the opposite side. The Secretariat will provide new tags for researchers in addition to posters for encouraging tag returns in four languages for distribution at appropriate locations around the Pacific Rim.

By Bill Heard

New Publication on the Ecology of Juvenile Salmon in the Northeast Pacific Ocean

A coastwide collaborative effort to synthesize current research on juvenile salmon ecology in the northeast Pacific was completed in November 2007. The fruit of this labor is the 247 page American Fisheries Society Symposium No. 57 titled *Ecology of Juvenile Salmon in the Northeast Pacific Ocean: Regional Comparisons,* edited by C. B. Grimes, R. D. Brodeur, L. J. Haldorson, and S. M. McKinnell (http://www.afsbooks.org/54057p.html). This volume contains nine chapters dedicated to the understanding of interactions between Pacific salmon (*Oncorhynchus* spp.) and their environment throughout their distribution in the northeast Pacific. Researchers from Alaska, British Columbia, Washington,

Oregon, and California shared data and authorship for this book. ABL researchers E. V. Farley Jr., E. A. Fergusson, J. H. Moss, J. M. Murphy, J. A. Orsi, M. V. Sturdevant, F. P. Thrower, A. C. Wertheimer, and B. L. Wing authored or coauthored seven of the nine chapters. Other authors were scientists from Fisheries and Oceans Canada, Northwest and Southwest Fisheries Science Centers, Oregon State University, and the University of Alaska.

By Joe Orsi

AFSC Scientist Participation at the Annual Meeting of the AFS Alaska Chapter

The American Fisheries Society Alaska Chapter's Annual Meeting was convened 13 November 2007 in Ketchikan, Alaska, by its president Jamal Moss of ABL's Ocean Carrying Capacity Program. The theme of the meeting was "Fisheries Under Pressure in the 21st Century." Several other ABL staff participated as session leader or presenter at the meeting. Joe Orsi organized the session "Juvenile Salmon Early Marine Ecology and Biological Interactions." Alex Wertheimer presented a paper in the Hatchery Straying Symposium and participated as a panel member discussing the implications of hatchery straying on wild stock conservation and management. Jacob LaCroix, Jim Murphy, and Molly Sturdevant also presented papers.

By Alex Wertheimer

OCEAN CARRYING CAPACITY PROGRAM

Juvenile Sockeye Salmon Distribution, Size, Condition, and Diet During Years with Warm and Cool Spring Sea Temperatures Along the Eastern Bering Sea Shelf

Interannual variations in distribution, size, indices of feeding, and condition of juvenile Bristol Bay sockeye salmon (*Oncorhynchus nerka*) collected in August - September (2000-03) during Bering–Aleutian Salmon International Surveys were examined to test possible mechanisms influencing their early marine growth and survival. Juvenile sockeye salmon were mainly distributed within the southern region of the eastern Bering Sea, south of 57°0'N during 2000 and 2001 and farther offshore, south of 58°0'N during 2002 and 2003. In general, juvenile sockeye salmon were significantly larger ($P < 0.05$) and had significantly higher indices of condition ($P < 0.05$) during 2002 and 2003 than during 2000 and 2001. The feeding index was generally higher for age-1.0 sockeye salmon than age-2.0 during all years. Among-year comparisons suggested that Pacific sand lance (*Ammodytes hexapterus*) were important components of the juvenile sockeye salmon diet during 2000 and 2001 (20% to 50% of the mean wet mass) and age-0 walleye pollock (*Theragra chalcogramma*) were important components during 2002 and 2003 (50%-60% of the mean wet mass). Warmer sea temperatures during spring and summer 2002 and 2003 likely increased productivity on the eastern Bering Sea shelf, enhancing juvenile sockeye salmon growth.

By Ed Farley

A Review of the Critical Size, Critical Period Hypothesis for Juvenile Pacific Salmon

Pacific salmon experience relatively high mortality rates during the first few months at sea, and it is believed that the high mortality rates may be partly related to size. Size-dependent marine mortality of juvenile salmon may be concentrated during two specific early marine life-history stages. The first stage may occur just after juvenile salmon enter the marine environment, where smaller individuals are believed to experience higher size-selective predation. The second stage is thought to occur following the first summer at sea, when smaller individuals may not have sufficient energy reserves to survive late fall and winter. Thus, larger individuals within a cohort likely have higher probability of survival, emphasizing the importance of size during the first summer at sea.

We consider size of juvenile Pacific salmon after the first summer at sea to be the trait on which size-selective mortality operates. The idea is based on the critical size, critical period hypothesis, where those individuals within a cohort that do not reach a critical size during their first summer at sea have higher rates of late fall and overwinter mortality. The results suggest that early marine growth of juvenile Bristol Bay sockeye (*O. nerka*), Prince William Sound hatchery pink (*O. gorbuscha*), and British Columbia coho (*O. kisutch*) salmon from geographically distinct regions (Bering Sea, northern Gulf of Alaska, coastal British Columbia, respectively) is important and that these salmon must attain sufficient growth

and size during their first summer at sea to survive the first winter and subsequent years at sea.

A critical size, critical period relationship to marine survival is a reflection of the carrying capacity of an ecosystem. A recognition that insufficient growth in the first marine spring and summer probably will result in death during the winter is also recognition that there is a matching of numbers of juveniles entering the ocean with the prey that is immediately available to juvenile salmon. Natural regulation in the absence of fishing or hatcheries would result in reduced adult returns in periods of reduced prey production and large returns in periods of favorable ocean environmental conditions. In managed populations, it should be possible to use early marine growth to optimize the production of smolts entering the ocean and to forecast marine survival. Producing too many smolts during years with low ocean productivity simply results in salmon dying in the first marine winter either directly from starvation or indirectly by being easy prey.

By Ed Farley

MARINE ECOLOGY & STOCK ASSESSMENT PROGRAM

Groundfish Stock Assessments

This quarter, scientists from ABL's Marine Ecology and Stock Assessment (MESA) Program completed major stock assessments for eight species or species groups of Alaska groundfish: Gulf of Alaska Pacific ocean perch, northern rockfish, rougheye rockfish, pelagic shelf rockfish, shortraker rockfish, and other slope rockfish; Bering Sea/Aleutian Islands sharks; and Gulf of Alaska and Bering Sea/Aleutian Islands sablefish. Stock Assessment and Fishery Evaluation (SAFE) reports were prepared for each assessment, and results were presented to the North Pacific Fishery Management Council's groundfish plan teams in November and also reviewed by the Council's Scientific and Statistical Committee in December. The Council used these assessments as the primary source for determining catch quotas (levels of Total Allowable Catch) for these species in 2008. For detailed information about these assessments, see the Status of Stocks and Multispecies Assessment Program report in the Resource Ecology and Fishery Management (REFM) Division section of this publication.

By Dave Clausen

2007 Sablefish Longline Survey

The AFSC has conducted an annual longline survey of sablefish and other groundfish in Alaska from 1987 to 2007. The survey is a joint effort involving two divisions of the AFSC: ABL and the Resource Assessment and Conservation Engineering (RACE) Division. The survey replicates as closely as practical the Japan-U.S. cooperative longline survey conducted from 1978 to 1994 and also samples gullies not sampled during the cooperative longline survey. In 2007, the twenty-ninth annual longline survey of the upper continental slope of the Gulf of Alaska and eastern Bering Sea was conducted. One hundred-fifty-two longline hauls (sets) were completed between 2 June and 1 September 2007 by the chartered fishing vessel *Ocean Prowler*. Sixteen km of groundline were set each day, containing 7,200 hooks baited with squid.

Sablefish (*Anoplopoma fimbria*) was the most frequently caught species, followed by giant grenadier (*Albatrossia pectoralis*), arrowtooth flounder (*Atheresthes stomias*), shortspine thornyhead (*Sebastolobus alascanus*), and Pacific cod (*Gadus macrocephalus*). A total of 79,461 sablefish were caught during the survey. Sablefish, shortspine thornyhead, Greenland turbot (*Reinhardtius hippoglossoides*), spiny dogfish shark (*Squalus acanthias*), and lingcod (*Ophiodon elongatus*), were tagged and released during the survey. Length-weight data and otoliths were collected from approximately 2,219 sablefish. Killer whales *(Orcinus orca)* took fish from the longline at seven stations in the Bering Sea and five stations in the western Gulf of Alaska. For the first time during the survey time series, killer whales also took catch from a station in the central Gulf of Alaska. Geographically, this is the farthest east the survey has ever recorded killer whale depredation. Sperm whales *(Physeter macrocephalus)* were often present during haulback and were observed depredating on the longline at 11 stations in the eastern Gulf and 2 stations in the central Gulf of Alaska.

Several special projects were conducted during the 2007 longline survey. An AFSC intern from the University of Washington participated on a survey leg collecting coral specimens for identification and preservation. A seabird occurrence study, conducted for the sixth year, helps to address where and when certain seabird species occur in Alaska waters. Spiny dogfish and lingcod were tagged with archival temperature/depth tags, and sleeper sharks were tagged with satellite tags. Genetic samples and whole spec-

imens of sablefish were collected in the Bering Sea and eastern Gulf of Alaska for population structure analysis. A grenadier study was conducted throughout the survey to examine potential morphology differences between big eye and small eye giant grenadier. Photographs of sperm whales observed during the survey were taken for contribution to the Southeast Alaska Sperm Whale Avoidance Project (SEASWAP) sperm whale catalog. A marine mammal observer was on board during the fifth survey leg in the Gulf of Alaska to collect photo identification of sperm whales, record dive behavior observations, and collect biopsy samples for genetic and fatty acid analysis. Sperm whales interacting with the survey vessel near Sitka were also tagged with satellite tags in a cooperative project with SEASWAP. Finally, a 2-day gear experiment was conducted near Yakutat to compare the catching efficiency of standard survey gear to autoline gear.

