AUKE BAY LABORATORY (ABL)

GROUNDFISH ASSESSMENT PROGRAM

Rockfish Modeling Workshop at Auke Bay Laboratory

A Rockfish Modeling Workshop was held on 23-25 May 2006 at the Auke Bay Laboratory (ABL) to advance assessment analyses of rockfish stocks in Alaska. The workshop objectives were to review the modeling history of rockfish, evaluate where improvements are needed, and identify key assumptions and sources of uncertainty in current rockfish assessment models. The potential for incorporating ecosystem components in rockfish stock assessments was also discussed along with approaches for communicating model results for the annual Stock Assessment and Fishery Evaluation (SAFE) reports. Participants included managers and scientists from the ABL, the Resource Ecology and Fisheries Management (REFM) Division, the National Marine Fiseries Service (NMFS) Alaska Regional Office, and the Alaska Department of Fish and Game (ADF&G).

Key life history features among rockfish species and stocks were compared. While age-at-maturity data for Pacific ocean perch (POP) appear to be adequate for assessment purposes, data on many other rockfish species were lacking. Natural mortality assumptions and estimates for Alaskan rockfish species were generally consistent with growth and longevity patterns. Estimates of area-swept survey "catchability" for bottom trawling varied considerably among species. Simulation analyses presented at the workshop revealed some evidence that patchy rockfish populations which tend to cluster by age or size may result in biased catchability estimates. The modeling impact of expanding within stratum area-swept estimates to cover untrawlable regions needs to be researched further. Presentations also showed that the impact of estimating recruitment variability terms is problematic. The workshop recommended that fixed values for dispersion terms for recruitment estimates be used.

Evaluations on the rockfish models note that they are fundamentally Bayesian models, in that prior distributions are assumed and for measures of uncertainty, posterior distributions are traditionally presented. The workshop concluded that the current SAFE report could be improved by better documentation on how prior distributions were developed. The group also suggested that the shape and distribution of priors be put into the SAFE documents. For posterior distribution analyses, the Markov Chain Monte Carlo (MCMC) integration is typically used. The group discussed using a basic set of chain diagnostics to check for convergence (i.e., that the posterior distribution is adequately represented). The workshop group recommended establishing a standardized approach for MCMC presentation and developing a common set of libraries, perhaps available via an Intranet site.

The group examined different SAFE reports and developed a standard list of tables and graphs. Regarding the "Ecosystem Considerations" section of the SAFE report, the workshop noted that developing models to evaluate environmental covariates may be most useful. For improving rockfish stock assessments, it may be more important to include environmental covariates affecting transport and recruitment rather than predation effects, because rockfish mortality does not appear to be dominated by predation.

Comparative reviews of POP population and fishery trends revealed a number of similarities between the Gulf of Alaska and Bering Sea/Aleutian Islands rockfish stocks. Overfishing during the early 1960s led to large declines, but since the late 1970s, POP abundances have steadily increased. Age-structured model results across other species of rockfish were also compared (e.g., northern rockfish, dusky rockfish, and rougheye rockfish) during this portion of the workshop.

A workshop summary and set of recommendations for future rockfish age-structured models was developed. In the short term, participants suggested: 1) adding tables in SAFE reports that clearly document management activities, 2) carefully evaluating different data sets for quality, 3) developing a system to evaluate model configurations where hypotheses about model assumptions can be easily performed, 4) evaluating the impact of different data sets on model results, 5) describing prior assumptions clearly and including associated posterior distributions, 6) standardizing computer code among rockfish stocks, particularly for generating standardized output and evaluations, 7) comparing results between areas and models to understand where assumptions and differences may exist, and 8) revising maturity estimates for the northern rockfish model prior to the next assessment cycle. For the longer term, suggestions were to 1) collect more maturity samples for a number of species, 2) continue research into vi-

ability of larvae produced by older rockfish females, 3) explore the utility of environmental covariates in rockfish models, 4) consider time-varying parameters, 5) where data exist, investigate more spatially explicit model configurations, and 6) evaluate the use of alternative likelihood specifications (e.g., robust forms).

By Kalei Shotwell (ABL) and Jim Ianelli (REFM)

Morphology of Bigmouth Manefish From the Eastern North Pacific Ocean

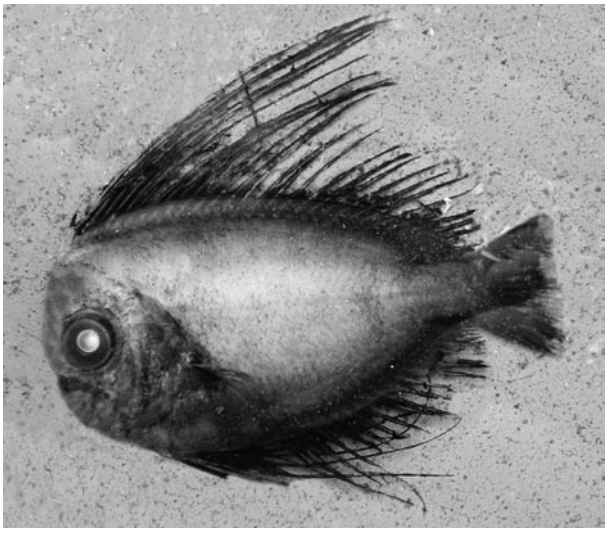

Figure 1. Photograph of *Caristius macropus* from southeastern Alaska. Photo by David Csepp.

Research cruises by the Alaska Fisheries Science Center occasionally encounter rare fish species, and capture of these fish provides a unique opportunity to increase our knowledge of their morpholology, distribution, and habitat. Such an opportunity arose on 8 April 2003, when scientists from ABL caught a juvenile bigmouth manefish, *Caristius macropus,* (Fig. 1) in Lynn Canal, southeastern Alaska. The capture of this specimen initiated the complete morphological examination of all preserved specimens of *C. macropus* from Alaska in order to report detailed morphological and meristic information on these fish in Alaska. This was a joint project involving scientists from both ABL and the AFSC's Resource Assessment and Conservation Engineering (RACE) Division. Data from this study provide additional information on the morphological variation and geographic distribution of this species and form a basis for comparison with specimens from other regions and with other species in the manefish family.

Caristiidae (manefish or veilfish) is a rare family of bathypelagic fishes characterized by an elongate fragile dorsal fin originating on the head and a fleshy sheath along the base of the dorsal and anal fins. *Caristius macropus* has been reported in the eastern North Pacific Ocean, but its distribution in Alaska waters and its general biology are poorly known. Before this southeastern Alaska collection, the only bigmouth manefish reported in Alaska waters were from infrequent collections in the eastern Aleutian Islands or farther north in the eastern Bering Sea (Fig. 2).

Most of the bigmouth manefish specimens examined in this study were collected by fishery observers in the AFSC's North Pacific Groundfish Observer Program during midwater trawl fisheries between 1983 and 2003 that targeted walleye pollock. The specimen from southeastern Alaska in 2003 was also collected from a midwater trawl, but the trawl was deployed during a hydroacoustic survey by ABL scientists. Depths of previous reported captures ranged from 135 to 684 m.

A total of 14 specimens were examined for morphology and meristics. Results indicated that proportional measurements, as well as meristics, of the 14 specimens of *C. macropus* from Alaska were similar to those from other areas of the North Pacific Ocean. The specimens examined for this study do not significantly differ in any of these characteristics from the original species description in 1903, nor do they differ consistently from previously published records of this species from the North Pacific Ocean. Therefore, we consider all examined material from the subarctic North Pacific Ocean to belong to *C. macropus*.

The specimen collected in southeastern Alaska represents the first known record of this family from the Gulf of Alaska and from protected inside waters, as well as the smallest specimen examined and the first specimen collected from coastal waters. All specimens of *C. macropus* previously reported in the eastern North Pacific Ocean have been collected in the mesopelagic zone in unprotected open ocean waters. The collection of a *C. macropus* in protected inside waters of southeastern Alaska adds a new habitat for this species and gives *C. macropus* a wider distribution than previously described.

By David Csepp (ABL) and Duane Stevenson (RACE)

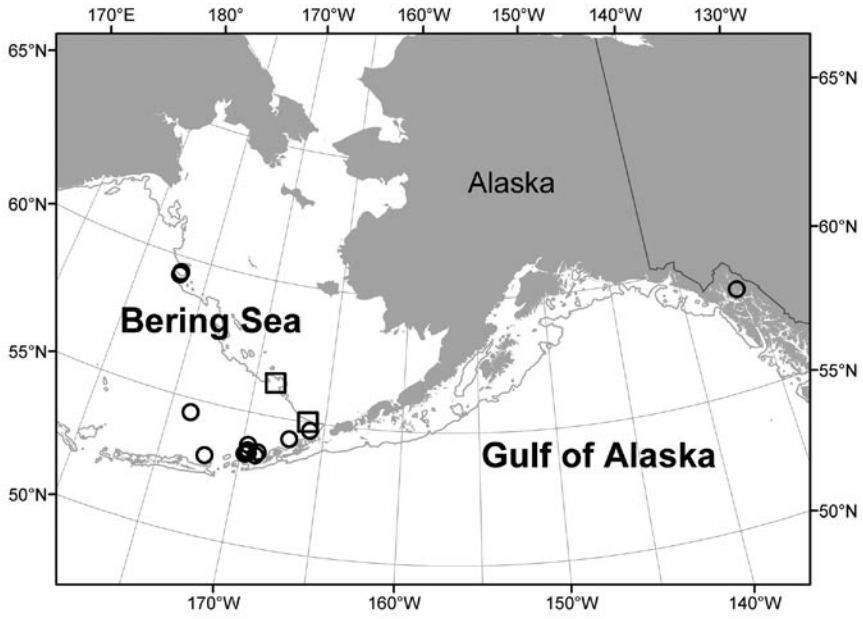

Figure 2. Distribution of *Caristius macropus* in the eastern North Pacific Ocean including specimens examined for this study (circles), specimens captured in commercial midwater fishing operations and discarded (squares), and 200 m contour line. Squares represent more than 25 records.

Steller Sea Lion Response to Prespawning Eulachon in Southeastern Alaska

Predictable, seasonally abundant aggregations of energy-rich forage fish may be critical resources for the survival and reproductive success of Steller sea lions (*Eumetopias jubatus*). In a spring 2006 study, we estimated the energy available to Steller sea lions from prespawning aggregations of eulachon (*Thaleichthys pacificus*) in Lynn Canal and Stephens Passage, southeastern Alaska. The study was a cooperative research project involving three ABL programs: Habitat, Groundfish Assessment, and the Ocean Carrying Capacity Program's Stock Identification Laboratory. Funding was also provided by the AFSC's National Marine Mammal Laboratory.

Eulachon are high-lipid, energy-rich fish that spawn in the spring and are likely vital energy sources for sea lions at a time of high energetic demands associated with pregnancy, lactation, and fasting. Our objectives were to characterize five spawning runs of eulachon by: 1) estimating the biomass of prespawning aggregations of eulachon available to marine predators prior to the eulachon's upriver spawning migration, 2) measuring the energy content of eulachon and calculating the total energy represented by the aggregations, 3) estimating the numerical response of Steller sea lions and other marine mammals to the eulachon runs, 4) characterizing the population structure of the five runs using genetics, and 5) characterizing eulachon movement within the marine environment prior to upriver migration for spawning.

Surveys were conducted in Taku, Chilkat, Lutak, and Taiya inlets, and in Berners Bay over the period of 2 April to 6 May 2006. Hydroacoustic surveys were performed to estimate fish biomass and behavior in the marine environment. Midwater trawls and gillnets were used to sample fish to delineate acoustic data. These methods of capture as well as dipnets and fish traps were used to collect fish specimens for morphological measurements, nutritional analyses, and genetic analyses. Aerial surveys were used to enumerate sea lions attending the eulachon runs and at adjacent sea lion haulouts. In addition, aerial surveys provided direction to help determine locations and timing of the hydroacoustic trawl and gillnet surveys.

Preliminary data analysis appears to show several interesting aspects of sea lion and eulachon behavior. The Berners Bay run was very low this year, and sea lions did not show up to feed as they have in the past several years. We are currently unaware whether this has ever happened previously. Inlets such as Taku and Chilkat are large river systems with large potential eulachon runs. However, due to the marine and freshwater bathymetry and fish behavior, sea lions are not able to efficiently feed on the eulachon. We

recorded substantial numbers of eulachon in these two locations but did not document many sea lions feeding, nor have there been many observed in past years. The fish appear to move quickly from marine to fresh water, not schooling much if at all in saltwater, and then spread out in the large riparian system to spawn. We also documented a vast osmerid larval layer (capelin and eulachon) throughout Berners Bay and Taku Inlet and possibly in the other three inlets, but we cannot verify species identification in the other inlets due to lack of trawling. Lastly, our acoustic surveys seem to show fish density peaking a day or two before the sea lion feeding numbers peak. For example, when the fish were most dense in Lutak Inlet, sea lion numbers were about 300. Two days later, fish density was much less, but sea lion numbers had increased to about 500.

By David Csepp and Johanna Vollenweider

Juvenile Rockfish Habitat Utilization

New research detailing the relationship between juvenile rockfish *Sebastes* spp. and benthic habitat is under way at ABL's Little Port Walter (LPW) Marine Station. The relative degree in which juvenile rockfish utilize different habitat features with or without the presence of predators or under varied light levels is mostly unknown. The results of this research will assess the strength of association between juvenile rockfish and several habitat features, including emergent epifauna such as sponge and coral as well as cobble and gravel. These assessments will be helpful in determining the relative productivity of sponge and coral and will aid in establishing priorities for protecting these vulnerable habitats specifically addressed in essential fish habitat (EFH) and Habitat Areas of Particular Concern (HAPC) priorities.

Beginning in summer 2006, juvenile quillback rockfish (*S. maliger*) and a predator, great sculpin (*Myoxocephalus polyacanthocephalus*), will be captured with beach seines and dip nets and transported to the LPW Behavior Laboratory. Once fish are acclimated, two separate experiments will occur. The first experiment will identify habitat preference of juvenile quillbacks. Rockfish will be placed in rectangular aquariums with two distinct habitat types, one on each half of the aquarium. After an acclimation period, the rockfish will be periodically observed to determine which habitat types are most utilized. Replicate comparisons will be made of the six possible combinations of habitat types under daylight and night conditions.

