AUKE BAY LABORATORY (ABL)

GROUNDFISH ASSESSMENT PROGRAM

Western Groundfish Conference

Kalei Shotwell (presenter), Jon Heifetz, and Dana Hanselman from the Auke Bay Laboratory (ABL) gave a presentation on their rockfish research at the 14th Western Groundfish Conference in Newport, Oregon, held on 30 January to 3 February 2006. The presentation summarized research conducted on adult rockfish benthic habitat associations in the Gulf of Alaska.

Many species of commercially valuable rockfish (*Sebastes* spp.) inhabit waters on the outer continental shelf and upper slope in the Gulf of Alaska, typically between depths of 100 m to 500 m. The benthic habitat requirements and spatial distribution of these rockfish species are relatively unknown. Information regarding benthic habitat use would improve current stock assessments and provide baseline information for an ecosystem approach to management. Several study areas in the Gulf of Alaska have recently been mapped with high resolution multibeam bathymetry and backscatter to generate detailed benthic habitat maps. Large populations of rockfish have been surveyed and fished within these mapped areas.

The objectives of ABL's rockfish research were to delineate habitat on two resolutions of classification, generate density estimates for rockfish, and identify useful predictors of rockfish distribution for use in stock assessments. The ABL researchers used a modified deep-water marine benthic habitat scheme to classify habit. The larger scale used multibeam imagery for determining benthic habitat, while the smaller scale used direct observations of seafloor features from submersible video.

In summer 2005, 40 dive transects were completed on three mapped sites (Albatross Bank, Cape Ommaney, and Hazy Islands) in the Gulf of Alaska using the two-person submersible *Delta*. Scientists observed schooling behavior in dusky rockfish typically in the water column and observed Pacific ocean perch in very large schools over soft bottom. Numerous gravid females were found in cobbles and small boulder fields. Solitary individuals such as shortraker, rougheye, redbanded, and sharpchin rockfish were encountered in fairly distinct habitat types.

The researchers identified habitat types with high densities of rockfish species within each classification method. In general, the multibeam classifications were too broad to be consistent with the high variability of the finer scale video classifications. However, when the two classification methods were compared using generalized features (i.e., boulder, sand, mud), densities for some species were more consistent, particularly on hard substrates such as boulders and cobble. Depth was also considered as an additional factor for determining species distributions. Major commercial rockfish species were clearly delineated by depth, occupying specific ranges. This finding was consistent with previous studies on adult rockfish distributions. The researchers concluded that more general habitat classifications such as substrate hardness combined with depth might be a better predictor for rockfish species distributions over large areas.

By Kalei Shotwell

2006 Sablefish Longline Survey

The AFSC has conducted an annual longline survey of sablefish and other groundfish off Alaska since 1987. The survey is a joint effort involving ABL and the Resource Assessment and Conservation Engineering (RACE) Division. Beginning in 1996, biennial sampling of the Aleutian Islands region and eastern Bering Sea was added.

The 2006 survey is scheduled 1 June to 1 September, using the chartered fishing vessel *Alaskan Leader*. The 2006 survey area covers the upper continental slope and selected gullies of the eastern Aleutian Islands and the Gulf of Alaska. The eastern Aleutian Islands will be sampled first, followed by the western Gulf of Alaska. The survey vessel then will travel to Dixon Entrance in early July and sample the eastern and central Gulf of Alaska.

Several special projects will be conducted during the 2006 survey. A marine mammal observer will observe killer whale depredation on the longline during the first two survey legs in the western Gulf of Alaska. A second observer will study sperm whale depredation in the eastern and central Gulf of Alaska, and there are tentative plans to tag sperm whales with bioacoustical tags during this time. Seabird observations and counts will be conducted throughout the survey to help address where and when certain seabird species occur in Alaska waters.

A giant grenadier reproductive biology study will be conducted during the Southeast leg. Finally, a 2-day experiment will be conducted off Yakutat to collect genetic tissues of rougheye rockfish (*Sebastes aleutianus*) and to investigate depth distribution patterns of "light" and "dark" color phases of rougheye rockfish.

By Chris Lunsford

HABITAT PROGRAM

Southeast Alaska Regional Science Fair

In March 2006, ABL scientists donated their time and expertise as mentors and judges for the Southeast Alaska Regional Science Fair. The fair, held in Juneau, provides high school students in Southeast Alaska the opportunity to compete for scholarships and awards while learning to apply the scientific method to research questions. The fair is affiliated with Intel's International Science and Engineering Fair, which is the world's largest science fair and awards more than $3.0 million in scholarships. Scientists from ABL mentored many of the 128 projects entered in this year's fair, and 3 of the ABL-mentored projects advanced to the final round of judging.

One of the ABL-mentored projects, *A toxicity assay to understand the effects of global warming* by students Brenna Heintz and Kevin Heffern and mentored by ABL fisheries scientist Ron Heintz, was among the four projects selected to advance to the international science fair in Phoenix in May 2005. Bonita Nelson and Lawrence Schaufler of the ABL Outreach Committee were on the judging and organizing committee for the Alaska Regional Science Fair. The ABL also provided 22 mentors and 17 judges to the fair.

By Bonita Nelson

Selendang Ayu Oil Risk to Early Life Stage Salmon

By request from NOAA's National Ocean Service, ABL researchers examined stream and marine water for evidence of pink salmon (*Oncorhynchus gorbuscha*) exposure to oil spilled by the freighter *Selendang Ayu*. The oil was spilled on 8 December 2004 (an estimated 7500 barrels) and spread into adjoining bays of Unalaska Island, extending approximately 40 km from the wreck. The impacted area included 19 streams utilized by pink salmon and other species as spawning and rearing habitat, raising concerns that incubating eggs, alevins, and fry could be damaged by oil exposure. Our primary objective was to determine if pink salmon embryos and alevins were exposed to meaningful quantities of biologically available oil, specifically polynuclear aromatic hydrocarbons (PAHs).

Polynuclear aromatic hydrocarbons from the *Selendang Ayu* oil spill were biologically available at detrimental concentrations in 1 of 14 streams examined, likely placing resident juvenile fish and possibly embryos at risk. Estimated aqueous total PAH concentrations in this stream (SKN14) were high enough to have negative impacts on survival and growth, but pink salmon embryos were generally absent in the affected river area. This was likely due to marginal habitat quality (too much sand and mud) rather than oil related mortality. Species that reared in oiled reaches of the main channel (Dolly Varden and coho salmon) were also at risk, but this remains unquantified because analysis of tissues for hydrocarbon exposure has not been completed. Even though bioavailable PAHs in bays was widely distributed, only the water of Skan Bay posed a risk to emigrant juvenile pink salmon during the sampling period. Bioavailable total PAH concentrations in Skan Bay were significant, but several unknowns precluded definitive assessment of risk in marine water, including the residence time of juvenile pink salmon, their dependence on potentially oiled prey, and true aqueous total PAH concentrations.

By Mark Carls

MARINE SALMON INVESTIGATIONS PROGRAM

2005 Water Temperatures at Auke Creek Were Second Highest on Record

The average annual water temperature at Auke Creek for 2005 was tied with 2004 as the second warmest year on record. Daily temperatures are routinely collected at Auke Creek as part of the ABL salmon investigation program. The average temperature for 2005 was 8.7°C, and only 1998 was warmer at 8.9°C. The 1964-2005 average annual water temperature at Auke Creek was 7.2°C. Daily water temperatures in 2005 were above average from January through August, and 19 record high temperatures were set during this period, most in April and May. Temperatures were near average from September through December, and on 34 of those days tem-

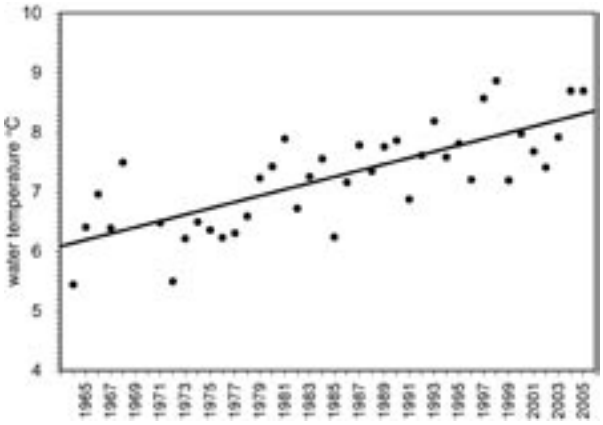


Figure 1. Average annual temperature of Auke Creek, Alaska, 1964-2005.

peratures were slightly below average, mainly because of the cool, rainy weather. Over the last four decades there has been a trend of increasing water temperature at Auke Creek, and the average annual temperature during this period increased from 6.1 to 8.3°C (Fig. 1). Seven of the highest annual temperatures occurred within the last decade.

Water temperatures can have a significant effect on pink salmon. During the last 33 years, as water temperatures at Auke Creek were on an increasing trend, the annual migrations of pink salmon fry occurred earlier in the year. The trend culminated in a 2005 migration that occurred 18 days earlier than in 1973. The earlier pink salmon runs at Auke Creek may have negative effects on survival of fry, and Auke Creek may eventually become an unsuitable habitat for spawning salmon.

By Jerry Taylor

March Freeze-up at Auke Creek Research Station

The key to salmonid research projects at Auke Creek Research Station is the fish counting weir. The Auke Creek weir is made operational each year in early March for counting seaward migrating salmonids leaving the Auke Creek-Auke Lake drainage. The 45-year data set from weir operations provides important information about the freshwater life history stages of seven anadromous salmonid species that migrate in and out of this drainage system. The weir is operated on a cooperative basis with the University of Alaska School of Fisheries and Ocean Sciences (UAF-SFOS) and the Alaska Department of Fish and Game. Both of these agencies conduct specific research projects on one or more salmonid species that migrate through the Auke Creek weir.

The weir is a permanent structure with the capability of capturing all downstream and upstream migrant salmonids and can operate during extreme water flows. During the downstream capture mode the weir is operated to spill most of the stream flow through five horizontal inclined screen traps and four vertical V-shaped panels. The traps and panels are covered with aluminum that has 3-mm perforations. More than 99% of the flow in Auke Creek is spilled through the traps and panels, and all fish are retained. The fish and a small amount of water, about 150 leters per minute, are diverted into a collection trough, through a fish grader, and then into separate holding tanks downstream from the weir. The fish are counted daily and the weir is checked

The upstream weir pool froze to a depth of at least 30 cm during the March 2006 cold snap. This is only the second time in 27 years that the weir pool has frozen.

An unusual freezing period and associated low stream flows at Auke Creek weir in March 2006 resulted in the massive accumulation of ice on the fish counting weir. Ice was removed daily to keep the weir operational.

several times a day during changing flow conditions and during peak fish migration times.

The Auke Creek weir was installed in the downstream capture mode in 2006 on 1 March. Stream flow was extremely low, and the weir was operating within a few hours of installation of the last trap structures. Stream flow remained low throughout March, and modifications to the weir were required to keep it working. Two horizontal traps were closed off, and the other three traps were lined with plastic sheeting to stop spillage. The entire flow of Auke Creek was diverted into the fish holding tanks at the weir.

Record cold air temperatures near –20°C during an unusual 8-day cold spell in mid-March froze the small impoundment pool used to manage stream flow on the upstream side of the weir. Stream temperatures dropped to near 0°C, and there was a massive accumulation of ice on the weir traps and holding tanks. It required an hour or more each day to remove the ice from the traps, holding tanks, and inside the trough to maintain water flow. On 18 March we used hammers and wooden stakes to knock the ice away from the weir traps, thus removing the weight of ice from the structures. A 2-inch pump was used to direct water onto the ice on the weir pool to melt the ice attached to the vertical panels and fish traps. It took several days to complete the ice-melting operation in the weir pool. Despite the unusual icing this year, the weir remained operational and the daily fish counts were maintained.

Usually during March, pink and chum salmon fry dominate the number of migrant salmonids captured at Auke Creek weir, with an occasional Dolly Varden or cutthroat trout captured. In 2006, a total of 1,820 pink salmon fry were counted at the weir through March, considerably less than the average count for March of 10,000. Six Dolly Varden char and one cutthroat trout were also captured in March 2006.

By Jerry Taylor

FEDZ Laboratory Sample Processing

The Fish Energy Diet and Zooplankton (FEDZ) Laboratory at ABL recently increased its capability for processing a backlog of biological samples, with the addition of two new contract technicians. Collections of zooplankton and juvenile salmon samples are being processed from the Southeast Coastal Monitoring (SECM) project and the Southeast Sustainable Salmon Fund (SSSF) Taku Inlet project. The SECM project is examining interannual patterns in early marine ecology of the five species of juvenile Pacific salmon in northern and southern Southeast Alaska, while the Taku project is a multi-agency, cooperative project examining hatchery-wild interactions of chum salmon in the Taku River estuary. Processing by the FEDZ Laboratory includes zooplankton volumes and species composition to assess prey fields, detailed stomach content analyses to examine fish diet, and calorimetry to determine whole body energy content as a measure of relative condition. Contractors Jacqueline Mitchell and Michael Kohan are now working with ABL scientists Molly Sturdevant and Emily Fergusson to complete sample series collected in 2004 and 2005.

Emily Fergusson (center) instructs contractors Jacqueline Mitchell (right) and Michael Kohan (left) on the finer details of zooplankton identification in ABL's FEDZ Laboratory.

By Molly Sturdevant

OCEAN CARRYING CAPACITY PROGRAM

Winter Pacific Salmon Survey

Jamal Moss from the ABL Ocean Carrying Capacity program, and Nancy Davis from the High Seas Salmon Research program at the University of Washington School of Aquatic and Fishery Sciences, participated in a winter North Pacific salmon research cruise during late January-early March 2006. The cruise took place aboard the Fisheries Agency of Japan's 93-m stern-ramp research trawler *Kaiyo Maru*. The primary objectives of the research were to 1) estimate spatial distributions and biomass of salmon by species, stocks, and developmental stage, 2) determine salmon habitat characteristics during winter, 3) evaluate winter mortality schedules, trophic conditions, and growth rate, and 4) contrast physical and biological conditions encountered by salmon during winter and summer months.

