AUKE BAY LABORATORY (ABL)

OCEAN CARRYING CAPACITY PROGRAM

Age-0 Pollock Distribution in the Eastern Bering Sea

The Ocean Carrying Capacity (OCC) program conducted its annual Bering Aleutian Salmon International Survey (BASIS) from 14 August to 30 September 2004. The objectives of BASIS are to identify the physical and biological mechanisms that affect the migration, distribution, and early life history of Pacific salmon and other commercially important species in the Bering Sea.

Of these species, walleye pollock is one of the most abundant pelagic fish in the Bering Sea. Besides being one of the largest fisheries resources in the world, pollock are important prey to marine mammals, seabirds, and piscivorous fishes. Because of walleye pollock's commercial importance, OCC scientists have assessed the distribution and abundance of age-0 pollock in the eastern Bering Sea during BASIS cruises.

During the 2004 cruise, a total of 2.6 million individual age-0 pollock were caught at 143 stations. Age-0 pollock were distributed throughout the eastern Bering Sea from lat. 55°30'N to lat. 64°N. The greatest catch per unit effort (CPUE) of pollock occurred at stations along the 50-m contour line within Bristol Bay and north to lat. 59°N (Fig. 1). Total catch in 2004 increased by 50% from 2003, when 1.3 million age-0 pollock were caught at 151 stations. Pollock distribution differed between 2003 and 2004, with the greatest CPUE of pollock in 2003 occurring in the middle domain (between 50 and 100 m) on the longitude 162°W transect (Fig. 2).

A variety of factors influence pollock distribution and abundance. Wind and current patterns, competition, prey availability, and predation all play a critical role in pollock distribution and biomass. Future OCC studies will look for relationships between prey availability, oceanographic conditions, and age-0 pollock diet and energy density.

By Angela Middleton

ABL Weather Station

The year 2004 in southeastern Alaska began with an exceptionally mild winter quarter (January–March) with above average air temperatures and below average snowfall. The spring quarter (April–June) continued this trend with record high air temperatures in May and June and record low rainfall in June. These unusual conditions may influence future salmon harvests in southeastern Alaska. The high temperatures resulted in record high stream and lake temperatures approaching and (in some cases) exceeding 20°C, stressing juvenile fishes rearing in low-elevation streams. Additionally, the low spring snowpack and low rainfall resulted in some small streams with water flows too low for early returning salmon to enter the streams. July frequently has cooler weather and more rainfall than June, and the continuing warming trend was not beneficial to salmon returning to spawning streams in July and August. Sufficient rain to raise stream flows was not seen until mid-September, much too late for most of the pink salmon and early chum salmon runs.

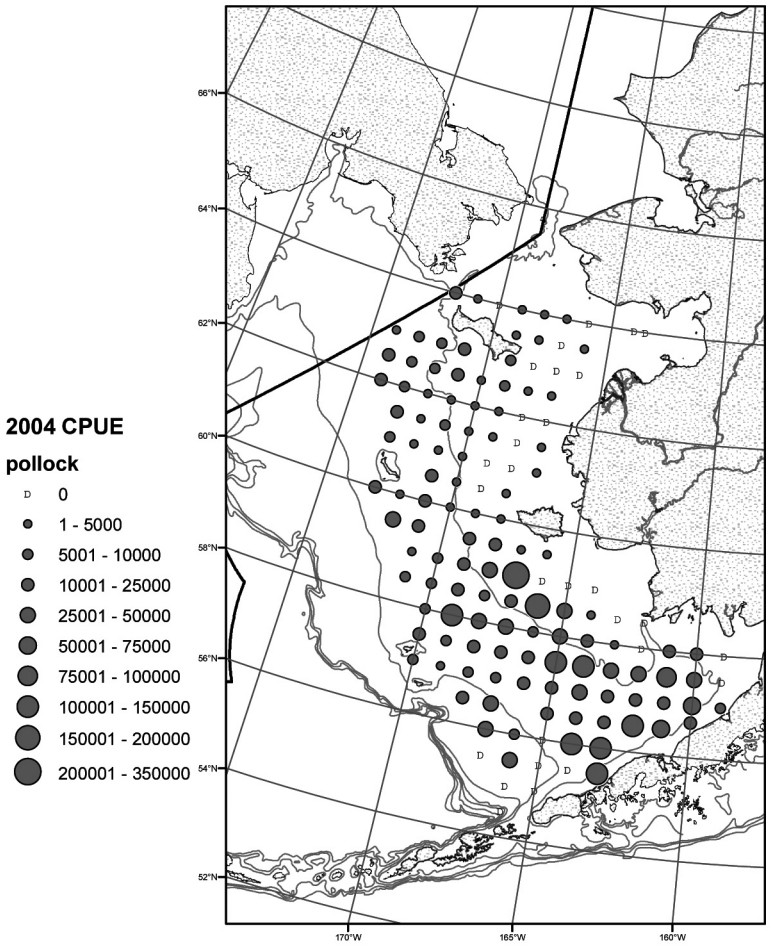

Figure 1. Age-0 pollock distribution and CPUE during the 2004 BASIS research cruise in the eastern Bering Sea, 14 August–30 September.

The abnormally high sea surface temperatures reported from Auke Bay were also evident in the oceanic areas of the Gulf of Alaska. Through most of the summer, the sea surface temperatures were 1°–2° C above the climatic mean. This not only reflects unusually warm air temperatures over the Gulf of Alaska, but also the transport of warmer than average waters from the south by the Alaskan Gyre. Possibly associated with these warm water conditions was the finding of a Pacific Ridley turtle (*Lepidochelys olivacea*) carcass near Yakutat, Alaska, and the sightings of white sharks (*Carcharodon carcharias*) off Noyes Island in August and Yakutat in September. Also, two thresher sharks (*Alopias vulpinus*) were caught by salmon fishermen in southeastern Alaska this season. In September, a longliner caught two jumbo squid (*Dosidicus gigas*) off the Fairweather Grounds between Sitka and Yakutat. Jumbo squid are rarely seen as far north as San Diego, California, but in 2004 the species was reported also off the Washington coast.

By Bruce Wing

HABITAT PROGRAM

Variation in Quality of Steller Sea Lion Prey from the Aleutian Islands and Southeastern Alaska

Nutritional stress is one of the leading hypotheses explaining the decline in the western stock of Steller sea lions (Aleutian Islands region). Central to this hypothesis is the possibility that western stock sea lions encounter prey of significantly lower quality than sea lions from the eastern stock (southeastern Alaska). To continue our investigations of this hypothesis, we collected and analyzed more than 1,200 whole fish representing species identified as Steller sea lion prey items from the Aleutian Islands and southeastern Alaska, including species that reside in both regions. We performed proximate analyses on the fish and calculated mean energy densities based on the lipid and protein contents.

Comparison of the energy densities between the Aleutian Island and southeastern Alaska fish on a species basis revealed significant differences in energetic prey content in the species from the two regions. Overall, the mean energy density for 22 forage species from southeastern Alaska (1.62 +/- 0.02 kcal/g on a wet weight basis) was greater than that of 15 species from the Aleutians (1.44 +/- 0.03 kcal/g), but these variations could be attributed to size differences among the fish sampled from the two regions as well as species composition differences. For example, Pacific cod sampled from the Aleutian Islands were significantly larger ($P < 0.001$) than those from southeastern Alaska and had a higher energy density ($P = 0.002$). However, controlling for size revealed no difference between the two populations of cod ($P > 0.5$). Similarly accounting for size, no difference was found in the energy density of pollock or arrowtooth flounder from the two locations. In contrast, squid and sandfish from southeastern Alaska had higher energy densities ($P < 0.001$) than those from the Aleutian Islands, while Aleutian Islands rockfish had larger energy

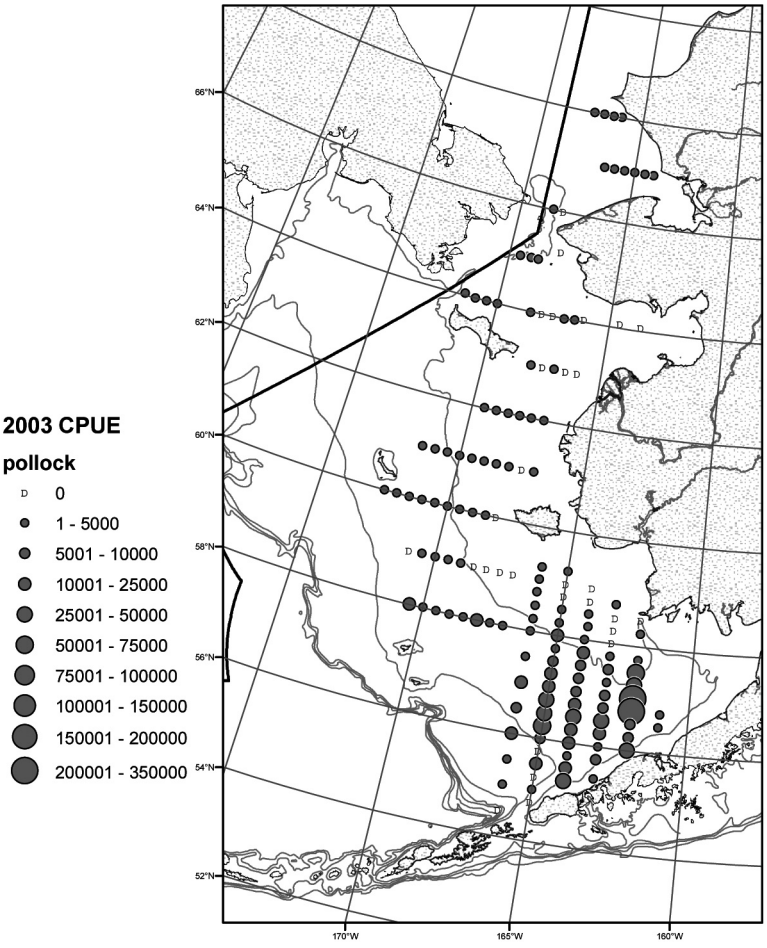

Figure 2. Age-0 pollock distribution and CPUE during the 2003 BASIS research cruise in the eastern Bering Sea, 21 August–8 October.

densities than those from southeastern Alaska (P = 0.003). These data reveal the importance of considering size when making energy density comparisons of the prey available to the western and eastern sea lion stocks.

By Lawrence Schaufler and Elizabeth Logerwell

Seasonal Prey Availability Near Two Steller Sea Lion Haulouts in Southeastern Alaska

To better understand the declining abundance of Steller sea lions in western Alaska, we examined the seasonal availability of prey in southeastern Alaska where sea lion abundance is increasing. From 2001 to 2004, we identified prey in nearshore waters (<100 m deep) near two Steller sea lion haulouts, Benjamin Island and The Brothers Islands, in summer and winter.

Catch and number of prey species available to sea lions were greater in summer than in winter at both haulouts and greater at The Brothers Islands than at Benjamin Island. Total catch at both haulouts and for all sampling periods was 201,331 fish by seining and 559 fish by jigging; 58 species were identified in summer and 44 species in winter. Seine catches for both locations were dominated by young-of-the-year walleye pollock, Pacific herring, and Pacific sand lance in summer and salmon fry, armorhead sculpin, and rock sole in winter. Jig catches were dominated by armorhead sculpin, Pacific cod, and rockfish in summer and winter.

Most fish captured by seining were juveniles (median fork length < 80 mm) and likely too small to be targeted by sea lions, whereas most fish captured by jigging (median fork length > 249 mm) were large enough to be consumed by sea lions. Thirty-four species captured have been identified in sea lion scat collected at either haulout. Availability of prey close to Steller sea lion haulouts contributes to overall diet diversity and provides a source of food that may reduce foraging effort in summer. Less available prey in winter, however, may force sea lions to travel farther from haulouts to forage.

By John Thedinga

Organochlorine Levels in Steller Sea Lion Prey from the Aleutian Islands and Southeastern Alaska

The ubiquitous distribution of organochlorines in high-latitude food webs suggests organochlorines may have a role in preventing the recovery of the western stock of Steller sea lions. However, there are few data describing the bio-availability of these contaminants in the Aleutian Islands region where the western Steller sea lion stock occurs.

We measured concentrations of dioxin-like and other selected polychlorinated biphenyls (PCBs), DDTs (dichlorodiphenyltrichloroethane), and hexachlorobenzene (HCB) in whole bodies of walleye pollock to test the hypothesis that contaminant loads in western stock food webs would be higher than those of the eastern Steller sea lion stock found in southeastern Alaska. More than 110 fish were collected from six areas in the Bering Sea and southeastern Alaska: the western Bering Sea, the western Aleutians, the eastern Aleutians, the Pribolof Islands, the northern Bering Sea, and southeastern Alaska. Whole fish were examined for the presence of 15 coplanar PCB congeners, four DDTs, and HCB; we also estimated total concentration of PCBs. Pollock from southeastern Alaska were significantly more contaminated than Bering Sea pollock (P < 0.01), with length-corrected concentrations of 167 ng/g lipid, 173 ng/g lipid, and 44.0 ng /g lipid for PCBs, DDTs, and HCB, respectively. The southeastern Alaska levels are higher than those reported for fish at similar trophic levels in the the Beaufort Sea, suggesting a higher degree of contamination in southeastern Alaska food webs. This high level of contamination in southeastern Alaska is consistent with the characteristically large amounts of precipitation in the region. Eastern stock sea lion populations have been increasing while apparently consuming prey with relatively high organochlorine loads. Consequently, the presence of organochlorines in high-latitude food webs does not appear to be inhibiting the recovery of the western Steller sea lion stock.

