AUKE BAY LABORATORY (ABL)

OCEAN CARRYING CAPACITY PROGRAM

Unusual Observations of Fish and Invertebrates From the Gulf of Alaska, 2004-05

During 2004-05, unusual fish and invertebrates were reported off the coasts of southcentral and southeastern Alaska. Most but not all of these occurrences are presumably associated with the unusually warm oceanographic conditions in the North Pacific Ocean and the Gulf of Alaska during these years. The records of occurrences are compiled from personal communications with Alask Department of Fish and Game (ADF&G) biologists and port observers, who receive their information from commercial fishers, charter boat operators, and sport fishers. Some observations are from NMFS personnel conducting surveys of juvenile salmon and sablefish. Where possible, the identifications were confirmed through photographs or actual specimens submitted to the Auke Bay Laboratory (ABL).

The helicid pteropod (*Limacina helicina*) was reported in 2005. When abundant, it is preyed on extensively by chum salmon, pink salmon, herring, and whales. In spring 2004, *Limacina* was reported as a dominant zooplankton in plankton net tows from Chatham Strait, Peril Strait and Icy Strait. The opalescent inshore squid (*Loligo opalescens*) was also reported in 2005. Previously reported in northern Southeast Alaska in the early 1980s, no additional occurrences were noted until spring of 2005 when they were abundant in the Sitka area and in northern Clarence Strait. The eight-armed squid (*Octopoteuthis deletron*) was reported in 2004; this was the first record for Alaska Inside waters. It has previously been reported only as far north as central Vancouver Island.

The jumbo squid (*Dosidicus gigas*) (Fig. 1) was reported in 2004 and 2005, and was first taken off the Fairweather Grounds in 2004. This very large squid forms an important fishery in the Gulf of California. The neon flying squid (*Ommasterphes bartrami*) was reported in 2005. At times, it is very abundant off the Washington and British Columbia coasts. The boreal clubhook squid (*Onychoteuthis borealijaponicus*) also was found in Alaska during 2005. Its northern distribution is typically along the southern edge of the Gulf of Alaska.

The blue shark (*Prionace glauca*) occurred along Alaska's outer coast in 2004 and 2005. Blue sharks were reportedly common along the outer coast of Alaska in 2005. Blue sharks are frequently reported during strong El Niño years. The white shark (*Carcharodon carcharias*) was reported in 2004. Although white sharks are known to occur in Alaska waters, they are not abundant. Most notable was a white shark photographed off Yakutat after taking a bite of a sport-caught halibut. The thresher shark (*Alopias vulpinus*) was reported in 2004. The 2004 record from west of Yakobi Island is the farthest north record for thresher sharks.

The Pacific sardine (*Sardinops sagax*) was reported for 2005 in unusual abundance in southern Southeast Alaska and were captured as far north as Cross Sound. They were previously reported in 1998 following a 67 year absence. The 2005 reports represent the highest abundance and most northerly reports of sardines in Alaska. Northern anchovy (*Engraulis mordax*) were also reported in 2005. Previously reported only in 1997 from the Yakutat area, they were reported in 2005 from southern Clarence Strait. Surf smelt (*Hypomesus pretiosus*) were reported in 2005. Their biology in Alaska is poorly known and populations are not followed by Alaska biologists. Its apparent increase in abundance may be real or due to increased awareness by field biologists.

Figure 1. Wade Loofborough, skipper of the ADF&G research vessel *Medeia,* with a jumbo squid (*Dosidicus gigas*). Photo by Joe Orsi.

Other unusual species (or species captured outside their normal range) reported for Alaska during 2004 and 2005 include Pacific barracuda (*Sphyraena argentea*), Pacific pomfret (*Brama japonica*), Pacific saury (*Cololabis saira*), opah (*Lampris guttatus*), cabezon (*Scorpaenichthys marmoratus*), green sturgeon (*Acipencer medirostris*), and Pacific ridley turtle (*Lepidochelys olivacea*). During the past 2 years, unusual catches of fish and invertebrates have been reported by fishermen and fisheries biologists working in the coastal waters of the eastern and central Gulf of Alaska.

These observations are associated with anomalously warm water in the eastern North Pacific Ocean. This is not the result of an El Niño but rather an overall warming of the whole North Pacific Ocean. The long-term implications of this ocean warming and these changes of distribution and abundance to Alaskan fisheries are not clear. The nearshore distributions and abundance of blue shark, pomfret, saury and the pteropod, *Limacina helicina* may be due to strong downwelling as a result of the decadal shift of the Aleutian Low.

Monthly average sea surface temperatures at the Auke Bay Laboratory have been about 0.75°C above average for most of 2004 and 2005. Peak anomalies were +2.48°C and +2.83°C in May of each year. Similar anomalies were observed throughout most of the eastern North Pacific Ocean and the Gulf of Alaska. The temperature patterns observed differ from the classical El Niño conditions in that the warming was initially observed in the central Pacific Ocean and gradually extended east and north to include the Gulf of Alaska and Bering Sea. A typical El Niño begins in the equatorial western Pacific Ocean, moves east to the coast of South America, and then moves north and south along the coast of the eastern Pacific Ocean.

By Bruce Wing

GROUNDFISH ASSESSMENT PROGRAM

Diel Sampling of Epipelagic Ichthyofauna in Offshore Waters of the Eastern Gulf of Alaska

During a research cruise in August 2005, ABL scientists conducted diel sampling of epipelagic ichthyofauna in offshore waters of the eastern Gulf of Alaska. The general objective of the cruise was to evaluate procedures for a trawl indexing survey for young-of-the-year (YOY) rockfish, sablefish, and salmon in offshore waters of southeastern Alaska. This research was done under a new annual partnership agreement between ABL and the ADF&G. Three programs within ABL collaborated on this study: Groundfish Assessment, Marine Salmon Interactions, and Ocean Carrying Capacity. The ABL scientists on the cruise were Dave Clausen and Dean Courtney of the Groundfish Assessment program, Joe Orsi and Alex Wertheimer of the Marine Salmon Interactions program, and John Pohl of the Ocean Carrying Capacity program. Bill Floering of the NOAA Pacific Marine Environmental Laboratory (PMEL) in Seattle also participated in the cruise.

Due to favorable weather, sampling was successfully completed at all priority stations and all cruise study objectives were met. On the first evening of the trip, an acoustical mooring buoy was deployed in Cross Sound near Cape Spencer as part of a project with PMEL; the buoy will measure subsurface currents at this location. During the rest of the cruise, day and night surface-trawl sampling with a Nordic 264 rope trawl was done at nine stations. These stations were located up to 75 km offshore in southeastern Alaska along three transects: Cape Edward, Cross Sound, and Icy Point. One station had to be moved inshore to Lisianski Strait during the only day of poor weather that occurred. Catches totaled nearly 40,000 fishes representing 22 species in 55 hauls. Catch in numbers for the target species of the study were as follows: YOY rockfish, 11; YOY sablefish, 70; and salmon, 587. Catches of YOY rockfish were less than anticipated, which may be an indication of patchy distribution or of poor survival in 2005 for YOY rockfish off southeastern Alaska. Oceanographic data were collected coincident with the vessel track and trawl hauls to investigate the relationship between oceanographic conditions and the distribution and abundance of fish caught in the trawl. These data included continuous measurements by a thermosalinograph of surface temperature and salinity, and conductivity-temperature-depth (CTD) casts to depths of 200 m at 31 hauls. Information from this study will provide a conceptual framework of diel interactions among species and enable scientists to better understand marine ecosystem dynamics.

Several unusual non-target species were captured during the cruise, including Pacific pomfret, Pacific sardine, blue shark, and Humboldt squid (*Dosidicus gigas*) (Fig. 2). Occurrence of these species may

Figure 2. Humboldt squid (*Dosidicus gigas*) caught offshore Cape Spencer in southeastern Alaska by the research vessel *Medeia* in August 2005.

be related to above average surface temperatures that were observed for 2005 in the eastern Gulf of Alaska. Although occasional Pacific pomfret are sometimes observed during the summer in the Gulf of Alaska, Pacific pomfret was the most abundant fish species caught in terms of weight for this cruise. Pacific sardine have become much more abundant in recent years in waters off the U.S. West Coast and British Columbia, and they appear to have expanded their range into southeastern Alaska in the last few years. We caught Pacific sardines in nearly one-third of the trawl hauls, indicating the widespread occurrence of this species in the area that was sampled. A total of six blue sharks were caught in the cruise, which suggests that blue sharks may have been unusually abundant in the study area. Finally, we caught a total of 29 Humboldt squid, including one haul that captured 20 individuals. This large squid normally does not range north of Baja California Mexico, and until last year had never been found north of Newport, Oregon. In 2004, it appeared off Washington State, British Columbia, and southeastern Alaska as far north as Sitka. The Humboldt squid that were caught in this cruise are the most northerly specimens that have been collected.

By Dave Clausen and Joe Orsi

Shark Research in the Gulf of Alaska With Sonic and Archival Tags

Scientists from ABL use sonic tags and archival electronic tags to study the ecology and life history of the Pacific sleeper shark (*Somniosus pacificus*) and spiny dogfish (*Squalus acanthias*) in Alaska waters. Electronic tags can be programmed to continuously record temperature and depth and have proven to be a valuable tool for gathering information on the geographic distribution and vertical habitat of sharks in Alaska waters. Sonic tags transmit to hydrophones deployed remotely in a fixed array or deployed manually from a vessel that follows tagged animals. Archival tags must be physically recovered to retrieve data.

Sonic tags were surgically implanted in the abdominal cavity of 24 Pacific sleeper sharks in Chatham Strait in southeastern Alaska during June 2004. The sonic tags had a predicted operational battery life of 1 year. Thirteen sonically tagged Pacific sleeper sharks (54%) were acoustically relocated with hydrophones deployed from a vessel in a search area of 588 km^2 within 1 month after release. The relocated sharks were tracked acoustically at depths greater than 500 m, made horizontal movements of 6 km per day, and made vertical migrations off of the bottom. An array of stationary hydrophones was remotely deployed within the same region 8 months after sonic tag release (February 2005) and recovered 4 months later (June 2005). However, no sharks with sonic tags were relocated with the stationary hydrophones. It is unlikely that all of the sharks with sonic tags left the area. One possibility is that the sonic tags had a shorter than expected operational battery life.

Archival tags were attached externally to the dorsal fins of 41 Pacific sleeper sharks in Chatham Strait in May 2005. A total of 88 Pacific sleeper sharks were tagged with archival tags in Chatham Strait during 2003-05. Archival tags were surgically implanted in the abdominal cavity of 62 spiny dogfish in Yakutat Bay in June 2005. A total of 99 spiny dogfish have been tagged with archival tags in Yakutat Bay during 2004-05. Pacific sleeper sharks and spiny dogfish are occasionally encountered as bycatch in Alaska commercial fisheries. The ABL offers a $200 reward for the return of electronic archival tags. Reward posters have been distributed to the Alaska commercial fishing industry and to the local communities where tags were released. To date, no archival tags have been recovered.

Recovery rates of sonic tags with the remote hydrophones and recovery rate of archival tags have been low (0%). Possible causes for low recovery rates include failure of external archival tag attachment methods, shorter than expected battery life of sonic tags, limited acoustic range and tracking technology for sonic tags, and low interception rates of sharks with archival tags in Alaska commercial fisheries. However, future recoveries of archival tags in the commercial fishery are possible, as the batteries of the tags have a life-expectancy of 10 years. These issues were discussed during a NOAA Advanced Technologies Tagging Workshop held during August 2005 in Seattle.

By Dean Courtney

Manned Submersible Studies in the Gulf of Alaska

ABL researchers completed two surveys in the Gulf of Alaska during summer 2005 using the two-person submersible *Delta*, which was launched from the support vessel *Velero IV*. The first survey was located on Albatross Bank southeast of Kodiak Island during 22 June to 2 July, and the second survey was in the Cape Ommaney and Hazy Islands vicinity off southeastern Alaska from 20 July to 1 August.

The purpose of the Albatross Bank survey was to perform a rockfish catchability experiment and to sample geologically-based habitats on previously mapped areas in this vicinity. The primary objectives were to 1) sample a glacial outwash habitat type to estimate survey gear catchability, and 2) groundtruth multibeam-derived habitat types on three sites along Albatross Bank. Survey participants were Kalei Shotwell (chief scientist from ABL), Dana Hanselman (research biologist from ABL), and Sean Rooney (graduate student from the University of Alaska Fairbanks).

A total of 24 dives were completed during the cruise, most of which were in the "Snakehead" area of the bank. Eight of these dives were on outwash habitat to estimate catchability, and 11 were on other habitat types for groundtruthing. Dives were also completed on two of the bank's pinnacles: two dives on "49 Fathom" pinnacle and one on "8 Fathom" pinnacle. Finally, two dives were inshore dives during poor weather near Two-headed Island near the southwest end of Kodiak Island. Transect lengths were usually about 1,800 m. For each dive, researchers recorded audio and video from two camera angles and collected conductivity-temperature-depth (CTD) data (usually from start to finish). Twenty-nine additional CTD casts were completed as time allowed. For the catchability experiment, researchers coordinated with the chartered vessel *Sea Storm,* which was conducting a biennial trawl survey for the AFSC Resource Assessent and Conservation Engineerig (RACE) Division. Scientists aboard the *Sea Storm* conducted four trawl hauls in areas that were surveyed with the *Delta*.