Survey stations were located from longitude 155.00˚E to 145.00˚W and latitude 41.00˚N to 51.00˚N. Oceanographic measurements were made immediately prior to each trawl during morning hours and immediately after each trawl during afternoon hours, and included conductivity, temperature, depth, and oxygen concentration. Fish scales and otoliths were collected for age, growth, survival, isotope, and genetics studies. Disk tags were attached to pink, chum, and sockeye salmon for stock distribution studies.

By Jamal Moss

Marine Growth of Sockeye Salmon From Karluk Lake in Relation to the Ocean Abundance of Maturing Sockeye Salmon, 1925-2000

Understanding factors that influence the marine growth of salmon is key to developing models for estimating the carrying capacity of salmon in the North Pacific Ocean. Annual growth patterns on salmon scales provide clues to factors that influence the ocean growth of salmon. Inverse patterns between scale growth and salmon abundance provide evidence that density-dependent factors affect the marine growth of salmon. For example, a trophic mechanism that may affect growth is competition for food. Responses among salmon to higher salmon abundances often include reduced feeding, changes in migration, and changes in prey selection that in turn reduce growth. However, little is known about the ocean growth of salmon prior to the mid-1970s.

In this study, we compiled and measured a 76-year historical time series of age-2.2 sockeye salmon scales collected at the weir on Karluk River, Alaska, from 1925 to 2000. Strong inverse patterns occurred between scale growth in the final year in the ocean (M3) and the abundance of maturing southern Alaska sockeye salmon (Fig 2). A shift to a higher magnitude of competition coincided with the 1976-77 ocean regime shift in the North Pacific Ocean. Regression analysis for time series data (TSMARS) showed that the contributions of marine growth in sockeye salmon on marine growth during their final year in the ocean were negative and significant (Fig. 3). Sockeye salmon abundance was also a negative contributor to marine growth of sockeye salmon during their final year in the ocean (Fig. 4). We conclude that the marine growth of maturing sockeye salmon is limited by the abundance of maturing sockeye salmon. Our results indicate that a possible carrying capacity exists for maturing salmon in coastal waters of the North Pacific Ocean.

By Ellen Martinson and Jack Helle

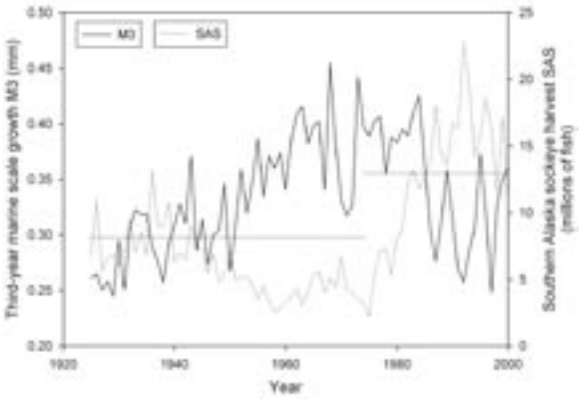


Figure 2. Ocean regime comparison of maturing sockeye salmon growth and maturing sockeye salmon abundance in southern Alaska waters, 1925-2000.

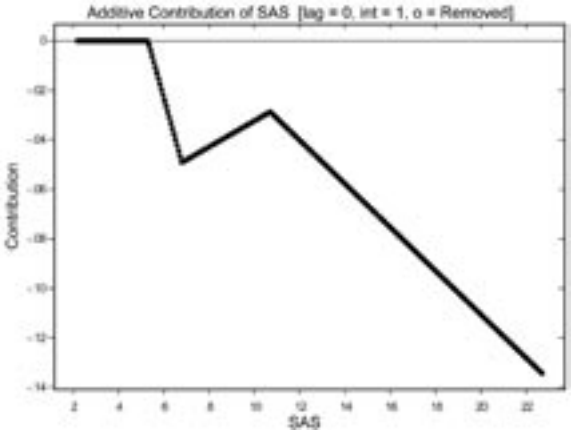


Figure 3. Changes in additive contribution of the marine growth of maturing sockeye salmon in year t-1 on the marine growth of maturing sockeye salmon in year t, as M3 lag 1 increases from 0.240 mm to 0.440 mm.

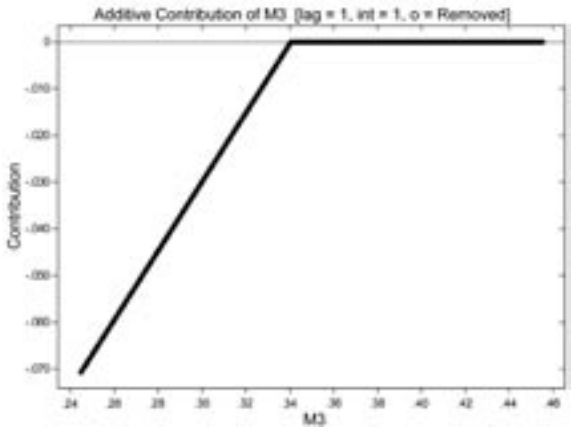


Figure 4. Changes in the additive contribution of abundance of southern Alaska sockeye salmon (SAS) on the marine growth of maturing Alaska sockeye salmon M3, as SAS increases from 2 million to 22 million.

FISHERIES MONITORING & ANALYSIS (FMA) DIVISION

A primary objective of the Fisheries Monitoring and Analysis (FMA) Division is to provide high resolution data from the North Pacific Groundfish Observer Program to meet end user needs. We collect and process a large volume of data each year and we use a combination of manual data review methods, computer programs, and input from end users to help us detect and correct data errors. All detected errors aid us in the continued development of computer programs to help identify problems before they reach a data user. This report summarizes our commitment to data quality with a focus on procedures to ensure our species identifications are correct, followed by an update on work to upgrade the program's administrative structure.

Information and Monitoring Technologies

Staff from the Information and Monitoring Technologies program, the Groundfish Assessment Program of the Resource Assessment & Conservation Engineering (RACE) Division, and Office of Fisheries Information Systems (OFIS) are collaborating to develop a system to improve the quality of the observer species identifications. The system will combine technology from Environmental Systems Research Institute (ESRI) GIS software and Oracle Corporation's relational database. Using ESRI's ArcView application and ArcSDE server, the group has developed a process for creating spatial representations of the historical distribution of fish species based on the information collected by observers and from RACE surveys. These spatial representations are then stored as a specialized data type within the Oracle database where they become part of the computer programs that screen the data collected by observers. When the data transmitted from the field by observers arrives in the FMA offices, the computer programs will identify data records that contain species that are outside the known distribution of each species encountered. Observers will then be requested to verify their identification of species outside their normal range. When implemented, this process will supplement the manual processes currently used by staff to verify species identification and will further improve the quality of the species composition data.

By Michael Brown

Observer Services

Correct species identification is a cornerstone of high quality observer data, and staff have recently been working on improvements to observer training materials and how we track each observer's species identification history. The major improvement made to observer species identification training materials this quarter was the creation of a waterproof fish identification key. The new key includes major finfish families, flatfish, salmonids, gadids, skates, crabs and a few select invertebrates. The new keys complement a waterproof "observer edition" of the *Guide to Rockfishes of the Northeast Pacific Ocean* by Orr *et al*., in use since 2000.

Observers work on deck and in factory processing facilities, where water, fish slime, and fish blood are abundant. However, with over 250 observers at sea during peak fishing seasons, we did not have sufficient resources to provide observers with dichotomous keys that could hold up well in this wet environment. Observers were issued plain paper guides, and instructed to keep them as dry as possible. This task was often difficult, because we also require observers to key out species with the fish "in hand." The new waterproof guides were enthusiastically greeted by the observer community, and we are confident that their use will increase our certainty of observer's species identifications in the future.

We require observers to complete a "Species Identification Form" for each species encountered so that we can verify these species identifications which are made in the field with no direct supervision. These paper forms were kept on file here at the AFSC, but were not readily available to observers, field staff, or data users with questions regarding a specific identification. New this year, we are using a computer application to record each observer's species identification history. The application allows us to create a "life list" of species described by each observer. The database allows for improved data quality by enabling debriefing staff to ensure that an observer has adequately described each species reported during a deployment. It also enables us to include images such as digital photos of the actual fish or scanned images of the species ID form and debriefer comments regarding the identification. This new application will allow the FMA Division to confidently stand behind our data when identification questions arise, such as "Was that *really* a green sturgeon?

By Jennifer Ferdinand

The fishery observer Ryan Braham on a trawl catcher vessel north of Unimak Island, Alaska, recorded what may be the first confirmed record of a green sturgeon in the eastern Bering Sea.

Field Operations

On 2 March 2006 Ryan Braham, an observer collecting data on a trawl catcher vessel north of Unimak Island, recorded what may be the first confirmed record of a green sturgeon, *Acipenser medirostris,* in the eastern Bering Sea. The 1.36 m sturgeon weighed 12.6 kg and was caught while the vessel trawled for Pacific cod in approximately 26 fathoms of water. This species is generally found much farther south, along the west coast of North America as far south as Mexico. While observers have documented a limited number of sturgeon in commercial catches off the Washington and Oregon coasts, this is our first confirmed record from an observer in the Bering Sea.

Ryan was a new observer on the third vessel of his first deployment when the sturgeon came up in the catch. He and the crew members recognized that this was a rare event and took several photographs. Scientists at the AFSC used these to confirm the specimen was a green sturgeon.

By Todd Loomis and Duane Stevenson

Operations and Administration

We met with the North Pacific Fishery Management Council's Observer Advisory Committee, Scientific and Statistical Committee, Advisory Panel, and the Council itself to provide an initial review of alternatives for changes in the design and administration of the North Pacific Groundfish Observer Program. The purpose of this analysis to address the following problem statement:

"The North Pacific Groundfish Observer Program (Observer Program) is widely recognized as a successful and essential program for management of the North Pacific groundfish fisheries. However, the Observer Program faces a number of longstanding problems that result primarily from its current structure. The existing program design is driven by coverage levels based on vessel size that, for the most part, have been established in regulation since 1990. The quality and utility of observer data suffer because coverage levels and deployment patterns cannot be effectively tailored to respond to current and future management needs and circumstances of individual fisheries. In addition, the existing program does not allow fishery managers to control when and where observers are deployed. This results in potential sources of bias that could jeopardize the statistical reliability of catch and bycatch data. The current program is also one in which many smaller vessels face observer costs that are disproportionately high relative to their gross earnings. Furthermore, the complicated and rigid coverage rules have led to observer availability and coverage compliance problems. The current funding mechanism and program structure do not provide the flexibility to solve

many of these problems, nor do they allow the program to effectively respond to evolving and dynamic fisheries management objectives."

The Council discussed this analysis at their February 2006 meeting and adopted the following motion:

1. The Council identified the alternative providing for the extension of the existing program as the preliminary preferred alternative. The Council also approved an addition to the problem statement as follows:

"While the Council continues to recognize the issues in the problem statement above, existing obstacles prevent a comprehensive analysis of potential costs. Immediate Council action on a restructured program is not possible until information is forthcoming that includes clarification of cost issues that arise from Fair Labor Standards Act and Service Contract Act requirements and statutory authority for a comprehensive cost recovery program. During the interim period, the Council must take action to prevent the expiration of the existing program on December 31, 2007."

2. The Council recommends that a new amendment proposing restructuring alternatives for the Observer Program should be considered by the Council at such time that: 1) legislative authority is established for fee-based alternatives; 2) the Fair Labor Standards Act issues are clarified (by statute, regulation, or guidance) such that it is possible to estimate costs associated with the fee-based alternatives; and/or 3) the Council requests reconsideration in response to changes in conditions that cannot be anticipated at this time. Subsequent amendment packages regarding the Observer Program should include an option for the Federal funding of observers.

3. The Council requests that the National Marine Fisheries Service (NMFS) prepare a discussion paper on issues and internal agency process for the use of video equipment to complement and augment observer monitoring of the North Pacific groundfish fisheries under the current service delivery model. Other ongoing issues that may be considered by the Council under the current service delivery model also should be identified.

It is important to note that this action was necessary to prevent expiration of regulatory authority for NPGOP in December 2007. In taking this position as an interim step, the Council recognized that restructuring of the program cannot proceed unless the reauthorized Magnuson-Stevens Fishery Conservation and Management Act includes the observer fee collection language proposed by the Administration. Furthermore, since industry costs must be estimated before analysis of additional alternatives can be completed, consideration of these alternatives cannot occur until the questions submitted to the Department of Labor are fully resolved. Information on this analysis is available on the Council web site at http://www.fakr.noaa.gov/npfmc/current_issues/observer/observer.htm.

We met with staff from the AFSC Socio-Economics Program and agreed on data collection protocols specific to their needs which we will implement in 2007.

By Allison Barns

NATIONAL MARINE MAMMAL LABORATORY (NMML)

ALASKA ECOSYSTEM RESEARCH PROGRAM

The Alaska Ecosystems Program focused on preparation and presentation of research findings during the winter quarter and planning future work. Program staff presented work at the 16th Biennial Conference on the Biology of Marine Mammals held in San Diego 12-17 December on topics including environmental composition of habitat used by juvenile Steller sea lions, the use of remotely-sensed satellite and sea glider measurements to characterize northern fur seal habitat, and use of isotope ratios in teeth as a method of identifying age-specific patterns in weaning of Steller sea lions. Program staff also presented papers at the Alaska Marine Science Symposium held in Anchorage in 23-25 January .

On 4 February staff provided updates on Steller sea lion population status, vital rates, and research programs to the Alaska Sea Otter and Steller Sea Lion Commission, at their annual meeting held in Anchorage, and again at the Forum for the Environment meeting also in Anchorage on 6 February. The 13th Ocean Sciences Meeting, a joint meeting of American Society of Limnology and Oceanography, Estuarine Research Federation, The

Oceanography Society and American Geophysical Union was held 20-24 February at the Hawaii Convention Center in Honolulu. Jeremy Sterling was invited to give a presentation entitled, "Enlisting the Northern fur Seal (*Callorhinus ursinus*) as an Oceanographic Probe." The talk focused on using the northern fur seal to direct biological and physical sampling. Several examples of fur seals foraging around interesting oceanographic features were discussed along with two examples of using autonomous underwater vehicles (sea gliders) to sample areas where fur seals were foraging. The abstract of this talk can be found at http://www.agu.org/meetings/os06/?content=program.