A second experiment will determine which habitat features are utilized by juvenile quillbacks in the presence of a predator and the relative protection the habitat features provide under predatory pressure. In this suite of experiments, juvenile quillbacks and two great sculpin will be placed in aquariums with uniform habitat features throughout. Periodic observations of rockfish will determine habitat utilization and counts of the number of rockfish consumed will determine the rate of habitat-mediated predation within each habitat type. Each trial will begin with rockfish and predators separated by a clear partition. Observations will occur under both daylight and night conditions.

This project is a continuation and expansion of a pilot study originated in 2005. The pilot study provided opportunities to develop experimental design, refine observational arrays, obtain suitable habitats, perform preliminary behavioral trials, and perfect the logistics of capturing and holding juvenile rockfish. In 2005, 350 juvenile quillback rockfish with an average length of 22 mm were captured and held in captivity for more than 6 months. Preliminary results indicated that juvenile quillbacks were about three times more likely to be observed in the coral habitat than in any other habitat type, and gravel was the least preferred habitat type. The lowest rate of predation was observed in aquariums with coral, whereas the highest rate of predation occurred in aquariums with gravel. The average number of rockfish consumed per trial was about four times higher in the gravel habitats than in the coral habitats.

By Pat Malecha

HABITAT PROGRAM

Use of Zooplankton Fatty Acids to Elucidate Trophic Pathways

ABL's Nutritional Ecology Laboratory (NEL) is collaborating with the RACE Division on a project that examines the fatty acid compositions of various taxa of zooplankton collected from the Bering Sea in the vicinity of the Pribilof Islands. Two primary objectives of the project are to use fatty acid data to elucidate trophic relationships and to examine the influence of nutrient- and zooplankton-rich slope water on populations near the continental shelf break. First, however, we needed to determine if

there were differences in composition between species and locations before we could ask the more important ecosystem questions.

The study involved collection and biochemical analysis of more than 150 zooplankton samples including copepods *Metcidia pacifica* and *Eucalanus bungii*; calanoid copepods *Calanus marshallae* and *Neocalanus cristatus*; euphausiids *Thysanoessa raschii*, *T. inermis*, and *T. spinifera*; as well as various species of pteropods, decapods, and mysiids. The study appears to be the first large-scale analysis of the fatty acid compositions of zooplankton in the North Pacific Ocean or the Bering Sea.

Due to the small size and fragile nature of most zooplankton, sample collection and storage, lipid extraction, and subsequent chemical analyses are particularly challenging on these samples. Handling of zooplankton samples on the vessel must be carefully performed to avoid specimen destruction, lipid oxidation, and breakdown. Furthermore, conventional laboratory processing methods must be modified to accommodate the particular nature and small size of zooplankton. Sample weights must be carefully measured and treated to avoid surface water but not desiccate the samples. Solvent volumes used for lipid extraction must be reduced and some conventionally automated methods must be performed manually. The special handling of these samples is worth it in the end, though, as the data are very intriguing and may provide clues to understanding complex trophic interactions that are not well understood.

Not all zooplankton are created equal. Preliminary analysis revealed significant differences in the fatty acid compositions of different zooplankton types. This variation permits comparisons between species and locations and provides various other important diet information. For instance, copepod fatty acid profiles are easily distinguishable from those of euphausiids or pteropods, likely related to diet differences. Significant differences can also be observed between species within a zooplankton type. For example, the euphausiid *T. spinifera* had a distinct fatty acid profile as compared to the euphausiid *T. raschii*. In addition, there were surprising differences in the fatty acid complexity of species within a zooplankton type, measured by the number of major fatty acid components in a profile. The copepod *C. marshallae* contained nine fatty acids with abundances greater than 5% of the total fatty acid composition, while the copepod *M. pacifica* contained only three fatty acids above the 5% abundance threshold. Fatty acid analysis can also identify specific types of diet components, based on the levels of key signals such as those that indicate a diatom-based diet or one that is rich in dinoflagellates. Specific ratios of fatty acids can indicate general dietary characteristics such as carnivory and herbivory. Such fatty acid-derived diet information is useful for the characterization of plankton-based trophic webs that include planktivorous fish and mammals and can be used to evaluate specific hypotheses regarding geographical influences on production.

By Lawrence Schaufler

OCEAN CARRYING CAPACITY PROGRAM

Size-selective Mortality of Juvenile Bristol Bay Sockeye Salmon

We tested the hypothesis that larger juvenile sockeye salmon (*Oncorhynchus nerka*) in Bristol Bay, Alaska, have higher marine-stage survival rates than smaller juvenile salmon. This study used archived scales from returning adults (33 years of data) and trawl samples of juveniles (n = 3,572) collected along the eastern Bering Sea shelf during August through September 2000-02. The size of juvenile sockeye salmon mirrored indices of their marine stage survival rate (i.e., smaller fish had lower indices of marine stage survival rate). However, there was no relationship between the size of sockeye salmon after their first year at sea as estimated from archived scales and brood year survival; size was relatively uniform over the time series, possibly indicating size-selective mortality on smaller individuals during marine residence. Variation in size, relative abundance, and marine stage survival rate of juvenile sockeye salmon is likely related to ocean conditions affecting their early marine migratory pathways along the eastern Bering Sea shelf.

By Edward Farley

North Pacific Salmon Survey

The North Pacific salmon survey was conducted from the Japanese trawler *Kaiyo maru* on 24 May to 23 June 2006. The survey transect area was from lat. 53.00°N, long. 160.00°W to lat. 46.00°N, long. 164.00°E. Kristin Cieciel participated on behalf of ABL's Ocean Carrying Capacity Program on Leg 2 of the survey, from Kodiak, Alaska, to Kushiro, Japan. The highlight of the second half of

Table 1. Tagging summary for North Pacific Salmon Survey Cruise, 24 May to 23 June 2006.

Species	Total number tagged	Japan Disk tag	U.S. Disk tag	DST tag	CTD tag
Chinook	4	3	3	3	1
Chum	46	40	46	5	0
Coho	1	1	1	0	0
Pink	24	23	24	0	0
Sockeye	47	33	47	15	0

the survey was the continuation of a North Pacific Anadromous Fish Council tagging project funded by the National Pacific Research Board. The tagging project uses data from line- and trawl-caught salmon for a tag-and-recapture study that examines salmon migration ecology.

Hook and line fishing for salmon was performed every day after the last station from 26 May to 10 June aboard the *Kaiyo maru*. Fishing effort consisted of up to 14 lines in the water for 1 to 3.5 hours; total time was weather and schedule dependent. Trawl-caught salmon were tagged dependent on scale condition and overall health of fish. Data storage tags (DST) used to measure temperature and depth were attached to sockeye, chum, coho, and Chinook salmon. United States and Japanese disk tags were used on all species of salmon, and a single CTD (conductivity, temperature and depth) tag was attached to a Chinook salmon. The tagging summary is shown in Table 1.

Three tags have been recovered in Alaska since the survey's end in June. Tag 10650 (DST) was tagged at lat. 54.00˚N, long. 175.00˚W on 8 June 2006 and was recovered in the Egegik fishing district on 5 July 2006. Tag 10638 (DST) was also tagged at lat. 54.00˚N, long. 175.00˚W on 8 June 2006 and was recovered in Nushagak fishing district on 5 July 2006. The single CTD tag, used on a trawl-caught, 85-cm Chinook salmon tagged on 8 June 2006 at lat. 175˚08'W long. 54˚50'N, was recaptured on 30 June 2006, 20 miles downstream from Mountain Village (lat. 163˚43'46"W, long. 62˚05'08"N). Trey Walker of the University of Washington believes this may be the first recovered high-seas-applied tag from a maturing Yukon Chinook salmon.

By Kristin Cieciel

Southeast Alaska Coastal Monitoring

The first of the 2006 Southeast Coastal Monitoring (SECM) cruises took place aboard the NOAA ship *John N. Cobb* on 23-25 May 2006. This is the 10th year that ABL's Ocean Carrying Capacity Program has collaborated with the Marine Salmon Interactions Program to examine interannual variability of oceanographic and biological conditions in the inside waters and nearshore coastal waters of the eastern Gulf of Alaska.

The May cruise sampled two transects, Icy Point on the outside coast and mid-Icy Strait in the inside waters, plus the Auke Bay Monitor. The third transect at the junction of Chatham and Icy Straits was canceled because of vessel engine problems.

Surface trawls, zooplankton tows, and conductivity, temperature, depth (CTD) profiles, as well as surface primary production observations were completed at each station. The surface trawls were taken primarily to confirm that young salmonids had not yet left the very nearshore littoral waters. Only a few Chinook salmon entering their second ocean year were taken by the surface trawls. Among the miscellaneous items captured by the trawls were *Loligo opalescens* (opalescent inshore or California market squid) and *Phacellophora camtschatica* (fried egg jellyfish). The market squid was not a component of the SECM cruise catches in northern Southeast Alaska until last summer although it was occasionally noted in southern Southeast Alaska. The fried egg jellyfish had not been seen by the SECM program, although it is not uncommon in some areas of the North Pacific Ocean.

By Bruce Wing

MARINE SALMON INTERACTIONS PROGRAM

Migrant Salmonid Counts at Auke Creek Weir

Activities through June 2006 at Auke Creek weir concluded 112 consecutive days of weir operations and fish counting, sampling, and marking. The weir was installed 1 March and operated in the downstream mode until 22 June, then converted to

count upstream migrants. This was the 27th consecutive year of total downstream counts of all migrant salmonids at Auke Creek. A total of 65,894 pink salmon fry were counted at the weir in 2006, nearly 50,000 fewer than the 1973-2005 average. Most fry, 63,474, migrated in April, and the migration declined rapidly during the last week of that month. Only 595 fry were captured in May. The May component of the historic run is no longer present. The midpoint of downstream migration was 14 April, 6 days earlier than average. The earliest midpoint of migration was 1 April 1998 and the latest was 7 May 1982; the average is April 20. There is a trend of earlier migration timing of pink salmon fry over the last three decades.

The count of sockeye salmon smolts, 25,515, was nearly 8,000 fish greater than the 1980-2005 average, and the fourth highest total count on record for Auke Creek. The midpoint of migration was 26 May, close to the average of 23 May at Auke Creek. Only the 1981 migration was earlier, with a midpoint of 11 May. Yearling smolts accounted for 22% of the migration, and averaged 4.3 g and 83 mm, and 2-year-old smolts were 14 g and 117 mm, both above-average sizes for sockeye salmon smolts at Auke Creek. The total biomass of sockeye salmon smolts leaving Auke Lake this year was the highest on record.

A total of 4,532 coho salmon smolts migrated downstream at Auke Creek this year. This was the fifth lowest count on record. The 1980-2005 average is 6,048. Auke Lake coho smolt production is in a decreasing trend that spans more than two decades. The midpoint of the 2006 emigration was 24 May, the latest in 15 years, but within the range observed in other years. The average migration midpoint is 19 May. Scales collected throughout the coho migration showed that yearling smolts accounted for 62% of the migration, and averaged 11.3 g and 105 mm, and 2-year-old smolts were 19.3 g and 124 mm. These fish were slightly larger than average sizes for these age groups of coho salmon leaving Auke Lake. Most smolts, 4,506, were tagged with codedwire micro tags and released.

This is a NMFS and ADF&G cooperative project to determine marine survival and fishery contribution of Auke Lake coho. The Auke Creek Dolly Varden and cutthroat trout populations are in a decade-long downward trend. The Dolly Varden count this year, 4,975, was about 1,000 fish less than average; the 1980-2005 average at Auke Creek is 6,115. The midpoint of migration was 13 May, about a week later than average and one of the earliest on record, but within the range observed in other years. A total of 208 cutthroat trout were counted 2006, about 40 fewer than average. The midpoint of the migration was 25 May, 10 days later than average, and the third latest on record. The average midpoint is 15 May. There was a 26-day difference between midpoints of cutthroat trout migration dates from 2005 to 2006, the largest difference observed between consecutive years at Auke Creek.

By Jerry Taylor

Protected Species Research on Steelhead at Little Port Walter Marine Station

While there are no Endangered Species Act (ESA) listings of salmonids in Alaska, ongoing research on Sashin Creek drainage anadromous steelhead and rainbow trout at Little Port Walter (LPW) is providing much useful and important data to help in recovery programs of many listed salmon and steelhead populations in the Pacific Northwest. Rainbow trout in these studies, originating from steelhead parents, were planted in Sashin Lake above high waterfalls and have been isolated there as a self-sustaining population for 70 years. This situation provides unique opportunities for a variety of genetic and life history studies relevant to protected species recovery efforts. Some of the current studies under way include: basic life history research for appropriate ESA listing determinations; comparisons of genetic variation between anadromous and resident populations; effects of small founder populations on genetic variability; effects of 70 years of freshwater sequestration on residual anadromous characteristics; and developing and evaluating cross types between these populations through breeding studies.

Aspects of several of these studies were the focus of research activities in spring 2006 involving several collaborators and agencies. Auke Bay Laboratory researchers Adrian Celewycz, Pat Malecha, and Frank Thrower were assisted by Drs. Krista Nichols and Michael Zanis from Purdue University, who spent 2 weeks at LPW to collect data for quantitative trait loci (QTL) analysis for identifying genomic regions associated with smoltification and the evolution of anadromy.

Four scientists from the Northwest Fisheries Science Center, Orlay Johnson, Melissa Byrd, Jason

Miller, and Jim Myers each spent a week at LPW in June 2006 collecting data for bilateral asymmetry analysis, QTL analysis, and final data on the freshwater growth phase for approximately 9,400 steelhead tagged with passive integrated transponder (PIT) tags.

This data collection period represented the endpoint of the freshwater rearing phase of the 2004 brood of juvenile steelhead just prior to their transition phase to seawater (smolting). Approximately 9,500 juveniles were tagged in April and June of 2005 from 69 families representing eight lines of fish of pure anadromous (steelhead) and pure resident (rainbow) types plus hybrid and inbred lines. Approximately 9,300 fish with functioning tags were weighed and measured and subsamples were taken for DNA, blood sodium, and seawater challenges, and over 1,000 digital photographs of fish representing each life history phase (smolt, mature, resident) in all families were taken for truss and bilateral asymmetry analysis. Heritability estimates of smolting, maturation, and growth will be made to compare estimates made on parents (F1), which have already been published (Thrower et al. 2004), with estimates made for their offspring (F2). QTL analysis will be conducted, pending funding, to specifically determine the loci responsible for smolting and early maturation so that the genetic underpinnings of these important traits can be fully understood. This information is vital in determining the genetic and demographic importance of resident rainbow trout populations in maintaining and restoring anadromous steelhead populations throughout the western United States where the majority of the anadromous steelhead populations are listed on the Endangered Species List.