Video was recorded of juvenile rockfish on several habitats, particularly moraines, bedrock-like exposures, and bedrock ridges. Gravid sharpchin (*Sebastes zacentrus*) and yelloweye rockfish (*S. ruberrimus*) were observed as well as rougheye rockfish (*S. aleutianus*) schooling behavior and multiple color morphs (Fig. 3). Several large schools of rockfish were noted by the submersible observer (e.g., dusky rockfish, *S. variabilis*) and a particularly active and large Pacific ocean perch (*S. alutus*) school was recorded on video in sandy mud habitat with occasional sea whips.

The purpose of the Cape Ommaney and Hazy Islands survey was to sample geologically-based habitats that had been previously mapped in this area by multibeam technology. The primary objectives were to characterize benthic habitat for juvenile rockfish and to groundtruth the multibeam-derived habitat types. In addition, a few dives were conducted to gain further information on trawl survey catchability. Survey participants were Jon Heifetz (chief scientist from ABL) and Kalei Shotwell (research biologist from ABL).

A total of 33 dives were completed during the survey. Twelve of these were on the Hazy Islands mapped site, one of which was for estimating catch-

Figure 3. School of rougheye rockfish (*Sebastes aleutianus*) in boulder/cobble habitat. Photo from Albatross Bank survey.

ability. Nine dives were completed on the Cape Ommaney mapped site, and two of these were for estimating catchability. The remaining 12 dives were conducted during a period when sea conditions were unfavorable for sampling the mapped areas, which were all located in offshore waters. These remaining dives were completed inshore in the vicinity of the mapped sites off the southern end of Baranof Island and outside of Craig, on Prince of Wales Island. Two of the inshore dives were completed off Coronation Island, four in the Gulf of Esquibel, four in Whale Bay, and two in Big Branch/Little Branch Bay. Researchers coordinated with the *Sea Storm* for the catchability dives. Scientists from the *Sea Storm* completed two hauls off Cape Ommaney near the dives sites (where they caught a large number of Pacific ocean perch) and attempted one unsuccessful haul off the Hazy Islands.

Juvenile rockfish were recorded on several habitats, particularly granite rock exposures and highly-fractured glaciated rock. Researchers observed large schools of juveniles in high relief habitats (e.g., boulder, rock outcrops) and fewer solitary individuals hiding in sponges and under rocks in the low relief habitats (e.g., flat pavement, hummocky sediments). Many gravid females occurred on rocky habitats; these fish included sharpchin, redstripe (*S. proriger*), redbanded (*S. babcocki*), greenstriped (*S. elongatus*), and pygmy (*S. wilsoni*) rockfish. Inshore habitats had a large diversity of rockfish, and many juveniles were seen mixed with adults.

By Kalei Shotwell

Sablefish Longline Survey

The AFSC has conducted an annual longline survey of sablefish and other groundfish in Alaska from 1987 to 2005. The survey is a joint effort involving two AFSC research divisions: ABL and the RACE Division. It 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 2005, the 27th annual longline survey of the upper continental slope of the Gulf of Alaska and eastern Bering Sea was conducted. One hundred-fifty-two longline hauls (sets) were completed between 2 June and 1 September 2005 by the chartered fishing vessel *Ocean Prowler*. 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*), shortspine thornyhead (*Sebastolobus alascanus*), and Pacific cod (*Gadus macrocephalus*). A total of 81,460 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 2,400 sablefish. Killer whales (*Orcinus orca*) took fish from the longline at several stations in Bering Sea and in the western Gulf of Alaska near Dutch Harbor; this has also commonly occurred in previous surveys. Sperm whales (*Physeter macrocephalus*) were present during haul back at multiple stations in the west Yakutat and central Gulf of Alaska areas where they were observed depredating on the longline. Sperm whale interactions with the survey have notably increased in recent years but exact depredation effects have been difficult to detect.

Several special projects were conducted during the 2005 longline survey. Corals caught on the line were collected for identification and sample preservation. A seabird occurrence study was conducted for the fourth year that helps to address where and when certain seabird species occur in Alaska waters. Spiny dogfish were sampled during the Southeast Alaska and west Yakutat legs for biological studies conducted by graduate students from the University of Alaska Fairbanks and the University of Washington. Giant grenadier were sampled for a maturity study during the Southeast Alaska leg. Finally, a 2-day experiment was conducted off Yakutat to collect genetic tissues of rougheye rockfish and to investigate depth distribution patterns of "light" and "dark" color phases of rougheye rockfish.

By Chris Lunsford

Southeast Alaska Estuarine Habitat Survey

ABL scientists continued work in 2005 to define essential fish habitat (EFH) in Alaska's coastal areas. This study focuses on resolving some of the technical and systematic issues with the "ShoreZone" resource inventory that is supported by the NMFS Alaska Regional Office. By developing a baseline inventory of estuarine resources that can be explored for correlations with ShoreZone classification data, scientists hope to improve classification criteria for estuarine and salt marsh wetlands and associate functional values with various ShoreZone classifica-

tions. Some data has already been incorporated into a GIS database in use for EFH consultations by the regional office.

During August, Mitch Lorenz served as chief scientist on a sampling cruise aboard the NOAA vessel *John N. Cobb*. Ten estuaries adjacent to Clarence Strait and Duncan Canal in Southeast Alaska were sampled, bringing the number of sites sampled in 2005 to 25 and the total number sampled to 53. Baseline sampling of the six biogeographic strata identified in Southeast Alaska is expected to be complete in 2006. To date, the surveys have identified more than 200 animal taxa and more than 70 plant taxa. These taxa represent more than 10% of all taxa contained in the RACE Division taxonomic database and include many taxa not in the database.

By Mitch Lorenz

HABITAT PROGRAM

Fish Assemblages Near Barrow, Alaska

The Habitat Program at ABL is working with the U.S. Army Corps of Engineers in a cooperative study to examine fish assemblages in coastal waters near Barrow, Alaska. The beach adjacent to Barrow is eroding at a rapid rate, and several locations near Barrow are being considered as possible sources of replacement sediment. Information is needed on potential effects of large-scale sediment removal and beach replenishment on nearshore fish communities.

Fish assemblages were sampled with a beach seine at 11 sites in 2004; these same sites plus 15 new sites were sampled in 2005. Seine sites at all locations are low gradient beaches with substrates predominately comprised of sand and gravel. In 2004, total catch for all seine hauls was 3,213 fish comprising 12 species. The most abundant species captured were capelin (*Mallotus villosus*) and young-of-the-year Arctic cod (*Boreogadus saida*). In 2005, total catch for all seine hauls was 715 fish comprising 12 species. The most abundant species captured were capelin and Arctic sculpin (*Myoxocephalus scorpioides*). Additional sampling in summer and other seasons is needed to obtain a full inventory of the fish communities in the Barrow area. Capelin and Arctic cod are important species in the diets of marine mammals, birds, and other fish species.

By Scott Johnson

MARINE SALMON INTERACTIONS PROGRAM

Southeast Coastal Monitoring Epipelagic Ichthyofauna Sampling in 2005

Biologists for ABL's Southeast Coastal Monitoring (SECM) project completed four research cruises in 2005. This was the ninth year of SECM sampling for juvenile Pacific salmon (*Oncorhynchus* spp.), ecologically-related species, and associated biophysical data in the marine waters of southeastern Alaska. Cruises were conducted from the NOAA vessel *John N. Cobb* in late May, June, July, and August. In June and July, surface trawling and associated oceanographic sampling were done in both the northern and southern regions of Southeast Alaska as part of a 3-year study designed to compare the utility of using juvenile pink salmon (*O. gorbuscha*) abundances to forecast adult returns. Other objectives of the SECM research are to investigate the role of juvenile salmon in the coastal marine ecosystem by identifying relationships among biophysical parameters that influence habitat use, marine growth, prey utilization, energetic condition, predation, stock interactions, and migration patterns. Monthly cruise reports and annual reports for the SECM project are available online at http://www.afsc.noaa.gov/abl/MarSalm/ablmsi.htm.

In 2005, Icy Strait and Upper Chatham Strait in northern Southeast Alaska (NSE) and Lower and Middle Clarence straits in southern Southeast Alaska (SSE) were sampled. A total of 20-23 trawl hauls were made in June and July in each region. Straits habitat in NSE was also sampled in May (biophysical oceanography only) and August (eight trawl hauls along with biophysical oceanography); coastal habitat off of Icy Point was sampled only in May (biophysical oceanography only).

In comparing the catches between the two regions of Southeast Alaska in June and July, total catches of juvenile salmon were similar: 2,941 in NSE and 3,005 in SSE (Table 1). The frequency of occurrence of each species was similarly high in the two regions in June, but was lower in SSE than in NSE for some species in July. Juvenile chum salmon (*O. keta*) were relatively more abundant in NSE, while pink salmon were relatively more abundant in SSE. Unusually large numbers of pink salmon were captured in August in NSE, but no comparable sampling was conducted in SSE. These catches

constituted the highest August catch-per-unit-effort (CPUE) for juvenile pink salmon in the 9-year history of SECM sampling; 2005 is the only year in which CPUE for pink salmon was highest in August. A total of 645 juvenile coho were caught in the two regions, 51 (7.9%) of which were missing the adipose fin, indicating the possible presence of a coded-wire tag. Of the coho salmon with missing adipose fins, 15 had coded-wire tags from stocks originating in Southeast Alaska, as well as in Washington and Oregon. The high percentage of fish with missing adipose fins caught in SSE that did not have a coded-wire tag suggests that these fish came from releases of fin-clipped coho salmon in the Pacific Northwest for selective fisheries management. Laboratory processing of juvenile pink and chum salmon samples is ongoing to collect biological information and determine the stock composition of otolith-marked juvenile chum salmon released by enhancement facilities in both regions of Southeast Alaska.

For the second consecutive year, and the third year for the 9-year SECM data series, unusually warm temperatures were observed in Southeast Alaska; these warm years coincided with earlier migration of juvenile salmon from nearshore habitats into strait habitats and the Gulf of Alaska. For example, although peak catches of juvenile pink and chum salmon typically occur in July, catches were highest in June during the warm years of 1998, 2004, and 2005. This first year of sampling in both SSE and NSE confirmed that migration occurred earlier throughout the region. Other observations of note included the unusual presence of market squid (*Loligo opalescens*) and relatively high jellyfish biomass in SSE. In June, the jellyfish *Aequoria* sp. and *Aurelia* sp. were abundant in trawls in SSE, while little jellyfish biomass was retained in trawls in NSE. In July, these species were about half as abundant in SSE, and *Cyanea* sp. became conspicuous in NSE. Also conspicuous in July were ichthyofauna associated with these large jellyfish: prowfish (*Zaprora silenus*), crested sculpin (*Blepsias bilobus*), and young-of-the-year pollock (*Theragra chalcogramma*).

By Molly Sturdevant and Joe Orsi

Ocean Ecology of Salmon in Western North America: Regional Comparisons

A symposium titled Ocean Ecology of Salmon in Western North America: Regional Comparisons was held at the annual meeting of the American Fisheries Society in Anchorage in September 2005. Several ABL scientists presented papers or participated as coauthors at the symposium. Presentations by Marine Salmon Interactions (MSI) Program staff included "Mortality Rates of Chum Salmon During Their Early Marine Residency" by Alex Wertheimer, and "Assemblages of Neritic Fishes Associated with Juvenile Salmon in the California Current and the Alaska Coastal Current" by Joe Orsi. Other MSI scientists who coauthored papers at the symposium were Molly Sturdevant, Emily Fergusson, and Frank Thrower. Two additional papers included Ed Farley, Jamal Moss, and Jim Murphy of ABL's Ocean Carrying Capacity Program as coauthors. In total, ABL scientists were senior authors or coauthors for 10 of the 18 papers presented at the symposium; the proceedings will be published as a volume in the American Fisheries Society symposium series.

By Joe Orsi

Interactions of Hatchery and Wild Juvenile Chum Salmon in Taku Inlet

The Early Ocean Salmon (EOS) task of ABL's MSI Program continued work begun in 2004 on a collaborative investigation of the ecological interactions of hatchery and wild juvenile chum salmon in Taku Inlet near Juneau. This research is funded by the Southeast Sustainable Salmon Fund to address concern about the recent decline of wild chum salmon in the Taku River that coincided with increased production of enhanced stocks of chum salmon in waters adjacent to Taku Inlet. Cooperating agencies and institutions include the University of Alaska Juneau Center for Fisheries and Ocean Sciences, the ADF&G, and the Douglas Island Pink and Chum (DIPAC) hatchery.