By Ron Heintz

MARINE SALMON INTERACTIONS

NMFS Scientists Attend Third International Otolith Symposium

The Third International Symposium on Fish Otolith Research and Application was held in Townsville, Queensland, Australia in July 2004. The symposium, hosted by the CRC Reef Research Center and James Cook University, provided a forum for wide-ranging discussions of new ideas, research, and clarification of methodology used in the field of otolith research. More than 300 scientists

from 32 different countries attended the symposium, including 40 researchers from the United States representing universities, federal and state governments, and private organizations. The National Marine Fisheries Service (NMFS) was represented by 19 scientists. (See also REFM Division's Age and Growth Program report.)

The symposium included oral and poster presentations in key themes areas. Dean Courtney of the ABL presented a poster of his work on otolith micro-increment periodicity of juvenile sablefish. Don Mortensen from the ABL presented posters on using otolith elemental analysis to separate Bristol Bay sockeye salmon stocks, and on the evaluation of strontium and calcein for marking hatchery and wild juvenile chum salmon.

The symposium also included several otolith-related workshops and visits to research facilities in the northeast Queensland area, the Coral Sea, and the Great Barrier Reef. The otolith symposium scientific committee recommended that the Fourth International Symposium on Fish Otolith Research and Application be held on the west coast of the United States in 2009, probably in Monterey, California.

By Donald Mortensen

GROUNDFISH ASSESSMENT PROGRAM

Deep-Sea Coral Distribution and Habitat in the Aleutian Islands

Two studies were completed in the Aleutian Islands in summer 2004 on the distribution and habitat of deep-sea corals and the biological communities associated with these corals. The first study used the piloted submersible *Delta* in June and July. The second study in late July used the RV *Roger Revelle* as a support vessel for the remotely operated vehicle (ROV) *Jason II*.

The *Delta* was used to complete the second and final phase of a project to assess Aleutian Islands coral habitat in waters less than 365 m deep (the maximum depth at which the submersible can operate). The North Pacific Research Board and the AFSC funded this component of the study. Participating ABL scientists were Robert Stone (chief scientist) and Eloise Brown. Scientists visited 10 sites and collected video of the seafloor on 23 strip transects. Previously undocumented beds of sponges, predominantly demosponges, were documented on an additional six dives. More than 150 coral specimens were collected for molecular and morphological taxonomic identification and for studies on reproduction. More than 100 sponge specimens were also collected, and 5 of the first 10 specimens analyzed microscopically were confirmed as species new to science.

On 24 July, the *Roger Revelle* departed Dutch Harbor, Alaska, with a team of biologists, fisheries scientists, and geologists to study deep-sea coral habitat in the central Aleutian Islands. The team, including Robert Stone (chief scientist) and also ABL scientist Jon Heifetz used the ROV *Jason II* (Woods Hole Oceanographic Institute) to document coral and sponge habitat. The team also collected deep-water specimens—many new to science—for ecological and taxonomic studies. This cruise was the final component of a comprehensive study initiated in 2003 and funded by NOAA Fisheries and the North Pacific Research Board through NOAA's Undersea Research Program. The team hopes to use their findings to construct a model to predict where coral habitat is located throughout the Aleutian Islands region. The model will provide fisheries managers with a powerful tool to conserve the region's coral habitat.

Dives were made with the *Jason II* at 10 sites in the Central Aleutian Islands, at depths ranging from 131 m to 2,948 m. Video footage of the seafloor was collected along strip transects ranging from 13.2 to 2.4 km in length. Corals and sponges were widely distributed at the study sites, with an apparent change in density, diversity, and species composition at a depth of approximately 1,400 m. Samples were collected at stations along transects and included 260 corals, 45 sponges, 165 miscellaneous invertebrates, and 82 rocks. Preliminary results indicate that representatives from all seven coral families known to occur in the North Pacific were collected and that several of the collected sponges represent new species.

By Robert Stone

2004 Sablefish Longline Survey

The AFSC has conducted an annual longline survey of sablefish and other groundfish in Alaska from 1987 to 2004. The survey is a joint effort between the Center's ABL and Resource Assessment and Conservation Engineering (RACE) Division. The survey replicates as closely as practical the Japan-U.S. cooperative longline survey conducted from

1978 to 1994 and also samples gullies not sampled during the cooperative longline survey. In 2004, the twenty-sixth annual longline survey of the upper continental slope of the Gulf of Alaska and eastern Aleutian Islands was conducted. One hundred forty-eight longline hauls (sets) were completed between 5 June and 1 September by the chartered fishing vessel *Alaskan Leader*. Sixteen kilometers of groundline were set each day, containing 7,200 hooks baited with squid.

Sablefish (*Anoplopoma fimbria*) was the most frequently caught species, followed by giant grenadier (*Albatrossia pectoralis*), Pacific cod (*Gadus macrocephalus*), and shortspine thornyhead (*Sebastolobus alascanus*). A total of 90,226 sablefish were caught during the survey. Sablefish, shortspine thornyhead, and Greenland turbot (*Reinhardtius hippoglossoides*) were tagged and released during the survey. Length-weight data and otoliths were collected from approximately 2,600 sablefish. Killer whales (*Orcinus orca*) took fish from the longline at several stations in the western Gulf of Alaska near Dutch Harbor; this also commonly occurred during past surveys. Sperm whales (*Physeter macrocephalus*) were present during haul-back at more than 20 stations and many were observed taking fish from the line. This is a substantial increase over previous surveys. A sperm whale depredation analysis is currently being done to determine the effects these whales may have on the catch. Results should be available in the 2005 sablefish assessment. The majority of sperm whale interactions occurred in the west Yakutat and central Gulf of Alaska areas.

Several special projects were conducted during the 2004 longline survey. Coral caught on the line was collected for identification and sample preservation. A seabird occurrence study was conducted for the third year to document where and when certain seabird species occur in Alaska waters. In addition, the Alaska Department of Environmental Conservation (ADEC) is conducting a monitoring project for environmental contaminants in Alaskan fish. Approximately 50 specimens of sablefish caught on the longline survey were collected throughout the Gulf of Alaska and Bering Sea and sent to ADEC for contaminants analysis.

By Chris Lunsford

Joint Research on Spiny Dogfish in Yakutat Bay, Alaska

Little is known about the life history or ecological role of spiny dogfish (*Squalus acanthias*) in the North Pacific Ocean. In this study, scientists from ABL and the University of Alaska Fairbanks School of Fisheries and Ocean Sciences, Juneau Center, conducted joint research on spiny dogfish in Yakutat Bay, Alaska.

Spiny dogfish were captured for tagging and biological sampling from a 30-ft sport-fishing boat chartered from 27 to 29 July 2004. A total of 59 spiny dogfish were tagged and released. Electronic archival tags were surgically implanted in 37 spiny dogfish. A fluorescent pink disc tag with the words "reward for tag inside fish" was attached to the first dorsal fin of each electronically tagged spiny dogfish. The ABL offers a $200 reward for the return of electronic archival tags from spiny dogfish. An additional 22 spiny dogfish were tagged only with externally attached, modified disc tags. The modified disc tags were uniquely numbered on one side with the ABL address printed on the other side.

A total of 118 spiny dogfish were taken for biological sampling of age, maturity, and diet, including 96 females (80–110 cm total length) and 22 males (80–90 cm total length). Age will be determined from dorsal spines. Maturity and diet were examined on the boat. Most (80%) of the spiny dogfish examined were immature. One female was pregnant with eight very young embryos. Most stomachs were empty, but the few items found suggest that spiny dogfish in the Yakutat region are opportunistic predators with a high incidence of invertebrates in their diet. Items found in stomachs in order of incidence of occurrence included several species of jellyfish, razor clams, shrimp/krill, and unidentified forage fish species.

By Dean Courtney

Pacific Herring/Steller Sea Lion Study Initiated in Southeast Alaska

In September 2004, a study assessing overwintering Pacific herring stocks in Lynn Canal, Southeast Alaska was initiated. The purpose of the study is to quantify herring as a prey resource for Steller sea lions inhabiting a haulout on Benjamin Island. Benjamin Island is a seasonal haulout attended by more than 800 sea lions during the winter months. Scat analyses have shown herring to be

the most frequently occurring prey item for sea lions at this site. Specific objectives of the study are to estimate the spatial predictability of herring schools on monthly, weekly, and daily time scales. Secondly, the seasonal biochemical composition of herring will be analyzed to quantify the schools as a nutritional source for sea lions. In addition, the cardiac fatty acids of the fish will be examined for the development of a tool to discriminate herring stocks.

On 27 and 28 September, the first research cruise of the study was conducted by ABL scientists J. J. Vollenweider and Dave Csepp on a chartered gillnet vessel. A portion of Lynn Canal was surveyed with hydroacoustics along a zigzag transect line, traversing deep trenches in which herring are known to reside (Fig. 3). Herring schools were observed along the transect line. Some of these were pelagic, while others appeared to be commencing their benthic schooling behavior characteristic of winter. One particularly large school spanning approximately 150 km was found from a depth of 23 m down to the bottom at 55 m. Single humpback whales were the only marine mammals observed feeding on the schools. Herring samples were collected at three locations using vertical sampling gillnets and jigs. Additional cruises are planned each month through April 2005.

By J. J. Vollenweider

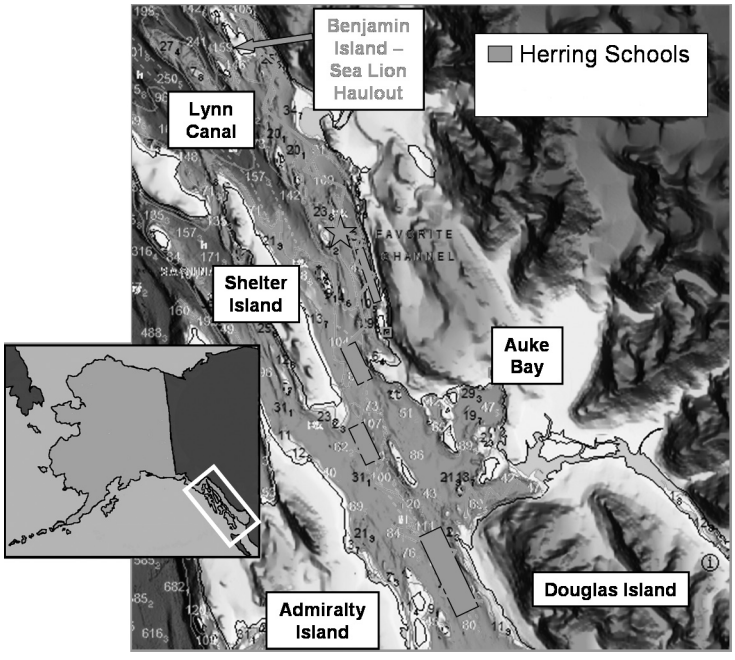

Figure 3. Map of Southeast Alaska showing locations of herring schools.

NATIONAL MARINE MAMMAL LABORATORY (NMML)

ALASKA ECOSYSTEM RESEARCH PROGRAM

Northern Fur Seal Research

Much of the northern fur seal research conducted by the Alaska Ecosystem Program continues the National Marine Mammal Laboratory's (NMML) long-term population monitoring study on the Pribilof Islands. The annual count of both territorial adult males with females and idle adult males was made in July 2004. The number of territorial males was estimated to be 3,286 on St. Paul Island and 760 on St. George Island. The number of idle males was estimated to be 5,027 on St. Paul Island and 905 on St. George Island. The percentage of idle males declined on both islands from last year (idle = 33.6% on St. Paul Island and 21.8% on St. George Island), and territorial males declined by 10% on St. Paul and increased by 6.1% on St. George. Pup numbers are estimated biannually and were counted in August 2004. We estimated 122,803 pups (SE = 1,290) were born on St. Paul Island and 16,876 pups (SE = 239) were born on St. George Island. Pup production continued to decline on both islands from previous years. The 2004 estimate for St. Paul Island is 15.7% less than the estimate in 2002 and 22.7% less than the estimate in 2000. The 2004 pup production estimate for St. George Island is 4.1% less than the estimate in 2002 and 16.4% less than the estimate in 2000.

To continue the work published in Robson et al. (2004), which demonstrated habitat partitioning by island and rookery complex, we instrumented 39 parturient female northern fur seals with satellite tags in August 2004. Nineteen adult female northern fur seals were captured on St. Paul Island, and 20 were captured on St. George Island. All fur seals were outfitted with satellite tags to collect location data to track the animals' movements, with 28 animals having additional instruments to collect data on diving patterns (12 on St. Paul Island and 16 on St. George Island). The satellite tags were left on the animals for multiple foraging trips in order to examine habitat site fidelity among individu-

als. In late September and early October, 33 of the instrumented animals were recaptured to recover the tags.

By Tonya Zeppelin

CALIFORNIA CURRENT ECOSYSTEMS PROGRAM

San Miguel Island Research

Resighting effort to determine survival and reproductive rates of branded California sea lions and flipper-tagged adult northern fur seals began in May and continued through August. Live-pup counts were conducted during July and August to assess the total pup production for both species. Dead pups were counted for each species starting in July and will continue through October to document the level and causes of pup mortality. Hookworms appear to be a major factor in mortality of both sea lion and fur seal pups.

During July, an effort was made to recapture the four 3-year old California sea lions that were outfitted with satellite telemetry instruments and from which blubber tissue biopsies were obtained during April. These animals were sampled and instrumented as part of two studies: 1) to describe the spatial patterns and distribution of juvenile sea lions using San Miguel Island; and 2) to assess the bioaccumulation rates of environmental pollutants by California sea lions. Preliminary exploration of the satellite telemetry data indicate that the animals frequented San Miguel Island and made daily or multiple-day trips to forage in the southern California Bight and north of San Miguel. To date, these individuals have not been recaptured.