Program members attended the final meeting of the Steller Sea Lion Recovery Team 15-17 March in Seattle and assisted in completing the Team's Recovery Plan which was submitted to NMFS on 31 March.

The upcoming field season is fast approaching and will include sea lion resighting work in the eastern Aleutian Islands and Gulf of Alaska, as well as sea lion pup measurements and aerial surveys throughout the Aleutian Islands.

By Tom Gelatt

CALIFORNIA CURRENT PROGRAM

Kachemak Bay Science Conference

Studies of beluga whales (*Delphinapterus leucas*) in Cook Inlet, Alaska, were described at an ambitious scientific conference focused on Kachemak Bay, Alaska. The conference, attended by over 100 citizens interested in the local environment, was held in Homer, Alaska, on 24-25 March 2006. Topics presented at the conference included monitoring oceanographic conditions, restoration of seagrass resources, stream turbidity reduction, seabird trends, shellfish declines, sea otter mortality, harbor seal abundance and movements, photo-cataloging humpback whales, the role of benthic microalgae, community composition of intertidal clams, impacts from natural and human predators, kelp chemical defenses, coastal habitat mapping, monitoring of nearshore habitats, climate changes, tracking salmon carcasses in the food web, documenting coastal erosion, and tribal subsistence resource concerns.

Dave Rugh gave a presentation about beluga management issues in Cook Inlet, which have become of acute concern because this small (approximately 350 whales), isolated population has not yet shown any appreciable rebound after unregulated hunting stopped in 1998. A status review is currently underway to reevaluate whether or not these whales should be listed as endangered. Dave Rugh also presented the keynote address for the conference, discussing the biology, abundance, distribution, and trends of belugas in Cook Inlet.

By Dave Rugh

Bowhead Whale Workshop II

On 21-22 March 2006, an international workshop met at the Alaska Fisheries Science Center (AFSC) regarding bowhead whale stock-structure studies conducted in the Bering, Chukchi, and Beaufort Seas in 2005-06. The workshop was convened by Sue Moore (AFSC), Craig George (North Slope Borough), Robert Suydam (North Slope Borough), and Dave Rugh (AFSC), with Marcia Muto (AFSC) serving as rapporteur. The 34 attendees included scientists from the United States, Russia, Canada, and Norway. The workshop objectives were to 1) assemble and discuss available evidence pertaining to stock-structure hypotheses for bowhead whales; 2) identify aspects of the stock-structure hypotheses that are and are *not* supported by available data (and identify the datasets relevant to each hypothesis); 3) select or modify plausible multi-stock hypotheses for bowheads, ranked by credibility, to provide to the International Whaling Commission (IWC) Aboriginal Whaling Management Procedure (AWMP) group for use at their April 2006 workshop; and 4) list the research to be completed prior to the 2007 IWC Scientific Committee (SC) meeting, where bowhead stocks will be reviewed in detail.

During the workshop, researchers provided updates on current studies, including deployment/retrieval of acoustic recorders that documented the presence of whales throughout much of the year north of Barrow, Alaska; aerial surveys and photo-identification studies of whales north of Barrow in September and near St. Lawrence Island in April; examination of stable carbon isotopes in whale baleen to detect the animals' migratory patterns; the use of traditional knowledge to learn more about the whales' distribution and trends; documentation of the commercial whaling catch from 1849 to 1914; shore-based counts of whales migrating in the spring past the Chukotka Peninsula; analyses of ge-

netic samples from whales taken in the annual harvest in several villages in northern Alaska; results of tagging, transect surveys, and genetic studies of bowheads in eastern Canada; and modeling of hypotheses with single or multiple stocks of whales.

The intent of the workshop was to provide the group with interim research results; final results are not expected until the May 2007 IWC Meeting. A summary report describing the previous bowhead workshop, held in February 2005, was submitted to the 2005 IWC SC meeting in Ulsan, Republic of Korea. A report summarizing the March 2006 Workshop will be submitted to the May 2006 IWC SC meeting in St. Kitts.

By Dave Rugh and Marcia Muto

Humpback Whale Studies (SPLASH Project) in Baja California

Sally Mizroch was invited to participate in SPLASH humpback whale studies in Mexican waters again this year, from 23 February through 2 March 2006. Mizroch continued her field and data management collaboration with Professor Jorge Urbán Ramirez and students (Universidad Autónoma de Baja California Sur, BCS, Mexico). This was a continuation of the work reported in the April-June 2004 Quarterly Report (Mizroch and González Peral, 2004). In addition to serving as the primary biopsy shooter while on the water, Mizroch assisted with digital field data collection techniques that she began developing during the 2004 field season and presented collaboratively at the Mexican Marine Mammal Society meeting in 2004.

By Sally Mizroch

POLAR ECOSYSTEMS PROGRAM

Final Report Issued on Harbor Seal Disturbance in Disenchantment Bay

NMML's Polar Ecosystems Program released a final report on the first year (2002) of research on disturbance of harbor seals by cruise ships in Disenchantment Bay near Yakutat, Alaska. The report summarizes the findings from each of the three spatiotemporal scales at which potential interactions were examined between ice-hauling harbor seals and cruise ships that visit the bay to view Hubbard Glacier. The impetus for the study was a concern expressed by the local Tlingit Tribe that cruise ship visits, which have increased dramatically in frequency over the past two decades, have caused the seal population to decline, perhaps through increased pup mortality or emigration.

The program's study's main findings were:

- Seals resting on ice reacted to cruise ships by entering the water with increasing frequency as ships approached within 500 m;

- More than 75%-90% of the seals approached by cruise ships within 100 yards (91 m) abandoned the ice on which they are hauled out;

- Seals detected when ships approached directly, entering the water at 3-4 times the frequency than when they were passed abeam of the ship;

- The relative abundance of harbor seals (and mother-pup pairs) scattered throughout the bay had no apparent relationship with the frequency, duration, or locations of ship visits;

- There were pronounced seasonal trends in abundance that did not appear to be related to the onset or incidence of cruise ship; shifts in abundance likely occurred in response to other environmental factors such as prey availability;

- The spatial distribution of seals was not related to the frequency or locations of ships' visits, but increased durations of stay at the ships' closest approach to seal habitat were related to tighter distributions of seals; and

- The two glacial study sites, with and without cruise ship traffic (Disenchantment and nearby Icy Bay, respectively), exhibited different seasonal trends suggesting that comparable numbers of seals use the two sites during pupping but that as few as one-third of the number of seals use Disenchantment Bay during molting season.

The long-term, population-wide implications of frequent disturbance of these harbor seals cannot yet be determined. Seals that enter the water when disturbed at close range, and those that may redistribute into denser aggregations in response to more distant approach by vessels, will spend more time

Top four photos: humpback whale breach sequence. Photos by Sally Mizroch (National Marine Mammal Laboratory). Lower four photos: whale reaction to initial dart and biopsy dart sequence. Photos by Ursula González Peral (Universidad Autónoma de Baja California Sur).

submerged than undisturbed seals. The energetic cost to remaining in the water can be significant, particularly in ice-filled fjords where water temperatures are just above freezing year-round. Additional information is needed about possible shifts in haul-out behavior and movement of individual seals in response to vessel disturbance. Such data will help to clarify whether disturbed seals, especially juveniles and pups, are likely to incur an energy deficit sufficient to reduce survival below the rates required to maintain the population. The report can be viewed online at: http://www.afsc.noaa.gov/Publications/ProcRpt/PR%202006-02.pdf

By John Jansen

RESOURCE ASSESSMENT & CONSERVATION ENGINEERING (RACE) DIVISION

RUSS NELSON IS APPOINTED NEW RACE DIVISION DIRECTOR

Russell E. Nelson, Jr. was appointed Director of the AFSC's Resource Assessment and Conservation Engineering (RACE) Division effective 19 March 2006. Russ has worked as second in command of the Division since 1992 and has an outstanding record of solving problems and providing steady vision for the Division and Center. Russ enjoys wide, ongoing support from the Division staff as well as from the other AFSC Division Directors. The Center welcomes him to his new position and responsibilities.

GROUNDFISH ASSESSMENT

RACE Groundfish Systematics

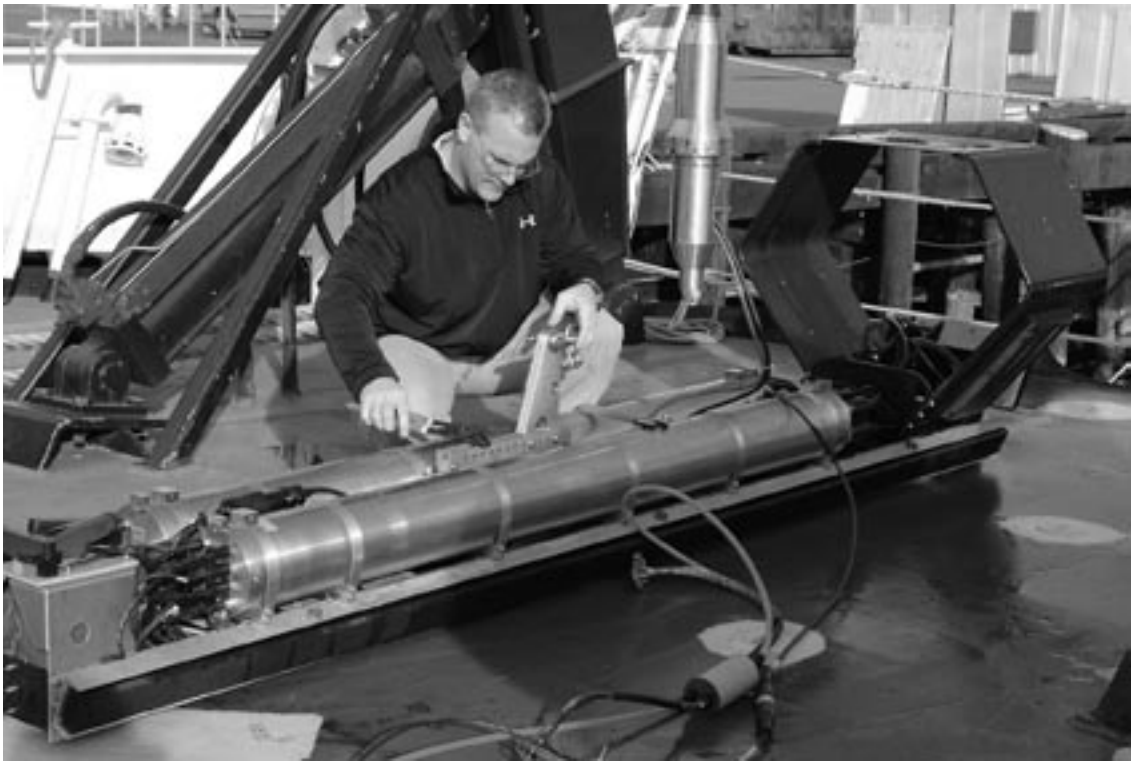
James Orr and Duane Stevenson are continuing work on the taxonomy and systematics of several families of fishes, most recently skates, snailfishes, rockfishes, eelpouts, manefishes, and deep-sea anglerfishes. With Jerry Hoff and John McEachran, Stevenson and Orr have prepared a guide to the cartilaginous fishes of Alaska to be published by Alaska Sea Grant. They are also participating in a collaborative study with Ingrid Spies and Mike Canino in their genetic analysis of skates of Alaska, a paper on genetic identification having just been submitted. Orr's research on snailfishes has expanded with descriptions of two new species of *Careproctus*, with Katherine Maslenikov of the University of Washington Fish Collection, and several new species of *Paraliparis*, with Zachary Baldwin an undergraduate intern from the University of Washington. Orr's work with Sharon Hawkins of Auke Bay Laboratory on the recognition, identification, and nomenclature of *Sebastes melanostictus*, a member of the rougheye rockfish, *S. aleutianus*, complex newly recognized in the eastern Pacific Ocean, will be completed with the examination of important Japanese type specimens. Orr is also collaborating with the University of Washington's Ted Pietsch on the description of a new species of sculpin from the western Pacific, as well as on the phylogenetics of deep-sea anglerfishes. Stevenson's two new species of eelpouts of the genera *Lycodes* and *Bothrocara* are now published. Stevenson's most recent research on eelpouts has focused on an examination of morphological variation in the black eelpout, *Lycodes diapterus*, from across its entire range in the North Pacific. He has also been working with Dave Csepp of the Auke Bay Lab on a range extension and review of the morphology of *Caristius* in the eastern North Pacific, a project that has led to his beginning a worldwide revision of the family Caristiidae with other collaborators.

By Mark Wilkins

FISHPAC Preintegration Exercise on NOAA Ship *Fairweather*

In preparation for a fisheries research cruise this summer, the RACE Division participated in a preintegration exercise in Seattle on the NOAA ship *Fairweather* from 27 February through 3 March 2006. The ship's officers and crew, along with a team of scientists, engineers and technicians from NOAA, the University of New Hampshire and the U.S. Navy worked to integrate electronic and mechanical systems on the ship with supplemental navigation and research sonar systems (Fig. 1). This effort was intended to minimize program risk and also reduce installation time requirements during the brief mobilization period in Dutch Harbor, Alaska. Several major systems were successfully integrated and tested, while several issues were identified for remedy.

The NOAA "FISHPAC" project is a multi-year collaboration between the NMFS Alaska



The long-range side scan sonar being developed for the FISHPAC project by L-3 Communications Klein Associates Inc. (Salem, NH). Shown here are the port and starboard pressure housings for the sonar electronics and the multibeam side scan sonar arrays (segmented black panels below) mounted on the towfish chassis. The final product will include additional sonar and navigation systems as well as environmental sensors and will be capable of better than 1-m resolution over a 1.5-km swath of seabed.