In 2005, the project again sampled for juvenile salmon twice weekly from mid-April until late-June using both a beach seine in littoral areas and a two-boat Kodiak trawl in nearshore waters adjacent to

Table 1. (Facing page) Southeast Coastal Monitoring project total catches (Num.) and percent frequency of occurrence (%FO) of juvenile and adult Pacific salmon, nonsalmonid teleosts, and squid, and average biomass of jellyfish per trawl in the marine waters of the northern (NSE) and southern (SSE) regions of Southeast Alaska, June-August 2005, using the NOAA vessel *John N. Cobb*. The numbers of trawl hauls are shown in parentheses.

		NSE						SSE			
		June (20)		July (23)		August (8)		June (20)		July (21)	
	Scientific name	Num.	%FO	Num.	%FO	Num.	%FO	Num.	%FO	Num.	%FO
Juvenile salmon											
Pink	*Oncorhynchus gorbuscha*	495	80	119	70	497	100	1,665	85	86	48
Chum	*O. keta*	1,650	100	113	61	97	88	681	95	153	71
Sockeye	*O. nerka*	154	80	25	52	15	50	160	85	19	43
Coho	*O. kisutch*	264	95	106	74	45	100	183	95	49	52
Chinook	*O. tshawytscha*	9	35	6	22	1	13	7	30	2	10
Total		2,572		369		655		2,696		309	
Adult and immature salmon											
Pink (adult)	*Oncorhynchus gorbuscha*	5	20	15	26	3	13	0	0	8	24
Chum (adult)	*O. keta*	0	0	2	9	1	13	0	0	1	5
Sockeye (adult)	*O. nerka*	1	5	1	4	0	0	0	0	0	0
Coho (adult)	*O. kisutch*	0	0	1	4	0	0	1	5	0	0
Chinook (immature)	*O. tshawytscha*	1	5	3	13	0	0	3	15	0	0
Chinook (adult)	*O. tshawytscha*	3	10	0	0	1	13	0	0	1	5
Total		10		22		5		4		10	
Non-salmonids											
Crested sculpin	*Blepsias bilobus*	11	45	56	78	8	75	0	0	0	0
Pacific herring	*Clupea pallasi*	2	10	0	0	0	0	2	10	0	0
Pacific cod larva	*Gadus macrocephalus*	0	0	0	0	0	0	1	5	0	0
Poacher larvae	Agonidae	0	0	0	0	0	0	1	5	0	0
Prowfish	*Zaprora silenus*	2	10	8	26	1	13	4	20	8	29
Salmon shark	*Lamna ditropis*	0	0	1	4	0	0	0	0	0	0
Pacific spiny lumpsucker	*Aptocyclus ventricosus*	0	0	1	4	1	13	0	0	0	0
Smooth lumpsucker	*Eumicrotremus orbis*	1	5	0	0	0	0	0	0	0	0
Spiny dogfish	*Squalus acanthias*	0	0	0	0	0	0	1	5	8	19
Starry flounder	*Platichthys stellatus*	0	0	0	0	0	0	2	10	0	0
Walleye pollock	*Theragra chalcogramma*	0	0	2	9	0	0	11	20	0	0
Walleye pollock larvae	*Theragra chalcogramma*	1	5	4	17	0	0	0	0	13	29
Wolf-eel	*Anarrhichthys ocellatus*	2	10	4	13	1	13	0	0	0	0
Total		19		76		11		22		29	
Jellyfish	combined species	2	100	20	100	25	100	195	100	116	95
Squid	Gonatidae	0	0	0	0	0	0	2	10	0	0
Market squid	*Loligo opalescens*	0	0	0	0	0	0	63	5	0	0

the littoral sites. Waters farther offshore were sampled for juvenile salmon with a larger surface trawl as part of the EOS Southeast Coastal Monitoring project, and ADF&G sampled for potential predators of juvenile salmon using small-meshed gill nets. The DIPAC hatchery chum salmon are released as juveniles at several locations near Taku Inlet; all of these hatchery releases are marked with thermally induced patterns on their otoliths.

Sample processing for 2004 collections is nearing completion. The salmon were analyzed for otolith marks to determine spatial and temporal overlap of hatchery and wild chum salmon stocks during their initial marine residency. Subsamples were then selected for further processing to compare diets and energetic conditions for evaluating the degree of competitive interactions between the two stock groups. Processing of collections from the second and final year of sampling and analysis of 2004 results will take place during the fall and winter of 2005.

By Molly Sturdevant and Alex Wertheimer

Release of 2003 Brood Year Chinook Salmon Smolts at Little Port Walter Field Station

Historically, smolts from three stocks of chinook salmon have been released from Little Port Walter (LPW) (Fig. 4); however, 2005 represented the 30th consecutive release of the stocks from the Chickamin and Unuk rivers. On 15 May, 163,823 chinook salmon (*O. tshawytscha*) smolts from the 2003 brood year were released from the facility on Baranof Island in Southeast Alaska. These smolts were tagged with coded wire tags. Of the total released, 124,871 (76.2%) were from the Unuk River stock, and 38,952 (23.8%) were from the Chickamin River stock. The survivors of the release will return to LPW at ages 2 to 7 years.

The mean weight of released fish was 29.8 g for the Unuk River stock and 25.0 g for the Chickamin River stock. Sizes for chinook salmon smolts previously released from LPW are shown in Figure 5. The mean weight at release for these two stocks has varied over time due to differences in experimental constraints. More information on chinook salmon research at LPW can be accessed online at http://www.afsc.noaa.gov/abl/MarSalm/5chhatchwild.htm.

By Adrian Celewycz

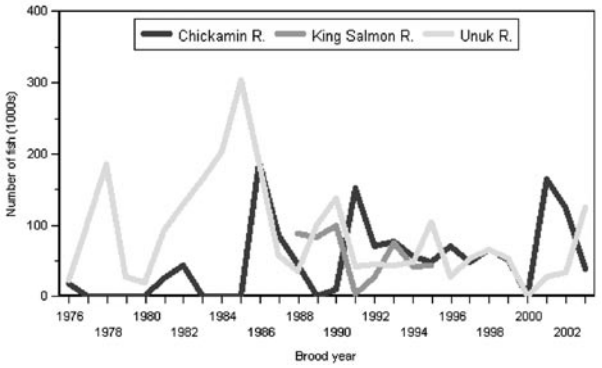


Figure 4. Number of chinook salmon released from Little Port Walter field station by brood year and stock.

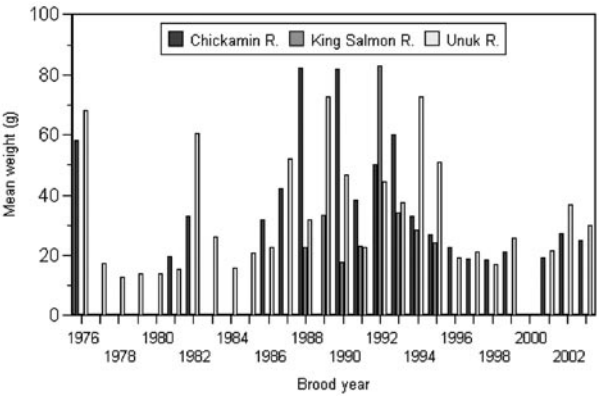


Figure 5. Mean weight (g) of chinook salmon released from Little Port Walter field station by brood year and stock.

Pink Salmon Abundance, Migration Timing, and Survival for Auke Creek

Year 2005 was the 35th consecutive year of operation of the Auke Creek weir. Although pink salmon abundance was slightly above average, and marine survival was identical to the long-term average, the timing of returns was substantially earlier than expected. The ocean survival of pink salmon returning to Auke Creek in 2005 was 6%. These fish were produced by the 2003 brood-year spawners, the progeny of which emigrated to the ocean as juveniles in 2004. Survival was estimated from when juveniles left Auke Creek to when adults were captured during the return upstream migration in 2005. The average survival of Auke Creek pink salmon over the last 35 years was also 6%. Pink salmon spawn throughout the Auke Lake system in the tributaries to Auke Lake, Auke Creek, and in the intertidal area. Pink salmon adults were counted at Auke Creek in 1967 and 1968, and annually since 1971.

In 2005, pink salmon were counted daily as they passed through the fish-counting weir at Auke Creek

from the third week of July through mid-September, which is within the normal range of timing for Auke Creek. The escapement of 10,010 wild pink salmon was greater than the long-term average of 7,500 and was the second earliest observed at Auke Creek. Annual counts of pink salmon adults at Auke Creek since 1967 show the interannual variability common for this species. Pink salmon escapements at Auke Creek ranged from 300 to 28,000 over the last 38 years, and it was not unusual to see a 5- to 10-fold increase or decrease in consecutive even- and odd-year brood lines.

In 2005, the time of return was bimodal with peak numbers occurring during the first and last weeks of August. This was a departure from the historic pattern of pink salmon migrations at Auke Creek, when migrations usually peaked in mid-August and mid-September. The overall midpoint of the 2005 run was 21 August, the second earliest on record for Auke Creek. The average midpoint of adult migration for 1967-2004 was 31 August, and during the 1960s and 1970s the midpoint of the run was in September. Prespawning mortality of adult pink salmon in Auke Creek was high because of high water temperatures. Estimates from daily recovery of fish on the fish counting weir showed that approximately 50% of the females died before spawning.

In even- and odd-numbered years there are two distinct runs of pink salmon at Auke Creek, referred to as the early and late runs. Because all returning fish are individually handled and are counted by sex at the fish counting weir, and due to differences in sexual maturity, it is possible to estimate the number of fish in both runs. The start of the late run for 2005 was 31 August. At that time, early-run females were ready to spawn while late-run females were not yet ripe, so that early run fish could be easily distinguished when handled during counting. The early and late runs numbered 8,872 and 1,138 fish, respectively. The larger proportion of fish in the early run continued the pattern of greater abundance of early fish, a trend which became apparent in the mid-1980s. Before then the late even- and odd-year runs dominated the total returns of pink salmon at Auke Creek, and averaged 73% of the total return. Prior to the mid-1980s, there were often large numbers of fish into the third or fourth weeks of September. Since the mid-1980s, the late component of runs for both even and odd years averaged about 30% of the total return, and runs have often dwindled to low numbers and ended during the second week of September. It appears that the late-September component of the Auke Creek pink salmon is no longer occuring.

By Jerry Taylor

FISHERIES MONITORING & ANALYSIS (FMA) DIVISION

The North Pacific Groundfish Observer Program formally became the Fisheries Monitoring and Analysis (FMA) Division on 21 August 2005. The change will improve our ability to provide high quality data to end users through training and deploying observers into the field, monitoring data collected while observers are still deployed, and finalizing the data during the debriefing process.

This report highlights our support activities and how these activities allow near real-time access to observer data that has been reviewed by staff.

Observer Services

The FMA Division coordinates with the University of Alaska Anchorage to provide several 3-week training sessions yearly, teaching potential observers how to collect quality data. Once observers complete this training, they are certified and eligible for deployment into the field.

Over 85% of deployed observers will work aboard fishing vessels equipped with custom software that allows FMA staff to monitor data collection with a minimum of delay and provides two-way communication with observers through a text messaging system. Text messaging allows observers to describe their sampling methods and ask questions regarding sampling scenarios they encounter in the field. Staff members answer questions, help observers improve their sampling methods, and inform them of any data corrections that need to be done while at sea. Two-way communication also provides emotional support to observers deployed in the field. Advisors offer encouragement to observers, helping observers through the mental strain of the job and to stay focused on data collection.

Data collected at sea are finalized for end users when observers go through postcruise debriefing. FMA staff review the entire data set and make necessary data corrections. Text messaging facilitates this process by resolving data errors while the observer is at sea. Monitoring the data collection process at-sea shortens the debriefing process, reducing the time required to prepare the data for use.

By Amie Olson

Information and Monitoring Technologies

Receipt of data from observers at sea and the near real-time response are made possible through use of an at-sea observer data entry and communication software program. This program, with built-in data checks and a communication link to observers, improves data quality by decreasing the amount of transmitted data errors. In addition, the software program offers two-way communication through a built-in password-protected text messaging system. This facilitates the resolution of data errors and ensures that sampling protocols are followed, all with a minimum of delay.

Once observer data has been transmitted and entered into our database, additional quality control checks are performed before making the data available to end users. Over 85% of observer data are received through the at-sea program; the remaining 15% are received as faxed paper forms. Faxed observer data forms first must be keypunched into our database before undergoing quality control checks and being made available. Receipt and entry of fisheries data in near real-time is a critical component of our efforts to help support staff in the NMFS Alaska Regional Office. As a result of communication and process improvements, we are continuing to reduce the time delay.