In addition to the work on hatchery juveniles, the adult steelhead weir was installed on 2 April 2006 to collect wild- and hatchery-produced steelhead returning to Sashin Creek from several research projects including research on Inbreeding and Outbreeding depression. A total of 75 wild adults were collected, which is the second highest recorded escapement for 18 years of escapement data and over 630 coded wire tagged experimental fish; this is also the largest return ever recorded. One of the most significant findings of the inbreeding research to date is the dramatic difference between survival in low versus high selection environments. A low selection environment is characteristic of hatchery operations where fish are protected from predators, provided abundant food, and in general maintain high survivals. After released from the hatchery into the wild, however, all manner of selection pressures come to bear on the anadromous smolts. In this case, inbred steelhead smolts survived well in the hatchery but their marine survival was poor.

Very little research has been done on the effects of inbreeding on populations in a wild environment ,and virtually nothing has been done with anadromous fish. The results of earlier research (by other researchers) in captive environments have been variable with modest reductions in fitness proportional with inbreeding coefficient in some studies. These results were not dissimilar to those observed at LPW during the low selection, freshwater phase; however, survival in a high selection environment while at liberty in the North Pacific Ocean has indicated a severe disadvantage for the inbred individuals. These results have serious implications for the persistence of small populations and should provide incentive for managers to maintain population levels above those at which inbreeding depression effects might occur.

By Frank Thrower

FISHERIES MONITORING & ANALYSIS (FMA) DIVISION

FMA Divisions Works to Ensure Safety of Observers and Staff

OPERATIONS AND ADMINISTRATION

Each year, approximately 400 observers spend a total of approximately 36,000 days at sea collecting data used in managing Alaskan groundfish fisheries. Fisheries Monitoring and Analysis (FMA) staff supplement this work with additional sea time on research cruises. Despite this large volume of deployments, the FMA Division maintains an excellent safety record. However, the sea can be a dangerous work environment.

Recognizing the high potential of danger at sea, safety is a key focus of FMA operations and training. NOAA Fisheries Service now requires all vessels carrying observers to have a current United States Coast Guard (USCG) Commercial Fishing Vessel Safety decal showing that they have passed a dockside safety inspection. Observers are required to review this decal when they board to ensure that

it is current and that key safety equipment is still on the vessel. Observers document these inspections and record emergency drills held onboard their vessels using the Vessel Safety Checklist in their logbooks. These measures help to ensure that necessary safety equipment is onboard and increase safety awareness for both the observer and vessel personnel. FMA field office staff provide monthly updates regarding all safety concerns reported by observers. These safety reports allow us to track areas of concern. FMA staff work closely with the NMFS Office for Law Enforcement and the USCG to support activities that promote the safety of fishing vessels required to carry fisheries observers.

FIELD OPERATIONS

Field experiences of observers in this year's fishery highlight important aspects of safety. The FMA Division does not train observers to be first responders in emergency situations as we defer to the vessel crew. However, there are times when observers are called to use their skills when emergencies occur. Early this year an experienced groundfish observer was asked to assist in a medical emergency when a crewmember was found unconscious in the bathroom of a catcher processor trawl vessel fishing in the Bering Sea. The observer and the chief steward stabilized the crewmember and monitored his vital signs. The USCG was notified and dispatched a helicopter from St. Paul Island. When the crewmember's pulse was undetected, the observer (who had previously obtained CPR certification) and the steward provided CPR until a pulse could again be felt. When the helicopter arrived, the observer again provided CPR before the crewmember was evacuated. She was able to provide the USCG rescue swimmer with a history of the crewman's vital signs. The boat was later informed that the man suffered from severe dehydration and had recovered fully after receiving medical attention.

In April one of our observers was abruptly awakened early in the morning when the fishing vessel *Laura*, a 93-foot trawl vessel, struck a rock 6 miles from the port of Kodiak while returning from a fishing trip. Upon receiving a Mayday emergency call from the vessel, the USCG instructed them to deploy their Emergency Positioning Indicator Radio Beacons. The crew of the *Laura* and the observer were hoisted off the vessel by a USCG helicopter and flown to Kodiak without injury. With assistance from a tug boat and another fishing vessel, the *Laura* was floated during high tide the following day and returned to Kodiak without any major incident and the observer continued work onboard another trawl vessel.

INFORMATION AND MONITORING TECHNOLOGIES

As part of the FMA safety precautions, FMA staff maintain frequent contact with observers via the Division's at-sea data entry software and communication system. The primary uses of this system are data transmission and communication related to sampling and data recording, but observers also use the system's text messaging feature to relay any safety concerns they may have. When a message that relays a marine casualty or safety issue is received, it is immediately forwarded to a network of NOAA and USCG personnel who are trained to respond appropriately. Should a message relay a serious threat to an observer's life or health, or require the removal of an observer from the field, a series of procedures are implemented to ensure a timely response. This at-sea data entry software and communication package provides a valuable tool and safety net to observers in the field.

OBSERVER SERVICES

FMA staff provide comprehensive cold water survival training to new observer trainees before they deploy to sea. This training has been reviewed on a national level by the National Observer Program and exceeds NOAA Fisheries Observer Safety training standards. All FMA safety trainers have completed the Alaska Marine Safety Education Association (AMSEA) marine safety instructor class. Consistent with FMA's emphasis on safety, the two full time field coordinators in Dutch Harbor and Kodiak also have completed the AMSEA training. This ensures the field coordinators are up to date with current safety materials and allows them to further assist observers in the field when evaluating potential safety concerns.

Beginning in 2006, cold-water refresher training was implemented for the hundreds of prior observers during their required annual 4-day briefing. The refresher training reviewed information presented in the initial cold-water survival training and provided additional hands-on practice with equipment and techniques used in the cold-water environment. The training began with a quiz on a range of topics covered in the initial cold-water training, which provided prior observers a means to evaluate their

Pictured above: (Top) An observer practicing the correct technique to enter water from a height while wearing an exposure suit. (Bottom) Observers practicing flipping an overturned life raft. Photos by Joanna Miles.

current knowledge and identify areas needing review. Following the quiz, the observers examined real life examples of accidents at sea. Observers reviewed the types of personal floatation devices with the opportunity to try on various models and discussed individual scenarios and the pros and cons of each type of device. In further preparation for an emergency, observers reviewed personal survival kits and were instructed in how to create an appropriate kit to bring to sea. A personal survival kit is an easy and effective way to ensure an observer has the fullest possible advantage in a survival situation. This year, a USCG commercial vessel safety inspection program representative reviewed the regulatory requirements vessels must meet in regard to safety equipment in order to carry an observer. This included an in depth review of life rafts, Emergency Positioning Indicator Radio Beacons, and hydrostatic releases, along with the other various equipment a vessel is required to have on board.

To wrap up the refresher training, all observers participated in a water drill. During the drill, observers were required to don an immersion suit in less than 60 seconds, enter the water from a height of 3-4 feet using the correct technique, swim both alone and in a group, demonstrate skills designed to increase the chance of survival if immersed in the water, board a life raft from the water, and flip an overturned raft in the water. Overall, the refresher training was well received by the prior observers, some of whom had not received any additional training in years, and provided them with the knowledge and skills to help ensure their safety while working in the cold waters of Alaska.

By Allison Barns, Glenn Campbell, Brian Dixon, Brian Mason, and Rob Swanson

HABITAT & ECOLOGICAL PROCESSES RESEARCH

LOSS OF SEA ICE WORKSHOP

On 3 May 2006, the AFSC's new Habitat and Ecological Processes Research (HEPR) convened a workshop to develop an implementation plan for a permanent, long-term research program directed at determining the impacts of the loss of sea ice in the Bering and Chukchi Seas. Three independent but interrelated research themes were proposed for the Loss of Sea Ice (LOSI) program, which focus on loss of sea ice in different regions and seasons.

- Theme 1 - Enhanced forecast capabilities through a focus on winter preconditioning and the influence of winter ocean conditions on the spawning distributions of commercially important fish and shellfish species;

- Theme 2 - Enhanced forecast model capabilities through a focus on ice-edge processes including the development of spring bloom and the foraging behavior and movement of ice-dependent seals;
- Theme 3 - Enhanced knowledge of stock status and trends, through expanded assessments and comparative approaches with focus on benthic-pelagic coupling.

These themes have been incorporated into the draft LOSI implementation plan which will be finalized following a 19 July 2006 workshop. The HEPR group is working with Center Leadership and NMFS headquarters to fund the research themes outlined in the LOSI implementation plan. If successful, HEPR will seek integrated proposals from the AFSC and the Pacific Marine Environmental Laboratory (PMEL) to implement the plan in spring 2009.

The impetus for the LOSI program stemmed from recent observations that the depth-averaged temperature of the eastern Bering Sea is warming and results of the Arctic Impact Assessment that indicate that climate change will have profound impacts on managed species in the Bering Sea. Scientists expect that in the next 50 years, these shifts will alter the spatial distribution and abundance of managed species in the Bering Sea, resulting in major changes to the Alaskan economy and the Bering Sea ecosystem. A research program targeting impacts of loss of sea ice is needed to study this unprecedented change within the historical record. Without a program in place now, the opportunity to monitor these changes will be foregone, and NOAA will be far less able to meet agency responsibilities for management of fish and marine mammal species.

Planning for the LOSI program in the Bering Sea was initiated by a series of intra- and interagency workshops. The workshops brought together an interdisciplinary group of scientists to discuss and review ideas for implementing research on the effects of climate on sea ice formation in the Bering Sea and its associated impact on living marine resources and habitat. The core elements of a joint AFSC/PMEL LOSI program were outlined in a proposal developed in April 2005 by the Fisheries-Oceanography Coordinated Investigations (FOCI) program and elaborated in reports on HEPR workshops conducted in June 2005, September 2005, and May 2006. Recognizing that efforts to understand the role of sea ice in the Bering Sea ecosystem would require an interagency coordinated effort employing the unique capabilities of each contributing agency also lead to the formation of the Bering Sea Ecosystem Interagency Working Group (BIAW). The BIAW represents the North Pacific Research Board (NPRB), the National Science Foundation's Bering Sea Ecosystem Study, the U. S. Geologic Survey, the U. S. Fish and Wildlife Service, the Alaska Ocean Observing System, the AFSC, the University of Alaska Fairbanks, the U.S. Arctic Research Commission, and PMEL.

By Michael Sigler

Loss of Sea Ice Workshop Participants

Robyn Angliss	(NMML/HEPR)
Kerim Aydin	(REFM)
Janet Duffy-Anderson	(RACE)
Ron Felthoven	(REFM)
Jennifer Ferdinand	(FMA/HEPR)
Nancy Friday	(NMML)
Jon Heifetz	(ABL/HEPR)
Ron Heintz	(ABL)
Anne Hollowed	(REFM/HEPR)
Tom Hurst	(RACE, Newport)
Jim Ianelli	(REFM)
Libby Logerwell	(REFM)
Bern Megrey	(RACE/HEPR)
Jamal Moss	(ABL)
Jim Overland	(PMEL)
Clarence Pautzke	(NPRB)
Phil Rigby	(ABL)
Kim Shelden	(NMML)
Mike Sigler	(HEPR)
Dave Somerton	(RACE)
Phyllis Stabeno	(PMEL)
Jeremy Sterling	(NMML)
Buck Stockhausen	(REFM)
Francis Wiese	(NPRB)
Chris Wilson	(RACE)

NATIONAL MARINE MAMMAL LABORATORY (NMML)

ALASKA ECOSYSTEM RESEARCH PROGRAM

Scientific Successes Amidst Court Ruling

NORTHERN FUR SEAL RESEARCH

The National Marine Mammal Laboratory's (NMML) Alaska Ecosystems Program saw both scientific success in the form of published research and field work completed, as well as cessation of future work during the last quarter.

Several new publications on northern fur seals reflect new information on population trends and foraging ecology of northern fur seals in Alaska. The majority of the world's northern fur seals breed on two islands of the Pribilof Island group in the Bering Sea. A recent publication in the journal *Marine Mammal Science*, "Decline in northern fur seal (*Callorhinus ursinus*) pup production on the Pribilof Islands," describes a substantial decline in pups born during 1998-2004. Pup production levels have now declined to that observed in 1918 on Saint Paul Island and in 1916 on Saint George Island. It is unknown why pup production has been declining at the Pribilof Islands yet has increased at Bogoslof Island in the eastern Aleutian Islands. This is an area of intensive current research.

Analysis of hard parts found in scats provided the basis for describing northern fur seal foraging habits in a new study published in the *Journal of Zoology*, "Foraging habitats based on the diet of female northern fur seals (*Callorhinus ursinus*) on the Pribilof Islands, Alaska." Dominant prey species consumed by fur seals on the two Pribilof Islands during 1987-2000 were juvenile walleye pollock and gonatid squids, though primary prey also included Pacific sand lance, Pacific herring, northern smoothtongue, Atka mackerel, Pacific salmon, and other squid species. Analysis of diet patterns among the 17 rookeries suggest that rookeries can be clustered into five complexes representing predominant diets associated with specific oceanographic domains. This clustering provides evidence of resource-partitioning among adult female northern fur seals.

Examination of hard parts found in collected scats has been the most common method for estimating diets of seals and sea lions in the wild. In a new study published in the journal *Fishery Bulletin*, "Application of two methods for determining diet of northern fur seals (*Callorhinus ursinus*)"; available at http://fishbull.noaa.gov/1043/gudmundson.pdf), estimates of diet in northern fur seals determined from scat analysis were compared with estimates based on remains found in spews (regurgitations). They found that not only did the relative occurrence of primary prey differ between scats and spews, but that hard parts found in scats were biased towards smaller prey items, while parts in spews were biased towards larger prey and cephalopods. Thus many sampling methods should be combined to accurately assess northern fur seal diet, and there may be a much greater overlap in sizes of commercially important prey species, such as walleye pollock, taken by fur seals and commercial fisheries than previously estimated.