In September the old field station on San Miguel Island was demolished and removed from the island. Work on the new station is essentially complete.

Harbor Seal Research

Observations of tagged and branded harbor seals at Gertrude Island, south Puget Sound, Washington, began in early July and will continue until the end of October. The peak number of seals was 526 in mid-August. About 110 pups were observed. These counts are similar to previous years. Resights of tagged and branded seals are used to determine survival, natality, and age of first reproduction. During the month of September, 64 harbor seals were caught and tagged; 52 of those were branded, increasing the number of seals branded since 1993 to 573.

Steller Sea Lion Research

Since July 2001, Steller sea lion pups have been tagged and branded at rookeries in southern Oregon and northern California to determine survival, movements, and distribution of yearlings and juveniles. Another cohort of 180 pups was branded at St. George Reef, California, in July 2004. Bimonthly vessel and land-based surveys to resight branded sea lions were conducted in northern California, Oregon and Washington. In addition, a series of remote cameras was installed at Rogue Reef, Oregon, for the third year to assist in brand resights and a resight network established with biologists from Pacific Rim National Parks, British Columbia, Canada. Preliminary evidence collected since 2001 indicates a general northward movement/dispersal of pups and juvenile Stellers into Washington and British Columbia beginning in September.

Sea Lion Symposium

Five members of the California Current Ecosystems Program presented oral (3) or poster (2) presentations at the Sea Lions of the World Symposium held during 30 September through 3 October in Anchorage, Alaska. The symposium was held to bring the international community of sea lion researchers together to address issues concerning the five species of sea lions.

By Harriet Huber

CETACEAN ASSESSMENT AND ECOLOGY PROGRAM

SPLASH Surveys

In the 2004 field season, NMML participated in the SPLASH (Structure of Populations, Levels of Abundance, and Status of Humpbacks) project by surveying summer feeding areas of humpback whales (*Megaptera novaeangliae*) in the waters of Alaska, including the inland waters of lower Southeast Alaska, the waters around the Aleutian Islands, and the southeast Bering Sea. SPLASH is an international cooperative effort to understand the population structure of humpback whales across the North Pacific and to assess the status, trends, and potential human impacts to this population. SPLASH brings together national research pro-

grams and independent whale researchers from the United States, Canada, Mexico, Russia, and Japan. This project is partially funded by NOAA Fisheries, with additional funding provided by other government organizations in the United States, Canada, and Mexico and private research foundations.

Humpback whale populations were depleted due to commercial exploitation and are still listed as endangered today. The most complete recent estimate of North Pacific humpback whale abundance is based on mark-recaptures of individual whales photo-identified between 1990 and 1993. Data from photo-identification and genetics studies have provided some information on North Pacific stock structure, verifying a high degree of site fidelity to feeding areas and some intermixing in the wintering areas. SPLASH will conduct the first-ever comprehensive field study of humpback whales throughout the North Pacific. Photographs of tail flukes and dorsal fins will be used to identify individual whales. By determining where and when individuals are seen, the abundance of breeding populations and feeding aggregations can be estimated using mark-recapture methods, and distribution and movements can be determined. A wealth of information can be obtained from biopsy samples, including sex, genetic structure and flow, pregnancy, toxicology, and feeding information. Portions of each biopsy sample will be archived for future use. Finally, photographs of tail stocks will be used to assess human impacts, including evidence of past entanglement or ship strike.

NMML worked in conjunction with local Alaska-based researchers and the SPLASH steering committee to determine which areas to survey. Four cetacean surveys were conducted by NMML throughout the 2004 field season: 1) in the southeast Bering Sea aboard the NOAA ship *Miller Freeman*, during an acoustic-trawl survey for walleye pollock conducted by the AFSC's Resource Assessment and Conservation Engineering (RACE) Division, from 5 June to 3 July; 2) in Southeast Alaska aboard the NOAA ship *John N. Cobb* from 1 to 12 July; 3) in the waters around the eastern and central Aleutian Islands and in the southeast Bering Sea aboard the charter vessel *Alaskan Enterprise* from 21 July to 27 August; and 4) in Southeast Alaska aboard the *John N. Cobb* from 11 to 24 September.

Although the cetacean research on the *Miller Freeman* was secondary to the activities of the walleye pollock survey in the southeast Bering Sea, samples collected from five encounters with humpback whales resulted in photographs of approximately 30 whales and biopsies of 6 whales. Additional information on this cruise is available in the April-June 2004 AFSC Quarterly Report.

During the July survey in Southeast Alaska on the *John N. Cobb*, 67.15 hours of search effort were conducted and 26.17 hours were spent with humpbacks during 26 encounters over 9 days. Photographs of tail flukes were collected for 58 individual whales and photographs of dorsal fins were collected for 10 whales for which tail fluke photographs were not obtained. In addition, photographs of dorsal fins were collected from 19 whales whose tail flukes may also have been photographed; however, these matches need to be verified by other Southeast Alaska humpback whale researchers. Four whales were positively identified during two different encounters, including a whale whose calf was tentatively identified (by matching photos of the right and left sides of the dorsal fin) in two encounters. Finally, during 18 biopsy attempts, seven biopsy samples were collected over the course of three encounters.

Photographic data are still being analyzed from the *Alaskan Enterprise* survey of the Aleutian Islands and Bering Sea and the September *John N. Cobb* survey in Southeast Alaska; however, preliminary results are available. The *Alaskan Enterprise* survey collected photographs of 118 individual humpback whales and biopsies from 45 whales. The September *John N. Cobb* survey collected 57 photographs of tail flukes and 5 photographs of dorsal fins during nine encounters with humpback whales.

By Nancy Friday and Christy Sims

North Pacific Right Whale Satellite Tagging Project

In August 2004, the Cetacean Assessment and Ecology Program (CAEP) at the National Marine Mammal Laboratory initiated a North Pacific right whale (*Eubalaena japonica*) tagging project. This is a collaborative study with the whale-tagging group at the Greenland Institute for Natural Resources in Copenhagen, Denmark. Three main questions are being addressed by this study:

1) Where do North Pacific right whales go in winter?
2) What migratory route do they take to get to their wintering grounds?
3) Do right whales found in the "right whale box" in the southeast Bering Sea in summer also use other feeding areas in Alaska?

The project should also provide information about specific habitat use in the Bering Sea, with the potential for investigating the oceanographic conditions of those areas.

The right whale satellite-tagging project was just one element of a 40-day multispecies cetacean survey called the Alaska Cetacean Ecosystem (ACE) survey. The ACE survey included four separate legs: 1) a survey focused on killer whales (*Orcinus orca*) and humpback whales in the eastern Aleutian Islands; 2) a survey focused on killer whales in the central Aleutian Islands; 3) a multispecies cetacean survey from Dutch Harbor along the Bering Sea shelf break to the Pribilof Islands; and 4) a right whale survey in the southeast Bering Sea. The killer whale studies are part of ongoing killer whale research conducted by CAEP in western Alaska. The humpback whale studies are one component of the international North Pacific-wide SPLASH humpback whale project.

The goal of the right whale survey was to find North Pacific right whales, deploy satellite tags on them, and collect photo-identification data and biopsy samples. The charter vessel *Alaskan Enterprise* was used to conduct a survey from 6 to 17 August 2004 in the southeast Bering Sea. Nine scientists participated in the survey, including a sighting team of six scientists, two acoustic technicians, and a technician to deploy the satellite tags. The sighting survey team used 25-power and 7-power binoculars to visually scan for whales from one half-hour after sunrise to approximately one half-hour before sunset. The acoustic researchers deployed directional sonobuoys (underwater listening devices) to listen for right whale calls. When calls were heard, the researchers could calculate a bearing (direction) towards the calls to lead the ship to the location of the whales.

At the beginning of the right whale survey, the *Alaskan Enterprise* was used to conduct killer whale studies along the north side of Unimak Island. Three groups of mammal-eating killer whales ("transients") were photographed near a Steller sea lion colony on Sea Lion Rocks near Amak Island. Then the ship headed north for the "right whale box" (where nearly all previous sightings have occurred in the last decade). On 10 August, the acoustic researchers deployed a sonobuoy at 1200h and heard distant right whale calls. They calculated a bearing towards the calls and the ship headed in that direction. At around 1900h, about 57 nmi from where the calls were first heard, two right whales were seen near the horizon. The ship approached the whales for some initial photographs and then launched a 22-ft rigid-hulled inflatable skiff to deploy satellite tags on the whales. The satellite-tagging technician placed a tag on the first whale around 2030h, and a tag was placed on the second whale around 2130h. Both whales were fairly large; the larger of the two was likely an adult and the second, slightly smaller whale was likely a small adult or subadult. No additional right whales were found during the survey; high winds that began on 12 August prevented further survey effort in the "right whale box."

One of the tagged whales was successfully tracked from 10 August through 19 September. This whale spent over 3 weeks in an area, approximately half-way between Unimak Island and the Pribilof Islands, that was south of the "right whale box." In September, location information for this whale was given to scientists aboard the NOAA ship *McArthur II*, who were conducting a SPLASH-project humpback whale survey in the Gulf of Alaska and Bering Sea. These scientists located right whales and were able to photograph 25 individual whales and biopsy sample 20 whales, more than doubling the known number of individuals in the North Pacific. In terms of samples, this was by far the most successful summer of right whale research conducted to date in the Bering Sea.

By Paul Wade

Cetacean Surveys in Southeast Alaska

NMML has conducted long-term studies on cetaceans in Southeast Alaska since 1989. The primary purpose of these studies is to collect information on the distribution, abundance and trends, and stock structure of cetaceans.

In 2004, two cruises were conducted aboard the *John N. Cobb*. From 1 to 12 July, the main focus was to collect photographs and biopsy samples from humpback whales. This study was part of the larger SPLASH North Pacific humpback whale research effort (see the SPLASH Surveys report in the beginning of this program section). The waters throughout Sumner Strait, Clarence Strait, and the west coast of Prince of Wales Island were surveyed. During the July survey, 67 hours of SPLASH search effort were conducted, and 26 hours were spent with humpback whales during 26 encounters over a 9-day period. Based on this research effort, 68 individual whales were uniquely identified and 7 whales were biopsy sampled.

During the 11-24 September cruise, the main emphasis was to collect photographs of killer whales. However, images of humpback whales were collected on an opportunistic basis. Inland waterways throughout Southeast Alaska from Juneau to Ketchikan were surveyed, including Icy Strait, Chatham Strait, Sumner Strait, Clarence Strait, Frederick Sound, and Stephens Passage. During nine encounters with humpback whales, photographs of 57 unique individual whales were collected. In September, humpback whales were found in large concentrations throughout Frederick Sound unlike the July survey in southern waters, when small groups of humpback whales were scattered throughout the survey area. Images of each individual whale photographed during the 2004 season will be compared to photographic catalogues of North Pacific humpback whales to determine if matches occur.

During the 2004 season, there were 12 encounters with killer whales, including whales from all three ecotypes (resident, transient, and offshore). Images collected over the last 3 years are being used to update NMML's photographic catalogue of Southeast Alaskan killer whales. Work is under way to create a digital catalogue that will be readily available to both researchers and to the various communities throughout Southeast Alaska.

By Marilyn E. Dahlheim

POLAR ECOSYSTEMS PROGRAM

Harbor Seal Surveys in the Aleutian Islands

Staff from the Polar Ecosystem Program (PEP) successfully completed aerial surveys of harbor seals in the Aleutian Islands, from Unimak Pass out to the Near Islands. Surveys of the Aleutian Islands region present unique challenges due to the length of the island chain (nearly 1,400 miles) and large-scale convergence of atmospheric and oceanographic fronts which commonly produce dense fog and inclement conditions (i.e., low visibility and turbulence). These surveys, conducted over a different segment of the Alaskan harbor seal range each year, provide an estimate of the minimum abundance of animals hauled out during low tide when peak numbers of seals typically haul out. These estimates will be adjusted upward to account for seals that remain at sea (and not counted) according to the haul-out behavior measured at representative sites. The final estimates are used to update stock assessments required under the Marine Mammal Protection Act.

During 5-15 August 2004, observers in four twin-engine planes, two based in Dutch Harbor (NOAA's Twin Otter and a Grumman Goose seaplane) and two on Adak Island (two turbine Aero Commanders), conducted surveys daily for a maximum of 4 hours centered on low tide. Observers took digital images of the larger seal haul-out sites that were too difficult to estimate visually. By using digital cameras linked to a GPS, very precise locations of the haul-out sites were recorded and archived with the images. This allows for more accurate counting by eliminating errors that may occur when tallying counts within a specific area. This year, the weather was especially problematic, causing several ground days, long transits with no breaks in the clouds or fog, and the use of alternate airports. Despite the weather, virtually all previously mapped haul-out sites were visited at least once and many up to three times. Reconnaissance of new haul-out sites was also completed for all but a few segments of coastline.

Due to the anticipated poor weather and remoteness of the survey area, a new technology was tested in order to provide an extra margin of safety. Automatic Flight Following (AFF) was used on two aircraft that were assigned routes requiring long transits over open water. This allowed survey coordinators in Anchorage and Seattle to follow aircraft in real time, thereby reducing the response and search times should a plane have encountered problems. The AFF hardware that was installed relayed position, altitude, speed and direction information every 2-3 minutes to a secure web-based tracking program. The two aircraft without AFF hardware used satellite phones to report status and position at regular intervals.