In addition to supplying and installing the data entry software used by observers, the information monitoring staff helps troubleshoot transmission or data entry problems observers may experience while at sea. Through open communication with observers and the vessels they work aboard, we help to facilitate the flow of incoming data. As vessels and plants change computer hardware and communication devices or experience transmission problems, we offer limited support and notification to help them remain in compliance with current regulations. Our programmers currently are creating a new version of the at-sea software program that will improve data quality and will work with a wider range of industry hardware and communication devices. Error checking scripts are also being improved to provide more accurate data and to meet the end users' needs.

We provide near real-time data and also maintain many years worth of fisheries data for use by AFSC scientists. The information monitoring group supports and tests these databases to make sure they function properly for all users. Working together with staff, the NMFS Alaska Regional Office, and observers at sea, we provide the vital link by compiling and storing fisheries data information to enable better informed management decisions.

By Shane Leach

Field Operations

Advising observers occasionally requires FMA staff to serve aboard a vessel for a period of time to observe sampling problems directly. Having staff based in Dutch Harbor, Kodiak, and Anchorage better enables us to board vessels when necessary. For example, recently we received messages through the at-sea text messaging indicating that an observer was having difficulty devising proper sampling methods. We contacted the fishing company and with its concurrence had our staff join the vessel to assist the observer with his sampling collection methodology. Once onboard, the FMA staff member worked with the observer to identify problems with his sample collection methods and modify them to meet the sampling requirements for this vessel type. Completing this deployment gave us a better understanding of the challenges new observers face on longline vessels.

By Todd Loomis

Operations and Administration

Annually, we solicit input from AFSC scientists and their colleagues regarding special projects that they would like us to consider for the upcoming year. These projects play an important role in meeting the needs of our end users. Typically, short-term special projects such as fin clips from Pacific cod for genetic analysis and Alaska plaice ovary collections can be completed by a few observers and provide key information relevant to fisheries research. When the information needs of end users are long-term, we consider them for inclusion in the regular observer duties.

Work continues on a draft analysis regarding observer procurement and deployment in the North Pacific. This analysis will go before the North Pacific Fishery Management Council early in 2006. The simplified alternatives for action are available on the Council website at www.fakr.noaa.gov/npfmc/current_issues/observer/observer.htm.

By Jerry Berger

NATIONAL MARINE MAMMAL LABORATORY (NMML)

ALASKA ECOSYSTEM RESEARCH PROGRAM

Northern Fur Seal Research

One of the responsibilities of the Alaska Ecosystem Research Program is investigation of the ecology of northern fur seals. Scientists within the program have been collaborating with investigators from the University of Alaska Fairbanks and Dalhousie University, Nova Scotia, to examine the consequences of northern fur seal foraging strategies at two separate locations in the Bering Sea. This is a collaborative study funded by the North Pacific Research Board and the AFSC. For largely unknown reasons, northern fur seal abundance on the Pribilof Islands (Saint Paul and Saint George) has fallen to less than half of peak numbers present in the 1950s and during the 1990s has continued to decline, while abundance on Bogoslof Island in the eastern Aleutian Islands has increased. Oceanographic conditions encountered by maternal seals during the summer are substantially different between these islands, but northern fur seals also spend about two-thirds of the year wintering at sea in the North Pacific Ocean. In this study we are tracking maternal fur seals from the Saint Paul and Bogoslof Islands during winter and summer, while measuring their health and condition and subsequent pup growth rates.

The study began in November 2004 when 20 adult female fur seals were captured on Saint Paul Island. Body condition was assessed, and seals were tracked with satellite telemetry in the North Pacific Ocean. In July 2005, the conditions of 20 mother and newborn pup pairs at each island were measured, and maternal foraging behavior in the Bering Sea was tracked via satellite transmitters and dive recorders. The seals will be recaptured in October near the end of the pup-rearing period to measure pup growth rates, maternal condition, and to retrieve the dive recording instruments.

The population of northern fur seal pups on Bogoslof Island was estimated using shear-sampling, a mark-recapture method, in August 2005. Staff of the Alaska Ecosystem Program estimated 12,631 (SE = 335) pups were born on Bogoslof Island this past summer. These results indicate that pup production has increased at 12% per year since pups were last counted in 1997 (Fig. 1). Some of the increase in pup production may be a result of emigration of adults from St. Paul and St. George Island rookeries, where pup numbers have been declining.

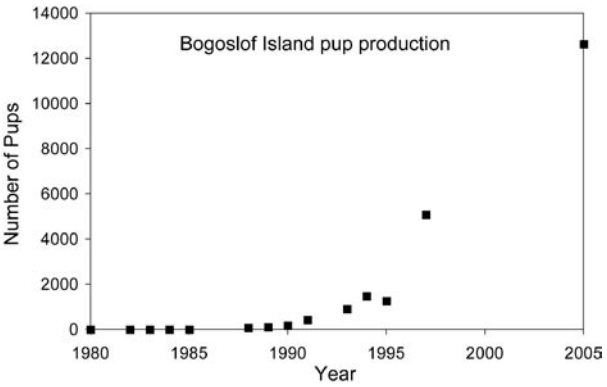


Figure 1. Estimated number of northern fur seal pups born on Bogoslof Island, Alaska, 1980 - 2005.

By contrasting between winter and summer and among rookeries on Saint Paul and Bogoslof Islands, we will quantify effects of foraging in different habitats on maternal condition and ability to raise pups. Additional project information can be found on the web at www.nprb.org

By Tonya Zeppelin and Brian Fadely

CALIFORNIA CURRENT PROGRAM

Gray Whale Surveys off Kodiak Island

Gray whale surveys were completed near Ugak Bay off Kodiak Island, Alaska, between 31 August and 5 September 2005. Survey objectives were to assess the abundance of gray whales, collect photo IDs, collect fecal samples, and determine overlap between the large feeding aggregation of gray whales in this part of Alaska and the feeding aggregations in Washington/British Columbia. Similar surveys were conducted in 2002 and 2003, which focused on photo ID and prey sampling. In 2005, we photographed 190 gray whales (Fig. 2) and collected fecal samples from 26 of them, compared to photographs of 70 whales in 2002 and 12 in 2003. The photo-ID matching in 2002 found four whales off Kodiak Island which were also found in Washington/British Columbia waters and three individuals in 2003. Because of the large numbers of whales observed in 2005, it may be possible to estimate the abundance of gray whales in the area using a mark-recapture method based on photographs. Fecal samples will

Figure 2. Gray whales off Kodiak Island, feeding over water 50 fm deep, show their flukes more frequently than whales off the Washington coast feeding in shallower water. Photo by Merrill Gosho.

provide information on gray whale prey and will be compared to earlier samples collected in 2002 when the grays were found to be feeding primarily on Cumaceans (also called lollipop shrimp). The Kodiak gray whale feeding aggregation is unique among Pacific Coast feeding aggregations because of the high densities of whale groups (7-8 individuals compared to 2-3) and the depth of the feeding areas which exceeds 100 m in some locations.

By Pat Gearin

CETACEAN ASSESSMENT & ECOLOGY PROGRAM

Cook Inlet Beluga Calf Survey

NMFS has been conducting annual aerial surveys to study the abundance and distribution of beluga whales in Cook Inlet, Alaska, each June or July since 1993. Late spring is an ideal time for conducting aerial surveys because of the relatively calm weather and long daylight hours. However, because belugas are known to calve between March and September (peaking in June and July), the annual abundance surveys may not accurately account for all calves of the year. Therefore, in order to examine the reproductive capacity and overall health of the stock, scientists from NMML and the NMFS Alaska Regional Office surveyed Cook Inlet 11-12 August 2005 with the intent to document the ratio of new calves (very small and dark, almost black) to yearlings (small and a dark gray) and adults (white) (Fig. 3). By conducting a survey in August in addition to the annual June survey, we assume that the data represent a period when most calves were born but before significant calf mortality has taken place.

Survey procedures used in August were similar to methods used in the annual abundance surveys. Approximately 10 hours were flown in a twin-engine, high-wing aircraft at an altitude of 244 m along tracklines 1.4 km offshore. Observers searched for whales on either side of the aircraft; however, unlike the annual abundance surveys, there was no attempt to conduct independent searches, and effort was focused solely on coastal areas where belugas were known to frequent.

After finding beluga groups, a series of aerial passes was made with observers counting surfacing whales while paired video and digital still cameras captured images for analyses. The digital video camera was used to document beluga groups and to allow precise documentation of whale counts as a function of viewing time recorded to 1/30 second. Counts from video will be used to determine abundance estimates with appropriate application of correction factors. A digital still camera was paired with the video camera to provide greater detail in detecting calves, which are darker than the adults and do not rise above the surface as much as white adults.

The sum of the aerial counts was 236 belugas for 11 August and 277 belugas for 12 August, numbers that represent a rough index of abundance uncorrected for missed whales. These counts were higher than uncorrected estimates from June during the past 7 years. Analysis of the video tapes and digital still images will determine whether or not the number of whales encountered in August was actually higher than in June, and the images will help establish the proportion of calves to juvenile and adult whales.

By Kim Goetz, Christy Sims, and Dave Rugh

Figure 3. A digital still image of an adult (white), juvenile (light gray), and calf (dark gray) taken during an aerial survey of belugas in Cook Inlet. Photo by Christy Sims.

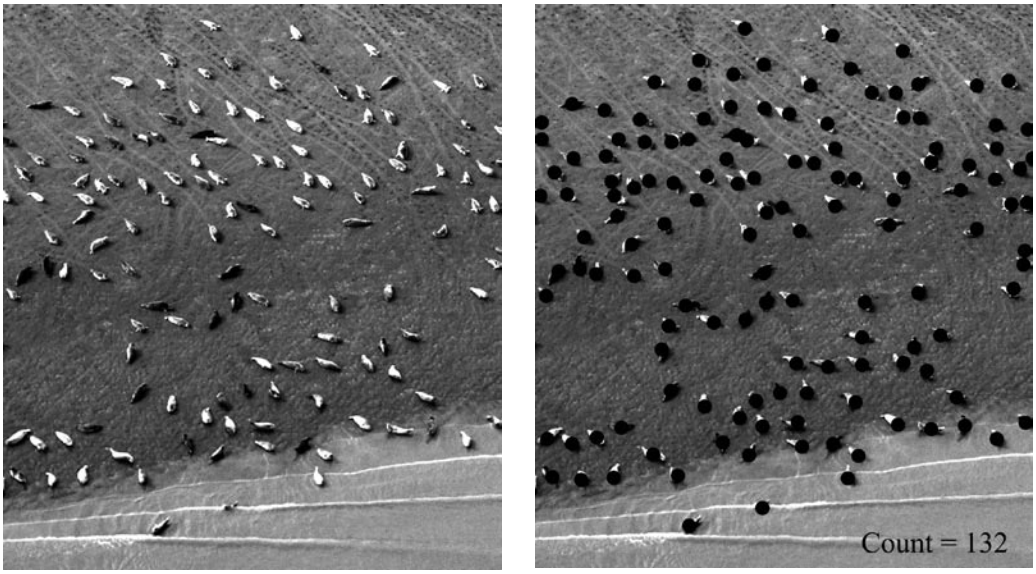


Figure 4. Aerial survey image of harbor seals on a sandbar in Bristol Bay, Alaska, (left) and that image after count processing in the laboratory.

POLAR ECOSYSTEMS PROGRAM

Harbor Seal Census in Bristol Bay and Along the Alaska Peninsula

The Polar Ecosystems Program (PEP) conducts aerial surveys for abundance of harbor seals in Alaska every August during the seals' molt, when they spend much of their time out of the water. For logistical purposes, Alaska is divided into five regions, and one region is surveyed each year. The five regions are the north side of the Alaska Peninsula and Bristol Bay (surveyed this year); Gulf of Alaska (2006), northern Southeast Alaska (2007), southern Southeast Alaska (2008), and the Aleutian Islands (2009). This year's surveys were conducted 10-25 August utilizing five aircraft and seven researchers from NMML, Alaska Department of Fish and Game (ADF&G), and U.S. Fish and Wildlife Service (USFWS). Routes were based out of Cold Bay, King Salmon, and Dillingham. All surveys were conducted within 2 hours on either side of low tide. Observers initially spent the first 3-4 days in reconnaissance covering the entire coastline in their zone. The location of all seals was recorded and marked as to whether the site was known from previous surveys or recently discovered. The remaining surveys were flown from site-to-site. Four to five replicate surveys were conducted to ensure adequate precision of the abundance estimates. High resolution digital cameras were used to photograph the seals. Image processing and counting will occur back at the laboratory during the next several months (Fig. 4).

By Dave Withrow

Photogrammetry Sampling of Molting Harbor Seals in Icy and Disenchantment Bays

PEP completed its field studies for 2005 on the disturbance of harbor seals by cruise ships in Disenchantment Bay, Alaska, near Yakutat. Nearby Icy Bay is not visited by cruise ships and is studied as a control. Both sites are tidewater glacial fjords where seals haul out on floating ice throughout the year. From May to September 2005, spanning the pupping and molting periods for harbor seals, Disenchantment Bay received about 170 visits from cruise ships. The Yakutat Tlingit Tribe relies on harbor seals for subsistence and has raised concerns about a perceived decline in the abundance of harbor seals since cruise ship visits began increasing from the 15 that occurred in 1989.