STELLER SEA LION RESEARCH

Since the year 2000, NMML has collaborated with the Alaska Department of Fish and Game (ADF&G) to mark Steller sea lion pups with brands or flipper tags at selected rookeries spanning the eastern Aleutian Islands through Southeast Alaska to estimate survival and vital rates. Two cruises covering the eastern Aleutian Islands and the central and eastern Gulf of Alaska were conducted during May 2006 to record locations and behaviors of marked Steller sea lions and to collect scats for diet analysis. Some of these scats were subsampled by a researcher from the University of British Columbia for stress hormone analyses and to test the efficacy of using genetic analysis techniques to determine sea lion diets. Between the two cruises, 173 sea lions marked as pups, and 10 marked as juveniles were observed among 51 sites. The oldest observed was a 19 year old female marked as a pup (from an earlier study) at Marmot Island in 1987.

Unfortunately, the Steller sea lion research planned for June was effectively terminated by a 31 May ruling from the U.S. District Court of the District of Columbia. The court found that NMFS failed to comply with the National Environmental Policy Act (NEPA) in issuing Steller sea lion research permits last year, and granted the plaintiff (Humane Society of the U.S., HSUS) motion to vacate all permits and suspend Steller sea lion research pending completion of an environmental impact statement (expected to be completed in 2007). As a result, all researchers conducting field work on Steller sea lions in Alaska had their work suspended. For our program, this included the collection

of data to assess population trends and status, survival, reproductive rates, diets, and pup condition. A subsequent appeal negotiated by NMFS and HSUS and granted by the Court authorized limited low-disturbance research activities to recommence. Though this authorized aerial surveys to estimate population trends and remote observations to estimate reproductive rates, the reprieve occurred too late for completion of those studies.

By Brian Fadely and Tom Gelatt

CALIFORNIA CURRENT PROGRAM

Washington Gray Whale Surveys

In 1996, NMML began surveys to count and identify individual gray whales which were present in Pacific Northwest waters from May to November. These gray whales were believed to be "summer residents" which appeared at the same locations year after year to feed. However, it was determined that only some of the whales actually returned to the area annually and that many of the whales observed were newcomers and were seen only once. Many of the whales were known to feed also in other areas off northern California, Oregon, Vancouver Island, British Columbia, and Kodiak Island, Alaska. This group of gray whales, consisting of whales which do not feed in the Bering Sea from June to November, is now known as the Pacific Coast Feeding Aggregation.

In May 2006, vessel surveys for gray whales were started along the northern Washington coast and western Strait of Juan de Fuca. On 4 May, 19 gray whales were sighted along the Washington coast both inshore and offshore. The inshore whales were foraging, while the offshore whales were traveling north. In early June, a group of four gray whales were observed foraging off Yellow Bank, south of Cape Alava. In mid-June, a group of three to four whales were sighted between Ozette Island and White Rock (Fig. 1). An additional gray whale was sighted off Third Beach in the Strait of Juan de Fuca (Fig. 2).

Figure 1. The fluke of a gray whale near Ozette Island, Washington. Photo by Merril Gosho.

Figure 2. Natural markings on the left side of a gray whale off Neah Bay, Strait of Juan de Fuca. Photo by Merril Gosho.

The unique natural markings on the sides and flukes of gray whales enable researchers to identify individuals. The photographs collected this year will be matched to other observers' photographs in the region and also will be compared with photographs from previous years. The gray whale surveys will continue into November 2006.

By Merril Gosho

CETACEAN ASSESSMENT & ECOLOGY PROGRAM

International Whaling Commission Comprehensive Assessment of Southern Hemisphere Humpback Whales

Two NMML scientists, Phil Clapham and Paul Wade, flew to Tasmania in April 2006 to attend the International Whaling Commission's (IWC) Workshop on the Comprehensive Assessment of Southern Hemisphere Humpback Whales. An assessment reviews all available information for a population of whales; by analyzing current numbers and growth rates together with the population's catch history, the assessment attempts to determine the original (prewhaling) size of the stock and its current status relative to environmental carrying capacity. More than 200,000 humpbacks were killed by whaling south of the equator in the 20th century, representing probably more than 90% of the pristine

population. The catch included more than 48,000 whales taken illegally by the former Soviet Union, which in just two seasons (1959-60 and 1960-61) killed 25,000 humpbacks in the Antarctic south of Australia and New Zealand.

There are at least seven populations of humpback whales in the Southern Hemisphere, which all feed in Antarctic waters in the austral summer and undertake long annual migrations to winter breeding areas in the tropics. For example, whales feeding off the Antarctic Peninsula migrate thousands of miles up the western coast of South America to breed off Colombia and Ecuador, and even north of the equator as far up as Central America. Similarly, humpbacks migrating up the eastern coast of Australia (probably to breeding grounds in the Great Barrier Reef and other areas) feed in the productive polar waters to the south of that continent. However, these feeding grounds also appear to be used by humpbacks from other regions. While the eastern Australia group is large and clearly increasing, other populations (e.g., one which was once substantial off New Zealand and Fiji) show little sign of recovery from whaling. With Japan set to begin scientific whaling on humpbacks in the 2007-08 whaling season, the concern is that the catch may involve whales from one of these small, struggling stocks.

The Tasmania workshop decided that only three of the seven humpback populations could reasonably be assessed—those breeding off western South America, eastern South America, and western Australia—and this analysis was continued at the IWC's annual Scientific Committee meeting in St Kitts in May-June 2006. Of these three assessments, that for the population off eastern South America was considered to be the most certain. It was estimated that this population is currently at 25%-34% of its pre-exploitation level, and that while there has been an observed increase in abundance in recent decades, the stock remains well below its pristine levels. Assessment modeling for the western South America stock was rather more complicated; the assessment suggested that current population size was at 30%-70%, but it was agreed that no conclusion could be drawn about the status of this stock, given the substantial variation in existing estimates for current abundance.

The breeding stock off western Australia was the most problematic of the three, particularly because of a concern regarding the potential for exchange on the Antarctic feeding grounds with the population that breeds off eastern Australia. As a result, the assessment for the western Australian stock was considered preliminary and will be reevaluated in the future; this will require clarifying stock structure of the humpback whale population(s) in Oceania and the potential for mixing in high latitudes. Nonetheless, it was agreed that there has been a substantial increase in the abundance of this population since protection.

The IWC briefly considered additional information on the remaining four Southern Hemisphere breeding stocks and will reevaluate the situation with regard to these populations in the future as more information becomes available. There was no further discussion on the issue of whether animals from small unrecovered populations in Oceania (e.g., New Zealand and Fiji) were feeding in the Antarctic area which is the focus of the Japanese scientific whaling program (JARPA II), but this remains a concern in light of Japan's intention to kill 50 humpback whales per annum beginning in 2007-08.

By Phil Clapham

POLAR ECOSYSTEMS PROGRAM

Ice Seal Operations

NMML researchers, were joined by two Alaska Native seal hunters and a wildlife scientist from the Vyatka Agricultural Academy in Kirov city, Russia, to conduct research on the four species of ice breeding seals (i.e., bearded, spotted, ribbon, and ringed seals) that are known to occupy the eastern region of the Bering Sea in spring and summer. The field work conducted aboard the University of Washington research vessel *Thomas G. Thompson* consisted of shipboard observations for pinnipeds and the capture and instrumentation of ribbon and spotted seals with satellite-linked dive and location recorders.

SHIPBOARD OBSERVATIONS:

Whenever the *Thompson* was within 300 m of sea ice and moving, between the hours of 08:00 and 20:00 (Aleutian Daylight Time), observers were posted on the bridge to record the presence of seals.

Table 1. Number of seals observed during surveys.	
Species	No. observed
Bearded seals	20
Ribbon seals	158
Ringed seals	0
Spotted seals	380
Steller sea lions	4
Unknown pinnipeds	197
Total	759

Information on the species, group size, and distance from the ship's track line (as calculated using angle measurements from inclinometers and reticle binoculars), were recorded along with sea ice type and concentration, weather, and visibility. Where possible, the age, sex, and molt stage of animals was also recorded.

In all, 759 individual seals (Table 1) were observed during 52 hours and 10 minutes of survey effort covering 925.8 nautical miles (nmi) of survey line. The number of ribbon seals observed increased as we approached 180°W. On 26-27 April 2006 we surveyed an area (near 58°30'N, 171°18'W) with very high numbers of seals (e.g., 10-20 seals observed/nmi). We did not encounter high numbers of seals when we returned to the same area on 28 April.

CAPTURES AND INSTRUMENTATION:

Capturing individual seals and fitting them with Satellite-Linked Data Recorders (SDRs) was the primary objective of the ice seal project. SDRs allow seals to be tracked, and transmit collected data via satellite for later analyses. Two types of SDRs were used:

SPLASH tag – This tag provides information on the movements, dive, and haul-out behaviors of the instrumented seal. It is attached to the seal's fur using epoxy and will fall off when the seal molts, which is likely to occur sometime in June. As such, SPLASH data will only be available for 1-2 months after deployment.

SPOT tag – This tag only provides information on the movements and haul-out behavior of the instrumented animal. It does not provide dive data, and the transmission frequency is restricted to once each week to conserve battery life. SPOT tags are much smaller and lighter than SPLASH tags and are attached to a cattle ear tag, which is then affixed to the inter-digital webbing of one of the seal's hind flippers. As such, SPOT tags do not fall off with the molt and are programmed to transmit for at least 18 months before exhausting the battery. Because the seal's hind flippers are nearly always submerged while the seal is at sea, these tags are best suited for studying haul-out behavior and long-term movements between haul-out locations.

While conducting shipboard observations, whenever a seal was seen in a location favorable for capture (e.g., with a pup, in the middle of a large floe, on the edge of an ice finger), the *Thompson* was stopped to launch three Mark-III Zodiac inflatable rafts. Directed by an observer on the *Thompson's* bridge, the three Zodiacs surrounded the seal; researchers jumped onto the floe and, using long-handled nets, captured the seal. After physically restraining the seal, the SPLASH and/or SPOT tag(s) were attached, a tissue sample for DNA analysis was taken from the rear flipper, any scat or urine present on the floe was collected, and the seal's length and girth were measured before releasing it.

Overall, 10 ribbon seals (5 adults, 5 pups), and 8 spotted seals (1 yearling, 7 pups), were captured and instrumented (Table 2) at different locations throughout the study area. Shortly after deployment, all instruments were transmitting as expected. Researchers from NMML will continue to monitor the seals' daily movements and dive behavior.

By Michael Cameron

Table 2. Number of seals instrumented with different SDR types.					
Species	Age Class	Sex	SPOT only	SPLASH only	SPLASH and SPOT
Ribbon	Pup	M	3		
		F	2		
	Adult	M	1		
		F		2	2
Spotted	Pup	M	6		
		F		1	
	Yearling	F			1

RESOURCE ASSESSMENT & CONSERVATION ENGINEERING (RACE) DIVISION

GROUNDFISH ASSESSMENT PROGRAM

Aleutian Islands Bottom Trawl Survey Under Way

Groundfish Assessment Program scientists began the 2006 bottom trawl survey of Aleutian Islands groundfish and invertebrate resources at the beginning of June, meeting and setting up the chartered vessels *Gladiator* and *Sea Storm* in Dutch Harbor, Alaska. The survey involves the two vessels sampling 366 assigned stations between Unimak Pass (long. 165°W) and Stalemate Bank (170°40'E) in waters as deep as 500 m. The *Gladiator*'s 50-day charter is divided into two legs, while the *Sea Storm*'s 70-day charter is divided into three legs. Charters begin and end in Dutch Harbor and all other leg breaks will be in Adak. Scientists will collect information on species composition of catches and biological data and specimens from the catch.

By Mark Wilkins

Annual Eastern Bering Sea Shelf Bottom Trawl Survey

On 30 May 2006, the fishing vessels *Arcturus* and *Northwest Explorer* began charters lasting 60 days to sample 405 stations on the eastern Bering Sea (EBS) shelf. This annual bottom trawl survey extends the time series of bottom trawl surveys, begun in 1971, for collecting data on distribution, abundance, and population biology of key groundfish, crab, and other invertebrate species within the EBS continental shelf ecosystem.

The first large-scale survey of the EBS shelf was conducted in 1975 in response to a need for baseline data to assess the potential impact of proposed offshore oil exploration and development on fishery resources. During this baseline survey, sampling was conducted between the 20-m and 200-m isobaths and from the Alaska Peninsula north to approximately 62°N. The spatial coverage of the annual surveys varied until 1979 when the most comprehensive survey of the EBS shelf and continental slope was undertaken in cooperation with the Japan Fisheries Agency. Subsequent annual bottom trawl surveys have essentially resampled the stations established during the 1975 shelf survey, with slight modifications each year.

Commercial groundfish and crab fisheries of the EBS shelf are vital to the Alaska economy. Results from this survey series are integral elements in the stock assessments of numerous crab, invertebrate, and groundfish species that are updated annually by the North Pacific Fishery Management Council per the requirements of the Magnuson-Stevens Fishery Conservation and Management Act.

In addition to the regular sampling, special studies are being conducted during the survey to investigate: 1) the effect of trawl speed through the water on catch rates and trawl performance; 2) groundfish feeding ecology; 3) use of highly quantitative acoustic data to supplement trawl survey catch data; 4) *in situ* light levels and pollock distribution; 5) reducing variance of trawl performance indices with net swapping procedures; 6) stationary seabird surveys; 7) incidence of bitter crab disease and black mat syndrome; 8) life history of Bering flounder, three *Myoxocephalus* species, and the yellow Irish Lord; 9) population structure of *Enteroctopus dofleini*; 10) fur seal sampling strategies; 11) parasites as indicators of ecosystem change; 12) *Ichthyophonus* in walleye pollock; 13) DNA-base identification of fish prey items, and 14) summer zooplankton biomass on the EBS shelf.

Preliminary results from this year's survey show water temperatures are the coldest since 1999. The pool of water with bottom temperatures less than 2°C extended all the way into Bristol Bay compared to last year when the cold pool extended to north of the Pribiloff Islands. Interannual variability in bottom temperatures is important because it can affect the distribution and behavior of crab and fish populations.