By Dave Withrow and John Jansen

Habitat Use and Diving Behavior of Harbor Seals in Cook Inlet, Alaska

The Polar Ecosystems Program (PEP) initiated a third project in a study of harbor seals in Cook Inlet, Alaska, under an Interagency Agreement with the Department of Interior, Minerals Management Service (AFSC Quarterly Reports April–June 2003, October–December 2003, January–March 2004, April–June 2004). The new project uses satellite-linked dive recorders (SDRs) that provide information on diving behavior and locations of the

Figure 1. Harbor seal with satellite-linked dive recorder about to be released in Cook Inlet, Alaska.

seals at sea and ashore. Between 26 August and 4 September, PEP researchers worked from a charter vessel using nets and small boats to capture 34 harbor seals at five locations in Cook Inlet and Kachemak Bay. SDRs were attached to the pelage of 19 of the seals that had completed their annual molt (Fig. 1).

Data from these SDRs will be used to: 1) investigate marine habitat use and diving behavior by seals, and 2) correct abundance estimates for the proportion of seals that are at-sea and not counted during aerial surveys. This proportion, and its relationship to date, time of day, tides, and weather, is a fundamental element of estimating the abundance of harbor seals. However, the proportion missed has been extremely difficult to estimate in surveys of harbor seals in Alaska and elsewhere, conducted during the seal's molting (peak haul-out period). During the molt, instruments that record haul-out behavior will not remain attached to the seals' pelage. One of the key features of the Cook Inlet studies that will allow a new method of estimation is that aerial surveys and estimates of the haul-out proportion will be available from multiple dates throughout the annual cycle. This will allow comparison of estimates from different times of the year to test whether historical estimates from the molt period are accurate. A total of 70 SDRs will be deployed in May and September of 2005-2006.

By Peter Boveng

RESOURCE ASSESSMENT & CONSERVATION ENGINEERING (RACE) DIVISION

GROUNDFISH ASSESSMENT

Annual Bering Sea Crab and Groundfish Assessment Survey

The Bering Sea Groundfish Assessment Program conducted the annual Bering Sea shelf crab-groundfish bottom trawl survey from 1 June to 4 August 2004. This years' survey was performed once again aboard the chartered fishing vessels *Arcturus* and *Aldebaran*, which marks the twelfthth consecutive survey using these vessels.

A total of 395 stations were sampled by the two vessels (Fig. 1). Nineteen special stations from inner Bristol Bay were included to continue our evaluation of yellowfin sole spawning populations during the survey period. Eight extra tows were made around two standard stations that met "Red King Crab Hot Spot" criteria (>150 legal males in haul). When the catch from a standard station meets this criteria, protocol requires four additional tows be made at 5 nautical miles (nmi) distance to the north, west, south, and east of the original station hot spot immediately following the tow.

Abundance estimates for the major groundfish are shown in Table 1. The abundance estimate of walleye pollock decreased from 8,140,573 metric tons (t) in 2003 to 3,751,514 t in 2004. A possible explanation for this decrease may be the effect of one large survey haul of almost pure pollock on the 2003 EBS survey estimates. All other species ex-

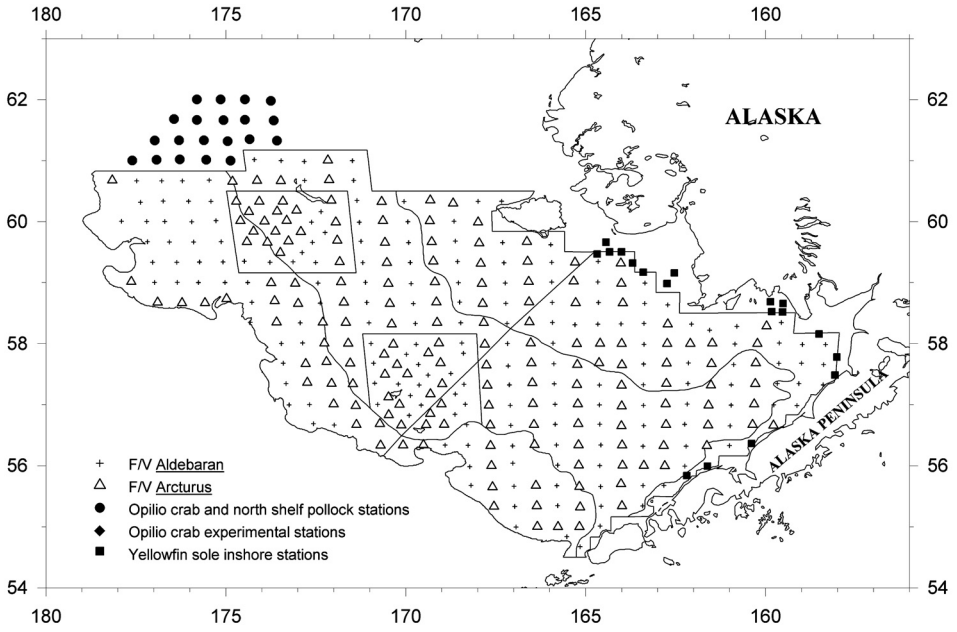

Figure 1. Eastern Bering Sea shelf survey area and sampling stations.

cept Greenland turbot showed a slight increase in abundance.

It should be noted that these abundance estimates are the bottom trawl survey biomass estimates and NOT the estimates of stock condition resulting from stock assessment modeling. Those estimates will be available in December 2004 when presented to the North Pacific Fishery Management Council. For comparative purposes Table 1 shows the trend in survey biomass estimates made over the last 5 years.

In general, temperatures were warmer than the long-term mean from 1982. Mean bottom temperature was 3.39°C, compared to the long-term value of 2.54°C. This was the fifth consecutive year of increasing bottom temperatures reflecting the reduced or missing winter ice cover of recent years. Surface values were also higher at a mean of 8.29°C and a long-term mean of 6.66°C.

After the standard survey was completed on 25 July, the *Arcturus* continued on to Pavlov Bay to conduct the annual shrimp survey. The *Aldebaran* was used for 7 days by scientists from the Midwater Assessment and Conservation Engineering (MACE) and the Groundfish Assessment programs in a collaborative experiment designed to evaluate the behavior of walleye pollock in response to cues from the oncoming survey trawl vessel. A free-drifting buoy equipped with a calibrated 38-kHz scientific echosounder was used to observe pollock abundance and vertical distribution as the *Aldebaran* towed past the buoy. Data from the acoustic buoy will be used to determine whether walleye pollock exhibit a behavioral response to the approaching vessel and trawl.

In addition to the standard groundfish survey, the Groundfish Assessment's Bering Sea team and the Shellfish Assessment Program participated in a bottom trawl survey of high density locations of snow crab (*Chionoecetes opilio*) in cooperation with the Bering Sea Fisheries Research Foundation (BSFRF) from 6 July to 26 July aboard the chartered fishing vessel *Sea Wolf*. The main objectives of the study were to 1) look at abundance of mature snow crab outside the standard survey area; 2) examine how survey variance estimates are impacted by selection of random survey stations; and 3) look at a modification to the survey trawl to increase the catchability of crab.

By Erika Acuna

2004 Aleutian Islands Biennial Groundfish Assessment Survey

The third in the series of biennial bottom trawl surveys of Aleutian Islands (AI) groundfish resources was conducted from 1 June through 9 August 2004. The full series of periodic AI surveys dates back to 1980. Prior to establishing a biennial schedule in 2000, these surveys had been done on a triennial schedule by the RACE Division. Surveys conducted prior to 1991 were cooperative efforts involving U.S. and Japanese vessels and scientists.

Table 1. Bering Sea trawl survey biomass estimates in metric tons.

Species	2000	2001	2002	2003	2004
Walleye pollock	5,134,600	4,139,837	4,842,151	8,140,573	3,751,514
Pacific cod	528,500	833,272	620,502	595,826	596,988
Yellowfin sole	1,581,900	1,863,656	2,016,713	2,239,643	2,530,599
Rock sole	2,127,700	2,424,813	1,921,470	2,099,331	2,182,086
Flathead sole	399,300	515,275	579,649	518,189	616,668
Alaska plaice	443,600	540,458	428,555	457,910	488,217
Arrowtooth flounder	340,400	409,191	356,403	542,894	547,398
Greenland turbot	23,000	25,347	21,545	23,685	20,909

Since 1991 they have been planned and conducted entirely by the RACE Division. The primary objective of the surveys is to provide a standardized time series of data to assess, describe, and monitor the distribution, abundance, and biological condition of AI groundfish and invertebrate stocks. Secondary objectives are to collect environmental data (e.g., surface-to-bottom water temperature profiles, etc.) and to make special collections of biological specimens and data requested by scientists from the AFSC or other cooperating research groups.

The 2004 AI biennial survey area stretched over 900 nmi from the Islands of Four Mountains (long. 170°W) to Stalemate Bank (long. 170°E), including stations on Petrel Bank. In addition, the region between long. 165° and 170°W along the north side of the archipelago is included as the Southern Bering Sea subarea. Stations range in depth from nearshore to 500 m. Sampling was conducted aboard two chartered commercial trawlers, the *Sea Storm*, and the *Gladiator*. The 70-day survey period was divided into three legs of 23-24 days each. Sampling began near the Akutan Pass and progressed westward to Stalemate Bank. Stations were allocated among 45 depth and geographic strata and were preselected randomly from a grid of potential sites overlaying the survey area. If untrawlable bottom, swift currents, or conflicts with commercial fishing prevented sampling a station, a nearby alternate station was selected. Of the 471 attempted standard survey tows, 420 were successfully completed, ranging in depth from 26 m to 488 m.

Over the total survey area, the most abundant species in 2004 were, in order, Atka mackerel, Pacific ocean perch, walleye pollock, giant grenadier, northern rockfish, Pacific cod, and arrowtooth flounder. Increases in survey-wide estimated biomass since 2002 were observed for all of these species: Atka mackerel by 39% to 1,154,000 t, Pacific ocean perch by 24% to 579,000 t, pollock by 3% to 366,000 t, giant grenadier by 14% to 248,000 t, northern rockfish by 9% to 192,000 t, cod by 38% to 114,000 t, and arrowtooth flounder by 7% to 95,000 t. Results have been supplied to stock assessment authors for updating assessment reports for the North Pacific Fishery Management Council.

By Mark Wilkins

Juvenile Pacific Ocean Perch Research in the Aleutian Islands

Two research cruises aboard the *Ocean Explorer* were completed by Groundfish Assessment Program scientists during summer 2004 to map and study juvenile Pacific ocean perch (POP) habitat. The research was conducted around Samalga Pass and the Islands of Four Mountains, in the eastern half of the Aleutian Islands archipelago (Fig. 2).

The goal of this study was to assess the value of AI habitat to juvenile Pacific Ocean perch (POP). The specific objectives of this research were to 1) map five study areas using multibeam and sidescan sonar and groundtruth these acoustic observations; 2) model relationships between juvenile rockfish abundance and habitat characteristics, such as depth, slope, temperature, sponge and coral abundance; and 3) link the habitat to the condition of juvenile rockfishes by determining if energetic content of juvenile rockfish is similar in different habitats.

During the initial cruise, beginning and ending in Dutch Harbor, Alaska, (28 May to 9 June 2004) habitat mapping was completed. Current speeds were high around the islands and passes (exceeding 6 knots), which slowed the mapping progress. Each of the five study areas surrounding the Islands of Four Mountains was mapped using towed side-scan sonar (Klein 3000) and multi-beam sonar (Simrad SM2000) systems. These instruments collected bathymetry and reflectivity data using sound charac-

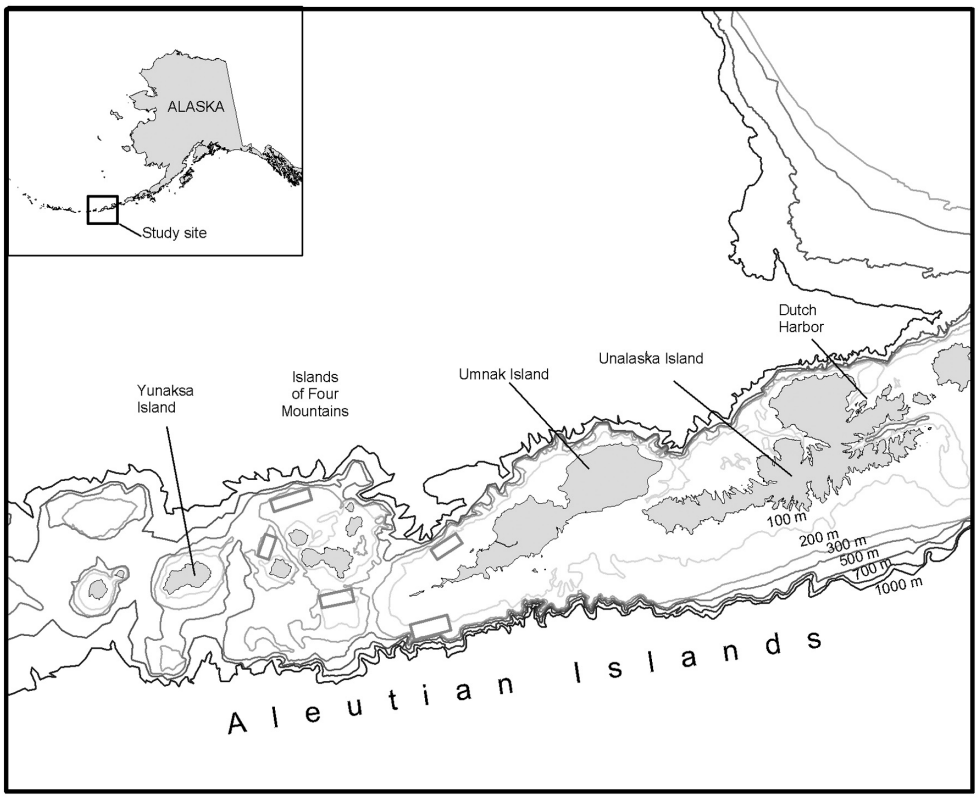

Figure 2. Juvenile Pacific ocean perch survey area. Study sites are outlined.

teristics reflected from the seafloor. This acoustic data was geo-referenced using an ultra-short baseline (USBL) tracking system to pinpoint the exact position of the bottom information. Acoustic data collection and tracking were performed by technicians from the U. S. Naval Undersea Warfare Center (NUWC), Keyport Washington. Much of the data processing was completed aboard the *Ocean Explorer* and mosaics were produced that depicted bottom depth and roughness (i.e., Fig. 3). In total, 25 km^2 were mapped using side-scan sonar, and multi-beam data was collected over almost twice that area.