Nineteen aerial surveys were flown during the pupping season in late spring, producing about 41,000 digital images. Eighteen additional surveys were flown in July-September, producing an additional 24,000 images. These late summer surveys will provide a detailed time-series of information on abundance and distribution of harbor seals during their annual molt at glacial haulouts. Transects and images were spaced to provide a sample of the ice field (with seals) that represents about 15% of the total area. Harbor seal and ice distributions

will be mapped by analyzing the images in a GIS (geographic information system) and then modeled with other environmental covariates including measures of ship traffic. Throughout both survey periods, observers from the PEP and the Yakutat Tlingit Tribe continued to board cruise ships in Disenchantment Bay to collect data on ship movements and seal density in relation to ship approach distance. Meteorological data were collected via automatic weather stations installed at both sites. Because the molting season can be energetically demanding for seals, requiring them to haul out for longer periods without feeding when compared to other times of the year, the seals may be more sensitive during molting to disturbance by cruise ships.

In addition, large-format photogrammetry (AFSC *Quarterly Report* October - December 2004) of the entire area was conducted daily from 9-11 August 2005 to provide an estimate of the total number of seals present during molting. Although these surveys are part of our ongoing efforts to estimate the statewide abundance of harbor seals, we were able to conduct our sampling photogrammetry at the same time on each of the 3 days to allow for direct comparisons between the two methods. These comparisons will ultimately provide the means to cross-validate the two methods and examine potential biases.

By John Jansen and Shawn Dahle

RESOURCE ASSESSMENT & CONSERVATION ENGINEERING (RACE) DIVISION

GROUNDFISH ASSESSMENT PROGRAM

Sampling Efficiency Estimated for Poly Nor'eastern Trawl Used on Gulf of Alaska and Aleutian Islands Bottom Trawl Surveys

Animal density can be estimated from bottom trawl catch-per-swept-area data provided there is knowledge of the whole-gear sampling efficiency or the proportion of animals that are captured within the area spanned by the trawl doors. One approach to the estimation of whole-gear sampling efficiency is to consider it as a function of the efficiencies of herding, mesh retention, and other components of the trawl catching process, because such components are often more tractable to field experimentation and estimation. For flatfish, which are unlikely to pass over the trawl headrope or through the mesh and are herded only by the section of the lower bridle that is sufficiently close to the bottom to elicit a behavioral response, a mathematical model of trawl efficiency can be formulated as

$$E = \frac{k_n (W_n + hW_{on})}{W_d},$$

where W_n and W_d are the trawl net and door spread, k_n is the net efficiency or proportion of fish retained at the trawl footrope, W_{on} is the width of the area swept by the bridles and h is the fraction of the flatfish within W_{on} that are herded into the net path. Evaluating this model requires data from three distinct experiments. In this study, k_n was estimated from data obtained from a net efficiency experiment which consisted of attaching an auxiliary bag under the trawl to capture fish escaping beneath the footrope, h was estimated from data obtained from a herding experiment which consisted of repeatedly conducting trawl hauls in which W_d was varied by varying the length of the bridles, and W_{on} was estimated from data obtained on a bridle measurement experiment using bottom contact sensors to measure the off-bottom distance along the lower bridle. These experiments were directed at four flatfish species (flathead sole (*Hippoglossoides elassodon*), rex sole (*Glyptocephalus zachirus*), Dover sole (*Microstomus pacificus*) and arrowtooth flounder (*Atheresthes stomias*)) using the Poly Nor'eastern trawl, the standard trawl used by the AFSC on its bottom trawl surveys of the Gulf of Alaska and the Aleutian Islands.

Estimates of the herding coefficient (h) averaged 0.55 for the three sole species (rex sole=0.53; Dover sole=0.58; flathead sole=0.55), all of which were higher than arrowtooth flounder (0.391). Thus, roughly 40%-50% of the flatfish encountering the lower bridle were ultimately herded into the path of the net. Estimates of the net efficiency (k_n) for arrowtooth flounder, flathead sole and rex sole increase with fish length and reach maximum values between 0.85 and 0.95. Estimates of k_n for Dover sole, however, decrease with increasing size both because small fish were not sampled and because this species apparently becomes more adept at escaping under the footrope with increasing size.

Trawl efficiency (E) estimates for arrowtooth flounder, flathead sole, and rex sole increased with increasing fish length and reached maxima of 0.45, 0.42 and 0.43 (Fig. 1), indicating that slightly more than 40% of the largest individuals that passed be-

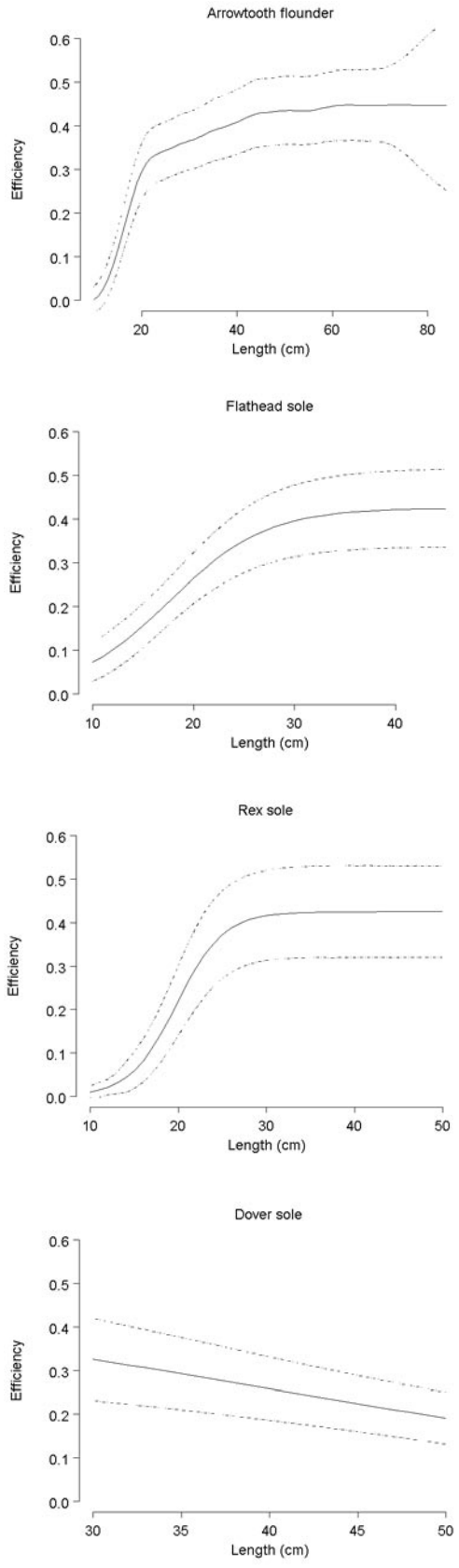


Figure 1. Efficiency of the 83-112 bottom trawl for arrowtooth flounder, flathead sole, rex sole and Dover sole as a function of total body length in cm. The dashed lines about each curve represent the 95% confidence intervals.

tween the doors of the trawl were ultimately caught. In contrast, the efficiency estimates for Dover sole were considerably lower over the sampled size range, and monotonically decreased with increasing length.

Since bottom trawl surveys conducted by the AFSC calculate swept area in terms of wing spread rather than door spread, as is the convention for most International Council for the Exploration of the Sea (ICES) sponsored surveys, to be useful in stock assessment models the above values must be multiplied by the quotient of the door spread and net spread, which for the Poly Nor'eastern trawl is approximately equal to 3 (47.8 m/16.1 m). Thus maximum efficiency for these species is slightly greater than 1.2. Details of this study are available in a draft manuscript by Dave Somerton, Peter Munro, and Ken Weinberg titled "Whole-gear efficiency of a benthic survey trawl for flatfish."

By David Somerton

Atka Mackerel Natural History Studies

Atka mackerel (*Pleurogrammus monopterygius*) spawn demersally in rocky areas, and nests comprised of egg clutches are defended by guardian males. Reproductively mature male Atka mackerel aggregate at specific nesting sites along the Alaskan continental shelf. Aggregations of nesting males, the developing embryos in the nests that males guard, and the nesting habitat itself are all vulnerable to the effects of bottom trawling. The potential impact of trawl fishing on Atka mackerel populations cannot be assessed without first understanding how the spatial and temporal aspects of their reproduction overlap with the commercial fishery.

The geographic distribution, depth range, and description of Atka mackerel nesting and spawning habitat were investigated in Alaska waters from 1998 to 2004. Scuba diving and *in situ* and towed underwater video cameras were used to locate and document Atka mackerel nesting sites and reproductive behavior. Results from this study extend the geographic range of nesting sites from the Kamchatka Peninsula to the Gulf of Alaska and extended the lower depth limit for nesting and spawning from 32 m to 143 m. There was no apparent concentration of nesting sites in nearshore coastal areas as was surmised by other investigations. Nesting sites were widespread on the continental shelf across the Aleutian archipelago and into the western Gulf of Alaska. Nesting habitat invariably had rocky substrate and current, and water temperatures for nesting sites ranged from 3.9° to 10.5°C. Water

temperatures within nesting sites varied little and did not appear to be limiting the upper or lower depth boundaries of nesting.

The temporality of the Atka mackerel spawning and nesting season in Alaska is currently being investigated using a towed video camera, time lapse camera, archival tags, and egg samples brought up in trawls. Using the time lapse camera and data from one archival tag, it was established that male Atka mackerel begin to aggregate at nesting sites in mid-June. In Kamchatka, nesting was found to start at the same time and spawning to last until September. Incubation for Atka mackerel eggs was determined as 40-45 days; hence, it was inferred that nesting season off Kamchatka lasted until early October.

Histological analysis of Atka mackerel ovaries by AFSC scientists indicate spawning lasts through October in Alaska waters, however, the ending time for nesting season remains unclear. As late as October, aggregations of nest guarding males were observed in Alaska waters with a towed video camera, and egg masses were brought up in trawl tows done through a nesting site. No effort has been made later into the year to see if aggregations of males or egg masses are present in November and December.

Recent laboratory incubation experiments of fertilized eggs obtained from the field and from fish in captivity at the Alaska SeaLife Center in Seward indicate that incubation of eggs lasts from about 1 to 3 months depending on temperature (at 10°C and 4°C, respectively). If eggs are being deposited in nests in October, it is likely that males are still guarding incubating eggs at nesting sites through November or December. The towed video camera will be used at a known nesting site near Dutch Harbor, Alaska, in late November or early December 2005 to see if aggregations of males are still guarding incubating eggs.

Other means besides histology and underwater video are being used to determine the end of the spawning and hatching periods. Incubation rates from laboratory experiments will be used to stage over 100 egg clutches brought up from trawl tows made through nesting sites. Eggs will be staged according to their embryological development. Historical temperature data from the areas near the nesting site where eggs were collected will be used to estimate the range of spawn and hatch dates for the egg samples.

By Robert Lauth

2005 Gulf of Alaska Biennial Groundfish Assessment Survey Completed

The fourth in the series of biennial bottom trawl surveys of Gulf of Alaska (GOA) groundfish resources was conducted from 18 May through 6 August 2005. Prior to establishing a biennial schedule in 1999, groundfish resources in the GOA had been surveyed by the RACE Division triennially beginning in 1984. The GOA triennial surveys covered the continental shelf (out to 500-m depth), but only included portions of the continental slope in 1984 (to 825 m) and 1987 (to 750 m). The GOA survey has been repeated on a biennial schedule since 1999. The biennial surveys were designed to cover the continental shelf and slope between the Islands of the Four Mountains (long. 170°W) and Dixon Entrance (U.S.-Canada border in Southeast Alaska) out to the 1,000 m depth contour. While the 1999 survey succeeded in sampling the entire area, the 2001 survey area was reduced because the Division's survey responsibilities were stretched across three major areas that year under limited funding. Consequently, the 2001 survey area did not include the area east of long. 147°W, nor did it extend deeper than 500 m. The 2003 survey covered the entire geographic range, but vessels were only capable of sampling to depths of 700 m. This year the survey covered the entire geographic and depth extent of the survey area.

Sampling was conducted aboard three chartered commercial trawlers: the *Gladiator*, which worked for 65 days between 18 May and 21 July, and the *Sea Storm* and the *Northwest Explorer*, which each worked 80 days between 18 May and 6 August. The survey period was divided into four legs of approximately 20 days each (the *Gladiator's* cruise ran for three legs lasting about 22 days each). Sampling began near the Islands of Four Mountains and progressed eastward on the continental shelf and slope to the U.S.-Canada border in Southeast Alaska. Originally, 777 stations were allocated among 54 depth and geographic strata and were preselected randomly from a grid of potential sites overlaying the survey area. If rugged bottom or heavy commercial fishing prevented sampling a station, a nearby alternate station was selected. By early July it became apparent that the vessels were significantly ahead of schedule. Another 109 stations were allocated to strata east of long. 154°W and most of these were also completed by the end of the survey. Of the 905 attempted standard survey tows, 839

were successfully completed, ranging in depth from 22 to 882 m.