Fisheries Science Center, the NOS Office of Coast Survey (Hydrographic Surveys Division), and the Office of Marine and Aircraft Operations (Marine Operations Center – Pacific), with significant technical support from the UNH Center for Coastal Ocean Mapping (Durham, New Hampshire) and the Naval Undersea Warfare Center (Keyport, Washington). The primary objective is to evaluate the utility of acoustic backscatter for characterizing essential fish habitat (EFH). In July-August 2006, acoustic surveys will be conducted along strong gradients of groundfish abundance, as estimated using trawl survey catches at fixed stations over many years. The value of backscatter as a habitat-defining character will be judged based on the statistical association between fully normalized backscatter and fish density. The benefits and costs of several different acoustical systems will be compared with data from multiple passes along the survey lines. Research in subsequent years will validate and/or refine any backscatter-abundance relationships with trawl sampling that targets specific backscatter levels. The end product of this research will be operational guidelines for seabed mapping in the eastern Bering Sea (EBS). Thereafter, a systematic survey covering the entire grid of EBS trawl survey stations will be conducted with the most cost-effective system, and spatially explicit habitat models for EBS species will be updated with these data. Ultimately, this research will be extended into the Gulf of Alaska, Aleutian Islands, and more northern waters, areas with substantial differences in vertical relief and seabed composition.

By Robert McConnaughey

MIDWATER ASSESSMENT & CONSERVATION ENGINEERING (MACE)

Winter Surveys in the Gulf of Alaska and the Southeastern Bering Sea Near Bogoslof Island

Scientists from the Midwater Assessment and Conservation Engineering (MACE) Program conducted winter echo integration-trawl surveys aboard the NOAA ship *Miller Freeman* in the Gulf of Alaska (GOA) and southeastern Bering Sea near Bogoslof Island. The surveys provide data on the abundance, distribution, and biological composi-

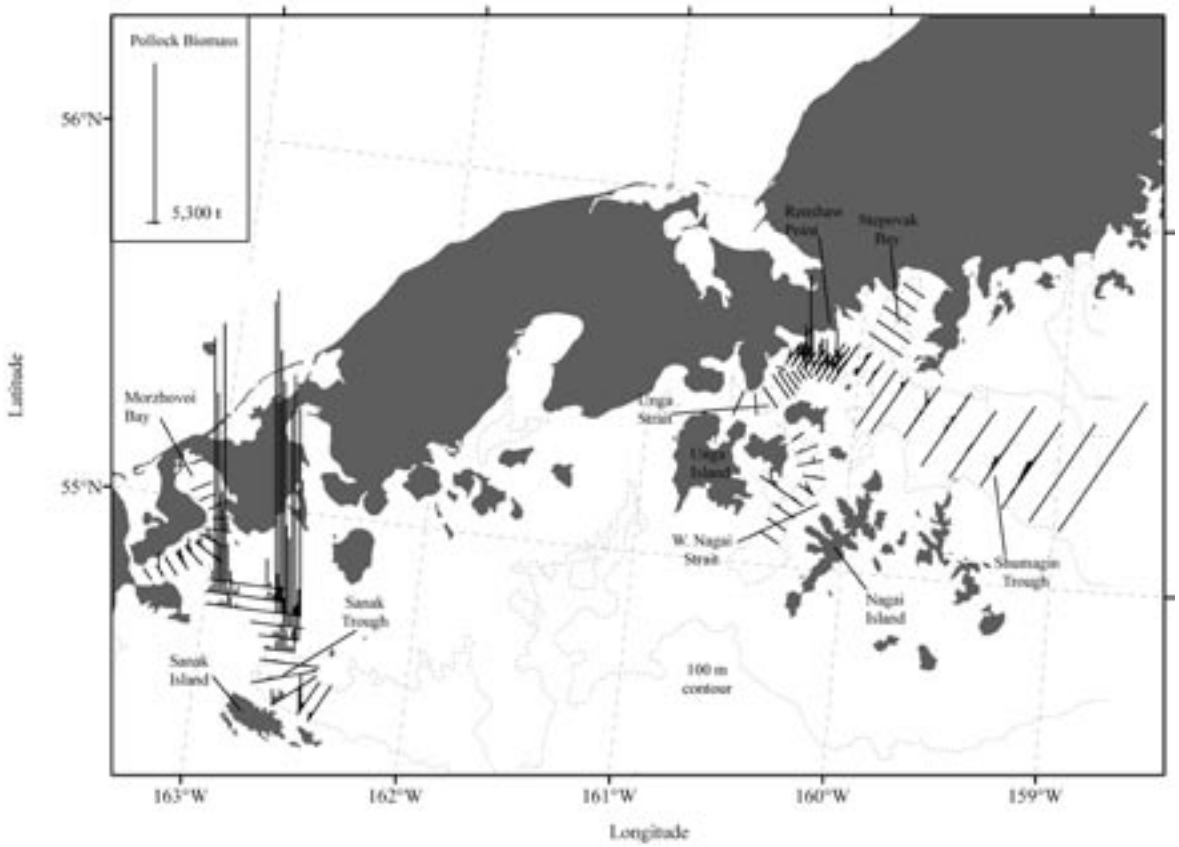


Figure 1. Estimated pollock biomass in metric tons (t) (vertical lines) along transects during the 15-19 February 2006 echo integration-trawl surveys of the Shumagin Islands, Sanak Trough, and Morzhovoi Bay in the Gulf of Alaska.

tion of spawning walleye pollock (*Theragra chalcogramma*). Areas surveyed in the GOA during 15 - 19 February include the Shumagin Islands, Sanak Trough, and Morzhovoi Bay (Fig. 1) and during 14-27 March included the Shelikof Strait area and Chirikof shelf-break area (Fig 2). The area in the vicinity of Bogoslof Island in the Bering Sea was surveyed from 4 to 11 March (Fig. 3). All surveys were conducted 24 hours per day.

The GOA survey results indicated that pollock abundance decreased in 2006 compared to 2005 in all areas except Sanak Trough where estimates nearly doubled in 2006. Nevertheless, localized dense adult pollock aggregations were observed in some of the surveyed areas. For example, relatively high fish densities were detected off Renshaw Point in the Shumagin Islands and in the northern part of Sanak Trough. Morzhovoi Bay was surveyed for the first time this year and the adult pollock densities were greater near the mouth, rather than inside the bay. Pollock densities from the Chirikof shelf-break survey were relatively greater along the eastern portion of the shelf-break near the mouth of Barnabas Trough whereas in previous years, greater densities existed farther to the west (Fig. 2). In Shelikof Strait, the highest pollock densities were observed in the southern end of the strait proper in amounts similar to 2005. Lower densities of pollock were detected between Cape Kuliak and Katmai Bay than last year.

The adult pollock size compositions for the GOA surveys were generally unimodal and centered around 50 cm fork length (FL). Age-1 pollock aggregations were detected in the Shumagin Trough, whereas age-2 pollock (21 cm FL mode) were broadly distributed in Shelikof Strait. Preliminary analysis of maturity stages indicated that survey timing was appropriate for the Shumagin, Shelikof Strait, and Chirikof shelf-break surveys but may be scheduled slightly earlier for the Sanak Trough and Morzhovoi Bay surveys in the future.

The pollock abundance estimate this year for the southeastern Bering Sea survey near Bogoslof Island was similar to the 2005 estimate. Adult pollock were concentrated in two main areas: northeast of Umnak Island, and north of Samalga Pass, between the Islands of Four Mountains and Umnak Island (Fig. 3). Most pollock were in the Umnak re-

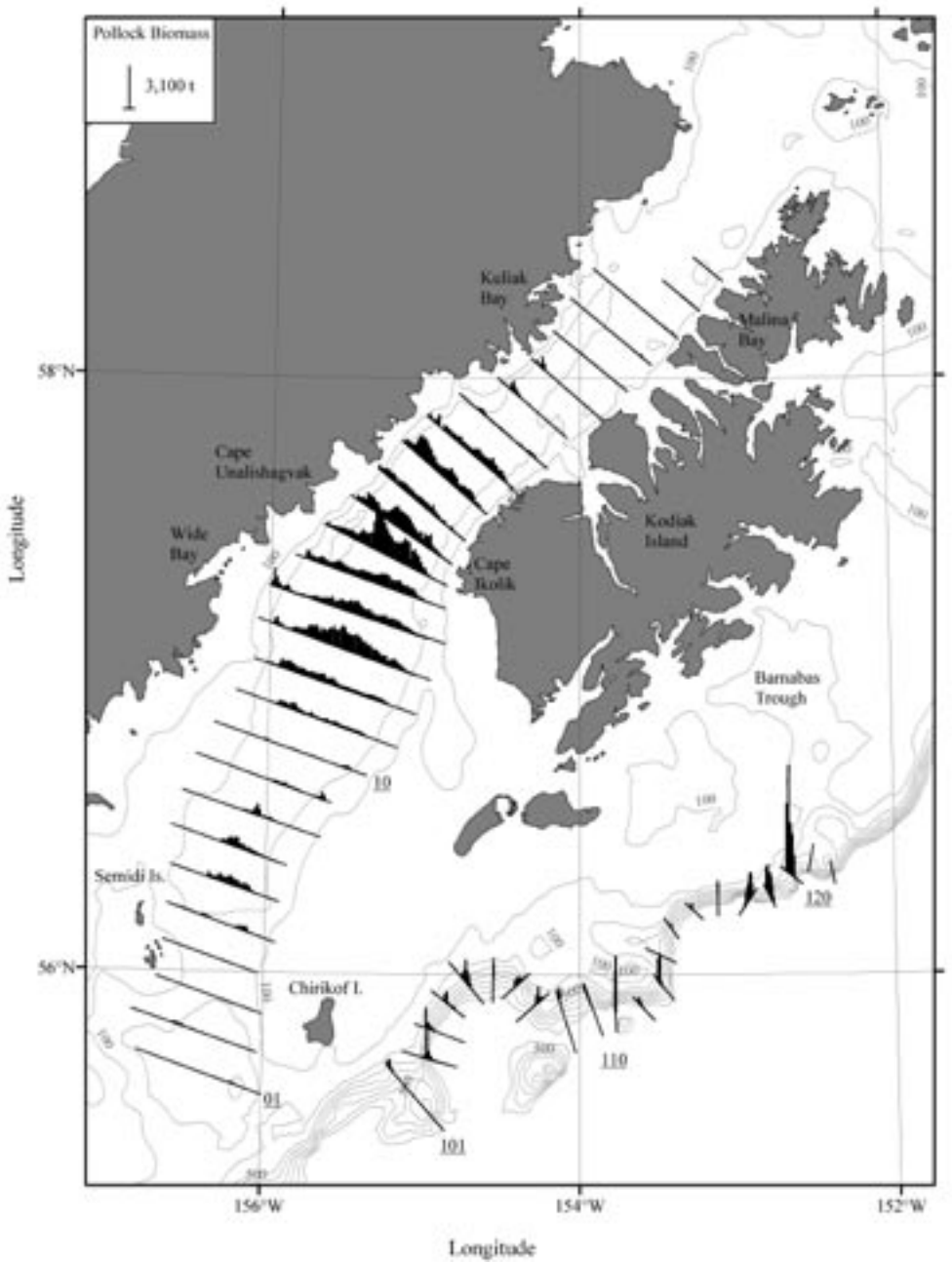


Figure 2. Estimated pollock biomass in metric tons (t) (vertical lines) along transects from the 14-27 March 2006 echo integration-trawl survey of the Shelikof Strait area and along the Gulf of Alaska shelf break near Chirikof Island. Transect numbers are underlined.

gion. Although the pollock size composition ranged between about 38 cm and 71 cm FL in both areas, the Umnak region was characterized by a unimodal distribution (45 cm FL mode), and the Samalga region was characterized by a bimodal distribution (48, 61 cm FL modes). Preliminary analysis of maturity stages indicated that spawning commenced earlier in the Umnak region than in the Samalga Pass area.

By Denise McKelvey

FISHERIES OCEANOGRAPHY COORDINATED INVESTIGATIONS (FOCI)

Members of the Recruitment Processes Program presented research results at the Alaska Marine Science Symposium (http://www.nprb.org/symposium/2006/index.html) held 22-25 January 2006 in Anchorage, Alaska. Included were talks about the current status of the Bering Sea, research on juvenile pollock, capelin, and eulachon in the Gulf of Alaska, assessing egg cannibalism and parentage in Atka mackerel, and fatty acids composition of zoo-