By Chris Lunsford

Sablefish Tag Program

The National Marine Fisheries Service (NMFS) has conducted a sablefish tagging program in Alaska for more than 30 years; ABL has been tagging sablefish in Alaska since 1982. ABL has also administered the Alaska sablefish tag database since 1995. In 2007, tags were recovered from 524 sablefish, including 18 fish tagged as juveniles, 7 fish tagged with electronic archival tags, and 499 tagged with external Floy anchor tags. Canadian recoveries of U.S. tags (not yet received) plus late U.S. returns will likely bring the total sablefish tag recoveries for 2007 close to the 5-year average of 602 tags.

Tags from shortspine thornyheads, Greenland turbot, and Pacific sleeper sharks are also maintained in the sablefish tag database. Eight thornyhead, two turbot, and two sleeper shark tags were recovered in 2007; the turbot tags were both electronic archival tags. The archival tags record data on depth of the fish and on water temperature for up to 11 years, depending on the frequency of observations. Besides adult sablefish (603) and Greenland turbot (156), archival tags have been implanted in juvenile sablefish (406), shortspine thornyheads (203), Pacific sleeper sharks (135), spiny dogfish (166), and lingcod (41) in recent years. To date, archival tags have been recovered from 104 adult sablefish, 10 turbot, one sleeper shark, and one spiny dogfish.

Releases in 2007 included 3,804 adult sablefish, 681 shortspine thornyheads, 82 turbot (including 38 with archival tags), 41 lingcod (all archival), 67 spiny dogfish (all archival), and 161 juvenile sablefish (99 archival).

Two more sablefish released on seamounts in 1999 and 2000 were recovered in 2007, bringing the total of seamount to continental slope recoveries to 24. All but one of the 22 tags with known recovery data have been recovered west of their release position.

By Nancy Maloney

FISHERIES MONITORING & ANALYSIS (FMA) DIVISION

2008 BRINGS CHANGES TO OBSERVER DATA COLLECTIONS

The close of the calendar year is a period of transition for the Fisheries Monitoring and Analysis (FMA) Division from the end of one fishing year to the start of the next. By late December 2007 most groundfish fisheries in the North Pacific had closed. Observers had returned from their deployments to debrief with FMA staff and finalize the data they collected at sea. In October through December, FMA staff debriefed 187 observers, which represents approximately one-third of all the observers debriefed during the entire year. Nearly 90% of these debriefings were conducted during October and November. Staff familiar with debriefing and data quality control processes set other tasks aside to assist with debriefings. Their help ensured that observers moved through the debriefing process expeditiously.

Where possible, the FMA Division strives to implement any major changes in its protocols with the start of the new year. Changes are driven by internal needs or by changes in fishing regulations, which often impact the work of observers. We monitor changes in regulations and update the Observer Sampling Manual and other training materials yearly in preparation for the upcoming year. For example, new regulations contained in Amendment 80 to the Bering Sea/Aleutian Islands fishery management plan include monitoring requirements with different observer protocols. Thus, it was necessary that FMA change its instructions to observers. Amendment 80 regulations also increased observer coverage requirements for some vessels, thereby increasing the overall number of observers who will be going to sea.

The Division also implemented major improvements to observer sampling and data recording methods, which now require recording discrete samples within hauls and recording them in detail. This replaces the past practice where individual samples were pooled and valuable information was lost. Full descriptions of these changes are contained in the "2008 Observer Sampling Manual" on the FMA web site at http://www.afsc.noaa.gov/FMA/Manual_pages/MANUAL_pdfs/manual2008.pdf**.** (Please contact Jennifer Ferdinand at Jennifer.Ferdinand@noaa.gov or 206-526-4076 if you have any questions regarding these changes.)

Changes to observer data collections required changes to the observer database and the custom software used by observers at sea to enter and submit data. This was a large and complex project with an inflexible deadline and required developing a new computer application which was deployed in the field on numerous vessels. Database tables at the AFSC were also developed to accept the new information, and the system was thoroughly tested.

These changes required training observers in new protocols. Training in December was intense and demanding on both FMA staff and observers. All prior observers needed focused study to transition to the changes. Given the demand for increased numbers of observers in the new fishing year, FMA added an additional 3-week training class for new observers to the normal class schedule. In the FMA Seattle office, two training classes were held subsequent to each other, one ending just before the Christmas holiday, and the other beginning the day after Christmas. By mid-January, we will have approximately 70 observers deployed to the field, and we expect that will increase to over 200 observers in the field by the end of January.

By Allison Barns

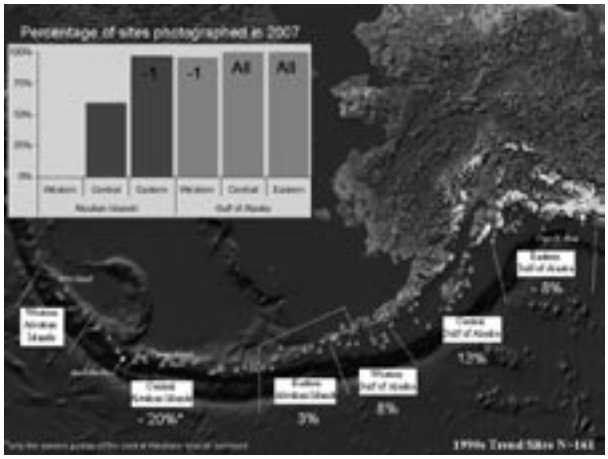


Figure 1. Percentage of Steller sea lion sites surveyed and regional trends (percentage change between 2004 and 2007) determined from the 2007 nonpup Steller sea lion counts.

NATIONAL MARINE MAMMAL LABORATORY (NMML)

ALASKA ECOSYSTEMS PROGRAM

2007 Steller Sea Lion Survey Results

In conjunction with the ship-based Steller sea lion pup survey (see article in the July-September 2007 AFSC *Quarterly Report*), an aerial survey to assess trends in numbers of western stock adult and juvenile (nonpup) Steller sea lions in Alaska was conducted from 9 June to 6 July 2007. The objective was to photograph all terrestrial rookery and haulout sites from Cape St. Elias (145°W) to Attu Island (172°E) (Fig. 1), using both medium format (5-inch film) and simultaneous digital, vertically-oriented photography with forward motion compensation. However, due to poor weather conditions and required aircraft maintenance, the survey was incomplete—covering 65 of the 87 trend sites from the 1970s and 124 of the 161 trend sites from the 1990s. As a result of this incomplete survey and the limited 2006 survey (see article in the July-September 2006 AFSC *Quarterly Report*), abundance trends are not available for the entire stock of western Steller sea lion nonpups. However, some western stock regions were completely surveyed, allowing for evaluation of regional trends (Fig. 1).

Trends of nonpup sea lion counts from 2004 and 2007 varied regionally. Summarizing from east to west, the 2007 count in the eastern Gulf of Alaska was 264 lower (-8%); counts in the central Gulf of Alaska, western Gulf of Alaska, and eastern Aleutians increased by 540 (13%), 431 (8%), and 163 (3%), respectively; and counts in the eastern portion of the central Aleutian Islands region declined by 858 or -20% (Fig. 1). Because most of the sites in the western part of the central Aleutians and in the western Aleutians were not photographed, trends in those regions are not reported. However, counts in 2004 and 2006 suggest that the western Steller sea lion population between Amchitka Pass and Attu Island continued to decline.

Despite the missing counts at some trend sites, available data indicate that the size of the adult and juvenile portion of the western Steller sea lion population throughout the majority of its range (Cape St. Elias to Tanaga Island: 145°-178°W) has remained largely unchanged between 2004 (n = 23,107) and 2007 (n = 23,118). More detailed results of the 2007 survey can be found in the NOAA Memorandum online at http://www.afsc.noaa.gov/nmml/pdf/SSLNon-Pups2007memo.pdf.

By Jeremy Sterling and Lowell Fritz

Northern Fur Seal Research

A number of northern fur seal projects were conducted by the Alaska Ecosystems Program (AEP) on St. Paul Island, Alaska, during October and November 2007. In addition to continued satellite-tracking studies investigating the winter distribution of both juvenile and adult female fur seals (see article in the April-June 2007 AFSC *Quarterly Report*), two studies measuring the vital rates of northern fur seals were initiated. These studies followed recommendations from the Conservation Plan for the Eastern Pacific Stock of Northern Fur Seals and the Northern Fur Seal Tagging and Census Workshop held in September 2005. The main objective of the first study is to determine whether the survival of fur seals, particularly juvenile fur seals, is a factor in the observed population decline. The first phase of this study aims to evaluate both the field and statistical methodology that will be required to successfully make such estimates, particularly the difficult problem of estimating tag loss rates to avoid bias in survival estimates. From 6 to 9 November 2007, 131 adult female fur seals were captured on St. Paul Island and tagged with two prospective tag types for comparison of tag retention rates and visibility on the rookeries next summer. Biometricians Devin Johnson (AEP) and Jeff Laake (NMML's California Current Ecosystems Program) are working to develop new statistical estimators that better account for tag loss and determine the feasibility and cost of estimating fur seal survival with the precision needed to adequately address the suggested recommendations and conservation concerns.

The second study investigating fur seal vital rates is the continuation of a successful pilot study conducted in 2005 testing the method of transrectal ultrasonography as a means of determining reproductive condition of northern fur seals prior to their winter departure from St. Paul Island. The objective of the ultrasonography work is to determine whether declining reproductive rates are a contributing factor to the current decline of this population. From 11 to 16 November 2007, a team from AEP, with collaborating veterinarians Gregg Adams (Western College of Veterinary Medicine, University of Saskatchewan) and Don Bergfelt (U.S. Environmental Protection Agency), used ultrasonography to examine 96 adult female fur seals at Polovina Cliffs rookery to determine how many had ovarian corpora lutea, indicative of ovulation the previous July, and how many had developing embryos in comparison to similar observations made from the lethal collections of fur seals in the 1950s and 1960s. The animals were released with numbered tags and VHF radio-tags to enable relocating them and estimating their pupping success next summer. From 15 June to 30 August 2008, a VHF receiving and data-logging station will be maintained over the rookery at Polovina Cliffs to monitor the presence of these radio-tagged fur seals. Visual confirmation of pupping success will be sought for each of the tagged animals that are present, and the attendance pattern from the VHF data logger will be compared to the suckling/foraging patterns of parturient females. Visual searches for flipper tags may also determine pupping success of females that lose their VHF tags during winter.