By Robert Lauth

MIDWATER ASSESSMENT & CONSERVATION ENGINEERING (MACE) PROGRAM

Bering Sea Ice Edge Cruise

Scientists from the Midwater Assessment and Conservation Engineering (MACE) program conducted an acoustic-trawl survey in the vicinity of the marginal ice zone in the eastern Bering Sea 20-27 April aboard the NOAA ship *Miller Freeman*. The survey occurred primarily north of the Pribilof Islands. This research was part of an interdisciplinary effort with other AFSC scientists from Recruitment

Processes/EcoFOCI, the National Marine Mammal Laboratory (NMML), and the Resource Ecology and Fisheries Management (REFM) Division, and scientists from the Pacific Marine Environmental Laboratory (PMEL), Institute of Marine Science of the University of Alaska Fairbanks, and Scripps Institute of Oceanography who were working aboard the University of Washington's research vessel *Thomas G. Thompson* in close proximity to the *Miller Freeman*. (See also Recruitment Processes program report below.)

Acoustic data were collected over 1,000 nautical miles (nmi) of trackline aboard the *Miller Freeman* and provisionally grouped into three different zones: an ice-free zone, a marginal ice zone, and a zone along the ice edge itself. Acoustic data were collected with a Simrad EK60 echosounder system and split beam transducers operating at 18, 38, 120, and 200 kHz. Species-specific, frequency-dependent differences in the intensity of the acoustic backscatter between 18-200 kHz were used to determine the species classification of the scattering layers. Observations of sea-ice characteristics and coverage as well as physical oceanographic data were also collected. Very little echosign was attributable to fish thoughout the study area. An extensive and persistent sound scattering layer was observed at 120 and 200 kHz. This layer exhibited diel vertical migrations in that it was distributed primarily within 30 m of the seafloor during daylight hours and moved upwards about 60-80 m to within 20 m of the surface during darkness. Methot trawl hauls were used to groundtruth the acoustic data and confirmed that this layer was dominated by backscatter from adult euphausiids and jellyfish (*Chrysaora melanaster*).

By Chris Wilson

Development and Evaluation of Trawl Groundgear Modifications to Reduce Damage to Living Structure in Soft Bottom Areas

Scientists from the the Conservation Engineering team of the MACE program have been working with the fishing industry to modify groundfish trawls to reduce their effects on the seafloor environment. We are initially focusing on areas with soft-bottom (sand and mud) substrates where most groundfish fishing occurs. In those areas, the seafloor features considered most likely to be both significant habitat elements and be vulnerable to fishing are sessile invertebrates such as anemones, ascidians, sponge, and basketstars. Because they have relatively low profiles and flexible bodies, trawl modifications that create more space between the trawl and the seafloor are being considered to reduce damage to these animals.

From 23 May to 7 June, MACE scientists compared the effects of conventional and modified sweeps (herding cables ahead of the trawl net) the on sessile invertebrates at four study sites on the eastern Bering Sea shelf (Fig. 1). We selected sites with high abundances of such animals as well as a variety of the most common types. A site about 60 nmi west of St. Paul Island (A) was dominated by sea whips and basketstars. Sites 45 nmi east of St. Paul (B) and 100 nmi west of Cape Newenham (C) had mostly ascidians (*Halocynthia*, *Boltenia* and *Styela*). Finally, sponge dominated the sessile seafloor fauna at a site 60 nmi NNE of Port Moller (D).

At each site, experimental trawling created parallel tracks of four types of modified sweeps and two types of conventional sweeps. Modified sweeps had clusters of larger diameter disks at 30-foot (9.1-m) intervals, lifting the sweep cables above the seafloor. Conventional sweeps had the same diameter throughout, causing more continuous seafloor contact. Both disk diameter and sweep material were varied.

A seafloor sled (Fig. 2) with both sonar and video sensors was then towed across the parallel trawl tracks at several points to compare the condition of seafloor animals in areas affected by these different gears. An acoustic camera (DIDSON) provided an image of seafloor terrain on which trawl marks

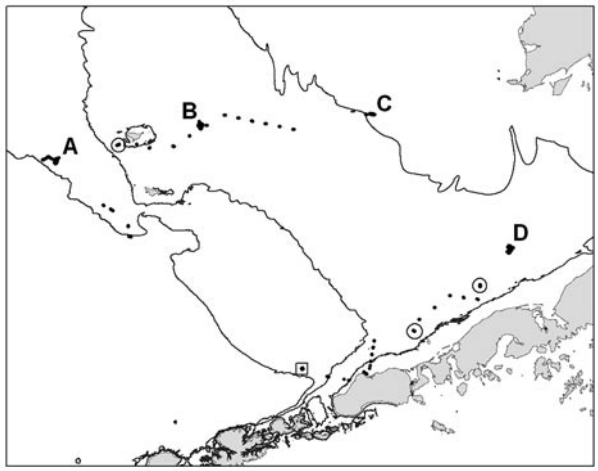

Figure 1. Locations of sled and trawl tows during May – June 2006 research on reducing seafloor effects of trawling. Principal sites (A-D), Fishing boundary transition sites are indicated inside circles, skate nursery area in square.

Figure 2. Launching the seafloor sled with DIDSON sonar and camera with strobed lighting. Photo by Carwyn Hammond.

could be consistently identified, making it possible to discern which part of which trawl track the sled was in or whether it was between tracks. A video camera with strobed lights was then used to assess the condition and abundance of seafloor invertebrates associated with each area. The imagery from these sensors will be analyzed to estimate the relative effects of the alternative sweep designs on each kind of structure-forming invertebrate.

Having the seafloor sled also provided many opportunities for additional observations while running between stations. These included:

1) Whenever possible (21 sites), the sled was deployed when crossing over stations (or points halfway between stations) that are sampled by the Bering Sea trawl survey. This will allow comparisons of trawl catches with direct observations of the seafloor as well as putting the study sites in the context of a wider range of comparable observations.

2) At three locations, the sled was towed several times across boundaries set by fishery managers that created contrasts between heavily fished areas and adjacent unfished areas. Comparisons of seafloor conditions across the boundaries should indicate the resultant effects of fishing.

3) The sled was towed at a series of eight stations at 5 nmi intervals north from Unimak Island, crossing an area of highest fishing intensities as well as adjacent nearshore habitats. A similar transect of three tows was made west from Unimak Island.

4) A skate nursery area was crossed with the sled east-west and north-south. On the southern end of the later transect, very high densities of skate egg cases were observed. This supplemented previous trawl observations by confirming the nursery location and providing distribution information on a finer scale.

The next phase of this project will use twin trawls equipped with conventional and modified sweeps to determine whether they affect catch rates of commercial species. A pilot cruise in fall 2005 found this technique effective and detected no significant loss of target species while trawling on the Bering Sea slope.

By Craig Rose

Tests of Halibut Excluders for Cod Trawls

From 18 to 23 June, the Conservation Engineering team tested a range of configurations for devices to reduce bycatch of halibut in cod trawls in the Gulf of Alaska. The principal excluders consisted of an array of slot-shaped holes approximately 67 x 600 mm ahead of the codend of the trawls. These slots are too narrow to allow most cod to escape, while being large enough to release the smaller halibut that have been a significant part of halibut bycatch during the last several fall cod fisheries. The principal challenge was to make sure that halibut spent enough time near the holes to escape, while not clogging up the net during periods of rapid cod capture. Observations ahead of the trawl showed many larger halibut escaping over the lower bridles, just ahead of the trawl net. Reducing structures that inhibit such escapes seemed to improve this movement.

Cooperating partners from the fishery have arranged a test fishery, under an exempted fishing permit, to determine the effectiveness to the resulting devices. That work will occur in August 2006.

By Craig Rose

RECRUITMENT PROCESSESS PROGRAM

Spring Field Season: Multidisciplinary Sea-Ice Cruise, Ichthyoplankton Surveys

Recruitment Processes/EcoFOCI (Ecosystems-Fisheries Oceanography Coordinated Investigations) finished its spring field season with 304 man-days at sea. Highlights included an EcoFOCI-led multidisciplinary sea-ice cruise on the University of Washington's (UW) *Thomas G. Thompson* (chief

scientist Nancy Kachel (FOCI-PMEL)), the Bering Sea spring ichthyoplankton cruise on the NOAA ship *Miller Freeman* (chief scientist Janet Duffy-Anderson), the late May spring ichthyoplankton survey on the *Miller Freeman* (chief scientist Annette Dougherty), and the summer Bering Sea ichthyoplankton survey on Hokkaido University's *Oshoro Maru* (AFSC chief scientist Steve Porter).

The sea-ice cruise (two legs) was of particular interest because it involved a collaboration between EcoFOCI, NMML, and MACE (participating collaboratively on the *Miller Freeman*, see MACE program report above) with 25 scientists from five different agency groups, three universities, and five countries, as well as two Native Americans, a Russian photographer, photographers and reporters from the Seattle Times, and a filmmaker. The purpose of the cruise was to observe the ice-edge ecosystem of the eastern Bering Sea. Sampling targeted the distribution of physical, biological, and chemical properties of the water column across the zone of the ice-edge and within the ice floes, with special attention to phytoplankton blooms and the zooplankton community. The marine mammal component tagged ribbon seas with ARGOS transmitters to track movements, and MACE personnel used hydro-acoustics to search for concentrations of fish under the ice edge.

Scientists from the EcoFOCI Program conducted a spring zooplankton and ichthyoplankton survey aboard the *Miller Freeman* in the southeastern Bering Sea near Unimak Island. This area is a known spawning ground for walleye pollock, northern rocksole, Greenland halibut, and Alaska plaice. The survey provides data on the abundance, distribution, and assemblage structure of the eggs and larvae of these fishes in spring. Data are also used to identify transport pathways for newly spawned eggs and larvae. Zooplankton are also sampled at each station, and data are used to describe associated zooplankton diversity and abundance over the slope and shelf. The cruise was conducted 9 - 19 May, and included Bering Canyon and the adjacent continental shelf (Fig. 1). Survey operations were conducted 24 hours per day. Satellite-tracked drifters were released in the Unimak Island vicinity to study currents at depth (40 m). Depth discrete ichthyoplankton sampling was accomplished through a series of tows made with the Multiple Opening and Closing Net and Environmental Sensing System (MOCNESS) to

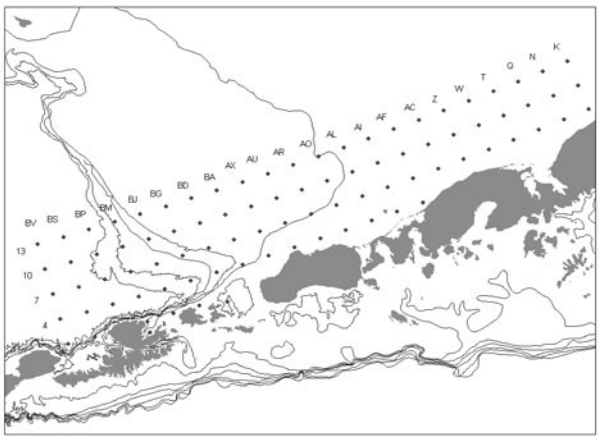

Figure 1. Stations occupied during cruise MF06-06, 9-16 May 2006.

provide information on depth-specific distribution of larval fishes. Data on physical characteristics of the water column were also collected.

By Kevin Bailey

U.S.-Polish Plankton Sorting and Identification Center Advisory Committee Meeting

The 32nd Annual Meeting of the Advisory Committee of the U.S.-Polish Plankton Sorting and Identification Center (Zaklad Sortowania i Oznaczania Plantou: ZSIOP) was hosted by the Recruitment Processes Program and held at the Alaska Fisheries Science Center in Seattle on 23-26 May 2006. Jim Coe, Center Deputy Director, provided the welcoming address. Participating in the discussions on the U.S side were Jeff Napp and Ann Matarese (AFSC), Elizabeth Clarke (Northwest Fisheries Science Center), Ken Sherman and Jon Hare (Northeast Fisheries Science Center), Joanne Lyczowski-Shultz (Southeast Fisheries Science Center), and Frank Hernandez (Dauphin Island Sea Laboratory). The Polish members of the Advisory Committee included: Rafel Geremek (Morski Institut Rybacki, Gdynia); Leonard Ejsymont and Wanda Kalandyk (ZSIOP, Szczecin). The Advisory Committee met to review the 2005-06 work and to determine whether it was in conformance with the Joint Studies Agreement. The committee planned the work for the 2006-07 agreement and discussed ZSIOP operations, funding, training, sorting priorities, data exchange, status of joint research and reports, and new initiatives.

By Kevin Bailey

SHELLFISH ASSESSMENT PROGRAM: FISHERIES RESOURCE PATHOBIOLOGY

New Diagnostic Tool Tested for Monitoring Bitter Crab Syndrome

Vanessa Lowe of the Fisheries Resource Pathobiology team has participated in the annual Alaska Department of Fish & Game (ADF&G) Southeast Alaska Tanner Crab Survey for the past 3 years to monitor and contrast Bitter Crab Syndrome (BCS) between historically low (eastern Bering Sea) and high (Southeast Alaska) prevalence areas. For example, overall prevalence in both *Chionoecetes bairdi* and *C. opilio* from the EBS remain 3%-5% although prevalences in crab less than 50 mm carapace width may exceed 10%, while overall prevalence in *C. bairdi* from Southeast Alaska may approach 100% in certain bays. From 2003 to 2004, bloodsmears were prepared and hemolymph was preserved in 100% ethanol from random (2004 and 2005) and nonrandomly (2003) selected crabs. Water and sediment samples were also collected from Stephens Passage (west of Douglas Island) and Icy Straits, two sites within Southeast Alaska where BCS is present at relatively high and low prevalences, respectively. The team was interested in developing and testing a DNA-based diagnostic tool for monitoring BCS that could also be used to search for free-living life history stages of the pathogen in both water and sediment. We also wanted to contrast the traditional method of detecting BCS (i.e., examination of bloodsmears) with the DNA-based diagnostic tool.

The DNA-based method has proven to be more accurate and rapid in detecting BCS in diseased crabs. However, detection of free-living stages of the parasite in water and sediment samples is not unequivocal. All bloodsmears have been examined and progress is being made toward applying the DNA-based diagnostic tool to all ethanol preserved samples. A report on the results of the bloodsmear examinations follows.

Crabs were collected by crab pot which limited our access to crabs less than 70-mm carapace width (Fig. 1). Regardless, BCS in male crabs greater than 75-mm carapace width ranged between 0% to 33% for each 5-mm size group. For females, prevalence ranged between 0% and 17% for each size group. No trend with respect to size and prevalence was observed. The 65-mm group is represented by one positive crab.