The primary focus of the biennial groundfish surveys is to build a standardized time series of data designed to assess, describe, and monitor the distribution, abundance, and biological condition of various GOA groundfish stocks. Specific objectives of the 2005 survey, as in others preceding it, were to

1. Define the distribution and relative abundance of the principal groundfish and invertebrate species inhabiting the continental shelf and slope of the GOA.
2. Collect data to define various biological characteristics of major groundfish species, such as age, sex, size, growth rates, length-weight relationships, and feeding habits.
3. Collect integrated fishing performance, net configuration, and position data for all trawl hauls with which to derive precise effort estimates.
4. Collect environmental data such as surface-to-bottom water column temperatures.
5. Collect biological specimens and data requested by scientists from the AFSC or other cooperating research groups.

Preliminary results have been analyzed from the survey data and estimates of abundance and size composition have been turned over to stock assessment authors. Results will be finalized soon following further examination of the effort data for each tow.

Over the entire survey area, the most abundant species in 2005 were, in order, arrowtooth flounder, Pacific ocean perch, giant grenadier, Pacific halibut, walleye pollock, northern rockfish, and Pacific cod. We can compare the 2005 abundance estimates with the 2003 results in all areas and in all depths except the deepest (700 – 1,000 m) depth stratum. Since 2003, increases in the estimated abundance were seen for Pacific ocean perch, by 68% to 766,400 t; northern rockfish, by over 400% to 359,000 t; giant grenadier, by 48% to 587,000 t; and Pacific cod, by 4% to 308,000 t. Reduced biomass estimates were seen for arrowtooth flounder, by 33% to 1,900,000 t; halibut, by 11% to 565,000 t; and pollock, by 11% to 378,000 t.

By Mark Wilkins

MIDWATER ASSESSMENT & CONSERVATION ENGINEERING (MACE) PROGRAM

Oscar Dyson Gulf of Alaska Survey

An echo integration-trawl survey of the GOA was conducted 1-30 July 2005 using the NOAA research vessel *Oscar Dyson*. The principal objective of the survey was to collect echo integration and trawl data to estimate walleye pollock abundance and distribution. The survey originally began on 1 June but the vessel returned to Kodiak on 3 June because of mechanical problems. Repairs were completed and the cruise resumed on 1 July. Pre-existing equipment problems mandated a 5-nautical mile (nmi) minimum distance from shore for safety concerns. This limitation prevented the vessel from surveying along the proposed trackline where significant pollock quantities were found during the 2003 GOA survey, including the Shumagin Islands area, Nakchamik Island, Alitak Bay, and Marmot Bay.

Acoustic data were collected with a Simrad EK60 quantitative echosounding system operating at four frequencies (18, 38, 120, and 200 kHz). Results presented here are based on 38 kHz data. Midwater and near-bottom echosign was sampled using an Aleutian Wing (AWT) 30/26 midwater trawl. On- or near-bottom echosign was sampled with a Poly Nor'eastern (PNE) trawl with roller gear. A midwater Methot trawl was used to target age-0 pollock and macrozooplankton. The survey design consisted of parallel transects at 20-nmi spacing along the GOA shelf and shelfbreak from the Islands of Four Mountains eastward to near the Shumagin Islands and then along the shelfbreak and seaward from the Shumagin Islands to Amatuli Trough (Fig. 2). Alternate transect pairs extended about 30 nmi beyond the shelf break. Barnabas and Chiniak Troughs were also surveyed using 6-nmi spacing and Shelikof Strait was surveyed using 10- or 20-nmi spacing. Echo integration and trawl data were collected along the transects only during daylight hours. Nighttime operations included additional trawling effort, physical oceanographic sampling, and rerunning portions of the tracklines for day-night comparisons.

Pollock was the most abundant species caught in the 28 AWT hauls, comprising 59% of the total catch by weight, followed by Pacific ocean perch (35%). In the 10 PNE trawl hauls, Pacific ocean perch (32%) was the most abundant species caught,

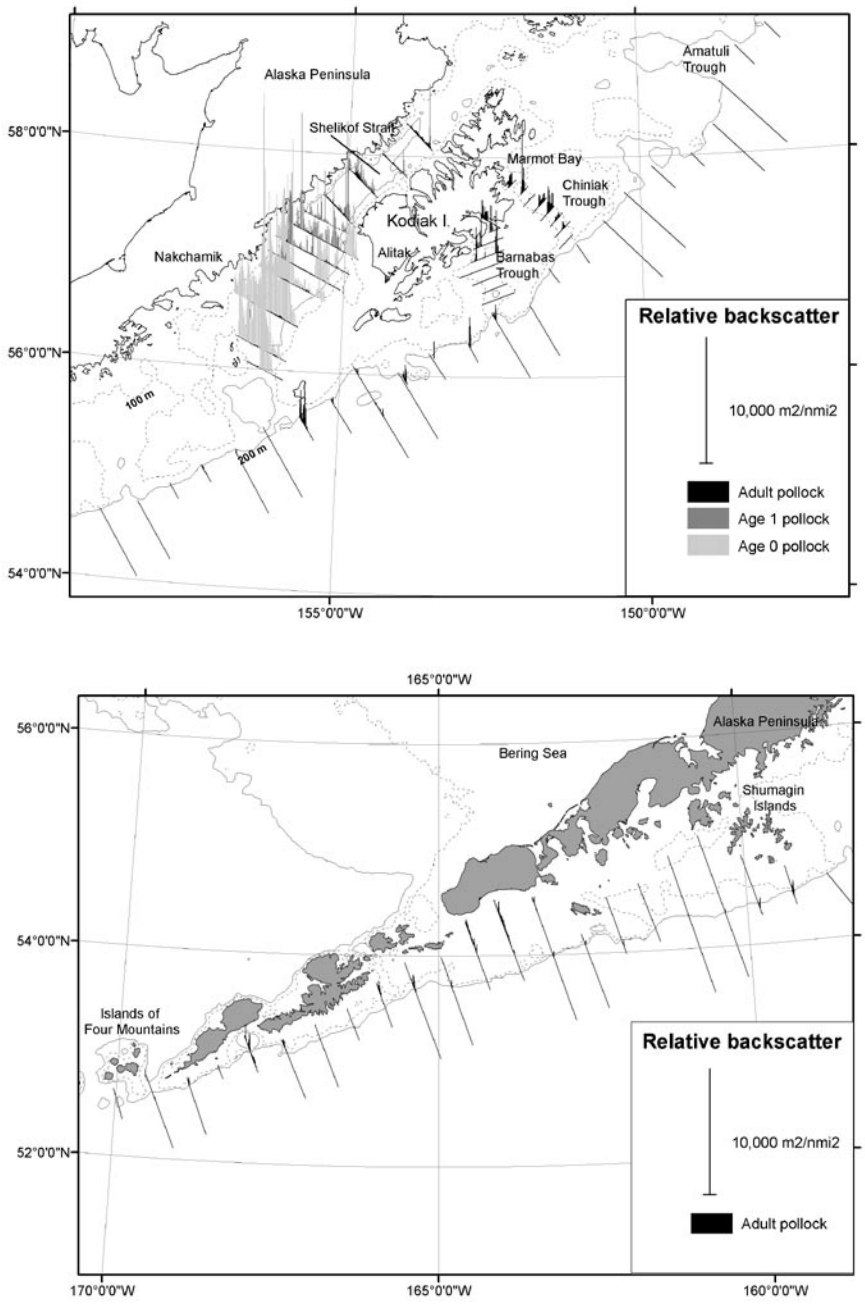


Figure 2. Relative backscattering attributed to pollock along tracklines during the 2005 echo integration-trawl survey in the Gulf of Alaska, OD2005-01.

followed by pollock (20%) and Atka mackerel (20%). Euphausids (41%) were the dominant species in Methot trawls. Most of the adult pollock echosign was detected in Chiniak and Barnabas Troughs and along the shelfbreak south of Kodiak Island (Fig. 2). Dense age-0 and age-1 echosign was detected in the southern part of the Shelikof Strait sea valley. No pollock were detected along the offshore transects.

By Mike Guttormsen

FISHERIES OCEANOGRAPHY COORDINATED INVESTIGATIONS (FOCI)

The Ecosystems and Fisheries-Oceanography Coordinated Investigations Program (Eco-FOCI) recently completed a cruise on board the NOAA ship *Fairweather* (July 2005). The *Fairweather* platform provided the unique opportunity to investigate climate-biological interactions in the east Kodiak region of the GOA during the summer. The cruise was a joint effort of two NOAA Line Offices (NMFS and the Office of Oceanic and

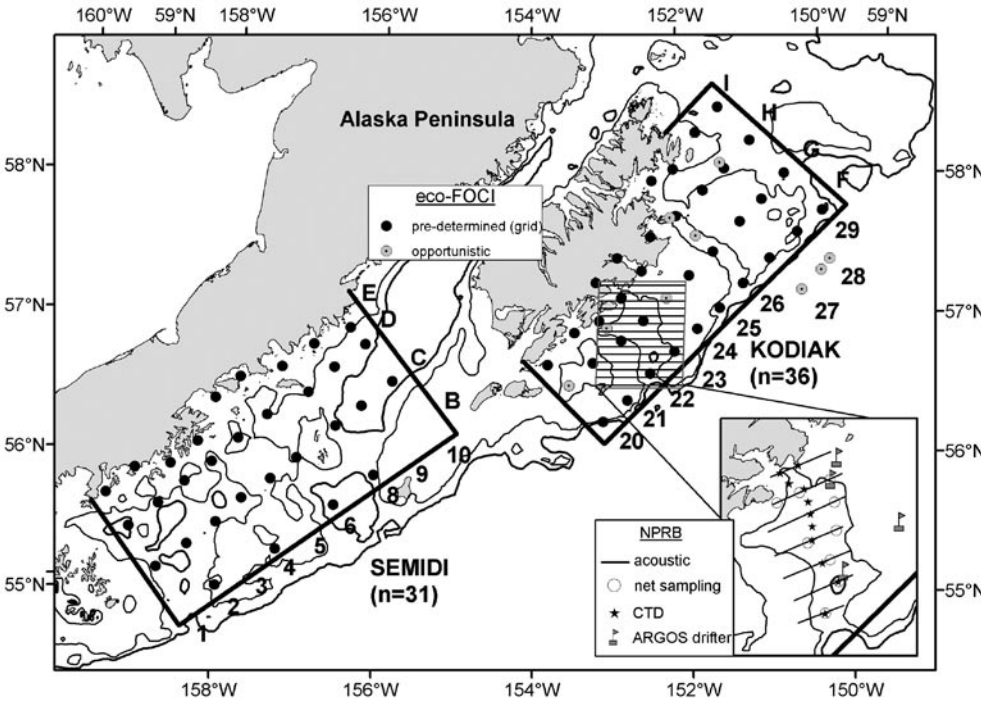


Figure 3. Location of stations occupied during the fall Eco-FOCI cruise aboard the NOAA ship *Miller Freeman*, 5-19 September.

Atmospheric Research) to examine how nutrients, phytoplankton, zooplankton, and ichthyoplankton over the continental shelf are advected to nearshore juvenile fish nursery areas. Climate variability can affect this transfer of production by modifying the paths of the Alaska Coastal Current and the Alaska Stream, potentially affecting the fish that utilize the nearshore areas as nursery grounds in the late spring and summer. Biological sampling included bongo and Tucker trawls to provide new information on the distribution of larval and juvenile fish and zooplankton. Oceanographic observations included deployment of satellite-tracked drifters to study eddy formation and current trajectories, and conductivity-temperature-depth (CTD) samples to provide much-needed summer collected information on phytoplankton biomass and distribution, and on nutrients that feed the continental shelf trophic web. Oceanographic and biological observations from this research cruise will be integrated to provide a clearer picture of how the GOA ecosystem may respond to climate forcing during summer.

In addition to this valuable climate-ecosystem research, we were also able to accomplish additional sampling for several other studies. We conducted multiple CTD casts in Barnabus Trough that will be used to characterize a local oceanographic front which may keep aggregations of fishes (pollock and capelin) separated. We were also able to occupy a series of stations that will compliment studies conducted by ABL scientists on seafloor habitat, and we were able to collect samples of northern rock sole larvae which will be used in ageing studies conducted at the AFSC Newport laboratory. Northern rock sole samples will be used to provide information on the duration of time to settlement between the pelagic larval and benthic juvenile phases.

In all, the cruise was highly successful in meeting its objectives thanks in large part to the multimission capabilities of the *Fairweather* and to her officers and crew. The vessel provided an excellent platform for work by the Eco-FOCI program, and gave us an opportunity to obtain much-needed information on the functioning and dynamics of the GOA ecosystem during summer.