By Jeremy Sterling and Ward Testa

RESOURCE ASSESSMENT & CONSERVATION ENGINEERING (RACE) DIVISION

GROUNDFISH ASSESSMENT PROGRAM

Eastern Bering Sea Slope Habitat Studies

A research cruise aboard the NOAA ship *Miller Freeman* was conducted from 2 to 13 October 2007 in the eastern Bering Sea that dealt with various groundfish research projects. Three skate nursery sites were sampled and mapped for an ongoing skate reproductive ecology study. During this cruise a new skate nursery site was mapped that was previously unknown. A unique rockfish habitat was mapped and sampled. For the first time data was collected on this unique habitat in the highly dynamic Zhemchug Canyon in the northern Bering Sea.

Biological data were collected from the bigmouth sculpin and the Kamchatka and Bering flounders and will be used to determine age and size at maturity for these poorly studied species. Specimens of deepwater pelagic and benthic fishes were collected for visual pigment analysis and study for a better understanding of eye functioning in a deep-sea environment. Demersal bongo net samples, collected at depths greater than 1,000 m, provided cephalopod specimens as well as samples for assessment of zooplankton densities during fall (Fig. 1). Testing was conducted of newly developed net mensuration gear and compared to the existing equipment in use. The new gear performed well and proved to provide accurate and extensive real-time trawl data with ease. Additional completed projects included collection of 978 stomach samples from many groundfish species, 204 rockfish genetic samples, 185 cephalopod specimens, and 139 skate age structures. In total more than 2,000 biological specimens were collected during the October cruise.

By Jerry Hoff

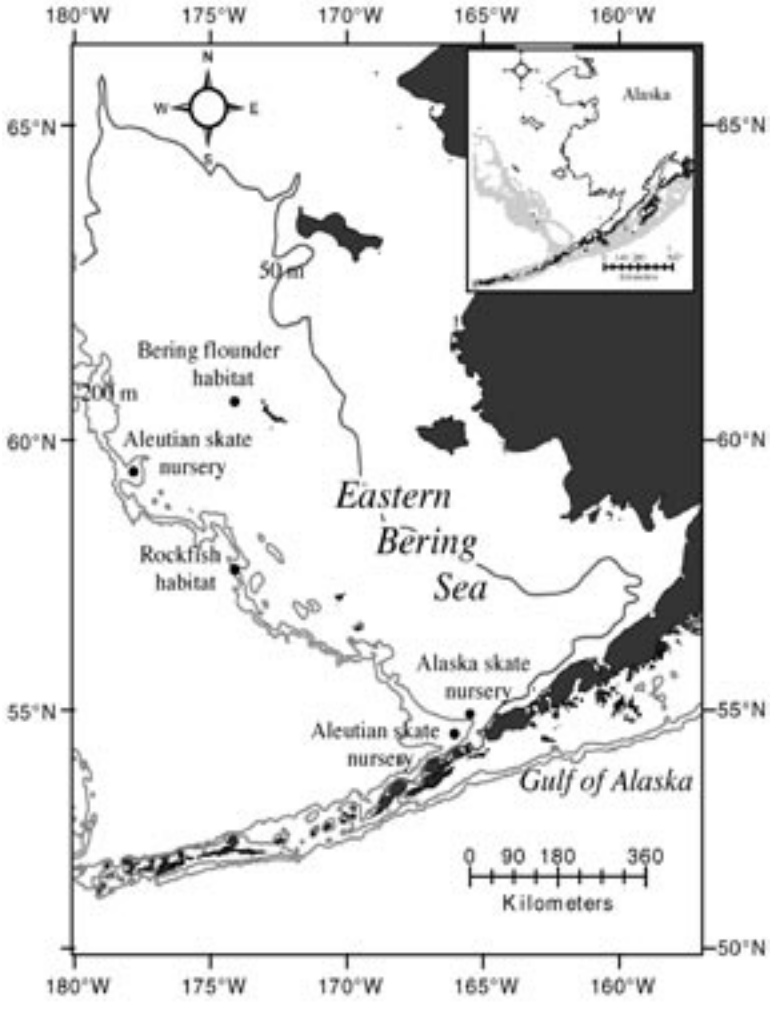


Figure 1. A map of habitat locations where bongo net and bottom trawl samples were collected during the NMFS eastern Bering Sea slope habitat cruise.

Groundfish Systematics: Skates, Snailfishes, Rockfishes, Sculpins, Eelpouts, and Manefishes

Throughout 2007, James (Jay) Orr and Duane Stevenson have continued work on the taxonomy and systematics of several families of fishes, most recently skates, snailfishes, rockfishes, sculpins, eelpouts, and manefishes. Stevenson, with coauthors Orr, Jerry Hoff, and John McEachran, has produced a field guide to the cartilaginous fishes of Alaska published by Alaska Sea Grant. Their skate work has continued with the description of a new species from the western Aleutian Islands within a taxonomic revision of the subgenus *Arctoraja*, a group of four species ranging across the North Pacific Ocean. In addition to discrimination by morphological data, this work will also include the important corroborative genetic results obtained by RACE geneticist and coauthor Ingrid Spies. Orr and Stevenson both participated in the annual meeting of the Charles Henry Gilbert Ichthyological Society where they presented papers on the identification of chondrichthyan fishes in Alaska and the systematic relationships of pipefish and related families based on ontogeny.

Jay Orr's research on snailfishes (Fig. 2) has expanded with the publications of descriptions of two new species of *Careproctus* with Katherine Maslenikov of the University of Washington (UW) Fish Collection, and the preparation of a manuscript on two new species of *Paraliparis*, with Zach Baldwin, an undergraduate intern from the UW. A study of the phylogenetic relationships of all genera of deep-sea anglerfishes, with senior author Ted Pietsch of the UW, was published. Stevenson's most recent research on eelpouts has focused on completing a systematic revision of the genus *Bothrocara* (Fig. 3) – a large group of species ranging throughout the cold, deep waters of the Pacific Ocean

in both the northern and southern hemispheres, in collaboration with M. Eric Anderson, from the South African Institute of Aquatic Biodiversity, and Gento Shinohara, of the National Science Museum, Tokyo. He also has nearly completed an examination of morphological variation in the black eelpout, *Lycodes diapterus*, from across its entire range in the North Pacific, a project with Boris Sheiko of the Institute of the Russian Academy of Sciences, St. Petersburg. His earlier publication of a range extension and morphological review of the manefish, *Caristius macropus*, with AFSC scientist Dave Csepp, has led to his beginning a worldwide revision of the family Caristiidae with Chris Kenaley from the UW, Karsten Hartel from Harvard University, and Ralf Britz of the British Museum of Natural History. Stevenson also participated in a midwater survey of the northern Gulf of Alaska. A result of this survey will be the publication of papers with AFSC scientist Nate Raring on the distribution and abundance of the midwater fishes encountered, including range extensions and systematic reviews of several species with Raring and Kenaley.

By Jay Orr

Figure 2. A newly described snailfish species, *Careproctus faunus*. Photo by Jay Orr.

Figure 3. *Bothrocara brunneum* (top) and *B. zestum* (bottom), a species newly discovered from the eastern Bering Sea. Photo by Duane Stevenson.

Habitat Scientist Participates in Long-Range Sonar Acceptance Testing

A technical team comprised of a Habitat Research group scientist and engineers from the NOAA Marine Operations Center and the University of New Hampshire-NOAA Joint Hydrographic Center participated in the factory acceptance test (FAT) for the first of two long-range sidescan sonar systems (LRSSS) (Fig. 4). The LRSSS is a new type of sonar for fisheries habitat research that is expected to produce fully corrected backscatter and bathymetry over a maximum swath of 1,200 m, while surveying at speeds greater than 7 knots. Performance of this and several other acoustic systems will be compared as part of the July-August 2008 FISHPAC cruise in the eastern Bering Sea. This project is evaluating acoustic data for describing essential fish habitat (EFH) and is developing operational guidelines for seabed mapping with NOAA hydrographic vessels.

A FAT consists of multiple tests intended to demonstrate that an item being purchased by NOAA meets the requirements of the procurement contract. The FAT for the LRSSS commenced after a detailed test readiness review at L-3 Communications corporate office in Sylmar, California, on 5-6 November. Parts of the inspection and analysis components of the FAT were completed in Sylmar before moving to Los Angeles harbor on 12 November to board the L-3 test vessel *Three Aces* (Fig. 5). The vessel proceeded to the test areas off Catalina Island, where the NOAA technical team witnessed operations demonstrating the performance and capabilities of topside and subsea components of the LRSSS under various environmental conditions. This phase of FAT for the first LRSSS ended 13 November, and FAT is scheduled to resume in February 2008.

By Bob McConnaughey

MIDWATER ASSESSMENT & CONSERVATION ENGINEERING PROGRAM

MACE Program Tests New Multibeam Sonar

Staff from the Midwater Assessment & Conservation Engineering (MACE) Program and Simrad Fisheries, Inc. conducted acceptance tests for the new Simrad ME70 multibeam sonar installed aboard the NOAA ship *Oscar Dyson* in Puget Sound during 15-19 October 2007. Other participants during the tests included scientists from the Northwest (NWFSC) and Southwest (SWFSC)

Figure 4. Launching the long-range side scan sonar from the test vessel *Three Aces* off Catalina Island, California. Photo by Bob McConnaughey.

Figure 5. Test vessel *Three Aces* with long-range side scan sonar in Los Angeles Harbor. Photo by Michael Webb, NOAA.

Fisheries Science Centers, and the University of New Hampshire's Center for Coastal Ocean Mapping. The acceptance trials included ME70 dockside testing, acoustic calibration, and underway data collection. The ME70 uses multibeam technology to image a wide swath of the water column. Unlike customary multibeam instruments designed for bathymetric purposes, the ME70 is specifically designed for fisheries research. Thus, the instrument has a much greater dynamic range and desirable lower side lobe levels than traditional multibeam sonars, as well as the ability to provide quantitative measurements over its entire profiling range (i.e., throughout the water column). These features enable acoustic quantitative measurements to be made on aggregations of organisms found in the water column ranging from fish to plankton. The ME70, and the closely related MS70, were developed as a joint collaboration among Simrad Fisheries, and the French (IFREMER) and Norwegian (IMR) Fisheries research institutes. Ultimately, ME70 multibeam systems will be installed on all four of the new noise-reduced NOAA fishery research vessels.