Fish and zooplankton were collected at nine transects in the five study areas using a bottom trawl. Atka mackerel and Pacific cod dominated the catch. Other species collected in large numbers were adult Pacific ocean perch, northern rockfish, Pacific halibut, and walleye pollock. Juvenile POP were collected from two of the five study areas, but were not found at the other sites. Sponge and coral were found at 85% of transects where trawls were made.

The second cruise (12-23 August 2004) benefited from excellent weather for 6 days that allowed researchers to make substantial progress in meeting project objectives. Researchers concentrated on completing underwater video collections and sediment sampling to verify acoustic habitat maps produced during the first cruise. The underwater video system was towed behind the research vessel from 1-2 m off the seafloor, and technicians from the NUWC used a USBL system to geo-reference the video camera position (Fig. 4). Video was collected at 12 transects in three of the study areas that bisected interesting areas from the multibeam and sidescan sonar mosaics. Scientists viewed the video feed aboard the research vessel in real time which allowed areas with juvenile POP present to be located using the camera system. Preliminary results indicate habitats sampled at each area varied widely, from bare sand fields to rocky ledges, ridges and pinnacles. Sponge and coral were the dominant epibenthic invertebrates observed in the video and trawl collections, although diversity in benthic organisms was quite high at some sites.

Sediment samples were collected from the seafloor using a van Veen grab (20 samples total). The samples were composed of coarse volcanic sands and rocks, some of which were quite large. These samples will be used to interpret reflectivity collected using the sidescan sonar system by determining the grain-size of each sediment sample.

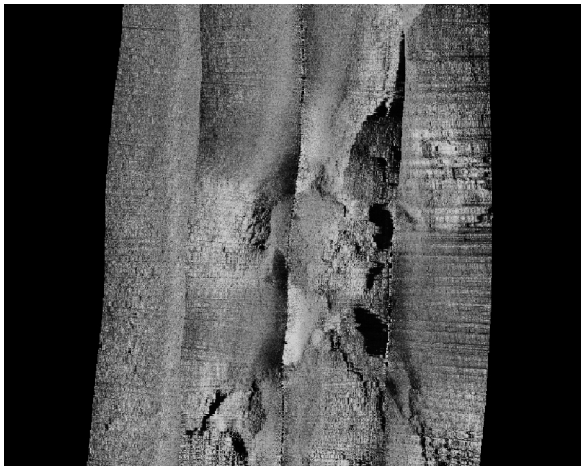

Figure 3. Sidescan sonar mosaic from the Islands of Four Mountains west study location showing interesting geographic features on the seafloor.

Figure 4. Researchers and vessel crew prepare to launch a towed underwater camera system aboard the *Ocean Explorer*.

Biological sampling was also carried out during the August cruise. Both bottom trawls and ring nets were used to sample the biota of three of the study areas. Zooplankton samples were collected using a 1-m ring net and were preserved for laboratory analysis. Juvenile POP were collected from five transects in three areas. These samples were taken at locations where juvenile POP were observed in the video, and the samples were frozen for laboratory analyses. Sponge and coral were observed at all sites where juvenile POP were present in August.

During the fall and winter of 2004-05, video, sediment samples, zooplankton, and fish collections will be analyzed in the laboratory. In the coming months we will determine the energetic content (indicating the relative condition) of juvenile POP collected from the different sites. Using biological (plankton abundance) and physical (temperature) data combined, we will predict the potential for growth of juvenile POP at each study site. This three-tiered approach (abundance, condition, and growth potential) will provide a method to determine the relative value of habitats to their inhabitants, as well as providing insight into the processes controlling fish-habitat relationships.

By Chris Rooper

Bogoslof Island Mapping and Colonization

We are studying the colonization process of benthic invertebrates at hard-bottom sites about 10-200 years old on Bogoslof Volcano as a proxy for measuring recovery rates of benthic invertebrates from benthic fishing activities. Bogoslof is a natural laboratory for our study because lava and tephra from historical eruptions (since 1796) have resurfaced different areas of the shallow seafloor around the island, providing new surfaces for benthic invertebrates to colonize. The results will provide information needed for fisheries management by defining an upper bound on the time needed for recovery. Currently there are no reliable estimates of Habitat Areas of Particular Concern (HAPC) recovery time from field work, and recovery rates on hard-bottom areas have been estimated as 1%-9% per year whereas gorgonian coral recovery rates were estimated as 0.5-2% per year (or 50-200 years) in the Habitat Recovery Model (EFH EIS).

The project involves three separate stages of research: mapping the seafloor, matching seafloor areas to specific eruptions (dates), and conducting an ROV census of benthic invertebrates within seafloor areas of known ages. The first phase of the project was completed in July 2004 when Fugro Pelagos (formerly Thales GeoSolutions, Inc.) successfully mapped the seafloor surrounding Bogoslof with a 100-kHz Reson SeaBat 8111 multibeam from approximately 20 to 750 m (Fig. 5). After the final multibeam maps are delivered we will develop a census plan for studying the invertebrates. In summer 2005 we plan to conduct remote operated vechile (ROV) transects within selected seafloor patches, and we anticipate that there may be three possible levels of resolution for the video census: 1) presence/absence of species or taxa groups, 2) density or percent horizontal coverage, and 3) age estimates of individuals.

By Mark Zimmermann (AFSC),
Jennifer Reynolds (University of Alaska Fairbanks),
and Chris Rooper (AFSC)

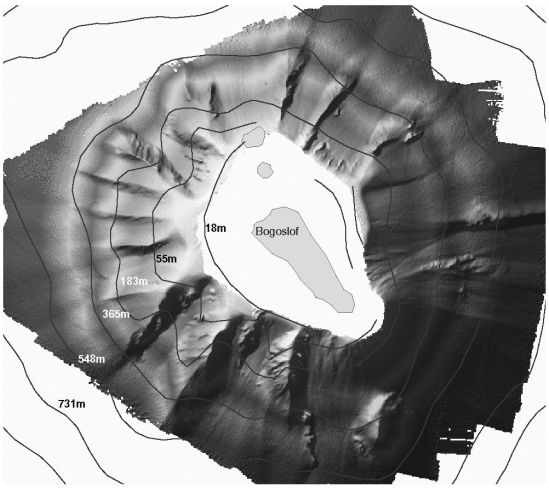

Figure 5. Preliminary bathymetric map of the seafloor surrounding Bogoslof Island, Alaska, from approximately 20 to 750 m. Light areas indicate the shallows and dark areas indicate the deeps.

Reproductive Ecology of Atka Mackerel in the Aleutian Archipelago

Atka mackerel support a commercial fishery in Alaska and play a key role in the marine ecosystem. More information regarding spatiotemporal distribution with respect to size, sex, and spawning condition, as well as habitat use for nesting sites, is needed to understand Atka mackerel distribution patterns during their reproductive phase. These patterns affect stock dynamics, recruitment, and distribution of Atka mackerel populations. Timing, geographic location, and hydrographic features at nesting sites can affect the dispersal of larvae and play a significant role in determining population structure. Variability in female reproductive output (i.e., maturity schedule) can also contribute to variability in recruitment; however, it is unknown if and how reproductive output varies over space and time. The specific objectives of this study are to 1) locate and characterize nesting habitat; 2) analyze the spatiotemporal distribution of Atka mackerel populations by reproductive stage, size, and sex; 3) describe the Atka mackerel embryonic developmental series over a range of temperatures; 4) investigate the temporality of spawning, nesting, and hatching within and between nesting sites; and 5) investigate the annual and spatial variation in reproductive output.

Exploratory underwater camera surveys have been used to locate Atka mackerel nesting sites in the U.S. Exclusive Economic Zone (EEZ). The existing camera and the winch system were improved and refurbished so that they were more reliable and could be used during summer 2004 on various vessels of opportunity in the Aleutian archipelago and western Gulf of Alaska. During July and August, research was coordinated with the AFSC RACE Division's 2004 Aleutian Island groundfish trawl survey. More camera drops were completed in September in conjunction with the U.S. Fish and Wildlife research vessel *Tiglax*. The geographical coverage of camera drops was from Stalemate Bank to Homer, Alaska. Numerous major nesting areas were located across the archipelago. The presence of nesting male aggregations will be analyzed in relation to bottom depth, water temperature, and the physical and biological habitat. The relationship of the nesting sites to other major geographic and bathymetric features of the Aleutian archipelago will also be investigated using GIS. Results from these studies will be combined with data from a histological analysis of gonad samples from Atka mackerel tag and tag recovery cruises.

The AFSC is also working with the Alaska Sea Life Center (ASLC) in Seward to do early life history research on Atka mackerel. Live Atka mackerel were captured and transferred to the ASLC where they are being monitored for spawning activity. During August and September, numerous clutches of eggs were spawned. Developing eggs are being kept in special temperature-controlled incubators. Egg clutches at several different temperatures are being sampled and preserved for producing egg developmental series. A video monitoring system was set up in the public viewing tank so that "time zero" for any spawning events and, thereby the starting time for an egg incubation developmental series, could be recorded.

By Bob Lauth

Reproductive Biology, Spawning Season, and Growth of Female Rex Sole in the Gulf of Alaska

Rex sole (*Glyptocephalus zachirus*) have a wide distribution throughout the North Pacific, ranging from central Baja California to the western Bering Sea. Although rex sole are an important species in the commercial trawl fisheries off the U.S. West Coast, knowledge of their reproductive biology is limited to one study off the Oregon coast that analyzed ovaries with gross anatomical methods. The largest commercial harvest of rex sole occurs in the Gulf of Alaska (GOA) where they are managed as a distinct flatfish unit with species-specific assessments of biomass and acceptable biological catch estimates; however, there is no information on length

or age at maturity to incorporate into analytical stock assessments. This study was initiated to determine reproductive and growth parameters specific to rex sole in the GOA stock. Female rex sole (n = 594) ranging in length from 166 to 552 mm were collected opportunistically around Kodiak Island, Alaska, from February 2000 to October 2001. All ovaries were analyzed to determine the maturity stage using standard histological criteria. Year-round sampling of rex sole ovaries confirmed that rex sole are batch spawners with a protracted spawning season in the GOA. The spawning season for rex sole spanned at least 8 months, from October to May, which is a longer duration and in different months than previously estimated.

Female rex sole in the GOA had an estimated length at 50% maturity (ML_{50}) of 352 mm, which is 46% greater than the estimated ML_{50} for the stock off the Oregon coast. At the same length that 100% of rex sole from Oregon waters were mature, only 15.8% of rex sole in the GOA are mature. The maximum age of collected female rex sole was 29 years. The estimated age at 50% maturity (MA_{50}) for female rex sole in the GOA was 5.1 years and was similar to the MA_{50} for rex sole off the Oregon coast. The von Bertalanffy growth model in the GOA was significantly different than the model from the Oregon coast. Higher growth rates in the GOA correspond with differences in length at maturity and similarity in age at maturity between the two regions. Reproductive parameters determined in this study will aid the development of a species-specific assessment of fishing mortality and exploitable biomass, yielding a more accurate management model for the GOA stock of rex sole.

By Alisa Abookire

Age and Length at First Maturity of Northern Rockfish Caught in the Central Gulf of Alaska

The northern rockfish, *Sebastes polyspinus*, ranges throughout the northeast Pacific Ocean and, as the second most abundant rockfish species in the GOA, is one of the top commercial rockfish species caught in Alaskan waters. In 2002, commercial trawl fisheries for rockfish were valued at $2.2 million in the GOA, with the northern rockfish fishery second only to Pacific ocean perch. Despite this species abundance and commercial value, detailed reproductive studies have not been conducted. One objective of this study was to describe the reproductive maturity of female northern rockfish and estimate the age and length at first maturity. Prior to this research, estimates of the length and age at 50% maturity for northern rockfish were based on visual observations of gonad maturity taken from a limited sample collected in 1996. Results of that study are used in the current GOA stock assessment for northern rockfish (Heifetz, et al. 2003). In order to improve the maturity parameters of the stock assessment model, this study determined the maturity stage of female northern rockfish at the histological level with samples collected over a 2-year period from areas near Kodiak Island and in the central gulf.

A total of 158 ovaries with corresponding otoliths and fish lengths were collected from female northern rockfish to estimate age and length at first maturity. The laboratory analyses were done at the Kodiak Fisheries Research Center. The author used standard histological and staining techniques. The diameter of the fifth largest oocyte on a randomly selected transect along the histological cross-section of the gonad was used as the criterion for evaluating the most advanced nonatretic oocyte and to determine the maturity stage of the ovary. Ovaries with oocytes in the migratory nucleus stage and the presence of postovulatory follicles were used as

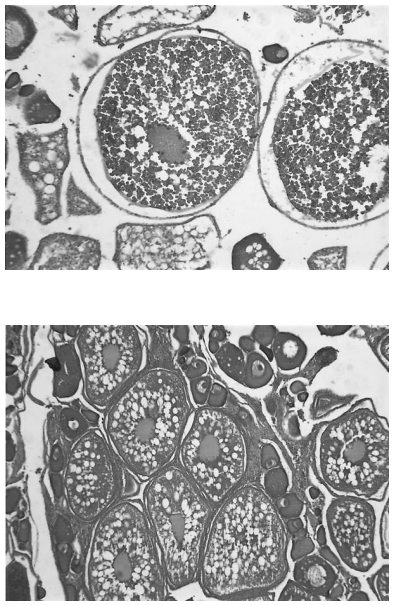

Figure 6. Examples of development stages in female northern rockfish ovaries; (top) mature ovary with migratory nucleus present in an oocyte measuring 550 mm in diameter and (bottom) immature ovary with oocytes developed to the vitellogenic stage (secondary yolk), 230 micrometers in diameter.