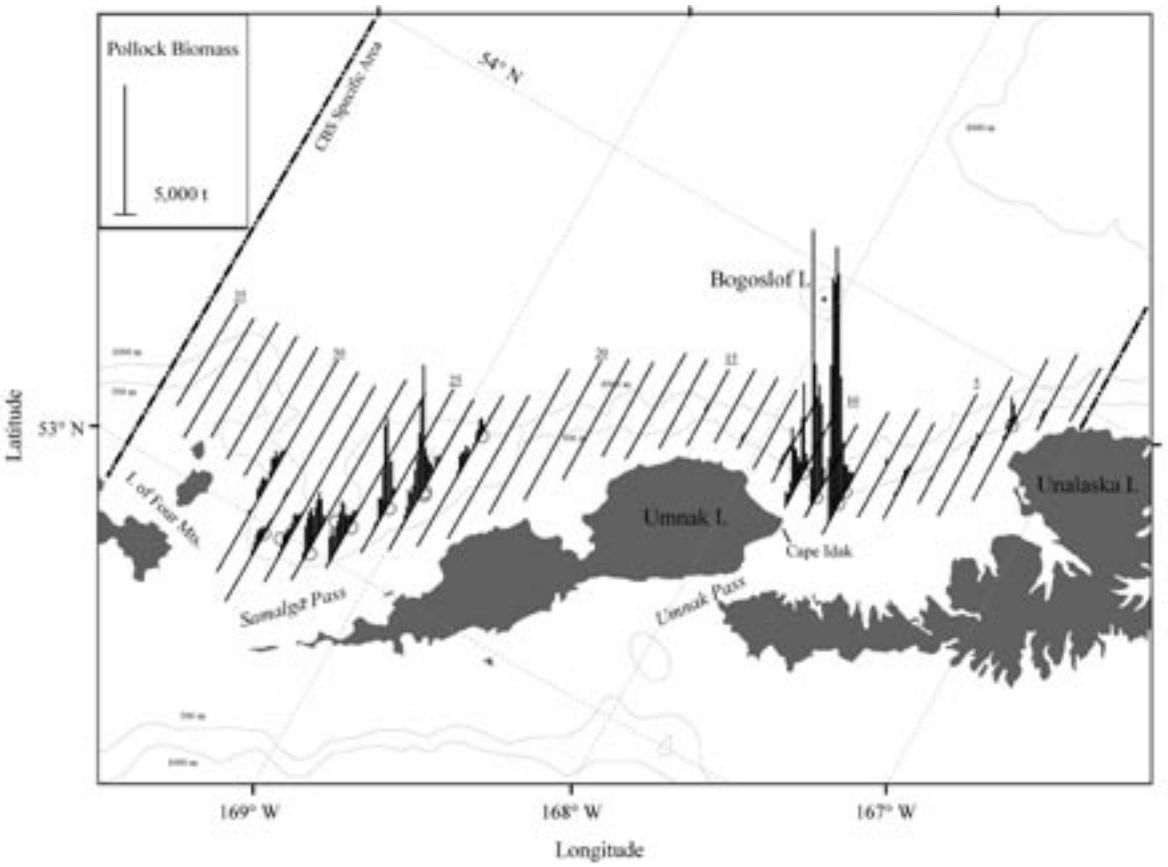


Figure 3. Estimated pollock biomass in metric tons (t) (vertical lines) and trawl hauls (circles) along transects during the 4-11 March 2006 echo integration-trawl survey of the southeastern Bering Sea near Bogoslof Island. Transect numbers are underlined and the Central Bering Sea (CBS) Specific Area boundary is marked.

plankton. Recruitment Processes staff completed a multiyear project on forage fishes of the Gulf of Alaska sponsored by the North Pacific Research Board and the Ichthyoplankton Information System (http://access.afsc.noaa.gov/ichthyo/index.cfm), the first web-accessible larval fish identification and early life history guide.

The first scheduled cruise of the new season to look at the eggs and larvae of winter spawning flatfish unfortunately was cancelled due to motor problems with the NOAA ship *Oscar Dyson*. Some of these flatfish such as arrowtooth flounder have great ecological importance in the Gulf of Alaska ecosystem, others such as Pacific halibut, and Dover and rex sole are economically important. Members of the Recruitment Processes Program also participated in an interagency working group focused on climate variability and loss of sea ice in the Bering Sea. The group published their first report and is working on ways to better coordinate climate and ecosystems research in the Bering Sea (http://www.afsc.noaa.gov/Publications/ProcRpt06.htm).

By Jeffrey Napp

NEWPORT LABORATORY

Laboratory Studies of Flatfish Reactivity and Herding Behavior: Potential Implications for Trawl Capture Efficiency

Trawls are inherently behavioral devices, harnessing the innate avoidance behaviors of fish to facilitate their capture with doors, bridles, and sweeps, herding flatfish into the path of the approaching net. While auditory and tactile senses may warn fish of an approaching trawl, thereby heightening vigilance, it is currently believed that visual signals provide the directional information to stimulate and guide herding behavior. Flatfish have been observed responding to trawl ground-gear, yet few studies have purposefully attempted to elucidate factors controlling their behavior. Several studies have examined secondary behavioral responses, such as swimming endurance and gait and net entry. However, the initial behavioral response, when flatfish first react to disturbance by the trawl ground-gear, has received little attention, even though it likely determines the course of subsequent behavior.

Laboratory experimentation was undertaken, using a simulated footrope in a flume tank, to examine the influence of two extrinsic factors, ambient illumination and temperature, upon the initial behavioral response of subadult Pacific halibut *Hippoglossus stenolepis*, and northern rock sole *Lepidopsetta polyxystra* (hereafter rock sole). In using subadults, the assumption is made that their behavior is comparable to those of larger individuals that constitute fishable stocks. Perhaps the most unexpected finding of this study was that 40% of fish did not react to the approaching footrope, that is, they were not flushed from the sand by the footrope. In so far as the apparatus used here simulates actual ground gear, the implication is that trawl ground-gear may frequently fail to stimulate any form of flushing response in flatfish, which means many fish may passively pass beneath the ground-gear and may not be adequately accounted for by current means of estimating trawl efficiency/catchability characteristics.

Light level had a pervasive influence upon the initial behavioral reaction of flatfish to approaching trawl ground-gear**.** In the light, fish were apt to respond with a 'run' response, where fish swam away from the gear while staying close to the bottom, (i.e., herding). In contrast, in the dark, 'rising' and 'hopping' off the bottom was more common, initiated by a startle response, which, elicited in the absence of visual input, resulted in the observed upward trajectory off the bottom. It has been widely observed that during the day, as fish herd in front of a trawl's footrope, many flatfish opportunistically escape through gaps between the ground-gear and the bottom, or are rolled over by the footrope. If herding ceases in the night/darkness, with flatfish rising off the bottom in response to ground-gear disturbance, more of these fish would be captured, potentially explaining the widely observed increase in flatfish catches from survey trawls in shallow (<100 m) North Atlantic waters at night. However, where this ambient illumination effect upon ground-gear function may have its greatest impact, is not on the trawl foot rope, but on trawl sweeps. Unlike survey trawls, specialized flatfish trawls often utilize sweeps up to 200 m or more in length between the doors and the wings of the net, to herd fish into the path of the net. Depending upon configuration, the herding behavior initiated and maintained by sweeps may be responsible for a large proportion of the catch. When flatfish cannot see the approaching sweep, their initial behavioral response may be to rise or hop off the sediment, thereby leaving the sweep's zone of influence, allowing the sweep to pass without initiation of herding. Therefore, while the footrope and net may become more efficient in the darkness, for the reason discussed above, the sweeps may actually become less effective at herding fish into the path of the net, decreasing the overall efficiency of the gear. If sweep efficiency decreases dramatically under low ambient, say at night, it might be plausible that catch would actually be greater during the day, than at night, the opposite of the pattern frequently seen in survey trawls.

Figure 1. DIDSON sled ready for deployment. Pictured are the aluminum benthic sled with the forward mounted DIDSON (black box), sweeps and doors. The sled is equipped with a light meter as well as a 'pinger' to aid in recovery should the sled become hung on the bottom.

Although small compared to the effect of light, temperature was also demonstrated to influence flatfish behavior in this study. Temperature is known to influence the sustained swimming speed and endurance of fish. It has been demonstrated that American plaice swimming endurance, as measured through failure time analysis, decreased with decreasing temperature. As a consequence, low temperatures would also be expected to diminish the ability of flatfish to engage in herding, both down a sweep, as well as in front of a footrope. The 'hop' response increased in frequency among rock sole at low temperature, particularly in the dark. While there is danger in overinterpreting this result, the consequence of low temperature for flatfish might

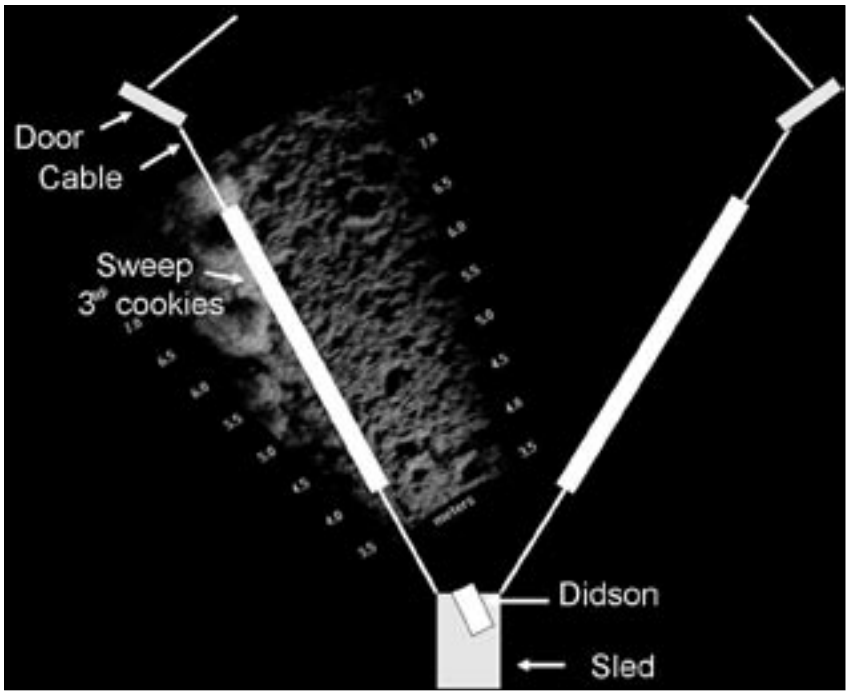


Figure 2. Diagram showing the "DIDSON eye view" of sweeps and seafloor. Actual DIDSON imagery is video, allowing detailed observation and behavioral scoring of flatfish responses to initial disturbance by the sweep.

be a greater likelihood of 'startling' in response to trawl ground-gear disturbance, as opposed to initiation of an ordered behavioral response (herding).

Another study is currently under way, with the goal of testing these hypotheses in the field. This study makes use of a new tool being used at the Alaska Fisheries Science Center: the DIDSON or Dual-frequency IDentification SONar. The DIDSON is a high frequency acoustic camera that provides multiple high-resolution images per second across a 29° fan-shaped sector with a range out to 10 m or more. In this project the DIDSON is mounted on a benthic sled (Fig. 1), which is in turn towed by otter doors and abbreviated (5 m) sections of trawl sweep (3-inch cookies). The DIDSON is aimed along the length of one of the sweeps, providing imagery of the seafloor and fish encountered by the sweep as it is dragged along the bottom (Fig. 2). In a parallel study, the sled is also being positioned on the sweeps of commercial trawls utilized in summer flatfish fisheries out of Kodiak, Alaska. Importantly, because the imagery is acoustic and therefore independent of ambient illumination, this provides a means of viewing flatfish behavior under differing light conditions, without the potential artifacts associated with artificial lighting. These studies should 'shed light' upon the role of ambient illumination in the herding behavior of flatfishes, as well as potential diel- and depth-related changes in the capture efficiency of both survey and commercial trawl gear.

By Clifford Ryer

RESOURCE ECOLOGY & FISHERIES MANAGEMENT (REFM) DIVISION

RESOURCE ECOLOGY & ECOSYSTEM MODELING PROGRAM

Fish Stomach Collection and Lab Analysis

Laboratory analysis was performed on 3,032 groundfish stomachs from the eastern Bering Sea and 684 stomachs from the Aleutian Islands region and Gulf of Alaska. During this quarter, 158 stomachs were returned by fishery observers. In total, 16,720 records were added to the groundfish food habits database.

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

Predator/Prey Interactions

The Resource Ecology and Ecosystem Modeling (REEM) Program estimated total biomass of snow crabs consumed by groundfish predators in the Bering Sea between 1997 and 2001 (Lang et al. 2005; http://www.afsc.noaa.gov/Publications/

AFSC-TM/NOAA-TM-AFSC-158.pdf).This analysis has allowed us to update long-term estimates of crab consumption in the region (Fig. 1). The main predator of snow crabs was Pacific cod, consuming at least 75% of the total biomass removals of snow crabs by predators between 1997 and 2001. The remaining predators were flathead sole, walleye pollock, Pacific halibut, northern rock sole, skates, Alaska plaice, and yellowfin sole. Biomass of snow crabs consumed by Pacific cod was highest in 2001 (160,353 metric tons (t)) and lowest in 1999 (62,848 t). Most of the snow crab consumed in 1997 through 2000 were less than 25-mm carapace width or approximately age 0 to age 1.

Similar to the 1993-96 period, consumption of snow crab by groundfish predators other than Pacific cod did not occur every year, particularly in 1998 and 2001, and was least prevalent in small-mouthed flatfish. This could indicate the availability of fewer small snow crab in the 1993-2001 period compared to the 1990-92 period where consumption was more widespread across all predators. Declines in predation consistent with population declines indicate that monitoring the amount of predation on small crabs by these predators may provide early indications of the presence of abundant year classes of crabs.

By Katie Dodd, Geoff Lang, and Kerim Aydin

Ecosystems Considerations

The Ecosystems Considerations chapter of the 2005 Stock Assessment and Fisheries Evaluation (SAFE) Report was made available in a browseable online format at http://access.afsc.noaa.gov/reem/ecoweb/Index.cfm. This new format provides links and documentation for data sources and also offers direct access to subsets of the data used in the yearly ecosystem assessment.

By Jennifer Boldt

Ecosystem Modeling

A database of life history characteristics of Alaska groundfish, as determined by extensive literature review, was made available to the public at http://access.afsc.noaa.gov/reem/LHWeb/index.cfm. These life history parameters will be a key to developing the next generation of multispecies models. Modeling results, including trends of estimated population consumption by key groundfish in the eastern Bering Sea, were also made available to the public. These results are from multispecies virtual population analysis (MSVPA) (http://www.afsc.noaa.gov/refm/reem/models/MSVPA.htm) and the multispecies statistical model (http://www.afsc.noaa.gov/refm/reem/models/MSM.htm).