Plans are currently under way for NOAA Fisheries researchers to develop the expertise necessary to realize the full research potential of the ME70. Thus, efforts are being made to expedite training of NOAA Fisheries researchers on the design, function, and application of the ME70. In addition, efforts are under way to develop a coordinated and complementary ME70 multibeam research plan among researchers representing NOAA, IFREMER, and IMR to more fully determine the performance capabilities of the ME70 and to address fisheries-related research questions of mutual interest. To facilitate these needs, Chris Wilson (AFSC) and David Demer (SWFSC) participated on a cruise aboard the IFREMER research vessel *Thalassa* in October 2007, when the ME70 was used during a survey of pelagic and demersal fishes off the west coast of France. Results of the *Thalassa* survey, the *Oscar Dyson* acceptance trials, as well as other ME70-related issues were presented at the AFSC during a recent teleconference meeting of an *ad hoc* group of ME70 users on 3 December, which included participants from Northeast Fisheries Science Center, SWFSC, and Simrad Fisheries.

By Chris Wilson and Patrick Ressler

SHELLFISH ASSESSMENT PROGRAM-KODIAK LABORATORY

Kodiak Fisheries Research Center Seawater Facility

The Kodiak Laboratory houses a state-of-the-art seawater laboratory at the Kodiak Fisheries Research Center (KFRC), a multi-agency Kodiak Island Borough-owned facility. The 707 m^2 (7,610 ft^2) area laboratory can deliver seawater at a rate of 757 L/min (200 gal/min) and is designed to be configurable in various arrangements. Currently the laboratory is configured with four 5,678 L (1,500 gal) round tanks, eleven 2,479 L (655 gal) round tanks, five 681 L (180 gal) rectangular insulated min-o-cool tanks, four 454 L (120 gal) rectangular tanks, and three 507 L (134 gal) rectangular tanks (Fig.

1). The seawater intakes extend out to depths of 15 and 26 m in Trident Basin, which is located adjacent to the facility. Both raw and sand-filtered seawater run into the laboratory; filters and UV sterilizers of various sizes are used to sterilize seawater, and effluent is treated through an ozone contact system for disinfection. Water quality of incoming filtered and raw seawater and some experimental tanks are continuously monitored for temperature, conductivity, dissolved oxygen, and pH. Additionally, nitrites and ammonia levels are tested weekly. In the seawater laboratory, researchers have the ability to chill water in a recirculation system for experiments. The laboratory also houses various specialized systems such as a Kreisel system for rearing larvae, a system to collect recently hatched larvae of up to 48 individual females at one time, and salmon egg incubator trays modified to decrease cannibalism among juvenile crabs. Three cold rooms are also available in the seawater laboratory (Fig. 2).

Researchers from various RACE programs including Shellfish Assessment (SAP), Groundfish Assessment (GAP), Fish Behavioral Ecology, and Fisheries Resources Pathobiology have conducted research in the KFRC seawater laboratory in recent years. In addition, scientists from the AFSC's REFM and ABL Divisions, NWFSC, Alaska Department of Fish and Game (ADF&G), University of Alaska Fairbanks, Oregon State University, Centro Austral de Investigaciones Científicas, and Alaska SeaLife Center have utilized the seawater laboratory.

To date, the majority of activities in the seawater laboratory have supported research focused on life history investigations of commercially important Alaskan crab species including red king (*Paralithodes camtschaticus*), blue king (*P. platypus*), golden king (*Lithodes aequispinus*) (Fig. 3), Tanner (*Chionoecetes bairdi*), snow (*C. opilio*), and Dungeness crabs (*Cancer magister*). Research has also been conducted on fuzzy crabs (*Hapalogaster mertensii*), which are closely related to king crabs, and may be used as a surrogate experimental species. Life history research conducted for many of the above species includes: reproductive cycles; embryo development and morphology; timing and duration of larval hatching; comparison of reproductive parameters of females with different reproductive history (primiparous vs. multiparous); incubation periods; larval cultivation including differing diet, density and temperature parameters; juvenile and adult diet studies; settlement; substrate preference and survival of early life stages; cannibalism among various early life stages and juveniles; handling mortality; progression of bitter crab syndrome; respiration and metabolic rate measurements; larval fitness; and stress hormones. Microalgae, *Artemia*, and rotifers have been cultivated as larval food for many of the above studies.

The Groundfish Assessment Program has studied numerous commercially important fish species in the seawater laboratory. Staff have examined tagging techniques and associated mortality for Atka mackerel (*Pleurogrammus monopterygius*), Pacific cod (*Gadus macrocephalus*) and walleye pollock (*Theragra chalcogramma*). Baurotrama of swimbladders among gadids was examined by assessing swimbladder recovery. In addition, Pacific cod ageing techniques were validated, and spawning days to hatching and

Figure 1. Kodiak Laboratory research tanks at the KFRC seawater facility. Photo by Brad Stevens.

Figure 2. One of the KFRC seawater facility cold rooms equipped for multiple species of phytoplankton cultivation. Photo by Sara Persselin.

duration of hatch were reported. Developmental stages and growth of fertilized arrowtooth flounder (*Atheresthes stomias*) eggs held in different water temperatures were described.

The KFRC seawater laboratory has also been important in support of other studies that include a multiyear rockfish reproduction study, a postsurgery recovery venue for Steller's eiders (*Polysticta stelleri*) implanted with satellite transmitters, and as a staging area for holding crabs, fish, and eggs before sending them to other seawater laboratories.

Current research at the KFRC seawater laboratory includes projects from numerous programs and agencies. SAP and ABL biologists are examining the effects of ocean acidification on crab larvae by examining the effect of various pH levels on the survival, calcium content, and morphology of early life stages of blue and red king crabs. The SAP is addressing reproductive potential of Bristol Bay red king crabs by assessing reductions in fecundity during brooding and occurrence of unfertilized or nonviable eggs, and by assessing egg quality and larval fitness by female size and reproductive history. Mortality predictors are being developed for Tanner and red king crabs in a collaborative effort between the SAP and Fish Behavior Ecology Program. Efforts by the SAP are under way to better understand golden king crab reproductive cycles, embryonic development and larval cultivation. SAP is continuing to cultivate microalgae and *Artemia* for crab larvae food. The GAP is conducting a preliminary study testing the feasibility of using age-0 arrowtooth flounder as a laboratory study species and determining proper conditions for cultivation. Reproductive biology of mature female snow and Tanner crabs and growth of immature snow crabs are being studied by ADF&G biologists. ADF&G staff are also observing the rate of biodegradation of cotton twine used on crab pots as a time-release escape mechanism.

Future research in the KFRC seawater laboratory is anticipated to involve numerous programs and agencies as well as increased collaboration between these groups. Ocean acidification research will continue in the seawater laboratory, and the laboratory is currently being outfitted with a CO_2 gas delivery system which will allow researchers to manipulate carbonate chemistry that reflects oceanic conditions. Additional crab and invertebrate species will be studied as well as different life stages. Reproductive potential of Bristol Bay red king crab will continue to be studied as described above. The SAP continues to refine culture methods for increasing survival of larval king crab in the KFRC seawater laboratory. The addition of live microalgae to the culture water of blue king crab larvae has optimized survival to the juvenile stages; this technique will be validated with red king crab larvae. Survival of larvae under rearing methods employed at KFRC will be compared to survival of larvae reared concurrently at the Alutiiq Pride Shellfish Hatchery in Seward, Alaska. Future groundfish research will focus on examining the effects of temperature, salinity, and other environmental factors on the metabolic rates, feeding, and growth of key groundfish species such as arrowtooth flounder and Pacific cod. These data would be useful in developing bioenergetic models for these species and helpful in understanding the impacts of changing ocean environments on their populations in the Gulf of Alaska.

Figure 3. Two Kodiak Laboratory research technicians, Jordyn Donnellon (left) and Lindsey Bidder (right), holding research specimens (*Paralithodes camtschaticus* and *Lithodes aequispinus*). Photo by Kathy Swiney.

By Kathy Swiney

FISHERIES BEHAVIORAL ECOLOGY PROGRAM - NEWPORT LABORATORY

Understanding Flatfish Behavior Facilitates Gear Design and New Approaches To Reducing Bycatch

Flatfish support a variety of targeted fisheries and constitute valuable incidental catch in numerous others, with an estimated 924,615 metric tons (t) harvested in 2003. However, as is becoming the norm, fishers are faced with attempting to exploit particular fish stocks while minimizing the incidental take or bycatch of those that are of little economic value, overexploited, or otherwise subject to catch/landing restrictions. Gear-based advances in bycatch reduction will likely come through a more thorough understanding of behavioral differences among species. While the behavioral interaction between fish and trawl gear has received focused attention for many commercially important roundfish species, there have been far fewer focused studies examining flatfishes, with most information on flatfish reported more anecdotally alongside more comprehensive data for roundfish.

Unlike baited gears which attract fish, trawls capture fish by taking advantage of avoidance behavior. This is, in essence, antipredator behavior; when fish move away from a trawl door, they are responding as they would to an approaching predator. Flatfish have evolved a highly specialized anti-predator strategy based upon detection minimization. When lying flat on the sediment, their low body profile and ability to cryptically match the color and texture of sediment, as well as bury in it, renders them nearly invisible to approaching predators and/or prey. Upon detecting an approaching predator, flatfish cease movement and are reticent to flee unless the predator gets very close. In contrast, many of the roundfish that are targeted by trawl fisheries (e.g., gadoids and clupeids) are less intimately associated with the seafloor, having evolved strategies where predator avoidance and escape are maximized. Compared to flatfish, they respond to approaching predators at greater distances and have stronger burst and sustained swimming capabilities.