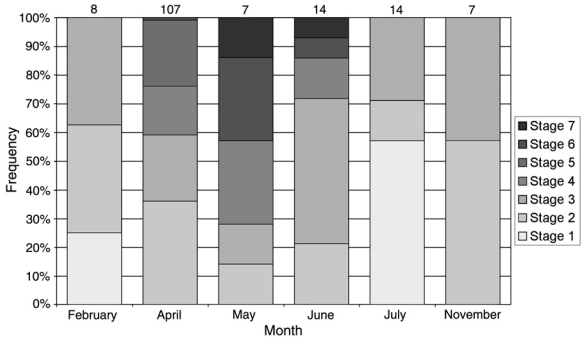

Figure 7. Frequency of the most advanced oocyte stage present in female northern rockfish for each month sampled. Sample sizes are shown above each bar.

evidence of a mature ovary (Fig. 6). Lengths of fish from the sample ranged from 14 cm to 44 cm and ages ranged from 3 to 34 years. The age and length at first maturity were estimated at 8 years and 310 mm. This research shows the presence of intermediate or maturing oocytes in all months sampled, as well as oocytes at the vitellogenesis stage with eyed larvae present in the month of April and post parturition in May and June (Fig. 7). Samples collected in April had the highest number of mature ovaries with 40% of the samples (n = 43) having oocytes at stage four or higher, while samples taken in July and November samples only had oocytes developed to the vitellogenesis stage, indicating a period of rest after parturition.

The maturity parameters used in the stock assessment model for GOA northern rockfish reflect an estimated length at 50% maturity of 36.1 cm and age at 50% maturity of 13 years. These estimates are based on a sample size of 77 females collected off Kodiak Island in April of 1996. Northern rockfish caught off the coast of northern British Columbia, Canada, are reported to mature at 19-22 cm and 5-7 years of age, values similar to the maturity estimates reported in this study. The maturity estimates used in the stock assessment report are larger and older than the values reported for northern rockfish in this study and Canada, which could be due to the small sample size or the limited seasonal component of the sample as well as the fact that these evaluations were based on macroscopic classification in the field, rather than histological assessment of the maturity stage.

By Liz Chilton

MIDWATER ASSESSMENT & CONSERVATION ENGINEERING (MACE)

Bering Sea Summer 2004 Pollock EIT Survey

MACE Program scientists conducted an echo integration-trawl (EIT) survey between 5 June and 1 August 2004 on the U.S. and Russian Bering Sea shelf near Cape Navarin aboard the NOAA ship *Miller Freeman*. This was the first year since 1994 that permission was granted to survey in Russian waters. The principal objective of the survey was to collect echo integration and trawl data to estimate midwater pollock abundance and distribution. Scientists from the AFSC's National Marine Mammal Laboratory (NMML) were aboard to census marine mammals along the EIT survey track during Leg 1. Four Russian scientists participated in the survey.

The planned survey design, including Russian waters, consisted of 31 north-south transects spaced 20 nmi apart over the Bering Sea shelf from Port Moller, Alaska, to Cape Navarin, Russia. Due to the ship's mechanical difficulties, only the southern portion of transect 30 was completed, and transect 31 was not completed (Fig. 8). Echo integration and trawl data were collected during daylight hours. Nighttime operations included additional trawling, target strength data collection, field-testing of a midwater trawl with a multiple-opening- closing codend device, net selectivity experiments, and acoustic system testing.

Biological data and specimens were collected from 154 trawl hauls, which included: 117 hauls with a large midwater trawl; 20 with a bottom trawl; 9 with a Marinovich trawl, and 8 with a Methot trawl. Walleye pollock was the most abundant and jellyfish (Cnidaria) was the second most abundant taxon captured by weight in both midwater and bottom trawl hauls. Jellyfish were the dominant species group by weight for both the Marinovich and Methot trawls. Numerically, age-0 pollock dominated Marinovich catches, and euphausiids dominated Methot catches. Trawl catches indicated that east of 170°W, pollock 38 cm to 50 cm in length were on average 8% heavier than pollock west of 170°W. Fewer than 1% of the pollock larger than 29 cm fork length (approximately age 3 and older) were actively spawning. Most pollock were either in the developing or post-spawning maturity stage.

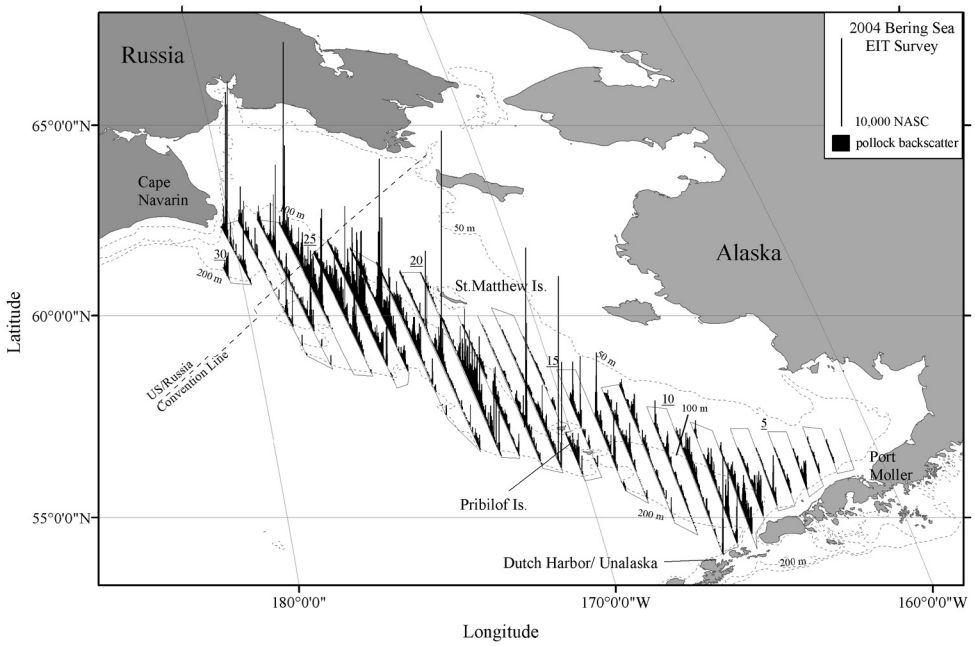

Figure 8. Relative backscattering (NASC) attributed to pollock observed between 12 m from the surface and 3 m off bottom along tracklines during the summer 2004 echo integration-trawl survey on the Bering Sea shelf, MF2004-08. Transect numbers are underlined.

Pollock were observed on all but the first transect (Fig. 8). In the U.S. EEZ most pollock were observed west and southwest of St. Matthew Island (transects 20-26). In Russia's EEZ, most were observed near the north ends of transects 26 and 29. Preliminary abundance estimates for pollock between 12 m from the surface and 3 m off the bottom indicated that approximately 90% of the total biomass was found in the United States and about 10 % was observed in Russia, off Cape Navarin. Of the U.S. pollock abundance, about one-third of the population was located east of 170°W and about two-thirds was observed west of 170°W. The largest pollock were observed east of 170°W, where the predominant length mode was 44 cm and relatively few juveniles were observed (Fig. 9). As the survey continued west, the predominant length mode became 39 cm in the U.S.-west of 170°W region. Off Cape Navarin, the predominant length mode was 31 cm, and relatively few adult pollock larger than 40 cm were observed.

By Taina Honkalehto

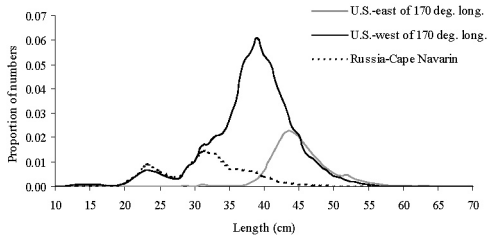

Figure 9. Estimated length distribution of pollock observed between 12 m from the surface and 3 m off bottom in three regions during the summer 2004 Bering Sea shelf echo integration-trawl survey, MF2004-08.

Trawl Avoidance Study

As part of the 2004 eastern Bering Sea Bottom Trawl survey, scientists from the MACE and the Groundfish Assessment Programs conducted a collaborative experiment designed to evaluate the behavior of walleye pollock in response to cues from oncoming vessels actively engaged in trawling operations. The study was conducted aboard the chartered fishing vessel *Aldebaran* in the vicinity (~58°30 N, 172°40 W) of Zemchug Canyon between 26 July and 5 August. A free-drifting buoy equipped with a calibrated 38-kHz scientific echosounder and associated electronics was used to observe pollock abundance and vertical distribution as the *Aldebaran* towed an 83/112 Eastern bottom trawl past the buoy. The acoustic buoy was deployed on six occasions, and the trawl was towed past the buoy a total of 24 times. Data from the acoustic buoy will be used to determine whether walleye pollock exhibit a behavioral response to the approaching vessel and trawl.

By Alex De Robertis

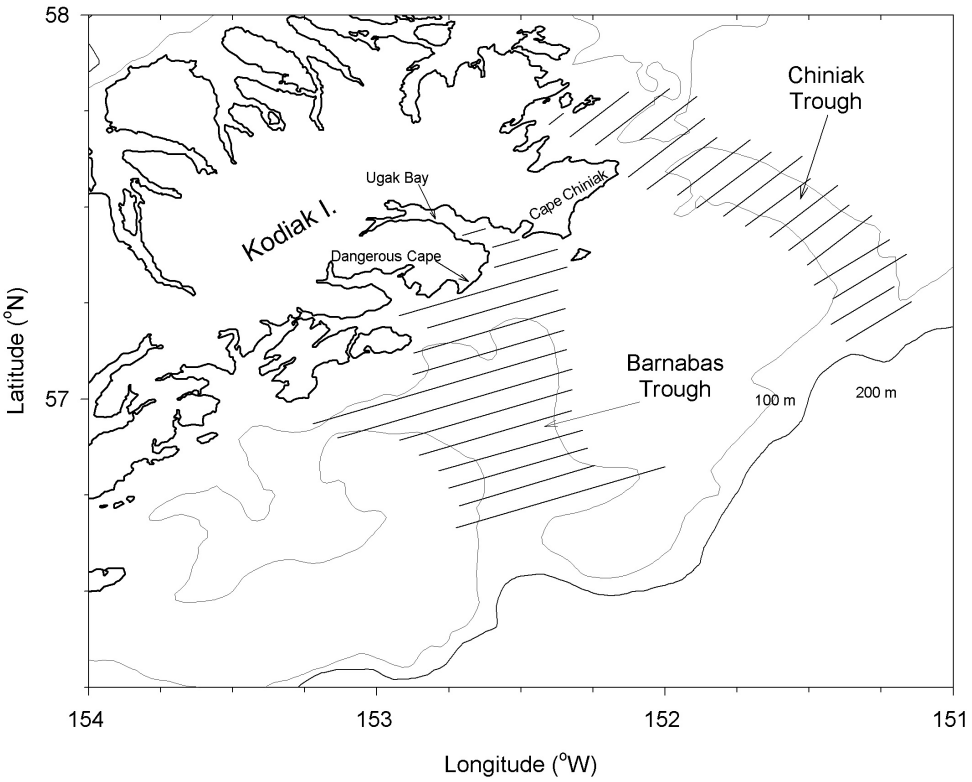

Figure 10. Trackline surveyed for each pass (see text) during the August-September 2004 echo integration-trawl survey of walleye pollock off the east side of Kodiak Island, Gulf of Alaska.

Fishery Interaction Study in Gulf of Alaska

Field work for the fourth year of a fishery interaction experiment was completed between 12 August and 6 September off the east side of Kodiak Island in the Gulf of Alaska as a collaborative effort between RACE and REFM scientists from the AFSC. The work is part of a larger program designed to evaluate the effect of commercial fishing activity on the prey availability of walleye pollock and other forage fish species to endangered Steller sea lions (*Eumetopias jubatus*).

The principal objective of the experiment was to use standard acoustic survey methods to describe the spatio-temporal variability in pollock abundance and distribution patterns in two troughs over a period of several weeks before and during the commercial pollock fishery. The study area consisted of a treatment site, Barnabas Trough, where commercial fishing was allowed, and a control site, Chiniak Trough, where commercial fishing was prohibited. Repeated survey passes (Fig. 10) were conducted within each trough before and during the fishery to document if a fishery-induced perturbation occurred in the fish distribution. To characterize the physical environment, oceanographic data were collected using drifters, CTDs, XBTs, and a vessel-mounted thermosalinograph.

Most of the acoustic backscattering was generally attributed to two principal groups: adult pollock, and age-0 pollock with some capelin (*Mallotus villosus*). The adults were generally detected as near-bottom schools or as an on-bottom "carpet." Adult pollock were generally distributed within the northern half of Barnabas Trough, although significant quantities extended farther south along the eastern side of the trough. Adult pollock were distributed throughout Chiniak Trough. Relatively large, dense aggregations of age-0 pollock/capelin, located in mid-water during daylight, were broadly distributed throughout Chiniak Trough and predominantly in the northern portion of Barnabas Trough. Unlike the deeper dwelling adults, the age-0 pollock/capelin mix often extended over relatively shallow bottom depths of less than 100 m. It appeared that fewer capelin and many more age-0 pollock were encountered during the survey compared to earlier surveys in 2000-02. However, additional data analyses need to be completed to verify this finding.