By Janet Duffy-Anderson

Recruitment Processes

During 5-19 September, Eco-FOCI conducted a research cruise aboard the NOAA ship *Miller Freeman*. The primary cruise objective was to collect data and samples for studying geographic variation in the productivity of forage fishes in two regions within the western GOA (Fig. 3). The fishes targeted in this study were capelin, eulachon, and age-0 juvenile walleye pollock. These species are abundant in midwater and eat zooplankton. They are also important prey for larger organisms such as fish, ma-

rine mammals, and seabirds. Walleye pollock is a major component of the groundfish fishery in the GOA and Bering Sea.

Occupation of stations in the Semidi Island region extended a 3-year study that began in 2000 on the distribution of forage fishes and their prey. Around the Semidi Islands, prey levels for forage fish in the Alaska Coastal Current (ACC) appear to be higher than outside the current. In contrast, the Kodiak region is not greatly influenced by the ACC but appears to have high prey levels for forage fish.

Environmental data and samples of zooplankton and fish were collected at each of 67 predetermined grid locations. In each study region, the targeted fishes comprised 67% of the catch by number, but only 5% by weight due primarily to the prevalence of large jellyfish. Nine additional trawl tows were conducted opportunistically to identify echo-sign, or to collect potential forage fish predators.

A secondary cruise objective, supported by the North Pacific Research Board (NPRB), was to examine zooplankton abundance and composition as a mechanism for geographic separation between capelin and sub-adult walleye pollock in the Barnabus sea valley (Fig. 3 inset). ARGOS drifters and CTD casts were used to measure water flow (at 40 m) and identify water masses within the sea valley. Subsequent acoustic transecting and net sampling was used to collect zooplankton and fishes from the different water masses. Capelin and age-0 juvenile walleye pollock comprised 30% and 60% of the catch by number.

By Matthew Wilson

NEWPORT LABORATORY

Fish Behavior and the Performance of Baited Fishing Gear

The effectiveness of baited fishing gear ultimately depends upon behavior of the target species—activity rhythms, feeding motivation, and sensory and locomotory abilities. While any environmental parameter that mediates feeding or locomotion can have an important influence on the active space presented by the bait and fish catchability, few biologists have considered how such variation in behavior might affect catch per unit effort (CPUE) and the resultant stock abundance estimates or population parameters. A review article was published last year (Stoner, 2004) showing that environment-related variation in feeding behavior can act through four different mechanisms: metabolic processes, sensory limitations, social interactions, and direct impacts. Water temperature, light level, current velocity, and ambient prey density are likely to have largest effects on fish catchability, potentially affecting variation in CPUE by a factor of ten. Feeding behavior is also density-dependent, with both positive and negative effects. Over time and geographic space, a target species can occupy wide ranges of environmental conditions, and in certain cases, spatial and temporal variation in feeding biology could have a larger impact on CPUE than patterns of abundance. Temperature, light and current can be measured with relative ease and corrections to stock assessment models are feasible. Making corrections for biological variables such as prey density and bait competitors will be more difficult because the measurements are often not practical and relationships to feeding catchability are more complex and poorly understood. There is a critical need for greater understanding of how environmental variables affect feeding-related performance of baited fishing gear. A combination of field observations and laboratory experiments will be necessary to parameterize stock assessment models that are improved to accommodate variation in fish behavior. Otherwise, survey data could reveal more about variation in behavior than abundance trends.

A new tool being used at the AFSC to observe the behavior of fishes around fishing gear is DIDSON (Dual-frequency Identification SONar), a high frequency acoustic camera that provides multiple high resolution images per second across a 29º fan-shaped sector with a range out to 10 m or more. Resolution is sufficient to show the body shapes of adult fish, while rapid update frequency allows individual fish to be tracked through the image. Experiments conducted during summer 2005 in the Fisheries Behavioral Ecology Program's seawater laboratory in Newport, Oregon, show that sablefish and some rockfishes (*Sebastes* spp.) demonstrate strong negative responses to artificial lighting, even at low levels. Therefore, field observations with an acoustic camera (requiring no light) present a large advantage. Acoustic cameras can also provide images in water too turbid for video cameras.

RACE biologists used DIDSON during May 2004 to observe the behavior of sablefish and Pacific halibut around baited fish pots and baited hooks in the deep shelf environment (220-366 m depth) off

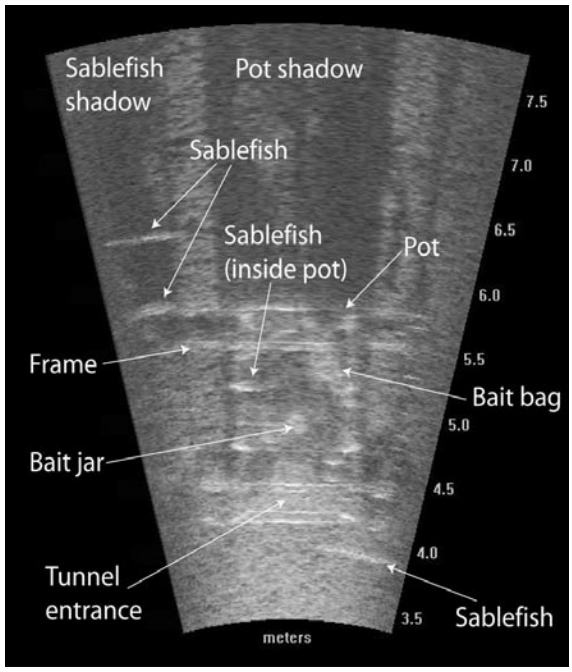


Figure 4. Example of an acoustic image provided by the DIDSON acoustic camera in fixed configuration and equipped with a standard Oregon sablefish pot. Sablefish (average total length = 70 cm), the pot frame, and other labeled features are visible.

Oregon**.** The acoustic camera, tested to a distance of 9.7 m (11.5-15.6 m^2 field of view), provided continuous high resolution imagery of approaches to the gear, entry into pot tunnels, bait attacks, and escapes. Fish inside and beyond the fish pot could also be observed (Fig. 4). Fishes, including small individuals and bait thieves (>20 cm), could be measured and tracked in the digital images. Concurrent observations with a low-light video camera and infrared lighting yielded a field of view of approximately 1 m^2, limited to just one side of the fish pot. A large proportion of the videotape produced was unusable because of turbidity, and the patterns of fish movement around the pots and baited hooks were poorly characterized by the video camera. The large field of view provided by the acoustic camera showed that a very low percentage of sablefish and halibut approaching the gear were captured. Observations on different gear types, including fish pots with and without tunnel triggers, provide insights into how acoustic camera imagery can be used to improve our understanding of fish behavior in the natural environment, to design increasingly selective and efficient fishing gear, and to improve bait-dependent stock assessments. A manuscript stemming from this investigation is currently in press

Research with baited gear continued in Kodiak during summer 2005, with the goal of observing patterns of fish attraction, bait attacks, and hooking efficiency under different conditions of bottom current and fish density. We were also interested in observing bait loss and competition among different species. The targeted species were Pacific cod and Pacific halibut. The required observations were made with a low-light camera suspended 1.8 m above a large rectangular frame where 10 circle hooks were baited with herring. The camera system was equipped with sensors to record depth, temperature, light level, and current speed and direction. Video was fed live to the surface and recorded in digital format for subsequent analysis. Forty-five deployments of the drop camera system were made over a 1-week period, with successful observations on both target species. Videotapes from this preliminary project await detailed analysis; however, large numbers of both target species were captured and observations were recorded for hundreds of contacts with the gear and interactions among individuals. It is already clear that fish arrivals, attacks on baits, and fractions hooked are highly dependent upon current speed, and the patterns of behavior vary by species. It is also apparent that unwanted bycatch, bait thieves, and competitive interactions among both species and size classes can greatly impact the catch. These experiments enhance our interpretation of surveys conducted with long-lines and fish pots.

By Allan Stoner

RESOURCE ECOLOGY & FISHERIES MANAGEMENT (REFM) DIVISION

RESOURCE ECOLOGY AND ECOSYSTEM MODELING PROGRAM

Fish Stomach Collection and Lab Analysis

Laboratory analysis was performed on 2,265 groundfish stomachs from the eastern Bering Sea and 1,140 stomachs from the Aleutian Islands region. Shipboard analysis of 1,362 stomachs from the eastern Bering Sea and 1,864 stomachs from the Gulf of Alaska (GOA) were conducted during the 2005 summer field season. During this quarter, no stomachs were returned by observers, and 807 stomachs were returned from research vessels in the

Bering Sea or the GOA. In total, 15,463 records were added to the groundfish food habits database.

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

Seabird Interactions

The Resource Ecology and Ecosystem Modeling Program (REEM) Seabird Program participated in field experiments to test first-generation seabird deterrent devices for trawl catcher-processor vessels. The devices were developed by the pollock fishing industry, represented by the Pollock Conservation Cooperative (PCC). Funding for development of the gear was supplied by the PCC and the NMFS National Cooperative Research Program. The field tests were completed using two pollock catcher processors for two trips each in the Bering Sea during July and August. The field component of this work was led by Ed Melvin of Washington Sea Grant. Funding to support the fieldwork was supplied by the U.S. Fish and Wildlife Service and by NMFS. Washington Sea Grant is compiling, editing, and analyzing the data and will produce a report describing the protocols and results. Three devices were tested: paired streamer lines, side boom arrays, and a third wire block.

By Shannon Fitzgerald

ECONOMICS & SOCIAL SCIENCES RESEARCH PROGRAM

Economic Status Report for the Groundfish Fisheries Off Alaska 2004

The economic status report for the Alaska groundfish fisheries has been completed and was included in this year's Stock Assessment and Fisheries Evaluation (SAFE) report. The report includes information on catch (by area, gear, species, and residency of vessel owner); value (both exvessel value and gross product value); prices (for catcher vessels, catcher-processors, shoreside processors, and motherships); prohibited species bycatch; discard totals and discard rates; number of vessels operating; total registered net tonnage; weeks spent fishing; number of vessels and plants with observers; observer deployment days and estimated observer costs; U.S. per capita consumption of fish and shellfish, fillets and steaks, and fish sticks and portions; producer and consumer price indexes; foreign exchange rates; and cold storage holdings of groundfish fillets and blocks. In addition, the report includes an appendix detailing recent research undertaken by the Economics and Social Sciences Research Program (ESSRP) staff, including a project to profile communities in Alaska; a study of fishing crew demographics; an analysis of economic impacts of the Steller sea lion conservation area; a prospectus for market analysis of Alaska pollock; and a study to determine the public's value of Steller sea lion protection. Additional details on these and other ESSRP research activities, will be available on the AFSC website at http://www.afsc.noaa.gov/refm/stocks/assessments.htm.

By Ron Felthoven

Halibut Sport Fishing Survey

The halibut sport fishery in Alaska is large. During 2000, for instance, over 400,000 halibut were harvested by sport anglers in the state. In recent years, several regulatory changes have been proposed that could significantly impact the sport fishery. To assess the impacts of pending and potential regulatory changes on sport angler behavior, it is necessary to have estimates of the baseline demand for halibut fishing trips and an understanding of the factors that affect it. To this end, Dan Lew has been working with Doug Larson (University of California, Davis) to develop a survey that will gather data from Alaska sport anglers for estimating demand and understanding angler preferences. From July through September, focus groups and one-on-one interviews were conducted with Alaska recreational anglers in several cities in Alaska and other parts of the nation. These activities were used to identify problem concepts and questions and to refine and improve the survey. With the completion of these activities, the qualitative pretesting stage of the project is complete, and efforts to obtain OMB approval under the Paperwork Reduction Act for the data collection stage are under way.

By Dan Lew

Recreation Demand Modeling Issues

Economists have recognized that when one estimates the demand for certain recreational activities, one should account for the time individuals must spend while traveling to the recreation site, as well as the time spent during the recreation activity itself. Failure to account for time can bias demand estimates and the economic welfare estimates of that activity. As a result, researchers have developed numerous approaches to include travel and recreation

time in these models, many based on using the wage rate, or a fraction of the wage rate, as a proxy for the unobserved opportunity cost of time. These methods invariably ignore the fact that opportunity costs of time are measured with error. The recently published paper "Accounting for Stochastic Values of Time in Discrete-Choice Recreation Demand Models," by Dan Lew and Doug Larson (UC Davis) develops and estimates a recreation demand model that explicitly accounts for the value of time. The model results are compared to the conventional non-stochastic approach of modeling opportunity costs of travel time in recreation demand models. A model simulation illustrates how ignoring the stochastic nature of opportunity costs of time in recreation demand models can lead to biased results.