These divergent strategies for dealing with predation threat have consequences for fish behavior relative to trawls throughout the capture process. From a detailed review of relevant literature, the following generalizations about flatfish behavior relative to trawls emerge. Flatfish generally 1) do not respond to the approach of trawl ground gear until it is less than 1 m away, 2) herd close to the bottom where they are primarily influenced by the action of ground gear, 3) herd for only a short while, and 4) remain low to the bottom during net entry and during their passage to the codend.

The tendency of roundfish to exhibit varying degrees of 'rise' as they tire and fall back into the net, has led to the development of multilevel trawls, with horizontal separators and multiple codends, thereby allowing partial segregation of catch by species, as well as trawls with low rise/swept back head ropes and/or large mesh or open top intermediates to facilitate roundfish escape. Similarly, the tendency of most flatfish to remain close to the seafloor during herding has led to experimentation with incorporating gaps in the footrope's center, or along the floor of the net, thereby providing an escape route for flatfish.

An as yet uninvestigated means of reducing roundfish bycatch in directed flatfish fisheries could capitalize upon the longer reactive distances of most roundfish, compared to flatfish, as well as tendency of many roundfish to herd farther off the seafloor. For lack of a better name, this can be referred to as reverse or 'counter-herding'. Conventional flatfish trawls make use of sweeps; two angled stimulus lines which form a 'V', with the apex of the V pointed toward the net (Fig. 1). This V herds flatfish along

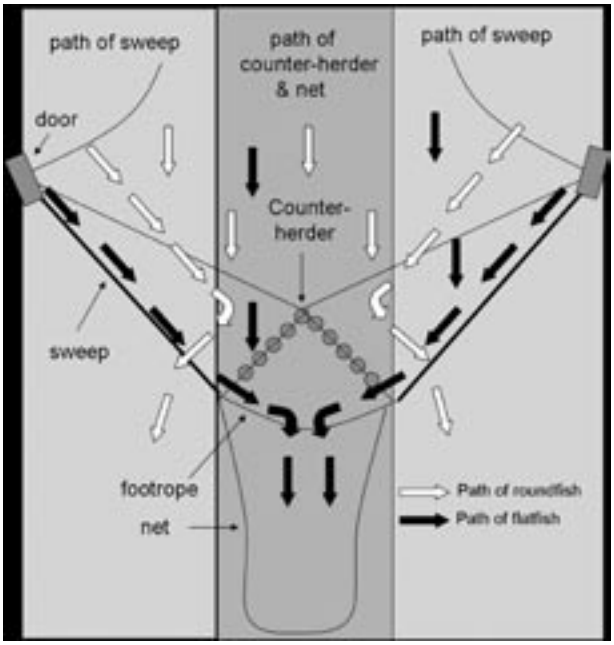


Figure 1. Diagram of hypothetical counter-herding gear that would take advantage of differences in behavior to reduce roundfish bycatch.

the bottom, inward toward the opening of the net. Counter-herding might be initiated in roundfish by installing a second inverted stimuli '/\' approximately a meter or so off the seafloor, positioned between the sweeps, with its apex pointing forward and its open end facing the net mouth. This could be a series of neutral density floats or bobbins of sufficient size that they constitute a prominent visual stimulus. Roundfish species encountering this 'counter-herder' would likely be herded out of the path of the net. Those that do not herd would likely rise into the water column, making it more likely they would pass over the trawl headrope. In contrast, flatfish would likely not respond to the counter-sweep. If some flatfish were herded toward the outside, this would likely be reversed when they came in contact with the tradition sweeps, which, being on the seafloor, would constitute a more immediate perceived threat. Realization of such a counter-herding device would entail significant engineering challenges. For example, changes in the tension on cables and/or lines of the device would need to be accommodated, since the spread of trawl doors changes with bottom topography and sediment characteristics. Further, the tendency of spheres, or other shapes, to oscillate when towed through the water would need to be considered. Successfully engineered, such a device could potentially be utilized alone, or in combination with the aforementioned selective flatfish trawls and/or other bycatch reduction devices to preclude roundfish from entering the net.

By Clifford Ryer

RESOURCE ECOLOGY & FISHERIES MANAGEMENT (REFM) DIVISION

RESOURCE ECOLOGY & ECOSYSTEM MODELING PROGRAM

Fish Stomach Collection and Lab Analysis

During October through December 2007, fisheries observers returned 1,297 stomach samples to AFSC laboratories, and AFSC scientists collected 994 stomach samples from the eastern Bering Sea. Stomach samples were not analyzed at sea this quarter, but 2,707 stomach samples were analyzed in the laboratory. A total of 16,605 records were added to the groundfish food habits database.

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

Sculpin Life History Investigations

As part of a larger study of sculpin life history, a total of 784 otoliths from the yellow Irish lord (*Hemilepidotus jordani*) and 682 otoliths from the warty sculpin (*Myoxocephalus verrucosus*) have been aged. Ageing has begun for the plain sculpin (*Myoxocephalus jaok*) and is ongoing for the bigmouth sculpin (*Hemitripterus bolini*). The maximum age for the yellow Irish lord in samples analyzed was estimated to be 28 years from a female collected in the Aleutian Islands; an age of 18 years was estimated for a female warty sculpin collected in the eastern Bering Sea. Natural mortality values were estimated and reported in the 2007 Bering Sea-Aleutian Islands (BSAI) sculpin stock assessment based on some of this work. These values varied considerably in this group. Using Hoenig's (1983) regression equation where mortality is a function of maximum age, values ranged from 0.15 for females of the yellow Irish lord to 0.47 in females of a previously aged sculpin of the eastern Bering Sea, *Gymnocanthus pistilliger*. Maturity work and stomach analysis from specimens collected in both survey and fishery-dependent samples are being processed and analyzed and will be updated in a later report.

By Todd TenBrink

Spatial Patterns of Arrowtooth Flounder

A new postdoctoral project to analyze spatial patterns of arrowtooth flounder (*Atheresthes stomias*) population growth, predation, and dynamic habitat characteristics in the eastern Bering Sea (EBS) was started in October 2007. Multiple lines of evidence suggest that changes in the EBS climate are leading to distributional shifts and changes in recruitment of fish populations. For example, the estimated biomass of arrowtooth flounder has quadrupled since the early 1980s in the EBS, in contrast to other groundfish species there. Recently, recommended catches for EBS walleye pollock (*Theragra chalcogramma*) have been reduced, in part due to concerns about the growing threat of arrowtooth flounder predation on juvenile pollock. Thus, one goal of the study is to improve our understanding of the impact of arrowtooth flounder to commercial fisheries in the EBS. To meet this goal, physical and biological habitat characteristics, specifically dynamic characteristics associated with water temperature and foraging, that are correlated with arrowtooth flounder biomass trends at individual trawl stations sampled

in the EBS are being identified, and spatial variations in arrowtooth flounder diet and length classes analyzed. Early data exploration has shown that the distribution of arrowtooth flounder is extremely sensitive to bottom temperatures; they are rarely found in waters with bottom temperatures colder than 0°C. Annual changes in arrowtooth flounder distribution are negatively correlated with the extent of the cold pool of bottom water over the EBS shelf, thereby potentially affecting their overlap with prey, such as juvenile pollock. Additional data exploration has indicated that while increasing in overall biomass, arrowtooth flounder have expanded their range to the northwest and that this expansion has been dominated by larger individuals. In addition, consumption of pollock by arrowtooth flounder appears to be greatest in the northwest portion of their range (Fig. 1). This analysis will provide information about the potential for arrowtooth flounder to further increase their distribution and abundance in the EBS and help to predict future responses to climate and fisheries management actions.

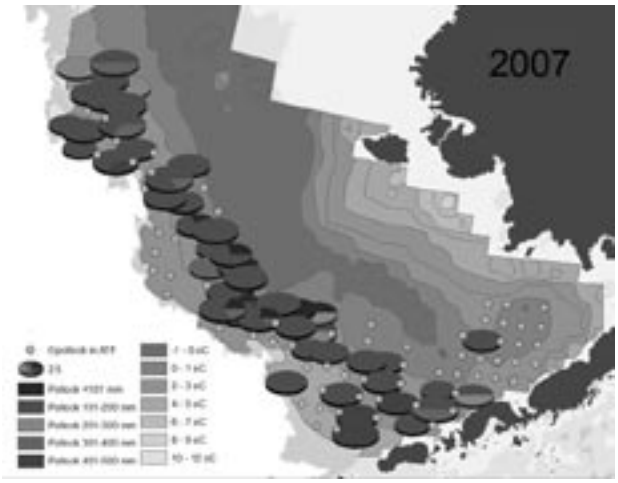


Figure 1. Proportional numbers of walleye pollock found in arrowtooth flounder stomachs at sampled trawl stations in the eastern Bering Sea during summer 2007. Small dots indicate stations where sampled arrowtooth flounder stomachs contained no pollock.

By Stephani Zador

Ecosystem Indicators

The Ecosystem Considerations report of the Stock Assessment and Fishery Evaluation (SAFE) Report was updated and finalized during fall 2007 and presented to the North Pacific Fishery Management Council (NPFMC). In September 2007, 22 contributions were updated and 6 new contributions were added to the report. In November and December 2007, 28 contributions were updated and 3 new contributions were added to the final report. New contributions include information on marine mammals, the Aleutian Islands, fishing effort, and human demographics. All of this updated and new information can be accessed on the Ecosystem Considerations web site at http://access.afsc.noaa.gov/reem/ecoweb/index.cfm.

Major trends in the climate included a relatively cold winter and spring in the Bering Sea, resulting in a large cold pool, with pronounced warming in late spring. The amount of ice and the extent of the cold pool can affect production and distribution of marine organisms. Westerly wind conditions in the Aleutian Islands region suppressed poleward flow of warm Pacific water through the Aleutian passes, thereby contributing to the anomalously cold conditions in the southern Bering Sea from winter into early spring. These winds reversed in the spring, enhancing northward flow, likely contributing to the warming of the southern Bering Sea from spring into summer. During spring, anomalously low sea level pressure was present in the central Gulf of Alaska, which promotes anomalous downwelling in the coastal zone, and a relatively strong Alaska Coastal Current. Gulf of Alaska (GOA) summer survey temperatures indicate cooling of surface waters and warming of deeper waters, supporting the idea that there was anomalous mixing on the GOA shelf. A major conclusion from the analysis of other indices and information regarding fishing effects on ecosystems and ecosystem trends is that no apparent adverse effects of fishing on the ecosystems have been documented to date. Concerns about high bycatch of Pacific salmon in the Bering Sea pollock fishery, however, remain, and these are being addressed by the Council.