The size composition of adult pollock ranged between modes of 44-50 cm fork length. The size

composition of age-0 pollock had prominent length modes at 6 or 7 cm standard length.

Analyses are currently under way to determine if significant changes in fish abundance and distribution patterns were detectable in response to the commercial fishing activities. Pollock and capelin echosign spatial patterns will be explored with variography and by comparison of other descriptive parameter estimates of the fish aggregations to evaluate if the scale of patchiness changed during the study period.

By Michael Guttormsen

FISHERIES OCEANOGRAPHY COORDINATED INVESTIGATIONS (FOCI)

The AFSC and NOAA's Pacific Marine Environmental Laboratory (PMEL) cosponsored a multinational workshop, "North Pacific Climate Regimes and Ecosystem Productivity" at the Talaris Conference Center in Seattle, Washington 13-14 September 2004. In attendance were 37 scientists from the AFSC, PMEL, University of Alaska Fairbanks, University of Washington, University of California Irvine, International Global Ocean Ecosystem Dynamics (GLOBEC) and the North Pacific Marine Science Organization (PICES). Scientists from NOAA Fisheries, Office of Science and Technology (Ned Cyr and Kenric Osgood) and NOAA NOS, Coastal Ocean Program (Elizabeth Turner) also participated. The purpose of the workshop was to present and discuss information that will guide the development of a science and implementation plan to monitor the Gulf of Alaska and Bering Sea for the purpose of providing management with indicators of climate-induced change in the Alaska marine ecosystems. The plan will describe the scientific design and rationale for a climate regimes and ecosystem productivity program. It will also identify partners, priorities, and a timeline. The program is called North Pacific Climate Regimes and Ecosystem Productivity.

The workshop began with a series of presentations of background information. Dr. Ned Cyr spoke to the participants about "NOAA, Fisheries, and Climate." Anne Hollowed and Patricia Livingston (AFSC) presented "Single Species and Ecosystem-Based Management." James Overland (PMEL) talked about climate and ecosystems from a physical science perspective, and Jeffrey Napp (AFSC) and Phyllis Stabeno (PMEL) presented a series of examples of how climate and ecosystems interact in the Gulf of Alaska and Bering Sea. Participants were divided into groups after the initial presentations to discuss key scientific questions and issues of implementation. After each working group session, rapporteurs and facilitators reported back to the workshop participants. All written comments were submitted to the organizers for use in writing the science and implementation plan.

By Jeff Napp

NOAA OPEN HOUSE IN ST. PAUL

The Groundfish Assessment Program's Bering Sea team had an opportunity to conduct a "NOAA Open House Day" aboard the chartered fishing vessel *Aldebaran* during its stay in St. Paul Harbor shortly after completing the annual Bering Sea shelf crab-groundfish bottom trawl survey. The children attending were all 6-12 year old Pribilof Islands (St. Paul and St. George) residents attending a summer educational program called Pribilof Stewardship Camp. Michael Etnier of the AFSC's National Marine Mammal Laboratory in Seattle directed the program this summer, which is in its twelfth year of providing cultural and science-based education for children. The main emphasis of the program, which started as a joint effort between the U.S. Fish and Wildlife Service and the Pribilof School District, is to revive traditional Aleut knowledge of the Bering Sea ecosystem and combine it with western-based science and research.

Children from St. Paul and St. George Islands Pribilof Stewardship Camp learn about marine life during the NOAA Open House aboard the *Aldebaran.*

Scientists from the AFSC and International Halibut Commission aboard the vessel took time out to conduct a hands-on day for the children and their instructors. The children were shown various live specimens (such as juvenile skates, hermit crabs, sea stars, sea anemones, and Tanner crabs) which were collected at the end of the survey and also were given a tour of the boat while teaching them some aspects of the research that is conducted during the survey and also some aspects of commercial fishing in the Bering Sea.

The day was enjoyed by all, and everyone involved plans on organizing a repeat event next field season.

By Erika Acuna

RESOURCE ECOLOGY & FISHERIES MANAGEMENT (REFM) DIVISION

STATUS OF STOCKS & MULTISPECIES ASSESSMENT PROGRAM

Management Strategy Evaluation Working Group

Evaluation of fishery management strategies has been an ongoing research activity of the AFSC for years. Most recently, the Programmatic Supplemental Environmental Impact Statement (PSEIS) for the Bering Sea–Aleutian Islands (BSAI) and Gulf of Alaska (GOA) Groundfish Fishery Management Plans (FMPs) devoted thousands of pages to evaluation of both current and alternative fishery management strategies. Nevertheless, further work remains to be done. Therefore, a working group (WG) has been established and tasked with continuing and expanding the AFSC's research in the area of management strategy evaluation (MSE). While it is understood that MSE research will never truly be finished, it is expected that the WG will be able to make significant advancements in this area over the next few years. The WG met for the first time on 17 August 2004 at the AFSC. Present from the AFSC were Kerim Aydin, Jeff Breiwick, Martin Dorn, Sarah Gaichas, Jim Ianelli, Pat Livingston, Paul Spencer, and Grant Thompson. Present from the University of Washington were Doug Kinzey, Arni Magnuson, and James Murphy.

Harvest Strategy Review

In October 2001, the North Pacific Fishery Management Council (NPFMC) commissioned an independent scientific review of the council's current groundfish harvest strategy. The review panel, chaired by Daniel Goodman, presented its report (the "Goodman report") to the Council in November 2002. The AFSC presented a written response to the Goodman report in October 2003. Briefly, that response noted that many of the MSE-related suggestions made in the Goodman report had already been addressed in the PSEIS or other documents, including use of a wide set of performance measures involving both utilization and conservation objectives, use of a public process to develop alternatives, use of species-specific harvest strategies for certain species, use of group-specific harvest strategies for certain groups of species, use of alternatives to the F40% reference point, use of a utility function approach to choose reference points, and examination of multi-annual catch limits. Furthermore, in some instances the MSE contained in the PSEIS went beyond the suggestions made in the Goodman report by using, for example, a state-of-the-art technical interactions model that facilitates simulation of the effects of the Optimum Yield (OY) caps in the BSAI and GOA groundfish fisheries.

However, the Goodman report also contained several suggestions pertaining to MSE that have yet to be implemented on a major scale, including 1) use of parallel "operating" and "assessment" models to facilitate simulation of the feedback nature of the management process, 2) use of ecosystem models, 3) use of multi-attribute control rules in the lower tiers, 4) use of constraints on the extent to which Total Allowable Catch (TAC) can change from year to year, and 5) reexamination of the extent to which the current tier system correlates information quality with management precaution. The Goodman report also suggested that alternative management strategies be tested with respect to the effects of regime shifts, spatial structure, depensation, and interspecific differences in life history and with respect to imprecision in estimates of selectivity and survey catchability. WG members suggested that the scope of MSE research should not be limited to issues raised in the Goodman report.

Marine Stewardship Council

Martin Dorn reported on the progress of the Marine Stewardship Council (MSC) in responding

to an industry request for certification of the BSAI and GOA pollock fisheries. It is possible that certification will be granted conditionally, with one of the conditions being completion of a more thorough MSE according to a specified timetable.

Literature Review

A preliminary list of references pertaining to MSE was distributed to the WG and is available on request from jim.ianelli@noaa.gov.

National Standard Guidelines

Grant Thompson reported on a draft proposed rule describing a possible revision of the guidelines for National Standard 1 of the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA). Some of the new features in the proposed revision focus on the distinction between "core stocks" and "assemblages." For example, an OY control rule would be required for each core stock and for each assemblage or each indicator stock within an assemblage. Targets, such as OY, would have to be achieved on average. The current minimum stock size threshold (MSST) would be replaced by a "biomass limit" (Blim), which has a default value of 1/2 biomass maximum sustainable yield (BMSY). The default Blim would not have to be used for a particular stock if the default does not make sense in light of the stock's natural variability. Also, Blim would not have to be specified if the available data are inadequate to do so or if the stock is managed under a sufficiently conservative OY control rule. The term "overfished" would be replaced by "depleted" throughout the guidelines.

Discussion

The WG spent the majority of the meeting hearing presentations on recent MSE research and discussing possible approaches to future MSE research. Presentations were given on recent research pertaining to the performance of the current management strategy in the presence of regime shifts and on use of an operational management procedure in which this year's catch limit is a linear function of last year's catch limit and this year's estimated biomass. Recent research was discussed pertaining to the impact of biological interactions on stocks managed using reference points derived on a single-species basis was also presented. Points raised during the discussion included the following:

1) Use of ecosystem models in defining reference points:

A) There is a difference between estimating a true ecosystem MSY and incorporating ecosystem considerations into the estimation of single-species MSYs.

B) The proceedings volume from the NMFS National Stock Assessment Workshop 6 (NSAW6) included a helpful discussion (p. 55-57) on the meaning of "ecosystem MSY" and possible multi-species management objectives.

C) It might be easier to use ecosystem models to establish a reasonable buffer between ABC and OFL than to determine a truly optimal harvest strategy.

D) Perhaps the use of ecosystem models could be confined initially to examination of aggregate OY caps rather than trying to determine how ecosystem considerations ought to influence single-species ABCs.

2) Other uses of ecosystem models in MSE:

A) At least initially, parallel MSEs could be conducted, one track using ecosystem models but ignoring some of the more complicated single-species considerations and the other track using fairly sophisticated single-species models but ignoring ecosystem considerations.

B) Perhaps the operating model could include biological interactions but the assessment model would still be based on single species. (This idea seemed to have widespread support.)

C) Some concern was expressed over the extent to which future MSEs should depart from status quo tools and management (e.g., should we base our planned research on use of highly parameterized ecosystem models before we even know whether they can be developed?).

D) Ecosystem models might be useful in estimating the natural ranges of fluctuations referenced in the proposed revision of the guidelines for National Standard 1.

E) Perhaps an ecosystem model could be used as a sort of "sidecar" which, for each year in a simulation, would return an adjustment to each projected single-species ABC.

3) Technical considerations in model development:

A) If we use an ecosystem model, will the parameters be estimated statistically or by some other method?

B) Given that it will be impossible to simulate the entire stock assessment process (e.g., the evolu-

tion of assessment methodology over time), it may be useful to test how well alternative simplifications of the stock assessment perform (e.g., simply drawing an "estimated" stock size at random from a distribution may prove to be an adequate simulation of the assessment process).

4) Risk analysis:

A) One method of risk analysis consists of producing tables showing the probabilities associated with the various possible outcomes (e.g., biomasses and catches of target and nontarget stocks). *Pro:* lots of fishery risk analyses are done this way, provides lots of information for decision-makers to study, does not require *a priori* specification of objectives. *Con:* creates information overload, invites decision-makers to "reverse engineer" objectives, unlikely to produce optimal decisions.

B) Another method of risk analysis measures the costs and benefits of the various possible outcomes, weights them by their respective probabilities, then determines the harvest strategy that maximizes the expected value of an objective function that has been specified in advance. *Pro:* minimizes the amount of information decision-makers need to synthesize, produces optimal decisions given the objective function. *Con:* few fishery risk analyses are done this way, requires advance specification of objective function.

C)Of course, it is possible to present both methods in the same document.

Next Steps

Major advances in MSE research will take a number of years to complete. The best course of action will probably involve incremental advances, starting from the simplest problems and working toward the most complex. The WG plans to meet again in the coming year to provide its members an opportunity to report on progress towards evaluating Alaska groundfish management strategies.

By Grant Thompson and Jim Ianelli

RESOURCE ECOLOGY & ECOSYSTEM MODELING PROGRAM

Fish Stomach Collection and Content Analysis

Laboratory analysis was performed on 2,285 fish stomachs from the eastern Bering Sea, 55 fish stomachs from the Gulf of Alaska and 2,422 fish stomachs from the Aleutian Islands. At-sea analysis was performed on 1,900 fish stomachs from the eastern Bering Sea slope and 1,563 fish stomachs from the Aleutian Islands. Stomach samples were collected from 2,353 fish from the Bering Sea shelf (including samples from the western shelf) and from 42 fish in the Aleutian Islands during AFSC surveys. Observers returned 441 stomachs from Bering Sea fisheries during this quarter. A total of 7,693 new data records were added to the groundfish food habits database.

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

Ecosystem Considerations for 2005

The first draft of the Ecosystem Considerations Section for 2005 was completed as part of the Stock Assessment and Fishery Evaluation (SAFE) Reports, which are provided to the NPFMC annually. A summary of the first draft was presented to the NPFMC groundfish plan teams 17 September 2004. The section content and format has changed slightly from last year and is comprised of three parts: the Ecosystem Assessment, Ecosystem Status Indicators, and Ecosystem-Based Management Indices and Information.

The Ecosystem Assessment this year focuses on the historical responses of ecosystem components to climate regime shifts and provides expert judgment on the near-future state of the climate. This assessment was derived primarily from a PICES study group report providing advice to the United States on the effects of climate on fisheries. Based on basin-wide North Pacific climate-ocean indices, there appears to have been a major regime shift in 1977, a minor shift in 1989, and recent shift in 1998. For regimes prior to 1977, the pattern of sea surface temperature spatial variability implied a west-east dipole. Since 1989, the pattern of spatial variability has been dominated by a second pattern of sea surface temperature variability, which implies a north-south dipole.