By Kerim Aydin, Todd TenBrink, Jesus Jurado-Molina, and Geoff Lang

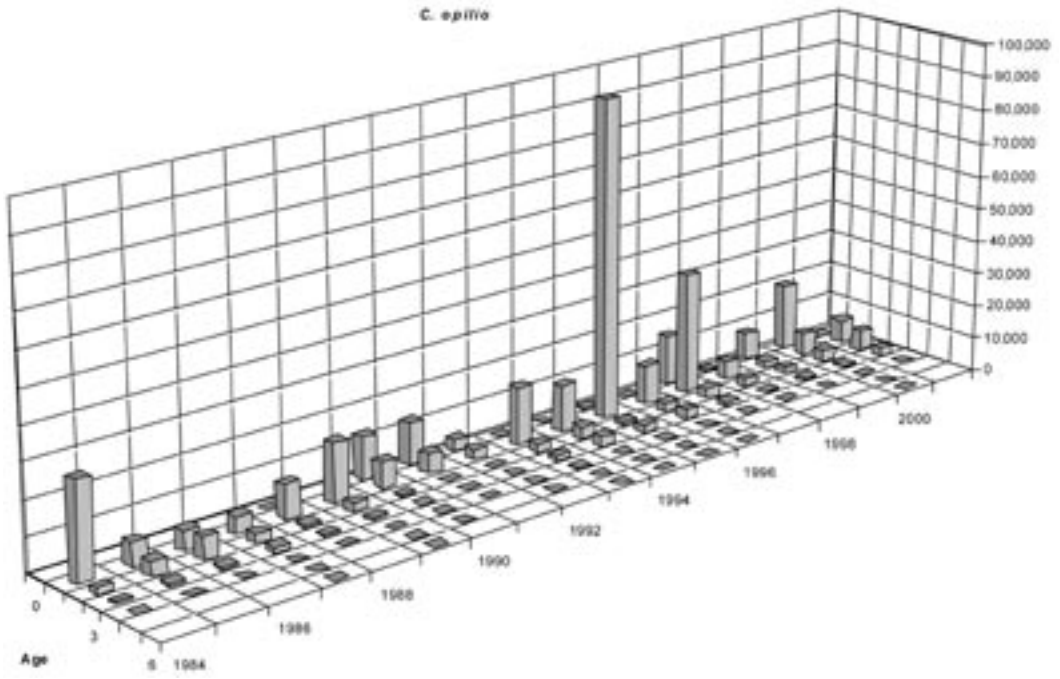


Figure 1. Estimated number at-age of snow crabs (*C. opilio*) consumed by groundfish during May-September from 1984 to 2001 in the eastern Bering Sea.

Seabird Interactions

The annual estimates of seabird bycatch have been posted on the AFSC website seabird page (http://www.afsc.noaa.gov/refm/reem/Seabirds/Default.htm). These estimates provide bycatch numbers by certain species groups or species from 1993 through 2004 for all gear types (longline, pot, trawl) in Alaskan waters. Numbers are provided for the Bering Sea, Aleutian Islands, and Gulf of Alaska regions as well. The estimate of seabird bycatch is completed by National Marine Mammal Laboratory (NMML) staff each year and is provided to the REEM Program. Two data sources are necessary for these estimates: 1) data provided by groundfish observers (managed by the Fishery Monitoring and Analysis Division), and 2) fisheries catch information maintained by the Alaska Regional Office's Sustainable Fisheries Division. While data are provided for all gear types, much of the focus has been on longline fisheries. Overall seabird bycatch has dropped in those fisheries to current levels of less than 5,000 birds (Fig. 2). This is primarily due to the voluntary adoption of paired streamer lines by the freezer-longliner fleet in 2002 after a Washington Sea Grant study showed that paired streamer lines were the most effective seabird deterrent measure. Paired streamer lines are now required for all vessels over 55 feet through regulatory rulemaking completed in February 2004. Prior to the use of paired streamer lines which began in 2002, the average annual bycatch of seabirds in the combined Alaskan demersal groundfish fleet was 15,888 birds. Since then (2002-04) the average has been 4,910, a 70% reduction.

By Shannon Fitzgerald

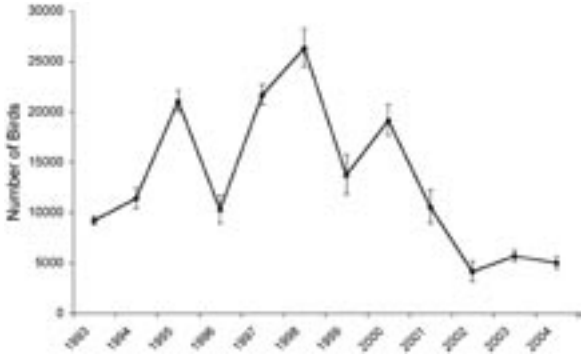


Figure 2. Total incidental take of seabirds in Alaskan combined demersal longline groundfish fisheries.

ECONOMICS & SOCIAL SCIENCES RESEARCH PROGRAM

Survey Form Developed for Southwest Region Economic Data Collection Project

Published regional economic data for Alaska fisheries are highly aggregated and do not provide detailed and reliable information needed for regional economic analysis of Alaska fisheries. For this reason, the AFSC has hired Hans Geier and Bill Hall (contractors) at the University of Alaska, Fairbanks (UAF) to conduct a regional economic data collection project for Southwest Alaska fisheries. Since the contractors are concerned about the low response rate of a voluntary survey, they will use an approach slightly different from those used by previous data collection studies. First, for gathering information on employment and earnings, they will rely on survey of vessel owners and interview focus groups. Second, for gathering information on costs of intermediate inputs used on harvesting vessels, they will survey the suppliers of the inputs rather than the vessels owners. This is because the suppliers of inputs are likely to be more cooperative than vessel owners. Using the information from the suppliers, the contractors will estimate the cost information for an average boat in a harvesting sector. Based on the estimated cost information for the average boat, the contractors will estimate the same information for all the vessels in the harvesting sector, by comparing factors such as horsepower, weight, gear types, etc. This approach will allow the number of questions on the voluntary survey to be minimized, which will help to increase the response rate. To accomplish this task the contractors have developed and revised a draft vessel survey and its cover letter with assistance from REFM economists, identifying the types of questions to be asked on vessel survey (questions on employment and income). The contractors will have a meeting with a focus group of fishermen on 7 April 2006 to gauge the reactions of the fishermen to the questions on the survey form and obtain their comments. The goal of this project is to improve our ability to conduct the requisite regional economic analyses. A similar data collection project will be conducted for the Gulf Coast and Southeast regions of Alaska when the Southwest region project is completed.

By Chang Seung

Second Phase of Integrated Economic-Ecosystem Modeling Project Launched

Commercially valuable fish species are dependent on many other species and organisms dispersed throughout their habitat. Understanding ecological relationships between these species is important when formulating renewable fishery resource policies. It is also important to have a good understanding of how these fishery resource policies impact human activity and the economy and how human activity affects these species in a marine ecosystem.

The objective of this project is to develop an integrated ecological/economic model for Alaska fisheries that can track both ecological relationships and human activities. The ecosystem model being developed is a general equilibrium ecosystem model (GEEM) which combines an ecosystem model with an economic general equilibrium model called a computable general equilibrium (CGE) model. Such an integrated ecosystem approach will provide more useful information to policy-makers than stand-alone regional economic or ecological models for fisheries and will better satisfy the National Standard 8. For the second phase of the project, a workshop was held at the AFSC in February. The contractors (Drs. David Finnoff and John Tschirhart from the University of Wyoming) presented their work based on on their report on the first phase of the integrated modeling project. In subsequent small group meetings, AFSC scientists with diverse research foci provided useful comments on the ecosystem and economics components of the model. Since then, the contractors have worked to improve the model using the comments from the AFSC scientists.

By Chang Seung

Estimating Economic Base Relationship for Alaska Fisheries Within Panel Cointegration Framework

Virtually all regional economic impact models developed to date for analysis of U.S. fisheries are static models. For example, frequently used input-output (IO) models that have been implemented for calculating regional economic impacts of fisheries are static models. However, the regional economic impacts of fishery management actions calculated based on a single period static model can be misleading, because most fishery management policies have permanent effects over time and the impacts occur over a number of periods. With static models, it is impossible to address the timing of the impacts, which needs to be considered in formulating fishery management policies; IO models always predict positive (negative) impacts with positive (negative) shocks to seafood industries. In addition, the IO models do not allow adjustment by other supporting industries to long-run equilibrium of a fishery-dependent regional economy.

An alternative to the static model is a dynamic economic base model, which is often implemented with a vector autoregressive error correction (VECM) model. The VECM model provides the time and magnitudes of regional economic impacts in response to shocks to seafood industries as well as the long-run relationships between basic industries (including seafood industry) and nonbasic (supporting) industries (which cannot be done in a static IO framework). Using monthly employment data at a regional level from 1990 to 2000, Dr. Chang Seung developed VECM models for two fishery-dependent regions in Alaska – the Southwest and Gulf Coast regions. In these models, the dynamic impacts of the seafood industry on the economies of the two regions were investigated. A very recent development in VECM modeling – "panel cointegration" – made it possible to apply this model with panel (a cross-sectional time series) data. Therefore, using panel employment data obtained via a project by Alaska Department of Labor and Workforce Development Dr. Seung is planning to develop a panel cointegration model of Alaska fisheries.

By Chang Seung

New Economic Data Collection Projects Planned for 2006

In January the Economics and Social Sciences Research (ESSR) Program finalized its plan for new data collection projects for 2006. The following four projects will be undertaken:

Project 1: Regional Economic Data Collection for Fisheries of Southeast Alaska. There is an ongoing need to improve the economic models for Alaska fishing communities by collecting additional data on these communities and revising published data (such as IMPLAN data, a commercially available set of data for conducting regional economic analyses) that can be inaccurate. There are three regions in Alaska which depend heavily on fisheries

– the Southwest, Gulf Coast, and Southeast regions. Currently, regional economic data collection projects are funded (by National Marine Fisheries Service (NMFS) Headquarters). Data collection activities are now under way for boroughs and U.S. Census areas in Southwest and Gulf Coast regions. Therefore, once regional economic data for these remaining fishery-dependent regions are collected, most of the important data required for regional economic impact analysis of Alaska fisheries will be ready, and extensive modeling efforts can begin.

Project 2: Fuel Consumption Pilot Survey for Alaska Groundfish Fisheries. One of the largest components of a fisher's costs of operating is the cost of fuel. As such, it is a critical element in the analyst's tool kit when attempting to estimate the economic impacts of any management action (such as marine protected areas) that will affect where fishers may fish. Unfortunately AFSC economists do not have reliable estimates from which to gauge the amount of fuel burned by vessels of a given gear type, length, tonnage, and horsepower. The other primary cost of fishing is the payment made to crew, which is typically some percentage of revenue (for which we have good data). If we could account for the cost of fuel for vessels, along with our current estimates of crew share payments, we would be able to account for a large portion of operating costs. This will not only facilitate analysis of impacts from having to fish in different location, but also allow us to calculate quasi-rents from the trip, and how such rents have been impacted by the recent increases in fuel costs. It is well known that the prices of fish products have increased in the recent past, in part attributable to increased fuel costs, and it would be interesting to estimate the percent of those cost increases that has been passed on to the final consumer. Simply put, data on fuel consumption per day or per nautical mile will be a major workhorse for analysts tasked with estimating the impact of all kinds of policies and will also be valuable in applied empirical models.

Project 3: Vessel Monitoring System Data Collection and Compilation. The National Marine Fisheries Service has long recognized the importance of spatially explicit data to improve fisheries management. Although data from the Observer Program, fish tickets, and logbooks allow AFSC researchers to conduct research on the various fishing fleets active in Alaskan fisheries, the Vessel Monitoring System (VMS) allows NMFS to have real-time knowledge of the precise location of trawling vessels in the Bering Sea. Researchers at the AFSC and at the NMFS Alaska Regional Office have employed VMS data to examine some aspects of fleet behavior, but due to the format of the VMS data, this information has been underutilized in spatial research. This is unfortunate, as the underlying spatial detail in VMS records is exactly the type of information that could be used by scientists trying to better understand and explain the fishing behavior of Alaskan fleets. VMS data truly present researchers with the best spatial data available in the world, a resource that should be fully utilized to improve management and methods of spatial fisheries research; this research aims to do just that.

Raw VMS data contain several basic pieces of information (e.g., vessel identification, location, and a time stamp) along with calculated fields that provide additional information such as the speed of a vessel. However, no information is currently provided in VMS data about whether a vessel is actively fishing, traveling to fishing grounds, in port, or waiting out a storm. Analyzing VMS data and determining whether vessels are fishing, traveling, or in port will substantially increase its usefulness in modeling fishers' behavior. Furthermore, linking it to existing Observer records will allow us to organize the VMS data on a trip-by-trip basis (the format most amenable to spatial behavioral analysis). The VMS data will also be integrated into a GIS framework in order to obtain a graphical depiction of the distances traveled while fishing, and distances traveled to and from port. An examination of these data may also provide information about fleet search behavior. Further, this project will allow us new insight into how observed and unobserved fishing trips may differ (in terms of fishing location choice and harvesting strategies).

Project 4: Fishing Target Accuracy Data Collection Pilot Project. The National Marine Fisheries Service uses the definition of a "targeted fishery" to develop management strategies and to define the vessels active in different fisheries. The target of a particular fishing trip is defined by the species that comprises the largest portion of retained catch, rather than what the skipper of the vessel *intended* to catch.

We recognize that vessel operators choose to accept certain amounts of bycatch at different times because the costs of avoidance are high. What we do not know, however, is to what degree skippers actually have control over what species they catch in a given haul or trip, particularly in the multispecies

flatfish fishery. There may be significant policy implications if we observe that vessel operators in some fisheries have little ability to make choices over their target species when attempting to avoid bycatch of prohibited species.

In general, the question of what fishermen expect to catch when choosing different fishing locations is an area that has received considerable attention from fisheries economists. However, there has been little systematic data collected to compare realized catch with intended catch, which is what this project proposes to do. We have expressed a desire to have observers collect this data on a regular basis and have proposed this as a pilot study. We hope that by verifying that target species and realized catch frequently differ, the Observer Program will collect this information in the future. The data collected in this project will also be useful in decisions and analyses regarding bycatch regulations and fisheries management.