By Jennifer Boldt

Multispecies and Ecosystem Modeling

Food habits data and ecosystem modeling results from the Resource Ecology & Ecosystem Modeling (REEM) Program contributed directly to 18 stock assessments included in the 2007 SAFE documents for the NPFMC. Assessments for Bering Sea-Aleutian Islands (BSAI) arrowtooth flounder, eastern Bering Sea (EBS) flathead sole, EBS walleye pollock, AI walleye pollock, BSAI cod, and AI Atka mackerel incorporated results from the EBS and AI ecosystem models. Ecosystem model results were

also included in the BSAI squid and "other species" assessments for squids, skates, sculpins, and octopus. Linkages between BSAI arrowtooth and EBS pollock were reviewed again this year, and recent data indicate that arrowtooth are an increasingly important predator of pollock in the EBS (although not at the scale observed in the GOA). Seven stock assessments incorporated information from the GOA ecosystem model: GOA walleye pollock, thornyhead rockfish, and skates have since 2005, and this year the GOA rex sole, flathead sole, Dover sole, and arrowtooth flounder assessments incorporated model results. All seven GOA assessments reported diet composition and total consumption of prey species, and the GOA arrowtooth assessment included annual estimates of prey consumption for GOA survey years between 1984 and 2005. In addition, the Alaska sablefish assessment incorporated recent diet data from the Gulf of Alaska and may incorporate further diet information and possibly ecosystem model results in future assessments.

By Sarah Gaichas

APEC Workshop on Proposal for Establishment of Deep-Sea Resources and Fisheries Network

Dr. Sarah Gaichas of the REEM Program was invited to travel to Lima, Peru, 2-5 October 2007 to participate in the Asia-Pacific Economic Cooperation (APEC) International Workshop on the Proposal for the Establishment of a Network for Deep-Sea Resources and Fisheries. The workshop's goal was to link knowledge and experiences in deep-sea resources and fisheries by applying a comparative approach to studying deep-sea ecosystems and fisheries. Dr. Gaichas presented an overview of Alaskan fisheries, including current research on grenadiers, thornyheads, sablefish, elasmobranchs, Greenland turbot, and corals, as well as ecosystem structure and function. The knowledge and experience of the participants from other Pacific Rim nations shared at the workshop may provide information for fisheries management actions before the NPFMC (e.g., fishery management plan considerations for grenadiers; developing interest in deep-sea fisheries resources). Since many Alaskan fisheries currently export to Asian and other international markets, the AFSC's involvement in an APEC network discussing developing deep-sea fisheries may also provide advance notice of economic changes which may affect fishery development in Alaska.

By Sarah Gaichas

Seabird Research: Effects of Increases in Oceanographic Variability

Research conducted for the AFSC by Dr. Ann Edwards, National Research Council research associate, suggests that the anticipated increase in oceanographic variability in the North Pacific due to global climate change may cause both a decline in the reproductive success of the Laysan albatross and possibly the black-footed albatross and an increase in albatross bycatch rates in Alaskan fisheries.

Based on stable isotope analyses of feathers, data from reproductive plots monitored by the U.S. Fish and Wildlife Service (USFWS), and published information on albatross movements, it appears that for the Laysan albatross, the most successful breeders forage almost exclusively in deep, mid-oceanic waters, especially within the North Pacific Transition Domain, even during the nonbreeding season. On the other hand, less successful breeders and nonbreeders also forage along continental shelves, including those of Alaska.

When marine habitats change due to oceanographic variability (e.g., when a distinct oceanographic feature such as the North Pacific Chlorophyll Front becomes more variable, as it did during the el Niño year of 1998), food appears to become less available to Laysan albatrosses (and possibly black-footed albatrosses), forcing breeders to forage farther from their breeding colonies, perhaps in unfamiliar waters. As travel distances increase, evidence from other albatross species indicates that reproductive success declines.

Large-scale shifts in foraging location are important and relevant to concerns about seabird bycatch because the highest seabird bycatch rates for Alaskan waters since 1993 occurred in 1998. Thus, as habitat quality deteriorated in the central North Pacific in 1998, it appears that more Laysan albatrosses may have travelled to Alaskan waters to feed, increasing incidental mortality.

Dr. Edwards' results suggest links exist between anticipated increases in oceanographic variability, changes in foraging distributions, lower albatross reproductive rates, and higher bycatch rates of albatrosses in Alaskan waters. Dr. Edwards presented these results in December 2007 at the First International Symposium of Climate Effects on Oceanic Top Predators (CLIOTOP), a GLOBEC program.

By Ann Edwards

ECONOMICS & SOCIAL SCIENCES RESEARCH PROGRAM

An Integrated Regional Economic-Ecological Model of Alaska Fisheries

Commercially valuable fish species are dependent on many other species that share their habitat. Therefore, for formulating 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 the interaction between human activity, the economy, and the marine ecosystem. In this project, an integrated ecological/economic model was developed for Alaska fisheries, which was designed to track both ecological relationships and human activities. The ecosystem model, called general equilibrium ecosystem model (GEEM), was combined with a regional economic computable general equilibrium (CGE) model. Principal investigators at the University of Wyoming completed this project. The project yielded the following outputs:

- A simulation of how human responses to changing prices of goods and factors causes changing energy prices in the ecosystem to which plants and animals respond;
- Estimates of the changes in economic welfare and ecological population attributable to alternative harvesting quotas;
- Measures of how the ecosystem externality generated by harvesting (an ecosystem service) impacts tourism (another ecosystem service);
- Welfare measures associated with changes in "charismatic" marine mammal populations; and
- A method for introducing a renewable resource into a CGE model.

The integrated ecosystem approach provides more useful information to policy-makers than stand-alone regional economic or ecological models for fisheries, and better satisfies National Standard 8 of the Magnuson-Stevens Act's National Standard Guidelines. While the economic and ecological underpinnings of this approach can be extended and improved in many ways, the CGE/GEEM approach is a step toward integrating disciplines with common structures and goals.

By Chang Seung

Estimating Regional Economic Impacts of Alaska Crab Rationalization

In the time since the Bering Sea and Aleutian Islands (BSAI) crab fisheries were rationalized in 2005, there have been rapid and dramatic changes within the industry. While total harvest in the Bristol Bay red king crab and Bering Sea opilio crab fisheries increased in 2005 relative to 2004, the number of vessels and crew members participating in both fisheries fell markedly. The effects of this consolidation have not been formally evaluated, nor have the complex changes that occurred with the timing and location of crab processing. Fishery managers and the public at large have expressed an interest in knowing how and by how much crab rationalization has affected employment and earnings of vessels and processors and the economic well-being of communities dependent on crab fisheries. This project will investigate these economic impacts by developing a regional economic model for Alaska and Washington that will provide fishery managers with the information on how the economic returns of stakeholders changed under crab rationalization. The model may also be used to estimate how alternative crab individual processor quota (IPQ) allocations will affect stakeholders and their communities. By estimating economic impacts of crab rationalization on fishery-dependent communities, this project will help address National Standard 8 and other federal mandates. The results of this project will also assist managers in considering and formulating modifications to BSAI crab fishery policies.

By Chang Seung

STATUS OF STOCKS & MULTISPECIES ASSESSMENT PROGRAM

Through-Ice Sampling Workshop

Libby Logerwell and Kim Rand from the Status of Stocks & Multispecies Assessment (SSMA) Program's Fishery Interaction Team (FIT) organized a workshop on methods for sampling the marine environment under the ice. The workshop was held at the University of Alaska Fairbanks on 7-8 November 2007. Participants included fishery biol-

ogists; fisheries acousticians; physical and biological oceanographers; and researchers with expertise in the operation of underwater vehicles, scientific diving, and the logistics of establishing ice camps. The purpose of the workshop was to gather information on state-of-the-art methods for fish and oceanographic surveys of the Beaufort Sea shelf during ice-covered periods.

The workshop was funded by the Interior Department's Minerals Management Service (MMS). The MMS has also provided funding to the AFSC for a pilot survey and test of hypotheses in the Beaufort Sea during an ice-free period. Scientists from the AFSC and their collaborators at the University of Washington and University of Alaska Fairbanks will conduct this survey during August-September 2008 (http://www.afsc.noaa.gov/hepr/losi.php). The distribution and abundance of fish will be assessed with bottom trawls and fisheries hydroacoustics. The distribution of zooplankton will be sampled with bongo nets and oceanographic properties will be measured with conductivity-temperature-depth probes. Although the survey will take place in ice-free waters, one of the project goals is to provide MMS with recommendations for how to optimally conduct an analogous survey during ice-covered periods. This was the motivation for the Through-Ice Sampling Workshop.

The following techniques for fish sampling were addressed: net sampling, fisheries acoustics (including DIDSON), and video cameras. Oceanographic sampling was also included in the agenda. Methods for deploying nets and instruments were discussed, specifically: remotely and autonomously operated vehicles and scientific diving. Finally, the logistics of establishing and maintaining ice camps were addressed.

The primary outcome of the workshop will be a review of methods and recommendations for a full winter survey that would accomplish the goals of the MMS. In other words, methods suitable for a survey of *ice-covered* waters over the Beaufort Sea shelf that would replicate, to the extent feasible, the summer survey in *ice-free* waters described above. The workshop also provided the opportunity for potential collaborations between institutions and individuals to be identified.

By Libby Logerwell

Groundfish Stock Assessments for 2008: Fishery Quota Recommendations

The Alaska groundfish management system is based on extensive data available from the AFSC's North Pacific Groundfish 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, such as 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 and make recommendations for future catch levels.