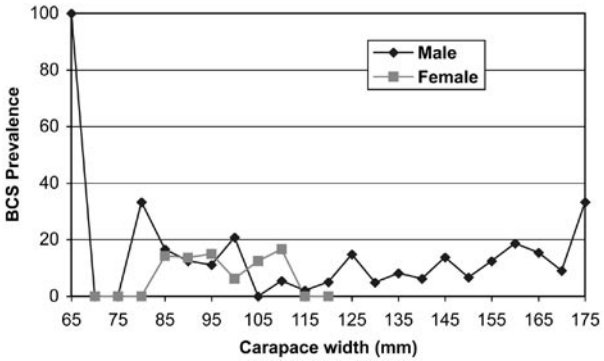

Figure 1. Prevalence of Bitter Crab Syndrome in Tanner Crabs by size.

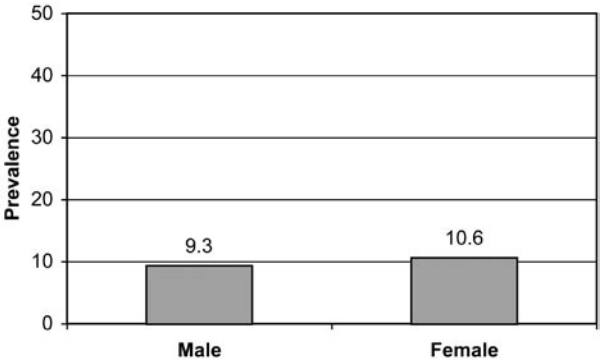

Figure 2. Prevalence of Bitter Crab Syndrome in Tanner Crabs by sex.

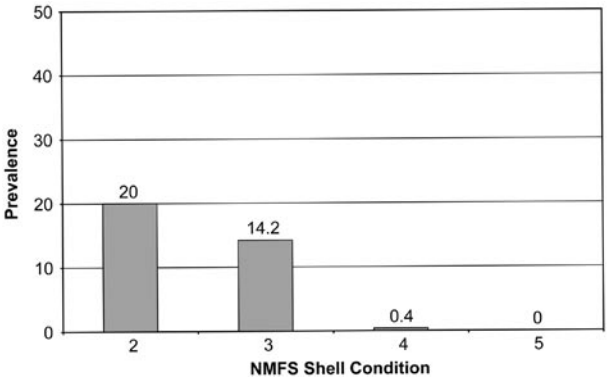

Figure 3. Prevalence of Bitter Crab Syndrome in Tanner Crabs by shell condition.

In general, many more male (N = 579) than female (N = 103) crab were randomly collected. Despite this disparity, there was little difference in BCS prevalence by sex (Fig. 2). Prevalence for both sexes hovered around 10%.

Shell condition determination is a traditional method to estimate time from a decapod's most recent molt. Our data indicate that shell "Condition-2" crabs are more frequently encountered with disease than other shell conditions (Fig. 3). The data indi-

cate that while older shell condition crabs may be infected, prevalences diminish over time.

The data were analyzed by logistic regression. The original model included the following variables: sample site, sex, size, shell condition, and depth. Initial analysis indicated that the variable size was not a good predictor of disease. As a result, the variable size was removed from the model and the data were again analyzed. This second analysis indicated that sample site, shell condition and depth are good predictors of disease. As a result, it might be expected that for this project, crabs collected from Stephens Passage, at shallow depths and of shell Condition 2 are more likely to be infected than crabs collected under other conditions.

By Frank Morado

FISHERIES BEHAVIORAL ECOLOGY PROGRAM

Reflex Impairment to Predict Mortality of Discarded or Escaped Fish Bycatch

Mortality of fish bycatch discards and escapees that is induced by capture or encounters with fishing gear has been a primary concern for fisheries managers for at least two decades. Mortality of discards may be immediate, which can be observed on the deck of a fishing vessel, or delayed, which is undetected. Mortality of escapees is generally undetected.

Estimating bycatch mortality rates has been difficult. Fishing experiments typically estimate delayed mortality by placing fish in cages or with tag-and-recapture studies over extended periods of time, which limits the scope and replication of experiments. A different approach which increases experiment scope and replication significantly is to predict discard and escapee mortality by observing fish condition during fishing experiments rather than after an extended recovery period. Fish condition has been discussed as a general predictor for mortality, but no guidance has been given for how this would be accomplished over a range of fisheries. The International Pacific Halibut Commission developed a condition index based primarily on wounding to predict Pacific halibut discard mortality in Northeast Pacific Ocean trawl, longline, and pot fisheries. However, use of wounding, autopsies, or plasma constituents as predictors for delayed and total mortality may be limited because these measures show inconsistent responses to different types of fishing conditions including capture, environmental factors, fish size, and combinations of stressors.

Reflex impairment is a measure of fish condition that responds to a wide range of fishing factors in a similar manner that is correlated with stressor intensity. Recent studies conducted by the Fisheries Behavioral Ecology Program showed that reflex impairment in walleye pollock, sablefish, northern rock sole, and Pacific halibut was related to mortality that was induced by stressors associated with fishing, discarding, or escaping from nets. A mortality predictor called the Reflex Action Mortality Predictor (RAMP) was formulated based on results of these studies.

To evaluate relationships between RAMP and mortality, fish were towed in a net for various times up to 4 hours to produce a range of mortality. Three minutes after towing, fish were tested for reflex impairment either while swimming freely in tanks or while placed in a foam-lined restraining device. Reflex impairment was defined as any decrease or complete inhibition of normal baseline reflex action in live fish. For fish in tanks, orientation and startle responses to visual stimuli (lifting the tank cover) and mechanical stimuli (knocking the side of the tank with a calibrated strike) were noted. For restrained fish, body flex, operculum closure, mouth closure, gag response, and vestibular-ocular response were noted. Responses were scored as present (1) or absent (0) and totaled for the five fish in a replicate group. Then RAMP was calculated where RAMP = 1 (total reflex response score / total score possible). RAMP ranged from 0.0 to 1.0, representing the proportion of reflex impairment where 0 = no impairment.

Total mortality increased with increased tow time, and RAMP was correlated with this gradient of mortality. RAMP for fish in tanks 3 minutes after towing (Fig. 1) showed a sigmoid relationship to total mortality in pollock (r^2 = 0.55), sablefish (r^2 = 0.80), rock sole (r^2 = 0.29), and halibut (r^2 = 0.44). Prior to fish showing mortality, RAMP initially increased with tow time, reflecting sublethal stressor effects. Then RAMP continued to increase while mortality became apparent and increased. Similar patterns in RAMP response were noted for restrained fish (Fig. 2), with a sigmoid relationship to total mortality in pollock (r^2 = 0.44), coho salmon (r^2 = 0.84), rock sole (r^2 = 0.93), and halibut (r^2 = 0.83).

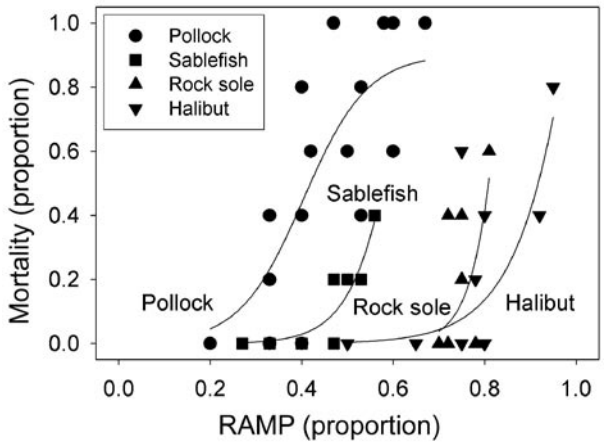

Figure 1. Relationship between RAMP (Reflex Action Mortality Predictor) measured for fish in tanks at 3 minutes after towing and total mortality (proportion) in walleye pollock, sablefish, northern rock sole, and Pacific halibut. Points represent replicate groups with five fish per group.

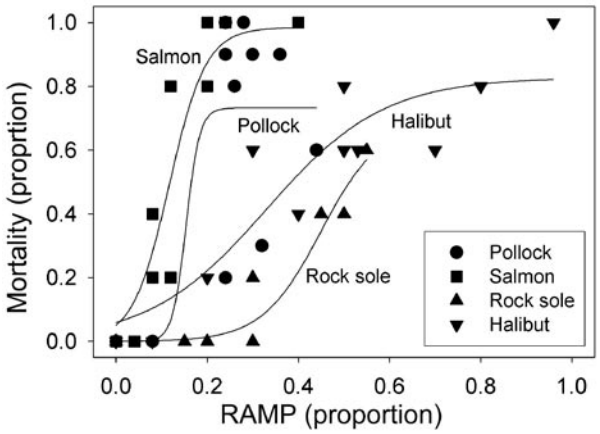

Figure 2. Relationship between RAMP measured for restrained fish at 3 minutes after towing and total mortality (proportion) in walleye pollock, coho salmon, northern rock sole, and Pacific halibut. Points represent replicate groups with five fish per group.

RAMP for discards in the field should ideally be measured on individually restrained fish as this would not require the use of tanks on board vessels and could be performed rapidly on numerous replicates through the course of discarding. RAMP for escapees should be measured on fish in cages at depth shortly after escaping from fishing gear. Reflex behavior could be observed using cameras mounted on the cages.

Relationships between RAMP and mortality could be validated by observing RAMP for species of interest in future fishing experiments that use tanks, caging, or tagging to estimate delayed mortality. Once validated, RAMP can be used to predict delayed and total mortality for individual species in extensive fishing experiments without the need for further caging or tagging. Because RAMP can predict mortality over comprehensive ranges of fish size and fishing-related stressors, differences in stressor intensity and mortality between fishing practices, conditions and fisheries can be evaluated for individual species. RAMP may be a powerful tool for investigating the efficacy of bycatch reduction devices and practices, as well as estimating fishing mortality associated with bycatch. The ability to estimate sublethal and lethal effects of seemingly unlimited combinations of fishing-related stressors using RAMP would greatly enhance our ability to model bycatch discard and escapee mortality in

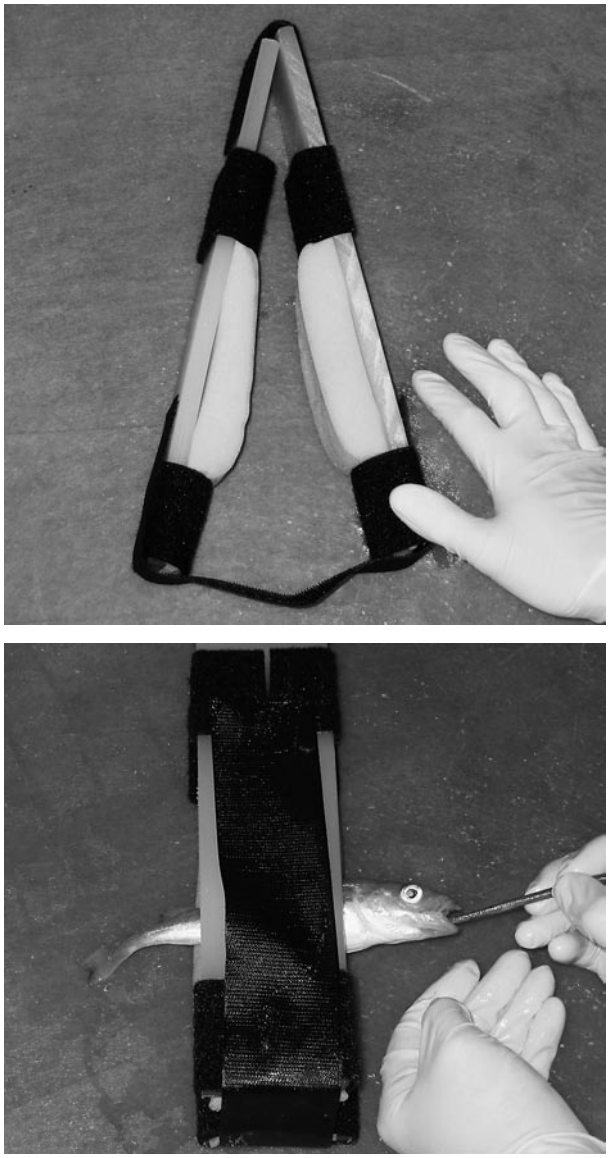

Figure 3. Pictures of fish restraining device (top) and walleye pollock being tested for mouth closure in fish restraining device (bottom). Photos by Michele Ottmar.

fisheries and to reduce uncertainty in estimates of fishing mortality associated with bycatch.

By Michael Davis

RESOURCE ECOLOGY & FISHERIES MANAGEMENT (REFM) DIVISION

RESOURCE ECOLOGY AND ECOSYSTEM MODELING PROGRAM

Fish Stomach Collection and Lab Analysis

Laboratory analysis was performed on 1,752 groundfish stomachs from the eastern Bering Sea and 62 groundfish stomachs from the Gulf of Alaska. During this quarter, 382 stomachs were analyzed during research surveys in the Bering Sea, and 460 stomachs were analyzed during surveys in the Aleutian Islands. Further stomach collection and shipboard stomach analysis is ongoing for the 2006 field season. A total of 9,849 records were added to the groundfish food habits database.

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

Predator/Prey Interactions

"Food Habits of Groundfishes in the Gulf of Alaska in 1999 and 2001" by Yang et al. 2006 has been published as a NOAA Technical Memorandum (NOAA Tech. Memo. 164; http://www.afsc.noaa.gov/Publications/AFSC-TM/NOAA-TM-AFSC-164.pdf). A total of 7,899 stomachs from 40 species were analyzed to describe the food habits of the major groundfish species in the Gulf of Alaska in 1999 and 2001. Arrowtooth flounder, Pacific halibut, sablefish, Pacific cod, bigmouth sculpin, big skate, and Bering skate were the main piscivores analyzed in this study. Overall, walleye pollock was the dominant prey fish.