By Ron Felthoven

Research Proposals Funded for 2006

The ESSR Program successfully competed for research funds from NOAA Headquarters for five research projects:

Proposal 1: Spatial Economic Performance: Regulation-Induced Changes in Fishing Location and Practices in the Alaskan Pollock Fleet. Current research at the AFSC has focused on evaluating the impacts on economic performance of the implementation of the American Fisheries Act (AFA) on the Bering Sea and Aleutian Islands (BSAI) pollock fishery. This research has resulted in an article on harvesting productivity and an ongoing study on processing productivity (including product choice and quality) in this fishery. Our analyses have identified important changes in the BSAI fishery structure since the AFA that may involve not only direct impacts of the Act, but also of concurrent regulations such as prohibitions on bottom trawling and fishing location. A combination of such regulatory factors has affected fishing productivity and revenues through adaptations in fishing strategies and practices, including fishing speed and thus the quality of the catch and choice of final products. Specifically, the AFA likely affected *how* fishers fish and the area closures *where* they fish, both of which affect the productivity and revenue of the fishery.

The proposed research will focus on disentangling the effects of regulatory changes on economic performance of the BSAI fishery, with particular attention to the impacts of fishing area closures for the protection of Steller sea lion habitat. These commercial fishing restrictions in the Steller sea lion Conservation Area (SCA) are designed to increase Steller sea lion populations by protecting the fish on which they prey. However, they also may have had effects on fishery productivity through restricted location choices, greater travel distances, and increased density of fishing in the remaining areas. This research will measure such impacts using parametric models of optimal catch or revenues that can directly represent, both within the estimation model and the stochastic structure, the impacts of regulatory factors on productivity and economic returns. The research will thus result in productivity measures that embody both direct regulatory impacts and indirect externalities from other boats' fishing choices.

Proposal 2: Community Development Quota Price Analysis. The Western Alaska Community Development Quota Program (CDQ Program) has operated in Alaskan communities since it was developed in 1992. The CDQ Program was created to ensure that communities in the Bering Sea region share in the wealth created by their fisheries. In many cases, quota holders in rural communities have leased their CDQ Program quotas to large commercial fishing companies to exploit cost economies of scale. The information detailing these transfers has been recorded in reports that community development corporations are required to file during each year with NMFS and the state of Alaska.

In particular, these reports contain a large amount of historical data on the prices that have been paid for the opportunity to fish in different fisheries. In some cases, the prices reflect the opportunity to fish in areas, and/or during times of the year, for which only CDQ fishing was authorized. These data therefore provide important information on the rents generated in Alaskan fisheries, and may allow us to answer various questions that, until now, could not be answered with available data.

NMFS uses temporal and spatial closures to help improve the biological health and economic performance of Alaskan fisheries. In many cases, it is very difficult or impossible to assess the value of these closures. A careful examination of the information in the CDQ Program reports will provide us with new and valuable insight into the relative values of fishing in different areas. By observing the changing lease rates across time, these data will

also allow us to better quantify the value added in the pollock fishery with the imposition of the AFA. In addition, economists at the AFSC have worked to measure the costs of marine reserves and other area closures. The data from the CDQ program will also complement this research. This information is more pertinent than ever as NMFS moves towards ecosystem management which will require that we make additional trade-offs across space and time.

The NMFS CDQ Program Coordinator, Sally Bibb, has expressed enthusiastic support for this project. The reports submitted by the community development corporations (Communities) contain a variety of information about the transfer of fishing rights. The information contained includes audited financial statements and the contracts between the Communities and commercial fishing companies, but this information is not recorded in a common format in the different reports. In addition to the economic goals of the project, we will help to identify the common features of the reports and provide input to the Alaska Region on how to standardize the data collected in the future.

Proposal 3: Estimating Interregional Economic Impacts of Vessels Participating in Both Alaska Fisheries and Fisheries off the West Coast. Many of the vessels operating in Alaska fisheries are owned and crewed by residents of Washington and Oregon. Some of these vessels also participate in West Coast fisheries during the year. While much of the income earned by these vessels leaves Alaska, expenditures made elsewhere will generate positive economic impacts for that region and may also have spillover effects. Previous research has demonstrated that assuming all commodities and services are locally supplied will significantly overestimate regional impacts. Understanding the location of expenditures made by these vessels, both in Alaska and elsewhere, will enhance our understanding of the overall economic impacts of Alaskan fisheries.

Standard regional economic models focus on a single region. These models generally fail to capture economic impacts transmitted outside that region, and also do not account for spillover effects in the study region resulting from events occurring outside. An inter-regional or multiregional model can more fully measure the impacts of a region's fisheries, including those impacts occurring in regions that supply commodities or factors of production to industries in the study region, or that demand the goods and services produced there. An interregional model would be especially useful in the case of Alaska, where most intermediate goods are imported and much of the factor income leaks out of the region to nonresident vessel owners and crew members. This type of model could also be used to track the impact of expenditures by vessel owners and crew members who are also active in other regions' fisheries. However, developing an inter-regional model involves the daunting task of estimating inter-regional flows of commodity inputs and factor services. Acquiring this information has traditionally been very challenging due to an absence of interregional trade flow statistics.

Proposal 4: Measures of Technical Efficiency and Their Impact on Spatial Regulatory Measures. The production function framework used to characterize production processes in nonfishery technologies fails to incorporate many of the spatial characteristics of fishing vessels that use inputs to create fish outputs: their production functions are highly mobile. This level of mobility implies that their production functions are not only defined by the technology they possess and the inputs they utilize but also by the location in which they employ them. Therefore, previous research conducted on the level of technical efficiency possessed by vessels within a fishing fleet ignores one of the most important inputs of production: where they chose to fish. The purpose of this research is to estimate the spatial technical efficiency of trawl vessels operating within the Bering Sea and Aleutian Islands within the regions potentially closed under proposed essential fish habitat (EFH) alternatives and to determine whether or not the proposed closures will have a deleterious effect on their production processes.

Proposal 5: Recreational Fishing Demographics in Alaska. The two most important saltwater recreational fisheries in Alaska are halibut and salmon. Of these, the halibut fishery is managed by the North Pacific Fishery Management Council, which has been debating instituting a controversial Guideline Harvest Level and limited allocation for the sector. Available information about the recreational fishermen who will be affected is limited. This project will analyze data which has been collected by NMFS, but which remains unprocessed, to create a demographic description of the participants in Alaska's saltwater recreational fisheries. Recreational license information for Alaska has previously been analyzed by AFSC scientists for data on community of residence and place of license purchase. But the value of this database is limited because demographic information is not requested

on the license application. In 2004, AFSC economists conducted a nationwide mail survey of people who had purchased recreational fishing licenses in Alaska the previous year. Six demographic questions were included in this survey: age, gender, race/ethnicity, education, household size, and income. This data is a unique window onto participants in Alaska's recreational fisheries just at the time when the Council is considering policies which will affect this otherwise undescribed group.

By Ron Felthoven

Gulf of Alaska Halibut IFQ and Small Remote Fishing Communities

Individual fishing quota (IFQ) programs, like other dedicated access privilege programs, are often criticized for their distributional consequences. In the Gulf of Alaska halibut fishery, many regulatory precautions were taken to preserve the character of the fishery. However, there is concern that fishing quota holdings are being reduced in small, remote Alaska fishing communities (SRFCs). Jennifer Sepez and Dan Lew have been working with University of Washington Ph.D. student Courtney Carothers to analyze quota share transactions from 1994 to 1999 to assess whether halibut fishing quota holdings are migrating away from SRFCs.

In this study, a community is a SRFC if it meets criteria based on population size, proximity to the coast, historical participation in Alaska fisheries, and designation as a rural area, which is a proxy for remoteness. Several size-based SRFC definitions are developed to account for sensitivity to population size threshold assumptions. The data show that quota share did leave the smallest SRFC communities over the 5-year period, as evidenced by the net quota share change in these communities during that time. In more populated SRFC communities, the trend is generally reversed; that is, more quota share entered these communities than left. These results suggest the size of a SRFC community may influence whether its residents will sell or buy halibut IFQ and hence whether we see quota share leaving or entering the community in aggregate.

To more formally investigate the role of SRFC residency in decisions to buy or sell halibut quota share, the probability that an individual is a buyer or seller is modeled as a function of characteristics of the individual and analyzed using logit techniques. In this way, the influence of individual characteristics, such as age and the community's population, on buying and selling behavior can be separated from effects due to residency specifically in SRFCs. The logit results indicate that the marginal effect due to SRFC residency influences the decision to buy or sell more than one's age (other individual and transaction-specific effects were precluded from the model due to data limitations). The size of SRFC communities matters as well. Additional analysis is planned to explore the extent to which specific characteristics of communities contribute to buying and selling behavior more generally and to investigate the reasons underlying the observed buying and selling trends in SRFCs.

By Dan Lew

Staff Appointments

Alan Haynie was appointed as an affiliate faculty member to the School of Marine Affairs at the University of Washington and to the expert panel for assessment of the economic impacts of climate change in Washington State.

Dan Lew was appointed to the editorial council of the *Journal of Agricultural and Resource Economics*, a peer-reviewed journal that publishes scholarly economic research on agriculture, natural resources, and related areas.

By Ron Felthoven

Alaska Community Profiles Released as Technical Memorandum

Community Profiles for North Pacific Fisheries – Alaska by Sepez, Tilt, Package, Lazrus, and Vaccaro has been released as NOAA Technical Memorandum NMFS-AFSC-160. This project was described in detail in the feature article of the AFSC Quarterly Report for April-May-June 2004 (http://www.afsc.noaa.gov/Quarterly/amj2004/amj04feat.pdf). The final document contains short profiles (5-10 pages) of 136 Alaska communities involved in the fisheries in the North Pacific. A color version of the document is available for download (18 MB) on the AFSC's Technical Memorandum section of its web site at http://www.afsc.noaa.gov/Publications/techmemos.htm. Bound hard copies (black and white) are available, as are CDs containing the color .pdf version. Send requests to Christina.Package@noaa.gov.

Communities involved in North Pacific fisheries, but not located in Alaska, are currently being profiled in a separate project using a similar format. *Community Profiles for West Coast and North Pacific Fisheries – Washington, Oregon, California, and Other U.S. States* by Norman, Sepez, Lazrus, Milne,

Package, Russell, Grant, Petersen, Primo, Styles, Tilt and Vaccaro profiles 125 West Coast communities involved in fishing. A draft of this document is currently available for review and comment at http://www.nwfsc.noaa.gov/research/divisions/sd/communityprofiles/index.cfm.

A variety of laws require the consideration of human communities, including but not limited to Magnuson-Stevens Fishery Conservation and Management Act and the National Environmental Policy Act. The profiles have been part of our effort to facilitate implementation of these laws, and improve available baseline information on a broader range of affected communities. Profiles from the Alaska document have already been utilized in EISs, FMPs, and as background to various analyses. Agency profiling efforts in other regions are using our approach as a template for their own efforts.

The Alaska profiles are given in a narrative format that includes three sections: *People and Place, Infrastructure,* and *Involvement in North Pacific Fisheries*. *People and Place* includes information on location, demographics (including age and gender structure of the population, racial and ethnic make up), education, housing, and local history. *Community Infrastructure* covers current economic activity, governance (including city classification, taxation, Native organizations, and proximity to fisheries management and immigration offices) and facilities (transportation options and connectivity, water, waste, electricity, schools, police, and public accommodations). *Involvement in North Pacific Fisheries* details community activities in commercial fishing (processing, permit holdings, and aid receipts), recreational fishing, and subsistence fishing. To define communities, we relied on the U.S. Census place-level geographies where possible, grouping communities only when constrained by fisheries data, yielding 130 individual profiles. Regional characteristics and issues are briefly described in regional introductions.

The communities were selected by a process which assessed involvement in commercial fisheries using quantitative data from the year 2000, in order to coordinate with 2000 Census data. The quantitative indicators looked at communities that have commercial fisheries landings (indicators: landings, number of processors, number of vessels delivering to a community), communities that are the registered homeports of vessels participating in the fisheries, and communities that are home to documented participants in the fisheries (indicators: crew license holders, state and federal permit holders, and vessel owners). Where appropriate, the indicators were assessed as a ratio to the community's population. Selection of a community was triggered by its surpassing a certain threshold in any one of the indicator categories, or in an aggregated category made up of the individual indicators.

By Jennifer Sepez and Christina Package

Salmon Bycatch in the Bering Sea Pollock Fishery

Alan Haynie has begun research to try to better understand and predict fisher reaction to salmon bycatch measures in the Bering Sea pollock fishery. In response to increased salmon bycatch in the pollock fishery over the last 5 years, the North Pacific Fishery Management Council passed Amendment 84 which will allow pollock cooperatives to be exempt from salmon savings areas beginning 1 August. In order to qualify for the exemption, cooperatives must be a party to an intercooperative agreement (ICA) which requires that vessels stay out of "hotspots" when they are declared by SeaState, a third-party hired by industry to manage the spatial closures.

In order to provide comment to the Scientific and Statistical Committee at the April Council meeting, Alan analyzed the incentives contained within the ICA and examined how vessels have responded to hotspot closures. In preparation for additional Council considerations of individual bycatch incentive programs, Alan also has been conducting research on how different bycatch quota or fee systems might be applied to better manage salmon bycatch.

By Alan Haynie

STATUS OF STOCKS & MULTISPECIES ASSESSMENT PROGRAM

Aleutian Islands Pollock Acoustic Survey Feasibility Study

Steve Barbeaux, of the Fishery Interaction Team and the Status of Stocks and Multispecies Assessment (SSMA) program, designed and conducted the Aleutian Islands pollock acoustic survey feasibility study, which occurred during March. The purpose of the study was to test the feasibility of using commercial fishing vessels to conduct acoustic surveys for pollock in the Aleutian Islands subarea. The acoustic and biological information from the project is currently being analyzed to determine: 1) if it is feasible to conduct acoustic surveys in the

Aleutian Islands subarea using commercial fishing vessels, 2) if the data collected in such a manner is of sufficient quality for management purposes, and 3) if the local aggregations of pollock are stable enough during spawning season to allow for fine-scale spatial and temporal management. Additionally, genetic samples were collected that will be used for stock structure analysis.