By Dan Lew

Estimating Historical Employment Data Under NAICS System for Alaska Fisheries

Recently, the way in which industries are classified was changed from the Standard Industrial Classification (SIC) system to the North American Industry Classification System (NAICS). Following this change, both the federal and state governments changed their data reporting system from SIC to NAICS. As a result, a lack of consistency in the time-series employment data has arisen, which severely limits analysis of the economic impacts of seafood industries on fishery-dependent regions and boroughs in Alaska. A NMFS-funded project is now under way to convert the Alaska monthly employment data in the old system (the data for year 2001 and earlier years) to the new NAICS system. The consistent data set to be generated for fishery-dependent regions and boroughs will serve as an important data set for assessing economic impacts of fisheries. Converting the longstanding SIC database to the NAICS format will add a significant number of observations to the monthly employment data set, and will likely lead to improved model results. This project is being conducted by economists at the Alaska Department of Labor and Workforce Development with NMFS oversight.

By Chang Seung

Integrated Regional Economic-Ecosystem Modeling Project

The growing emphasis by NOAA on adopting an Ecosystem Approach to Management (EAM) to replace single-species fisheries management presents a challenge to biologists and economists who must be concerned with the highly adaptive nature and interconnectedness of ecosystems and economic systems. In Alaskan marine ecosystems, commercially valuable species share relationships with many other species that provide few direct benefits to humans but play an integral role in sustaining productive fisheries. Analogous relationships exist within the Alaskan economy; commercial fishing and other industries draw inputs from the same pools of capital and labor resources and they sell their resulting outputs to consumers. Therefore, the policies governing the fisheries of Alaska will have wide-ranging impacts throughout both Alaskan marine ecosystems and the Alaskan economy. In such situations, general equilibrium models may be used to evaluate the impacts of fishery policies, and ideally would jointly capture the interconnected nature of both the physical and economic environment. Although economies and ecosystems are interconnected, integrated models that link ecosystems and economies have not been adequately developed. This is in part due to their complexity, but also because of the unique nature of the Alaskan economy. Based on the concept of "general equilibrium of an ecosystem" and well established concept of economic general equilibrium, this project attempts to develop an integrated model of multi-species marine ecosystems and regional economies for Alaska fisheries. The goal of the project is to begin developing an integrated ecological/regional economic model for Alaska that can serve as a decision-making tool for EAM management and for better satisfying National Standard 8. Researchers at the University of Wyoming and AFSC economist Chang Seung are working jointly on this project.

By Chang Seung

Measuring Fishing Productivity for the Pollock Catcher-Processor Fleet

Traditional productivity measures have been much less prevalent in fisheries economics than other measures of economic and biological performance. It has been increasingly recognized, however, that modeling and measuring fisheries' production relationships is central to understanding and ultimately correcting the repercussions of externalities and poorly designed regulations. Ron Felthoven and Catherine Morrison Paul (at the University of California, Davis) completed a manuscript that uses a transformation function production model to es-

timate productivity and its components for catcher-processors operating in the Bering Sea and Aleutian Islands pollock fishery for 1994 to 2003. Their research recognizes the roles of externalities from pollock harvesting by incorporating data on environmental conditions, bycatch, and biomass stock, and captures regulatory impacts through fishing strategy indicators and fixed-effects econometric methods. The authors find that the productive contributions and interactions of environmental conditions, bycatch, and fishing strategies are statistically significant, and that regulatory changes have had both direct and indirect impacts on catch patterns.

By Ron Felthoven

Economic Data Collection Program Begins in Bering Sea and Aleutian Islands Crab Fisheries

The AFSC has received hundreds of economic data reports (EDRs) from Bering Sea and Aleutian Islands crab fishery harvesters and processors during the past quarter. The EDRs contain historic data on cost, revenue, ownership, and employment from the years 1998, 2001, and 2004. Our contractors, Pacific States Marine Fisheries Commission, have subcontracted with a company to have the data coded from the existing paper format into an electronic database.

By Ron Felthoven

Spatial Fisheries and Bycatch Modeling

During the past quarter, Alan Haynie has completed a draft of a paper (joint with David Layton at the University of Washington (UW)) that estimates the economic impact of the closure of the Steller Sea Lion Conservation Area (SCA). In related work, Haynie and Layton have further developed and extended the methods that are applied in the SCA valuation paper to examine fishers' reactions to various types of spatial closures (e.g., marine sanctuaries, marine protected areas (MPAs), essential fish habitat (EFH). Alan's research has also continued to focus on developing a new modeling technique for Bering Sea flatfish fisheries. Specifically, this paper will model dynamic intra-trip behavior and examine whether fishers change their bycatch avoidance strategy as the fleet approaches bycatch limits. During this quarter, Alan has interviewed industry representatives and Alaska region staff, developed a dataset for analysis, and worked with co-authors on model development.

By Alan Haynie

STATUS OF STOCKS & MULTISPECIES ASSESSMENT PROGRAM

Development of the Species Assessment of Concern for the BSAI and GOA FMP

In December 2001, the North Pacific Fishery Management Council's (NPFMC) Scientific and Statistical Committee (SSC) requested that AFSC and NPFMC staff meet to discuss management issues associated with non-target species. An ad hoc group was formed to 1) discuss whether alternative management measures were necessary to enhance protection of non-target species, 2) begin looking at possible ways to evaluate alternative management measures, and 3) determine which species would best be served by alternative management measures. In 2004, the NPFMC formed the Non-Target Species Committee which included one member from the AFSC. The committee concluded that it should first define the level of concern for each non-target species or species complex.

In May 2005, AFSC scientists from the AFSC met to assist the Non-Target Species Committee in developing an assessment that included criteria for evaluating the level of concern for non-target species. A series of meetings subsequently followed that led to the identification of criteria based on a variety of information for each candidate species. AFSC scientists further expanded these criteria and incorporated them in the form of a worksheet called the Species Assessment of Concern (SAC). The creation of the SAC was also prompted by ongoing work on rockfish and the need to evaluate whether revising management measures were necessary to enhance the protection of non-target rockfish species. The SAC provides an objective method for identifying nontarget species that may be of immediate concern.

The goal in the development of the SAC was to identify which species or complex may be in most need of management action. The SAC does not provide recommendations for the mitigation of those species most impacted by fishing, nor does it provide research priorities for those species whose life histories are poorly known. Each SAC, however, does provide critical information that might aid in future decision-making processes. Further information can be found in each species or species complex respective stock assessments.

The criteria in the SAC are based on sets of key information that best illustrate a species or species complex level of concern: Productivity, Fishery

Interactions, Abundance Trend, and Catch Trend. The first step of the SAC determines the productivity of the species or species complex based on key life history parameters. The second step determines the fishery impact level of concern (FILC). In this part of the SAC, the level of fishery interactions, and fishery and survey data are used to assess whether a species or species complex interaction with any fishing activities is at a level of concern. Species that are found to be at a high level of concern due to fishing impacts are those whose exploitation rate (catch/biomass) is higher than the maximum allowable Tier 5 ABC (acceptable biological catch) fishing mortality rate (0.75 x natural mortality rate (M)) and whose data quality is ranked as "good". Each section, except Fishery Interactions, is qualified with a data quality section. For Abundance Trend, the data quality is based on the AFSC's RACE Division survey coefficient of variation (CV); catch trend data quality is determined by data reliability (which is based on how the catch data were obtained); and Productivity data quality is based on whether the life history parameters are from the same species for the appropriate area within Alaska or from the same or similar species in another area outside of Alaska.

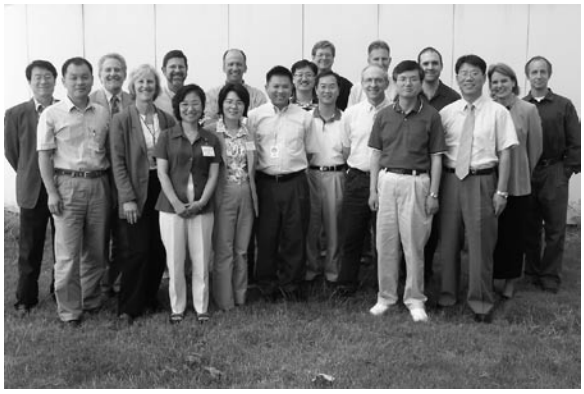
Other information to determine species assessment of concern that is not discussed in the SAC worksheet are: the role of the species in the ecosystem, habitat restrictions, and recommendations for mitigating those species found to be most impacted by fishing effort. The SAC will be presented to the NPFMC SSC during the October 2005 meetings.

By Rebecca Reuter and Todd TenBrink

Fourth Annual Bilateral Conference on Fisheries Sciences Between the United States and the Republic of Korea

The AFSC hosted the fourth annual bilateral conference on fisheries sciences between the United States and the Republic of Korea on 12-13 July 2005. This conference was attended by 16 scientists. The conference focused on three major themes: 1) new perspectives on ecosystem approaches to management, 2) monitoring fishes and fisheries, and 3) evidence of oceanographic change and prediction of climate impacts on future stock production. Conference participants discussed a wide variety of topics including Korean and Alaskan groundfish fisheries management and stock status; stock assessment research incorporating environmental factors; habitat and bycatch impacts; and issues associated with data collection and data management needs. The group also discussed opportunities for cooperative research between the two countries. Both parties agreed to pursue the following activities in 2006:

- Convening the 5th Bilateral Meeting in Busan, Korea in May 2006 with an exact date to be determined.
- Training and collaboration in 2005/06 on climate change and fisheries.
- Training on ecosystem-based assessment and management.
- Convening a workshop on fisheries resource management and development of rebuilding plans.



Participants in the fourth annual bilateral conference on fisheries sciences between the United States and the Republic of Korea.

By Anne Hollowed

American Fisheries Society/Lowell Wakefield Symposia Presentations

Staff from the Status of Stocks and Multispecies Assessments Program attended the American Fisheries Society (AFS) and Lowell Wakefield Symposia in Anchorage, Alaska, 12-16 September 2005 and gave the following presentations and posters. Abstracts are available on the AFS web site at http://www.fisheries.org/html/index.shtml.

Oral Presentations

"Environmental Disturbance and Resource Partitioning as a Source of Population Regulation of Northeast Pacific Groundfish." By Anne B. Hollowed and Vera N. Agostini (School of Aquatic and Fisheries Science, University of Washington).

"Developments in Stock Assessment Modeling for North Pacific Groundfish." By James Ianelli.

"Bayesian Methods in Fisheries Management Strategy Evaluations." By James Ianelli.

"The Role of Ecosystem Models in the Alaska Management Process." By Kerim Aydin and Sarah Gaichas.

"Managing the New Gulf of Alaska Skate (*Raja* spp.) Fishery: Can Slow Growing, Long Lived Species Sustain Rapid Fishery Development?" By Sarah Gaichas.

"Movements of Pacific Cod, *Gadus macrocephalu*s, Around "Cod Alley" in the Southeast Bering Sea." By Sandra Neidetcher and Yunbing Shi.

"The Diet of Juvenile Pacific Ocean Perch in Two Areas of the Aleutian Islands." By Jennifer Boldt (REFM/Joint Institute for the Study of the Atmosphere and Ocean (JISAO), University of Washington), Chris Rooper (RACE), and Mary Auburn (Inverte Inc).

Poster Presentations

"A Proposed Framework For Balancing Yield Optimization and Conservation Objectives in Alaskan Groundfish Fisheries." By Sarah Gaichas and Jane Dicosimo (North Pacific Fishery Management Council).

"Histological Validation of a Visual Maturity Key for Pacific Cod." By Sandra Neidetcher and Jim Stark (RACE Division).

"Marine Reserve Selection for Rockfish: Incorporating Larval Dispersal Considerations Using Coupled Bio-Physical Models." By William T. Stockhausen and Albert J. Hermann (Pacific Marine Environmental Laboratory).

AGE & GROWTH PROGRAM

Estimated production figures for 1 January through 30 September 2005.

Species	Number Aged
Flathead sole	1,474
Northern rock sole	934
Yellowfin sole	1,268
Arrowtooth flounder	1,223
Walleye pollock	10,911
Pacific cod	1,220
Sablefish	2,392
Atka mackerel	3,203
Pacific ocean perch	1,459
Northern rockfish	1,467
Sharpchin rockfish	569
Rougheye rockfish	489

Total production figures were 26,609 with 6,563 test ages and 230 examined and determined to be unageable

Due to the abundance of rockfish (*Sebastes* spp.) in Alaska waters, the Age & Growth Program has always had a special interest in rockfish age determination. Craig Kastelle and Charles Hutchinson presented ageing research at the Lowell Wakefield Rockfish Symposium 12-16 September 2005. Kastelle presented "Age validation of Pacific ocean perch (*Sebastes alutus*) using bomb produced radiocarbon." Hutchinson presented results from "Using radiometric ages to develop conventional ageing methods for shortraker rockfish (*Sebastes borealis*)," a paper that will also be submitted for publication in the symposium proceedings.

Have you ever wondered what the Age & Growth Program goes through to provide quality ages? "Quality control of age data at the Alaska Fisheries Science Center" written by Dan Kimura and Delsa Anderl is available on the AFSC Age & Growth web site at http://www.afsc.noaa.gov/refm/age/Docs/MF04141.pdf. The paper documents in substantial detail the sometimes difficult steps necessary to obtain age data that are consistent over time.

By Dan Kimura