The main predators that fed on Tanner crabs were halibut, Pacific cod, big skate, longnose skate, and great sculpin. Flathead sole, sharpchin rockfish, rougheye rockfish, longnose skate, and walleye pollock were the main consumers of pandalid shrimp. Sharpchin rockfish, Pacific ocean perch, redbanded rockfish, Atka mackerel, and pollock fed mainly on zooplankton. Southern rock sole, northern rock sole, rex sole, Dover sole, deepsea sole, and darkfin sculpin were benthic feeders; they fed mainly

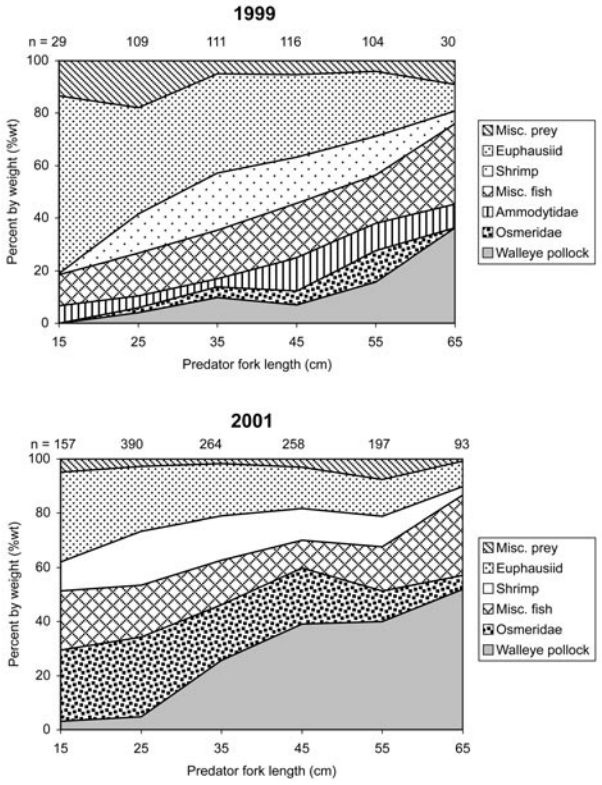

Figure 1. Main food items (percent wet weight) of arrowtooth flounder by predator size, as measured by food habits data from summer trawl surveys in the Gulf of Alaska, 1999 and 2001. (n = number of stomachs with food.)

on polychaetes, marine worms, and brittle stars. Internannual variation was also observed, for example, the diets of arrowtooth flounder showed higher consumption of pollock and osmeridae (primarily capelin) in 2001 while, in 1999, zooplankton was more prevalent in arrowtooth diets (Fig. 1).

By Mei-Sun Yang and Kerim Aydin

Multispecies Modeling

The AFSC is developing a scientific framework for providing ecosystem-based advice for the management of groundfish fisheries. This framework has three main goals for protecting the ecosystem attributes: 1) maintain predator/prey relationships, 2) maintain energy flow and balance, and 3) maintain diversity. The framework includes using multispecies models (biological and technological interactions) for developing statistically rigorous multispecies forecasts. In particular, we have developed a multispecies virtual population analysis (MSVPA) and a multispecies forecasting model for the eastern Bering Sea. Unfortunately, these models lack statistical assumptions which hamper the inclusion of uncertainty into multispecies model parameter estimation. Therefore, we recently developed a simple

version of a multispecies statistical model to show that it is possible to incorporate MSVPA predation equations into a statistical catch-at-age model. In this work we show a more elaborated version of this model set up in the AD Model Builder platform (Otter Research Ltd.).

The multispecies statistical model (MSM) includes two species, walleye pollock and Pacific cod. The MSM estimates abundance, suitability coefficients, and predation mortality based on catch-at-age data (1979-2002) for both species. It incorporates the AFSC's bottom trawl survey (walleye pollock and Pacific cod), the echo integration trawl (EIT) survey (walleye pollock), survey age composition data, fishery age composition data, and annual total catch of both species (1979-2002), predator ration, and stomach contents data in a statistical framework. With the MSM configured in the AD Model Builder platform, we were able to estimate for the first time the uncertainty of the predation mortality (Fig. 2) and the suitability coefficients (Fig. 3) and the residual mortality. This new version is more efficient and has more flexibility for the estimation of parameters, indicators, and their uncertainties. It is also an ideal platform to incorporate the technological interactions and create a powerful new analysis tool that will improve our evaluations of broad range of implications of management policies within a multispecies framework.

By Jesús Jurado-Molina, James Ianelli, and Patricia Livingston

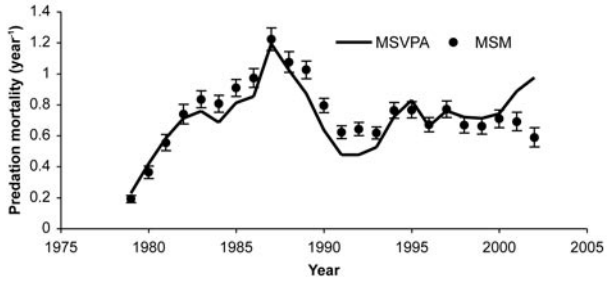

Figure 2. Temporal trend of maximum likelihood estimates of age-1 walleye pollock predation mortality, MSVPA – multispecies virtual population analysis, MSM – multispecies statistical model.

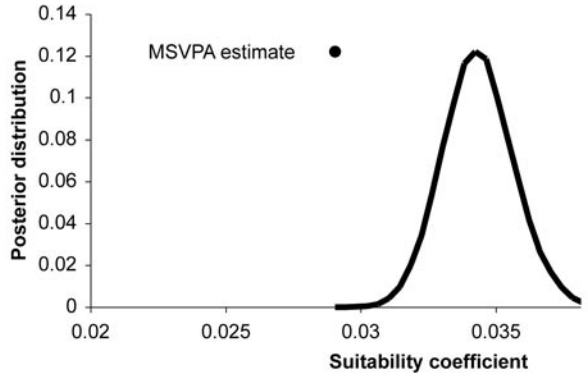

Figure 3. Posterior distribution of the suitability coefficient of Pacific cod as predator (age-8) and walleye pollock as prey (age-1).

Ecosystem Modeling

Assessing interactions between fisheries and marine mammals remains a critical national and international issue, and ecosystem models continue to enter this debate. In making policy decisions based on these models, it is important to evaluate the ecological assumptions underlying each model. For example, how do predators react to changes in prey in the model and in the real ecosystem?

In May, Kerim Aydin and Sarah Gaichas contributed a paper to the 2006 annual meeting of the International Whaling Commission in St. Kitts, Caribbean Islands, entitled "In defense of complexity: Towards a representation of uncertainty in multispecies models." In the paper, they described specific implications of the scale of predator competition: do predators forage over separate areas, each selecting from a range of prey choices (Fig. 4a) or do they compete directly in local "hotspots" for individual prey types (Fig. 4b)? The answer may differ by predator, by ecosystem, or especially by local conditions. Current multispecies and ecosystem models tend to make a single assumption on the scale of competition and this may lead to biased results: the "complexity" of predator/prey interactions discussed in the paper may be best evaluated by using a wide range of statistically validated models and assumptions for any particular predator/prey interaction.

By Kerim Aydin

Seabird Interactions

The AFSC's Seabird Program focused on two types of seabird surveys during the last quarter. The first is the stationary survey format developed by Washington Sea Grant for longline cruises in 2004. This format was expanded to all AFSC research and charter cruises conducted in 2006. Staff also coordinated with the Northwest Fisheries Science Center to implement the surveys on its West Coast charter cruises. That was accomplished and data are

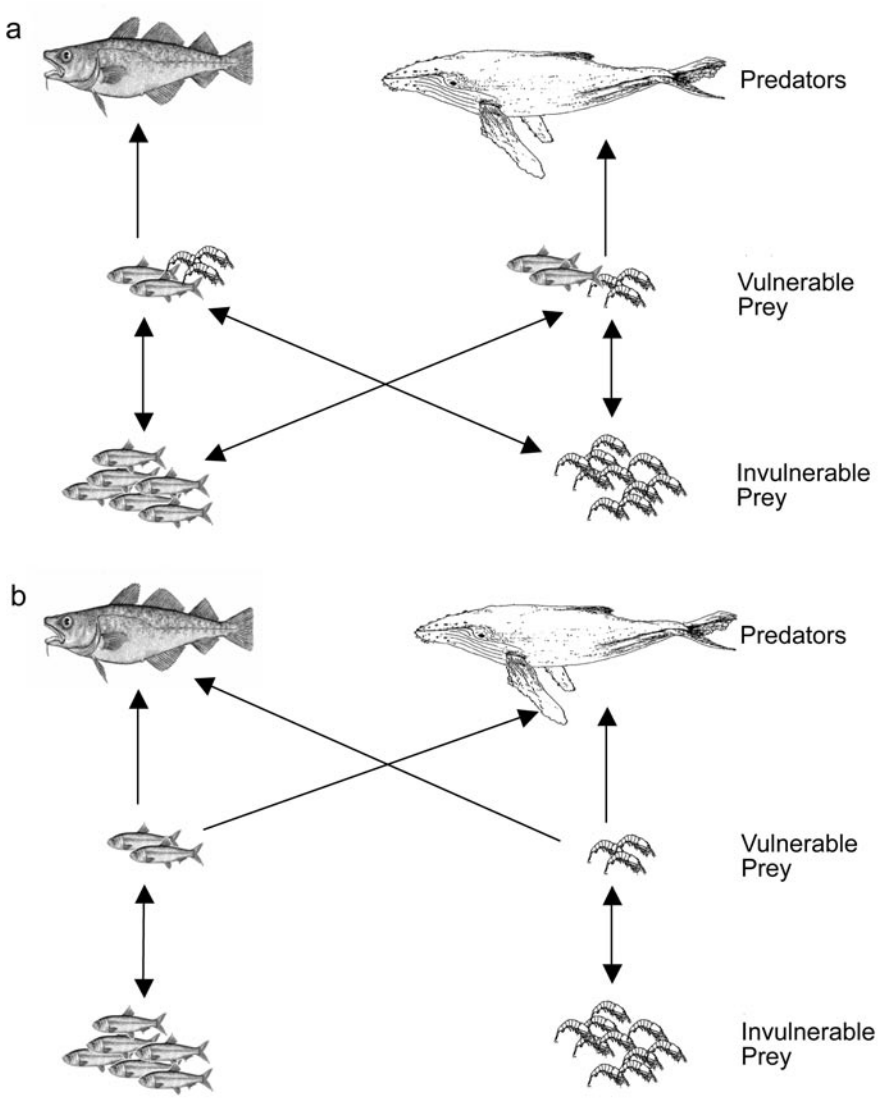

Figure 4. Two schematic diagrams of competition between top predators (shown here as a groundfish and a whale) and two prey types (shown here as forage fish and krill). In (a), each predator chooses separately from a range of prey, in which case the predator competition is relatively indirect. In (b), each prey type forms local "hotspots" of abundance, in which predators must compete directly for food.

being collected throughout the summer. These surveys now cover NMFS research and charter cruises from southern California, up the West Coast, and throughout Alaska waters. The U.S. Fish and Wildlife Service (USFWS) and many other clients have expressed great interest in the results. Data from previous years are being analyzed and will be made available to the public in the near future.

The second survey type is the strip-census. Staff have worked very closely with the USFWS Migratory Bird Division, Anchorage, Alaska, to support its North Pacific Research Board grant to conduct strip-census seabird surveys on appropriate platforms. The work will add to the extensive survey work completed in the 1970s and early 1980s and will ultimately be made available to researchers through the North Pacific Pelagic Seabird Database (www.absc.usgs.gov/research/NPPSD/index.htm).

Stephani Zador, Andre Punt, and Julia Parrish of the University of Washington working under direction of the AFSC Seabird Program through funds provided by the National Seabird Program are nearing completion of a risk assessment of short-tailed albatrosses interactions with trawl vessels in the Alaskan groundfish fishery. Stephani recently presented a talk, "Assessing the risk of endangered short-tailed albatross bycatch in the Alaskan trawl fishery" at the Society for Conservation Biology meeting in San Jose, California.

By Shannon Fitzgerald

ECONOMICS & SOCIAL SCIENCES RESEARCH PROGRAM

Comments Sought on North Pacific and West Coast Fisheries Community Profiles

Community Profiles for West Coast and North Pacific Fisheries – Washington, Oregon, California, and other U.S. States has been released for public review in draft form. The individual profiles of 125 communities, along with introductory and methodological information, are currently available on the Northwest Fisheries Science Center's (NWFSC) Web site at http://www.nwfsc.noaa.gov/research/divisions/sd/communityprofiles/index.cfm. The project is a joint effort between the AFSC and NWFSC, with additional support from the Southwest Fisheries Science Center. The profiles are being reviewed by community representatives and volunteers affiliated with the Port Liaison Project (PLP). The PLP, administered by Oregon Sea Grant and funded by the NWFSC, is designed to connect members of the commercial fishing industry with fisheries researchers. Other members of the public who are knowledgeable about these communities are also invited to read the profiles and send in suggested revisions during this review period.

This is the follow-up document to NOAA Technical Memorandum NMFS-AFSC-160, *Community Profiles for North Pacific Fisheries – Alaska* (available on the AFSC Web site at http://www.afsc.noaa.gov/REFM/Socioeconomics/Projects/CPU.htm) which describes 136 communities located in the state of Alaska with involvement in North Pacific fisheries. A large number of communities located on the West Coast participate in North Pacific fisheries; consequently it was more efficient to jointly profile these communities along with the other communities involved in fishing along the West Coast.

One hundred and twenty-five predominately West Coast communities were selected for profiling, from over 1,500 communities in the contiguous United States and Hawaii that had some involvement in either commercial fishing in the North Pacific or along the West Coast, or some involvement in both regions. The 125 selected communities primarily include U.S. Census Places from: Washington (40 communities), Oregon (31 communities), California (52 communities), New Jersey (1 community), and Virginia (1 community). All of the profiled communities except for one (Valleyford, California) had some involvement in North Pacific fisheries, either commercial, recreational, or both. The two communities, Seaford, Virginia, and Pleasantville, New Jersey, were selected for profiling solely because of their involvement in North Pacific fisheries.

The narrative profiles follow an outline nearly identical to the preceding Alaska profiles and include sections titled "People and Place" and "Infrastructure", but distinguish between "Involvement in West Coast Fisheries" and "Involvement in North Pacific Fisheries." "Involvement in West Coast Fisheries" details community activities in West Coast commercial fishing (landings delivered to community, processing, vessels, and permit holdings), sportfishing (sportfishing operators, license vendors and revenue, and landings), and subsistence fishing. "Involvement in North Pacific Fisheries" details community activities in North Pacific commercial fishing (landings delivered by community residents, crew member licenses, and permit holdings), and sportfishing (businesses and licenses).

Together with the Alaska profiles, this document provides a consolidated source for baseline social and fisheries information for the communities most involved in North Pacific fisheries. Consideration and analysis of fishing communities is mandated under National Standard 8 of the Magnuson-Stevens Fishery Conservation and Management Act. The draft profiles will be finalized and published later this year.