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 levels (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. 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:

$$\text{Catch} \leq \text{TAC} \leq \text{ABC} < \text{OFL}$$

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 on the web at http://www.afsc.noaa.gov/refm/stocks/assessments.htm.

In 2007 the Resource Assessment and Conservation Engineering (RACE) Division's groundfish assessment group conducted a summer bottom trawl survey in the Gulf of Alaska (the previous such survey was in 2005). The RACE Division's Midwater Assessment Conservation Engineering (MACE) Program conducted three major surveys in 2007: the winter echo-integration trawl (EIT) survey in the Shelikof Strait and nearby areas, the winter Bogoslof Island region survey of spawning pollock from the Aleutian Basin, and a survey of the entire shelf region of the eastern Bering Sea (EBS) to assess the summer abundance of pollock and other species. Scientists from the AFSC's Auke Bay Laboratories (ABL) conducted the annual longline survey which is designed primarily for sablefish but also produces data used in the 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 groundfish assessment group also conducted the standard summer-trawl survey for the EBS shelf area and an extensive survey of the GOA.

Ecosystem considerations sections were enhanced within individual assessment sections, in addition to the extensive document detailing an overall picture of the ecosystem status, on the web at http://access.afsc.noaa.gov/reem/ecoweb/index.cfm. This report plays an ever increasing role in evaluating quota recommendations, and ecosystem considerations are continually being enhanced within the individual species-specific stock assessment report sections

Presently, projections of 2008 spawning biomass for the main groundfish stocks are estimated to be near or above their target stock size (B_{msy}) while the 2007 catch levels were below F_{msy} levels for both the BSAI and GOA regions (Figs. 1 and 2). Fisheries for these groundfish species during 2006 yielded 2.1 million t valued at approximately $2.0 billion after primary processing. This harvest represents over half of the weight of all commercial fish species landed in the United States. The main pollock stock yields in 2007 dropped from previous years but resulted in catches of about 1.4 million t. Virtually all flatfish resources (e.g., rock sole, yellowfin sole, Alaska plaice, and arrowtooth flounder) are at high levels, but catches remain relatively low. Atka mackerel abundance is declining and is presently at about

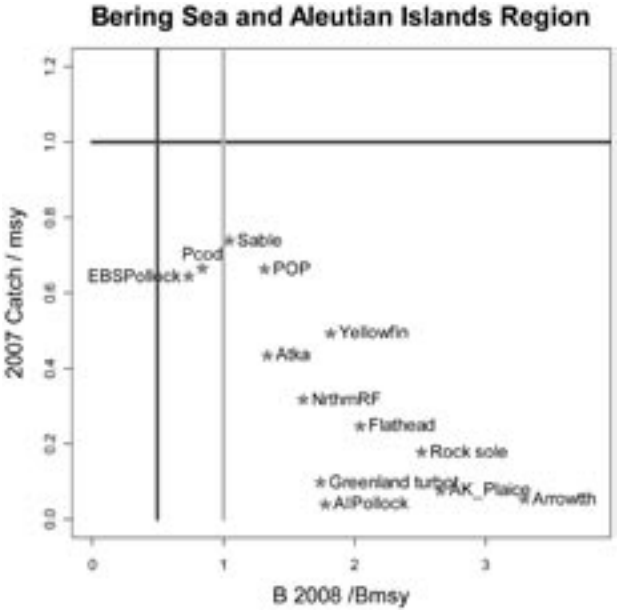


Figure 1. Relative 2008 spawning stock size compared to B_{msy} (taken to be $B_{35\%}$ for all species except EBS pollock) versus relative 2007 catch levels compared to 2007 F_{msy} levels for BSAI stocks.

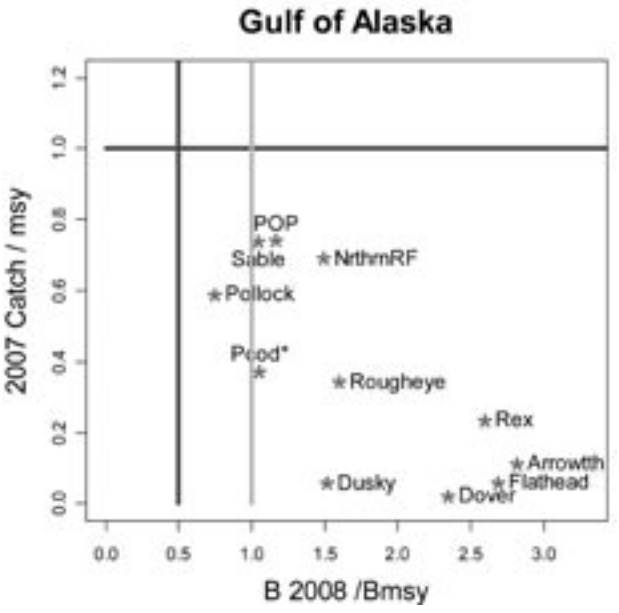


Figure 2. Relative 2008 spawning stock size compared to B_{msy} (taken to be $B_{35\%}$ for GOA stocks) versus relative 2007 catch levels compared to 2007 F_{msy} levels for GOA stocks. Note that Pacific cod stock status is based on a previous assessment results.

Table 1. The 2007 catch levels compared to the 2007 and 2008 ABC specifications (and change in ABC) for the groundfish species types for the Gulf of Alaska. In metric tons (t).

		ABC			
Species	2007 Catch	2007	2008	Change	
Pollock	51,779	68,307	0,180	down 8,127	(12%)
Pacific cod	36,696	68,859	6,493	down 2,366	(3%)
Sablefish	12,539	14,310	2,720	down 1,590	(11%)
Flatfish	14,260	108,367	3,759	up 15,392	14%
Arrowtooth flounder	25,073	184,008	6,470	up 42,462	23%
Rockfish	22,816	33,720	3,548	down 172	(1%)
Atka mackerel	1,441	4,700	4,700	same	(0%)
Skates	3,498	8,056	8,321	up 265	3%
Total	168,102	490,327	536,191	up 45,864	9%

Table 2. The 2007 catch levels compared to the 2007 and 2008 ABC specifications (and change in ABC) for the rockfish stock components for the Gulf of Alaska. In metric tons (t).

Species	2007 ABC	2008 ABC	Change
Other slope rockfish	4,154	4,297	3%
Northern rockfish	4,938	4,549	-8%
Pacific ocean perch	14,636	14,999	2%
Shortraker rockfish	843	898	7%
Rougheye rockfish	988	1,286	30%
Pelagic shelf rockfish	5,542	5,227	-6%
Demersal shelf rockfish	410	382	-7%
Thornyhead rockfish	2,209	1,910	-14%
Total	33,720	33,548	1%

average levels. Rockfish species comprise 5%-8% of the groundfish complex biomass and are generally increasing based on recent surveys. Below are summaries of stock assessment results by area and species or species group.

GULF OF ALASKA (GOA)

In the GOA, the sum of the recommended ABCs for 2008 is 536,200 t, which represents a 9% increase from the 2007 total. The largest contributor to this increase was due to the arrowtooth flounder assessment. Brief summaries of each GOA species or species group follows. Units are in metric tons.

GOA Pollock: The 2007 winter Shelikof Strait EIT survey biomass estimate was 38% less than the 2006 estimate and is the lowest biomass estimate observed from this region. The Alaska Department of Fish & Game (ADF&G) crab/groundfish survey biomass estimate increased 11% from 2006, whereas the NMFS summer bottom trawl estimate was 20% lower than the most recent 2005 estimate. Combining these in the assessment resulted in estimates of spawning biomass for 2008 at around 145,000 t, which is 26% of unfished spawning biomass and below $B_{40\%}$ (221,000 t).

GOA Pacific Cod: The 2007 survey estimate of Pacific cod was 233,000 t compared to the 2005 estimate of 308,000 t. The assessment analysis presented this year is under review, hence the Council was unable to agree that estimates of 2008 spawning biomass relative to reference points were available. The ABC dropped from previous years by 3% but the catch levels have been a little more than half of the TAC. The survey data suggests that some young fish are moving into the population in this region, as evidenced by a mode of Pacific cod at around 18 cm (Fig. 3).

GOA/BSAI Sablefish: This year's assessment adopted revised growth estimates within a split-sex model so that differences in growth and maturity between males and females can better be accommo-

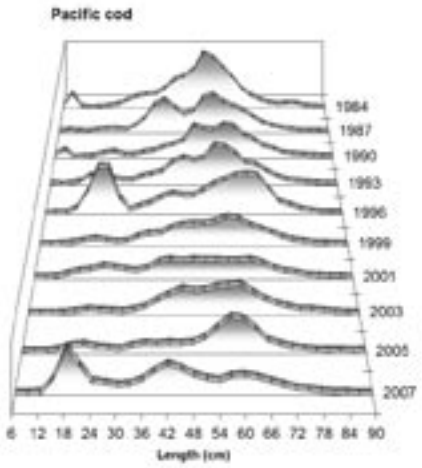


Figure 3. Pacific cod abundances-at-length (cm) observed in the NMFS shelf trawl surveys, 1984-2007, for the Gulf of Alaska.

dated. The survey abundance index decreased 14% between 2006 and 2007, a change which follows the 13% increase between 2005 and 2006. The fishery abundance index was down 8% from 2005 to 2006. The projected 2008 female spawning biomass is 37% of unfished biomass compared with about 29% of unfished biomass estimated during the 1998 to 2001 period. The 2000 year class now appears to be larger than the 1997 year class and is expected to comprise 18% of the spawning biomass in 2008. The Alaska-wide recommended 2008 ABC is 18,030 t, approximately 10% lower than the 2007 level.

GOA Flatfish: Arrowtooth flounder continues to dominate this group (and leads all groundfish based on the 2007 survey biomass estimates (for the western and central GOA). The 2007 survey estimate indicated an arrowtooth flounder biomass of 1.94 million t compared to 470,400 t for Pacific halibut and 894,200 t for all other flatfish species in this region combined. The 2008 ABC recommendation for arrowtooth flounder increased 23% from the 2007 value to 226,500 t (compared to the 2007 catch of 25,000 t). The other flatfish management groups and 2008 ABCs were: deepwater flatfish—8,903 t (compared to 2007 catch of 267 t); shallow-water flatfish—60,989 t (compared to 2007 catch of 8,042 t); flathead sole—44,735 t (compared to 2007 catch level of 3,105 t); and rex sole—9,132 t (compared to 2007 catch level of 2,846 t).