The project had three activity phases: 1) evaluating the commercial fishing vessel's appropriateness as an acoustic sampling platform; 2) opportunistically collecting acoustic data of pollock distribution around two sites, Kanaga Sound and Atka Island and 3) direct acoustic and biological data sampling at Atka Island (up to ten 1- to 3-day trips). To verify the acoustic data and to support the study, 1,000 t of walleye pollock were permitted to be harvested within an area that includes waters within 20 nmi of Steller sea lion haulouts and rookeries. This harvest was permitted under an Experimental Fishing Permit awarded to the Aleut Enterprise Corporation. The acoustic survey and fishing were conducted on board the fishing vessel *Muir Milach*. Conducting the project within Steller sea lion critical habitat was necessary because pollock aggregations must be encountered to support the work, and historical information about the occurrence of pollock indicates that pollock aggregations were likely to occur inside critical habitat.

By Elizabeth Logerwell

Western Groundfish Conference Presentations

SSMA Program staff attended the Western Groundfish Conference held 30 January to 3 February in Newport, Oregon, and presented talks and/or posters. Abstracts from select presentations are provided with SSMA staff names presented in italics.

LOOKING FOR LOCALIZED DEPLETION IN BERING SEA PACIFIC COD

M. Elizabeth Conners, Peter Munro, Sandi Neidetcher, Elizabeth A. Logerwell

The Fisheries Interaction Team at the AFSC has conducted a field experiment on Pacific cod in the heavily-fished region of the southeast Bering Sea. Alaskan groundfish fisheries have been restricted in recent years due to concern over possible competition with the endangered Steller sea lion. The goal of the experiment was to determine if intensive trawl fishing for cod creates a localized depletion in fish abundance that could adversely affect prey availability for sea lions. A regulatory notrawl zone intersecting historical trawl grounds provided opportunity for a treatment/control type experiment. The experiment uses a before-after, treatment-control type design to compare the seasonal rate of change in cod abundance within the Cape Sarichef notrawl zone to the rate of change in the adjacent heavily trawled area. Use of fixed gear (pots) for the study allowed much higher sample size than would have been feasible with trawls, and much lower variance in the catch data. These features made it possible to perform a statistically accurate, powerful, and robust test for the presence of a localized depletion.

While the cod catch rates and observed seasonal changes were variable over the 3 years of the study, the result of the comparison between trawled and untrawled areas was remarkably consistent. In each of the 3 years, the nonparametric statistical test overwhelmingly indicated no difference between sites in the trawled and untrawled areas (P-values of 0.86 to 0.98). Power of the 2003 test was low due to small sample size, but power calculations indicate that the experiments in 2004 and 2005 would have been able to detect a reduction in the average catch of the trawled zone in the range of 20%-30%. Maps of the observed catches and seasonal percentage change showed no consistent spatial pattern.

The concept of localized depletion is strongly dependent on assumed spatial and temporal scale. This experiment looked for an effect based on assumptions that fishing effects would be evident within 5 nmi of the removal and persist for at least several weeks. The observed results indicate that actual fishing effects occur at different spatial and temporal scales. The results of concurrent tagging and biological studies suggest that cod stocks in the study area were highly mobile over time scales shorter than 2 weeks. In order for a fishery to produce persistent localized depletion, the target pool of fish must be static over an extended time period. Our work near Unimak Pass leads us to believe that this assumption is not valid for Pacific cod, at least in this region.

ASPECTS OF THE LIFE HISTORY OF THE ALASKA SKATE, *BATHYRAJA PARMIFERA*

Beth Matta and Don Gunderson

The Alaska skate (*Bathyraja parmifera*) is a large-bodied species that accounts for over 90% of the skate biomass on the eastern Bering Sea shelf. *Bathyraja parmifera* is commonly caught as bycatch

in Bering Sea trawl and longline fisheries, yet information regarding its life history is limited. Studies focusing on age, growth, and reproductive biology are essential to stock assessment and management of this species. Since 2003, over 600 specimens have been collected during summer groundfish surveys conducted by NMFS and seasonally by the NMFS Observer Program. Banding patterns in thin sections of vertebral centra and in whole caudal thorns are being compared for age determination. Maturity, estimates of batch fecundity, and seasonal reproductive timing are also being studied. Males exhibited a preliminary maximum observed age of 17 years and females an age of 21 years. The preliminary median age and size at maturity was 10 years and 91 cm for males and 11 years and 94 cm for females. This species also appears to be reproductively active throughout the year, supported by gonadosomatic index (GSI), uterine egg case, and ovarian egg data. Research is ongoing, and results will be considered in future stock assessments for *B. parmifera*.

THE MANAGEMENT STRATEGY EVALUATION APPROACH AND THE GULF OF ALASKA WALLEYE POLLOCK FISHERY

Z.T. A'mar, Punt, A.E., and *Dorn, M.W.*

Management strategy evaluation (MSE) is the process of using simulation testing to examine the robustness of proposed management strategies to error and uncertainty. Implementing a MSE involves three main parts: 1) a model (the "operating model") to represent the true underlying dynamics of the resource and to generate future data; 2) an estimation model to assess the state of the stock relative to agreed target and limit reference points at each time step based on the simulated data; and 3) a catch control rule to determine management actions (e.g., the Total Allowable Catch) given the results of the estimation model. The latter two steps constitute the management strategy. The parameters of the management strategy can be selected to achieve desired (but conflicting) management goals and objectives. The results of an MSE are evaluated based on performance measures designed to quantify the effectiveness of the management strategy toward stated management goals. A MSE has been developed for the Gulf of Alaska walleye pollock fishery. A number of factors including pollock stock structure, climate effects, and ecosystem changes constitute hypotheses in the operating model that are being tested.

THE EFFECT OF MATERNAL AGE OF SPAWNING ON ESTIMATION OF F_{MSY} FOR ALASKAN PACIFIC OCEAN PERCH

Paul Spencer, Dana Hanselman, and *Martin Dorn*

Recent laboratory research suggests that rockfish larval survival rates increase with the age of the spawner, thus potentially necessitating more conservative harvest policies that explicitly consider the age structure of the spawning stock biomass. In this study, we use simple deterministic population dynamics equations to examine how reduced spawning effectiveness of younger spawners may affect commonly used reference points such as F_{msy} and $F_{xx\%}$, the fishing rates corresponding to the maximum sustained yield and conservation of *xx%* of the reproductive output per recruit relative to an unfished population, respectively. Reduced effectiveness of younger spawners results in reduced reproductive output conserved for a given level of fishing mortality, but also increased resiliency in stock-recruitment curves due to an equivalent number of recruits being associated with a reduced measure of reproductive output. For Bering Sea/Aleutian Islands and Gulf of Alaska Pacific ocean perch, these two effects nearly equally counteracted each other, producing stable F_{msy} estimates for three different measures of reproductive output. However, estimates of $F_{xx\%}$ rates that consider uncertainty in the stock-recruitment parameters and in the degree to which maternal age affects reproductive success are more conservative than those based on analyses using spawning stock biomass as reproductive output. These results indicate that perception of stock resiliency is not necessarily independent of the life-history parameters describing production of reproductive output. The degree of adjustment of $F_{xx\%}$ rates required will depend upon further analyses with realistic environmental variability and careful consideration of the range and weights assigned to the stock-recruitment and life-history parameters evaluated.

HISTOLOGICAL VALIDATION OF A VISUAL MATURITY KEY FOR PACIFIC COD

Sandra Neidetcher and Jim Stark

Investigations of spawning processes of Pacific cod, *Gadus macrocephalus*, require knowledge of the gonad developmental stage of individual fish. Visual staging based on the external and internal appearance of gonads can be a quick and easily applicable tool to assess maturity stages. Though these methods allow for increased sample sizes, they are subjective and sometimes inaccurate, especially for gonads in transitional stages of development. We describe the visual gonad key employed in cod research conducted by the Fisheries Interaction Team of the Alaska Fisheries Science Center, NMFS. We present data collected as part of studies of cod spawning processes near Unimak Pass in the southeastern Bering Sea in the winters of 2002 through 2005. Histological specimens were collected for gonads that had also been coded according to the visual key. The histological specimens were processed to identify the presence of the most advanced structures and were then used to validate the development stages indicated by the visual key.

Alaska Marine Science Symposium Presentations

SSMA staff attended the Alaska Marine Science Symposium in Anchorage, Alaska during January. Abstracts from select presentations are provided with SSMA staff names presented in italics.

PROCESSES AFFECTING THE PRODUCTIVITY OF CAPELIN AND POLLOCK IN THE GULF OF ALASKA

E. A. Logerwell, J. T. Duffy-Anderson, and M. T. Wilson

The Gulf of Alaska (GOA) is a highly productive ecosystem that is influenced by oceanographic forcing and climate variation. Studies that examine the distributional ecology of key fish species in the GOA relative to environmental variables provide an opportunity to better understand how external forcing factors influence and modify fish production. We present information on the effects of local hydrography on the distribution and feeding ecology of two key forage species in the GOA, juvenile walleye pollock (*Theragra chalcogramma*) and capelin (*Mallotus villosus*). Multiple research cruises were undertaken in Barnabus Trough, located to the east of Kodiak Island. Biophysical sampling (temperature and salinity profiles, chlorophyll-a concentrations, acoustic backscattering) in these areas suggests that juvenile walleye pollock and capelin were spatially separated by a local hydrographic front in Barnabus Trough. These observed differences in habitat selection have implications for resource use and competition between pollock and capelin in that region. Our current research examines whether mesoscale hydrography is associated with differences in zooplankton composition, limits in geographic distribution, and fish feeding and diet. Results will provide a better understanding of the mechanisms by which climate variability influences fish populations in the Gulf of Alaska.

REPRODUCTIVE ECOLOGY OF ATKA MACKEREL

Daniel Cooper and Susanne F. McDermott

A reproductive ecology study of Atka mackerel was funded by the North Pacific Research Board. Atka mackerel length and age at maturity were examined as part of the study. Ovaries were collected from International North Pacific Fisheries Commission (INPFC) areas 541 and 542 from 2002-04 during NMFS Atka mackerel tag recovery cruises. Maturity was determined by histology. Ages were assigned by NMFS AFSC age readers. A generalized linear model with binomial error distribution was used to test for maturity differences by area and over time. A logistic model was fit to the data using S-PLUS:

It was found that Atka mackerel female maturity is more dependent on age than length. The difference in length at 50% maturity between areas is likely due to different growth rates between areas.

A strong 1999 year class caused the maturity samples to include a high percentage of age-3 fish in 2002 and a low percentage in 2003. This is likely the cause of the fluctuations in length at maturity between years. Maturity at age was not significantly different between time periods at the alpha = 0.05 level (P=0.054). The 2003 estimate of 50% age at maturity differed the most from the one traditionally used in the stock assessment. Using the 2003 maturity estimate increases the 2003 spawning biomass by 14%. Variation in age and length at maturity can have an important influence on estimates of spawning biomass and therefore, stock assessment.

AGE & GROWTH PROGRAM

Estimated production figures for 1 January through 31 March 2006	
Species	**Specimens Aged**
Pacific cod	2,668
Sablefish	1,196
Atka mackerel	315
Rougheye rockfish	1,374
Great sculpin	400

Total production figures were 5,953 with 1,505 test ages and 81 examined and determined to be unageable. This release of great sculpin ages are the first ages of this species from the Age and Growth Program.

Because of the significance of walleye pollock in Alaska groundfish fisheries, the Age and Growth Program has made a significant effort to corroborate/validate the ageing criteria we are using for this species. This research has lead to two studies which will soon be published in the scientific literature. The first is by D.K. Kimura, C.R. Kastelle, B.J. Goetz, C.M. Gburski, and A.V. Buslov called "Corroborating ages of walleye pollock (*Theragra chalcogramma*)," which will be published in the journal *Marine and Freshwater Research*; the second is by C.R. Kastelle, and D. K. Kimura called "Age validation of walleye pollock (*Theragra chalcogramma*) from the Gulf of Alaska using the disequilibrium of Pb-210 and Ra-226" to be published in the *ICES Journal of Marine Science*. Together these papers confirm that AFSC ageing methods being applied to walleye pollock is supported by a broad range of scientific evidence.

By Dan Kimura

US-VIETNAM BILATERAL WORKSHOP AND EIGHTH PACIFIC RIM FISHERIES CONFERENCE

The REFM Division played a key role in organizing a U.S.-Vietnam Bilateral workshop and the eighth Pacific Rim Fisheries conference, which were held in Hanoi, Vietnam. The workshop theme focused on research and survey needs on marine fisheries resources off Vietnam. The objective of the workshop was to review such needs so that the documentation could be used for planning future cooperative activities under a 2001 Agreement on Scientific and Technological Cooperation between the two countries.

The participants reported on the status of various research and survey activities on demersal fisheries resources, nearshore and offshore pelagic fisheries resources, tunas, corals, sea turtles, bycatch avoidance gear technology, marine protection areas, oceanography, and ecological studies. The technical presentations made at the workshop are available for public access through the AFSC web site at http://www.afsc.noaa.gov/InternationalResearch/conferences.htm The Eighth Pacific Rim Fisheries Conference on "Challenges of Stewardship of Living Marine Resources in the Pacific Marine Ecosystem" was held after the workshop. The conference featured daily topic focuses.

Day 1 was for keynote address and Country reports. Kitty Simonds (Executive Director of the Western Pacific Fishery Management Council) and Bill Robinson (Regional Director of the Pacific Islands NMFS Regional Office) presented a two-part keynote address "Who gets the Fish? Kitty reported from a domestic perspective for the Western Pacific Fishery Management Council and Bill reported from an International perspective for the newly formed Western and Central Pacific Fisheries Convention. National Marine Fisheries Service Assistant Administrator Bill Hogarth gave the U.S. report. The focus topics for Day 2 were on special challenges of stewardship from many perspectives by a diverse group of international experts. Papers were presented on Asian regional fisheries experiences, ecosystem approaches to management, market based management, open access systems, stock rebuilding, overcapitalization and overfishing, essential fish habitat protection, aquaculture and trade issues, eco-labeling, and coordinated enforcement. Day 3 topics focused on natural and man-made disasters – tsunamis, tropical storms, global warming, and coastal mitigation. The closing remarks were made by U.S. Department of State representative, Stetson Tinkham. The presentations at the conference are available for public access through the AFSC web site at http://www.afsc.noaa.gov/InternationalResearch/conferences.htm.

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