In the Bering Sea (BS) and Gulf of Alaska (GOA), the major atmospheric shift of 1977 resulted in a change from a predominantly cold climate to a warmer maritime climate as part of the Pacific Decadal Oscillation (PDO). Responses of various physical and biological indices to the 1977 and 1989 regime shifts can be seen in newly created tables of time series anomalies in the Ecosystem Assessment. For example, after 1977, salmon catches increased in the BS and GOA, GOA shrimp survey catch-per-unit-effort CPUE decreased, and survival indices of some groundfish shifted. Given the variability in

indices since 1998, there is some uncertainty about the level of productivity of the new regime; however, there is growing evidence that there are strong responses in the California Current ecosystem and weak evidence of responses in the GOA ecosystem. It is projected that the Bering Sea will most likely continue on its current warm trajectory, with biomass transitioning northward allowing walleye pollock a larger domain at the expense of cold- and ice-adapted species, rather than transitioning back to a cold regime. It is currently unclear if changes observed in the GOA after 1998 will persist. For example, shrimp CPUE in the north GOA increased from 1998 to 2001 but has since decreased again.

The next draft of the Ecosystem Assessment will include some information on ecosystem models that will be used to summarize possible future effects of climate and fishing on ecosystem structure and function. Currently, not all of the modeling tools are ready for use in projections; however, future development of modeling tools will enable scientists to provide advice on management strategies that are robust to a wide range of future ecosystem states. The assessment could be used to evaluate aggregate effects of groundfish fisheries on ecosystem and habitat and could result in advice regarding changes in aggregate catch levels (OY cap), species mix of the catch, and discard amounts. The assessment this year also provides a more analytical presentation of the historical trend and variation in key indicators in a graphical red/green indicator table that indicates direction and magnitude of indicator changes over time.

The Ecosystem Status Indicators section summarizes the historical trends and current status of physical, biological, and community or ecosystem-level indices. New this year is the addition of status and trend information pertaining to nutrients and productivity; age-0 pollock diet, distribution, and energy content in the Bering Sea; error bars on bottom trawl survey CPUE estimates of forage fish, HAPC, and miscellaneous species; a regime-shift analysis of recruit-per-spawning biomass anomalies; and a detailed summary of Alaska Native Traditional Environmental Knowledge of climate regimes. Data gaps still include lower trophic levels, such as phytoplankton, and zooplankton information.

The Ecosystem-Based Management Indices and Information section contains updated indices that are intended to provide either early signals of direct human effects on ecosystem components or to provide evidence of the efficacy of previous management actions. Indices presented address four main goals of ecosystem-based management that the NPFMC proposed: maintain diversity, maintain and restore fish habitats, ensure sustainability, and include humans as part of the ecosystem.

Stock assessment scientists continued to use indicators from the Ecosystem Considerations section to assess ecosystem factors such as climate, predators, prey, and habitat that might affect a particular stock. Also, information regarding a particular fishery's catch, bycatch, and temporal/spatial distribution was used to consider the possible impacts of that fishery on the ecosystem although updated non-target species catch data were not available this year. We are still in early stages of using this type of information in stock assessments. However, we anticipate the information could be used to modify allowable biological catch recommendations or spatial/distribution of the catch due to ecosystem concerns, or to target further research that would be needed to quantify ecosystem impacts.

By Jennifer Boldt

Seabird-Fishery Interaction Research

Efforts to characterize seabird incidental take within the Alaskan groundfish fisheries continued during this quarter. A U.S. North Pacific Groundfish Observer Program special project was expanded in the trawl fleet to identify trawl industry components that have additional sources of mortality due to seabird interactions with third-wire cables, trawl door main cables, and the trawl net itself. In addition to increased efforts to characterize seabird incidental take, we also continued collaboration with the fishing industry and the Washington Sea Grant Program to explore the use of mitigation measures to reduce seabird interactions with fishing gear. Cooperative research funds were awarded to the Pollock Conservation Cooperative to investigate measures to reduce seabird interactions for trawl vessels. This preliminary work will lead to a rigorous field experiment, likely beginning in 2006. We also coordinated with the Observer Program to deploy staff to a longline vessel to work on vessel-specific bycatch reduction. That trip was made in September 2004.

To assist with efforts to monitor seabird/trawl gear interactions, a pilot project was completed in 2002 that employed the use of electronic monitor-

ing to view seabird interactions with trawl third wires. The results of this study, McElderry et al., 2004. Electronic monitoring of seabird interactions with trawl third-wire cables on trawl vessels – a pilot study. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-147, 39 p, are available on the AFSC website at http://www.afsc.noaa.gov/Publications/AFSC-TM/NOAA-TM-AFSC-147.pdf. The pilot study, conducted by Archipelago Marine Research Ltd. and the AFSC, involved field testing of electronic monitoring (EM) systems on shoreside delivery and head and gut bottom trawl vessels conducting operations in the Bering Sea, U.S. Exclusive Economic Zone. The EM systems, consisting of two closed circuit television cameras, GPS, hydraulic and winch sensors, and on-board data storage, were deployed on five fishing vessels for 14 fishing trips during a 1-month period in fall 2002. Detailed analysis of about 200 hours of fishing imagery occurred, representing 20 shoreside delivery vessel fishing events and 32 head and gut fleet fishing events. Results from the study demonstrated that EM could effectively monitor seabird interactions with trawl third-wire cables. The EM system provided imagery of sufficient quality to detect the presence, abundance, and general behavior of seabirds during most daylight fishing events. As well, EM-based imagery was also able to detect third-wire entanglements of seabirds although it was not possible to determine the cause of these entanglements. The EM imagery was not very useful for seabird enumeration and species identification. In regard to monitoring seabird interactions with trawl third-wires, EM would be suitable for monitoring the use and effectiveness of mitigation measures

In other related research, stationary seabird surveys were conducted in conjunction with most haul locations for the summer AFSC groundfish research charters. Data are being collated, and we will work with Washington Sea Grant to combine the trawl and longline research charter information. Staff from both the AFSC and the NMFS NMFS Alaska Regional Office participated in the Third International Albatross and Petrel Conference in Montevideo, Uruguay, 22-27 August 2004. Seabird specialists from around the globe gathered to address concerns about the incidental mortality of albatrosses and petrels in commercial fisheries. The conference was attended by participants from every continent and presentations and posters reported on the latest research and information in the fields of: population status and trends, population dynamics, molecular ecology and systematics, general biology and behavior, feeding ecology and foraging area, incidental mortality and mitigation, and conservation policies and international initiatives. Several posters were presented by Alaska Regional Office and AFSC staff.

By Shannon Fitzgerald

U.S. NORTH PACIFIC GROUNDFISH OBSERVER PROGRAM

Observer Staff Placed on Fishing Vessels

Observer Program staff members, Jason Stern, Russ Seither, Kerry Waco, and Jonathon Rothman, were placed aboard four different fishing vessels through a new provision in Federal regulations which grants NMFS the authority to place NMFS staff aboard vessels in order to improve the ability of observers to do their jobs. Observer Program staff are sometimes deployed in addition to the regular observer onboard, and other times they replace the regular observer. In all cases, the arrangement is an example of respectful cooperation between the fishing vessel owner and operator, the observer provider company and the Observer Program staff.

Jason Stern from the Observer Program's Seattle office worked aboard a trawler catcher vessel fishing for rockfish in July 2004, while Russ Seither from the Observer Program's Anchorage office worked aboard a trawler catcher vessel targeting Pacific cod in September 2004. Both were testing a new sampling tool called a brailer. A brailer is a nylon meshed, collapsible bag that is used to collect a sample of catch from the trawl. It is placed randomly on the stern deck before the trawl codend is emptied over the deck. The brailer, which is then covered with fish, is hoisted off the deck, collecting a random sampling of catch. The amount of fish collected in this manner ranges from 10 to 700 kg depending on the depth of fish poured over the brailer. The brailer may eventually replace the traditional, time-consuming and labor-intensive, basket sampling technique currently used by many observers. The work of these two staff members will generate design modifications to the brailer and further feasibility testing will be conducted later this year and early in 2005. In addition, they are both certified observers and performed regular observer duties,

providing Federally required observer coverage for the vessel.

Jonathon Rothman from the Observer Program's Seattle office was placed aboard a trawler catcher vessel fishing for pollock in August 2004. Jonathon, like Jason and Russ, was the only certified observer onboard and provided the vessel with required observer coverage. The vessel Jonathon worked aboard was chosen because of the inherently difficult sampling and working conditions onboard. His knowledge and experience as an observer, coupled with his status as an Observer Program staff member, helped him to develop standardized sampling methods, which will aide observers assigned to this vessel in the future.

In September 2004, Kerry Waco from the Observer Program's Anchorage office was placed aboard a longliner catcher processor vessel fishing for Pacific cod. Kerry was helping a new observer with a difficult sampling situation and was developing standardized sampling methods for this particular vessel. She was also assessing the performance of the vessels' seabird avoidance techniques. This particular longliner provided a unique opportunity to observe seabird avoidance gear in action and suggest alternative means to enhance the performance of the gear.

Gulf of Alaska Project

The Observer Program along with the NMFS Alaska Regional Office and the Pacific States Marine Fisheries Commission are combining efforts to develop alternative observer deployment models for the Gulf of Alaska. The project is in the early planning stages with a goal of beginning observer deployment in a pilot program starting during summer 2005. The focus of this endeavor is to examine different observer deployment models and data collection methods and priorities. Sampling will focus on catch discards and more intensive validation of shoreside catch delivery reporting.

Safety Training Standards

National observer safety training standards are being developed in response to a report by the Alaska Marine Safety Education Association (AMSEA). The National Observer Program issued a contract with AMSEA to evaluate observer safety training in all observer programs in the United States. Several recommendations to improve observer safety training were made in the AMSEA report. One recommendation was to develop a national safety training standard for all observer programs nationwide. A team of observer trainers and managers has been formed to work on developing these standards. Jennifer Ferdinand represents the AFSC Observer Program on this team. The team conducted its second meeting in September 2004 at the National Observer Program office in Silver Spring, Maryland.

By Bob Maier

ECONOMIC & SOCIAL SCIENCES RESEARCH PROGRAM

Economic Data Collection Programs

Center economists continued working with NMFS Alaska Regional Office and PSMFC staff to implement the economic data collection program that will be an integral part of the BSAI Crab Rationalization Program. During this quarter, they assisted in completing the following: 1) the draft regulations and preamble for the data collection program; 2) the cooperative agreement under which PSMFC will collect the data; and 3) the terms of reference for the data collection program.

Center economists also provided input to the Task Force for the Reauthorization of the Magnuson-Stevens Fishery Conservation and Management Act. Specifically, the economists identified restrictions in the current act that explicitly limit their access to the data required to analyze the effects of fishery management programs and compute the net benefits generated by Alaska fisheries. They also made recommendations for new language that would increase the amount of available economic information.

Community Profiling and Demographics

Christina Package traveled to Dutch Harbor, Unalaska and conducted interviews with local residents to gather information necessary for the profile of the community derived from fieldwork conducted by Dr. Jennifer Sepez during summer 2002. Also, interviews were conducted with native community members who were removed to internment camps during World War II. Information from these in-

terviews will aid in research dealing with history and globalization as it pertains to Unalaska.

New Economist

Alan Haynie, a Ph.D. candidate in the Department of Economics at the University of Washington, joined the REFM Division in July 2004. He presented a paper at International Institute of Fisheries Economics and Trade Conference in Japan, "Estimating the Economic Impact of the Steller Sea Lion Conservation Area: Developing and Applying New Methods for Evaluating Spatially Complex Area Closures" (joint with David Layton). Alan has initiated an effort to analyze the effects of real-time bycatch monitoring (through the SeaState Inc., system) on bycatch rates and fishing site location. He will work with academic researchers, AFSC staff, and industry to construct a model that relates fishing choices to the reports presented by SeaState, Inc.

Other Activities

Program staff have been involved in ongoing efforts to 1) implement a comprehensive data collection program for the BSAI crab fisheries; 2) estimate the nonconsumptive value of Steller sea lions; 3) identify and profile fishing communities; 4) develop regional economic impact models; 5) assess the economic effects of the BSAI pollock fishery cooperatives; 6) implement improved electronic reporting of fisheries data; 7) summarize fisheries data for the Economic SAFE report, the NPFMC, industry, environmental organizations, and other stakeholders.

By Ron Felthoven

AGE & GROWTH PROGRAM

International Otolith Symposium

Dan Kimura attended the Third International Otolith Symposium in Townsville, Queensland, Australia, 11 - 17 July 2004 (see Auke Bay Lab report in this issue.). The symposium was hosted by the CRC Reef Research Center and James Cook University. Kimura presented an oral paper "Quality Control of Age Data at the Alaska Fisheries Science Center" and a poster "Is Corroborating Ages a Valid Concept in (walleye pollock, *Theragra chalcogramma*) Fish Age Determination?" The oral presentation, coauthored by Delsa Anderl, described the quality control procedures used in the ageing lab, along with new insights into measures of between age reader precision. The poster described current confusion in the meaning of the terms age "corroboration" and age "validation." An argument was made concerning the usefulness of age corroboration data in our ageing of walleye pollock. Coauthors of the poster were Alexander Buslov (Kamchatka Research Institue of Fisheries and Oceanography, Russia), and AFSC scientists Betty Goetz, Christopher Gburski, and Craig Kastelle. Written versions of these presentations were submitted for consideration in the planned proceedings.

Estimated production figures for 1 January through 30 September 2004.

Species	Number Aged
Northern rocksole	1,152
Yellowfin sole	1,359
Arrowtooth flounder	3,396
Longhead dab	223
Walleye pollock	12,270
Pacific cod	2,067
Sablefish	2,460
Atka mackerel	1,073
Pacific ocean perch	704
Northern rockfish	873
Rougheye rockfish	669
Light dusky rockfish	1,066
Dark dusky rockfish	120

Total production figures were 27,432 with 8,298 test ages and 130 examined and determined to be unageable.

By Dan Kimura