GOA Rockfish: For Pacific ocean perch, the 2008 ABC increased by 2% to 15,000 t based on new survey data and an updated assessment model. For northern rockfish, an updated assessment resulted in a drop in the ABC for 2008 by 8%. Substantial developments in the rougheye rockfish assessment included adding 2002 and 2006 fishery length compositions, four additional years of historic trawl survey age compositions to supplement the regular updates including the 2007 trawl survey biomass estimate, and longline survey estimates. Dusky rockfish comprise the bulk of the "pelagic shelf rockfish" management group and assessment results for this species indicate a stable to increasing trend. However, the ABC for this group has dropped by 6% due to the fact that the 2007 survey estimate was about 2.5 times lower than the 2005 estimate (but in-line with estimates from earlier years). A summary of GOA rockfish ABCs relative to the 2007 levels are given in Table 2.

BERING SEA/ALEUTIAN ISLANDS (BSAI)

The sum of the ABCs for 2007, as recommended by the Scientific and Statistical Committee, is just over about 2.4 million t, about 10% lower than the sum of the 2007 ABC values. This drop was driven by the continued reduction in ABC from EBS pollock (1.45 million t in 2007 compared to 1.0 million t in 2008). Brief summaries of each BSAI species or species group follows.

EBS Pollock: The 2007 summer bottom-trawl survey estimate of the pollock stock increased from the 2006 estimate but was only about 87% of the long-term mean for this survey. Similarly, the 2007 EIT survey estimate increased over the 2006 estimate but was still only about 55% of the long-term mean for this survey. Abundances at age patterns as observed in NMFS groundfish trawl surveys are shown in Figure 4. Combined with new information on the age composition from NMFS observer data and these surveys, and lower-than-expected mean weights-at-age for pollock observed from the 2006 fishery, the projections for 2008 and 2009 are lower than what was estimated last year. The Council recommended a 2008 maximum permissible Tier 1b ABC of 1.170 million t. Additionally, they decided that more precaution was required and decided that it would be most prudent to have the ABC set at 1.0 million t which would return the spawning biomass exploitation rate to pre-2006 levels. For the near term, the expected trends are for the declines

to ease and abundance to increase in 2010 as the apparently above-average 2006 year class recruits to the population.

Aleutian Islands and Bogoslof Region Pollock: The Aleutian Islands pollock spawning biomass is projected to be over 82,000 t in 2008 and above the $B_{40\%}$ level of 51,500 t, which results in an ABC level of 28,200 t. However, due to current regulations, the TAC for this region is set to 19,000 t. For Bogoslof pollock, winter survey results show a stable to slightly increasing stock with an ABC (under Tier 5) set to about 8,000 t. However, consistent with past practices, the Council prohibits a directed pollock fishery in this region and recommended a TAC of 10 t to account for pollock bycatch that occurs in other fisheries.

BSAI Pacific Cod: The 2007 EBS shelf bottom-trawl survey estimate was 424,000 t, representing a drop of 18% from the 2006 value, and is the all-time low in the time series. The assessment evaluated an array of model configurations. As with past years, the models indicated a series of poor year classes (2001-05). However, the 2006 year class appears to be more than 2.5 times higher than the average recruitment. The Council-selected model resulted in an ABC (and TAC, not counting state-waters allocation) of 176,000 t.

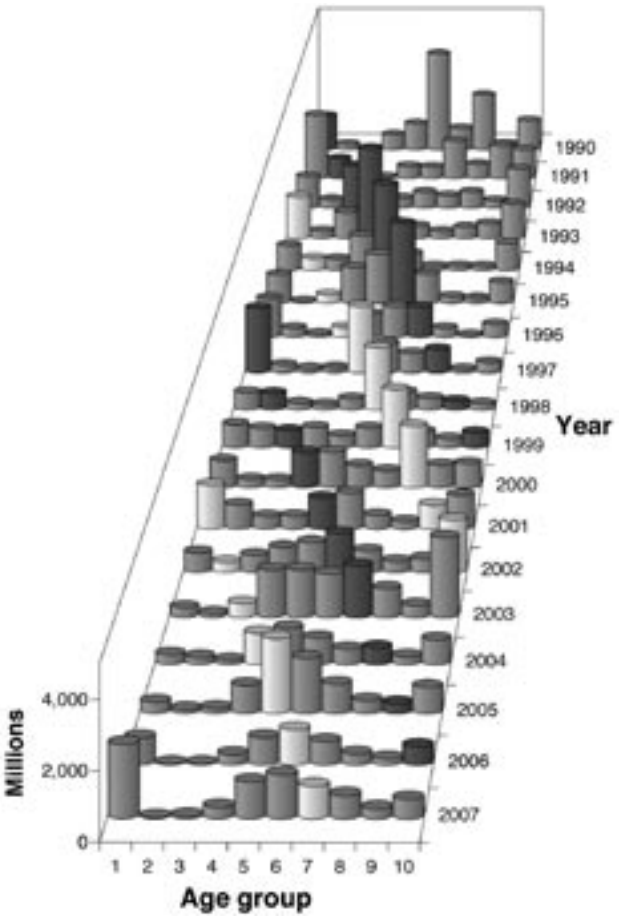


Figure 4. Abundances-at-age of EBS pollock biomass as estimated from NMFS summer groundfish trawl surveys, 1990-2007. Some recent strong year-classes shown as they age are highlighted by gray tones.

BSAI Flatfish: Combined, the five main species groups of flatfish (not counting Greenland turbot) continue to trend upwards with a 24% increase from the 2007 levels of ABC (representing about 43% of all groundfish). As with last year, the Council accepted that estimates of F_{msy} and the associated uncertainty were adequately estimated, based on fitting a stock-recruitment relationship within the integrated assessment model, for yellowfin sole and northern rock sole. This results in management under Tier 1 and implies somewhat higher ABCs than estimated under Tier 3 methods. Critically important this year is the fact that the TAC for yellowfin sole has been set to 225,000 t—an increase of 65% from the 2007 level. This is due to the decrease in pollock TAC and will potentially have important repercussions on future harvest rates and halibut bycatch levels. The arrowtooth flounder 2008 ABC increased 54% to 244,000 t but led to a TAC of only 75,000 t. Northern rock sole 2008 ABC increased by 52% (primarily due to increasing survey estimates and Tier 1 calculations) to 301,000 t but the TAC was set at 75,000 t. The flathead sole ABC dropped by 9% to 71,700 t while the Council set the TAC to 50,000 t. Alaska plaice and other flatfish assemblage ABCs increased by just over 1% from the 2007 levels leading to a combined TAC of 71,600 t.

BSAI Greenland Turbot: Surveys suggested a slight decline from previous year's results but still indicated that recent recruitment conditions improved. A number of issues remain with this assessment, in particular, the fact that this species tends to be distributed in more northerly regions and the degree of mixing between other regions (e.g., north of the U.S. convention line) is unknown. Due to funding limitations, the slope survey (which covers the main habitat for Greenland turbot) was cancelled in 2006, but it is hoped that one will be conducted in 2008. Due to the assessment uncertainties and

stock structure issues, the Council recommended a conservative ABC level, which for 2008 is 2,540 t.

BSAI Rockfish: Since the main survey in the Aleutian Islands was most recently conducted in 2006, the BSAI rockfish stock assessments were updates of projections from last year's models. The only change was noted for the BSAI Pacific ocean perch ABC, which dropped 1% to 21,600 t for 2008. Northern rockfish and the other species shortraker and rougheye rockfish, and "other" rockfish biomass levels were reported as stable based on projections.

BSAI Atka Mackerel: The assessment model results indicate that the stock is declining from above-average levels, and the projected 2008 biomass estimate results in a decline of about 18% from the 2007 ABC level. The projected female spawning biomass for 2008 is estimated at 110,200 t, roughly 47% of unfished spawning biomass and above the $B_{40\%}$ level (94,000 t). The 2008 ABC recommendation is 60,700 t (which is also equal to the TAC). This is down from the 2007 level of 74,000 t.

By James Ianelli

Estimated production figures for 1 January through 31 December 2007. Total production figures were 34,616 with 9,696 test ages and 347 examined and determined to be unageable. This is the second highest yearly production total since 1990.

Species	Specimens Aged
Giant grenadier	359
Greenland turbot	502
Flathead sole	1,373
Alaska plaice	449
Dover sole	447
Northern rock sole	1,241
Yellowfin sole	496
Arrowtooth flounder	738
Bering flounder	258
Walleye pollock	12,558
Pacific cod	4,999
Sablefish	2,366
Atka mackerel	1,629
Pacific ocean perch	2,316
Northern rockfish	929
Rougheye rockfish	1,502
Shortraker rockfish	1,052
Dusky rockfish	314
Blackspotted rockfish	390
Warty sculpin	185
Yellow Irish lord	513

AGE & GROWTH PROGRAM

Shark Ageing Research

The Age & Growth Program and Professor Vince Gallucci (University of Washington) began an informal collaboration on the ageing of salmon sharks (*Lamna ditropis*) and Pacific sleeper sharks (*Somniosus pacificus*). The Age and Growth Program has not previously aged sharks. Some shark species are especially difficult to age due to their minimal amounts of skeletal calcification. The salmon shark shares the same genus as the porbeagle shark (*L. nasus*) which has validated ages, so the salmon shark is believed to be ageable. The Pacific sleeper shark, which shares the same genus with the Greenland shark (*S. microcephalus*), presents a more difficult challenge. Researchers of the Greenland shark think this species grows to be quite old, so the Pacific sleeper shark may be similar. The problem is that the Pacific sleeper shark and Greenland shark show very little calcification, so age determination is very difficult. If you have had success ageing these species or know of any successful ageing studies please let us know!

By Dan Kimura