By Christina Package and Nicole Milne

Database Updates

Commercial Fisheries Entry Commission (CFEC) fish tickets for 1975-89 plus 1984-89 Commercial Operators Annual Report (COAR) production data from the Alaska Fisheries Information Network (AKFIN) were added to the Economics & Social Sciences Research (ESSR) Program's fisheries databases.

By Terry Hiatt

Southwest Region Economic Data Collection Project

Two contractors working for the ESSR Program (Hans Geier and Bill Hall from the University of Alaska, Fairbanks) conducted two focus group meetings to obtain feedback from Southwest Alaska

fishermen as part of an ongoing Southwest Alaska regional economic data collection project (see *AFSC Quarterly Report*, January-February-March 2006 issue). The first meeting occurred in Anchorage in April where contractors obtained useful comments from small boat fishermen on the survey questions. In the second meeting the contractors met with the members of Kodiak Draggers' Association to get comments on the survey. The contractors identified the types of questions that fishermen are very concerned about and unlikely to answer. Also, the contractors learned that different groups of fishermen (small boat vs. large boat fishermen) respond differently to the same set of questions. The results from the two focus group meetings led the contractors to delete some of the questions in the previous version of the survey, and to develop two slightly different surveys for different groups of fishermen. In addition to fishermen's feedback, ESSR Program economists provided valuable comments to improve the survey questions.

The contractors visited boat builders and suppliers in Oregon and Washington to find out if they would provide the information for estimating much of the operating and ownership costs for different types of vessels. The builders and suppliers expressed willingness to provide the information. Using the information from the boat builders and suppliers, the contractors will estimate the cost information for an average boat in a harvesting sector. Based on the estimated cost information for the average boat, the contractors will estimate the same information for all the vessels in the harvesting sector, by comparing factors such as horsepower, weight, gear types, etc. This approach will decrease the number of questions on the voluntary mailout surveys for the vessel owners, in turn increasing the response rate.

To estimate the population parameters (such as employment and labor earnings) using results from the mailed survey, a sampling methodology is needed. In this project, the entire population will be stratified into three strata or harvesting sectors depending on the size of the vessels and by the type of fishery in which the vessels are engaged. Within each stratum, an unequal probability sampling will be conducted. The first step in estimating the population parameters is to calculate the optimal sample size for the entire population. Next, the optimal sample size will be allocated across three different strata. Next, the issue of differences between the sample sizes of the strata and the actual sizes of response samples will be addressed, and the population parameters for each stratum will be conducted using the Horvitz and Thompson method. Finally, confidence intervals will be estimated.

The goal of this project is to improve the ESSR Program's ability to conduct the requisite regional economic analyses. A similar data collection project will be conducted for the Gulf Coast and Southeast regions of Alaska when the Southwest Alaska region project is completed.

By Chang Seung

Integrated Economic-Ecosystem Modeling Project

In this project, an ecosystem model (GEEM) is combined with an economic general equilibrium model (called a computable general equilibrium (CGE) model) to examine the relationships between the Alaska marine ecosystem and human activities. On the ecology component of the modeling, the contractors (John Tschirhart and David Finnoff from the University of Wyoming) rewrote the thirteen species ecosystem in Mathematica software which will make it easier to add new species to the model. On the economic component of the modeling, they have worked to better develop their model of capacity restriction and rent dissipation in a regulated open-access fishery. In addition to the open access fishery model, they will develop a model reflecting current regulation in the pollock fishery, which will be incorporated in their CGE portion of the integrated model.

By Chang Seung

Promoting Key Economic and Social Scientific Concepts to Fisheries Managers

The National Marine Fisheries Service (NOAA Fisheries Service) has recognized that the agency will benefit from increasing the role that social scientists play in fisheries management. The number of economists and social scientists in the agency has increased significantly over the last decade, but in many cases economists and other social scientists have not adequately conveyed their insights to fisheries managers, the fisheries management council community, or the larger academic fisheries science and policy communities.

ESSR Program researcher Dr. Alan Haynie conducted a survey of NMFS economists and other social scientists about their opinions on priority topics for fisheries management. The survey found that NMFS economists have encountered a wide range of topics where marine policy makers have expressed confusion. The survey produced a range of responses, but several common themes emerged:

- Biological and economic planning should happen jointly. A biologically well-managed fishery alone will not generate substantial wealth.
- Opportunity costs matter. Just because we don't pay for something doesn't mean that it is "free" to society.
- Confusion about the nature of community and national economic benefits and impacts is common.

Alan presented this research at the San Francisco NOAA Fisheries Social Scientists Meeting and at the International Symposium on Society and Resource Management (ISSRM) in Vancouver, British Columbia in June. Since Alan's initial survey, Alan has been working with NMFS headquarters economists on a new initiative to promote economic awareness throughout the agency.

By Alan Haynie

Regional Economic Models Review Paper Published

Regional or community economic analysis of proposed fishery management policies is required by the Magnuson-Stevens Fishery Conservation and Management Act, National Environmental Policy Act, and Executive Order 12866, among others. To satisfy these mandates and inform policymakers and the public of the likely regional economic impacts associated with fishery management policies, economists need appropriate economic models. There are many regional economic models available for use in analysis of fishery management. A number of studies have assessed the community economic impacts of fishery management policies in the United States using some of these models. However, there has been no comprehensive review of the regional economic studies of U.S. fisheries in the literature. Recently the paper "A Review of Regional Economic Models for Fisheries Management in the U.S." reviewing these models and studies was published in *Marine Resource Economics*. By first providing a short theoretical overview of the types of regional economic models and then offering a review of the studies that have been conducted for various fisheries throughout the U.S., this paper provides guidance on appropriate model choice in certain instances, and points out which shortcomings, especially data deficiencies, are most crucial to overcome in developing future modeling applications. One of the important conclusions in this paper is that, without reliable data obtained through a comprehensive and mandatory data collection program, it will continue to be very difficult to develop viable regional economic models for U.S. fisheries.

By Ron Felthoven

STATUS OF STOCKS & MULTISPECIES ASSESSMENT PROGRAM

National Stock Assessment Workshop

Martin Dorn and Grant Thompson of the Status of Stocks and Multispecies Assessment (SSMA) Program attended the NMFS National Stock Assessment Workshop in San Francisco, held mid-April 2006. Abstracts from their presentations follow.

POLLOCK IS GREEN! ADVENTURES IN MSC CERTIFICATION OF WALLEYE POLLOCK

In April 2005, Gulf of Alaska walleye pollock became the first federally managed fishery to be certified to meet the Marine Stewardship Council's (MSC) environmental standard for a well managed and sustainable fishery. While certification programs are relatively recent in fisheries, similar programs are well established in forestry and organic farming. The MSC's certification program has expanded rapidly since its inception in 1999, and other federally managed fisheries are likely to enter into MSC assessment in the future. The paper gave an overview of the MSC certification program and discussed some of the issues that proved contentious with the walleye pollock certification. It is hoped that the experience gained will be beneficial as other fisheries undergo the MSC certification process.

For the extended abstract and further information, please contact Martin Dorn at martin.dorn@noaa.gov.

By Martin Dorn

A DECISION-THEORETIC APPROACH TO ECOSYSTEM-BASED FISHERY MANAGEMENT

Our study concerned "ecosystem-based fishery management" in the sense that it included consideration of: 1) both target and nontarget species; 2) both consumptive and nonconsumptive values; 3) both systematic and stochastic (process error) interactions between species; and 4) both biomass estimation and parameter estimation error.

The study was conducted in four stages. Stage 1 assumed purely deterministic dynamics and known true values for all parameters and variables. The level of risk aversion did not affect the optimal fishing mortality rate, because no uncertainty existed. Stages 2 and 3 added process error and biomass estimation error (in the "management strategy evaluation" sense). The objective function was obtained in closed form. The optimal fishing mortality rate varied inversely with the level of risk aversion (the optimal fishing mortality rate for the risk-neutral case was identical to the Stage 1 optimum). Except for the risk-neutral case, the optimal fishing mortality rate was shown to depend not only on the means and variances of state variables (as has previously been shown for single-species applications) but also on covariances between state variables. Stage 4 added parameter estimation error. Parameter values and covariances were estimated via the Kalman filter. Here, it was no longer possible to obtain the objective function in closed form. The results for Stage 4 were not always straightforwardly related to those of the other stages, because parameter estimates differed from the true values.

For the extended abstract and further information, please contact Grant Thompson at grant.thompson@noaa.gov.

By Grant Thompson

Section 7 Consultation

Scientists from the REFM Division responded to a request for assistance on an Endangered Species Act (ESA) Section 7 consultation. In October 2005, the North Pacific Fishery Management Council (Council) recommended that NMFS reinitiate consultation under Section 7 of the ESA. The consultation is on the possible effects of authorizing fisheries pursuant to the Bering Sea-Aleutian Islands (BSAI) and Gulf of Alaska (GOA) groundfish fishery management plans on ESA listed species, such as Steller sea lions, and their critical habitat under jurisdiction of NMFS. In a 29 November 2005 letter to the Council, NMFS agreed with the recommendation and described the process NMFS would follow for the consultation. NMFS plans to provide a draft Biological Opinion (Opinion) on the proposed action by mid-August 2006 and a final Opinion by late 2007.

In preparation for writing the Opinion, a consultation group was formed, consisting of representatives from Sustainable Fisheries Division (Melanie Brown), the Council (Bill Wilson), the Protected Resources Division (Shane Capron) and the AFSC (Lowell Fritz and Libby Logerwell). The consultation group developed a list of important issues related to ESA-listed Steller sea lions and their designated critical habitat and held a workshop in Seattle in February 2006 to refine those issues into a series of requests for information. A memorandum listing these requests for information was sent to AFSC Science and Research Director Doug DeMaster in mid-March 2006. REFM scientists conducted the necessary analyses and syntheses of existing information and prepared detailed responses to all of the requests for information. The responses were completed and sent to DeMaster for review in mid-May and forwarded to Protected Resources personnel responsible for drafting the Opinion.

By Elizabeth Logerwell

Bering Sea Crab Working Group Progress Report

King and Tanner crab stocks of the eastern Bering Sea (EBS) are managed under the aegis of the Bering Sea/Aleutian Islands (BSAI) King and Tanner Crab Fishery Management Plan (FMP) of the North Pacific Fishery Management Council (NPFMC). The plan provides the framework for cooperative management of these stocks between the ADF&G and NMFS. Under this framework, certain management controls such as setting of annual catch quotas and fishery restrictions are deferred to the ADF&G, while NMFS is responsible for making the two annual status determination criteria of overfishing and overfished and for insuring overall plan compliance with the provisions of the Magnuson-Stevens Fishery Conservation Management Act (MSFCMA) and the National Standard Guidelines (NSGs).

Since 1998, four of the ecologically important and economically valuable crab stocks of the EBS have been declared overfished, and fisheries for

several more stocks are closed due to low levels of stock biomass. The existing overfishing definitions for crab stocks under the FMP were established in 1998, with a provision for review after 5 years. A Working Group (WG) of the NPFMC's Crab Plan Team consisting of NMFS and ADF&G scientists was formed in September 2003 to evaluate the current overfishing definitions and to propose revisions in those definitions to insure the conservation and effective utilization of the stocks. The WG was also charged with ensuring that the revisions to the FMP were consistent with the operational tenets and mandates of the MSFCMA and the NSGs.

Since its inception, the Crab Working Group has been actively involved in characterizing the relevant life-history and population dynamic characteristics of the EBS crab stocks suitable to formulating new overfishing definitions. It has also actively developed requisite modeling frameworks necessary to derive these definitions, improved length-based stock assessment methodologies, and crafted simulation models to enable the evaluation of overfishing control rules and rebuilding strategies of overfished stocks. The complex nature of crab reproductive dynamics, mating processes, male only fisheries, and the lack of age and other essential life-history information all contribute to difficulties in developing appropriate thresholds.

The WG has succeeded in developing a tier system similar to the current groundfish management plan tier system which has been approved by the NPFMC Scientific and Statistical Committee (SSC). A NPFMC-sponsored workshop on proposed overfishing definitions, and the WG's modeling efforts, was held in Seattle in February 2006 to assist in clarifying some of the complex biological issues. The workshop included members of NMFS, the ADF&G, and the SSC, as well as other prominent regional and international crab biologists and stock assessment scientists. In April 2006, NMFS funded a peer review of the modeling products and preliminary results of the WG by the Center for Independent Experts (CIE). The CIE review resulted in many informative and helpful suggestions on the work to revise these overfishing definitions. Preliminary analyses by the WG and the CIE review were presented to the SSC at its June, 2006 meeting. Based on review of these results, the SSC gave their approval for the Crab Working Group to proceed forward with developing a Draft Environmental Assessment (EA) to formally amend the existing BSAI King and Tanner Crab FMP. The EA is scheduled to be presented to the SSC in the fall of 2006.

By Lou Rugolo (RACE, Kodiak Laboratory) and Jack Turnock (REFM)

2006 Aleutian Islands Cooperative Acoustic Survey Study

The Aleutian Islands Cooperative Acoustic Survey Study (AICASS) conducted a feasibility study in February-April 2006 to assess using a small (<35 m) commercial fishing vessel to estimate the abundance of walleye pollock (*Theragra chalcogramma*) in waters off the central Aleutian Islands. NMFS currently has limited resources to conduct acoustic surveys of pollock in the Aleutian Islands subarea. The acoustic and biological information from the study is being used to assess: 1) if it is feasible to conduct acoustic surveys in the Aleutian Islands using commercial fishing vessels, 2) if the data collected are of sufficient quality for management purposes, and 3) the extent that fine scale spatial and temporal management measures may be biologically reasonable. The project was envisioned as a first step in the development of a comanagement/comonitoring system that would involve the Aleut Corporation (the local Alaskan native corporation that has been allocated the pollock quota for this area), local fishermen, and NMFS. This could potentially lead to limited pollock harvests that explicitly accounts for the needs of Steller sea lion (*Eumetopias jubatus*) within critical habitat.

The project was conducted aboard the fishing vessel *Muir Milach*, a 32-m stern trawler (Fig. 1) in three activity phases: 1) evaluating the commer-

Figure 1. At port in Adak, Alaska, the F/V *Muir Milach,* a 32-m stern trawler was used to conduct the 2006 Aleutian Islands cooperative acoustic survey study.

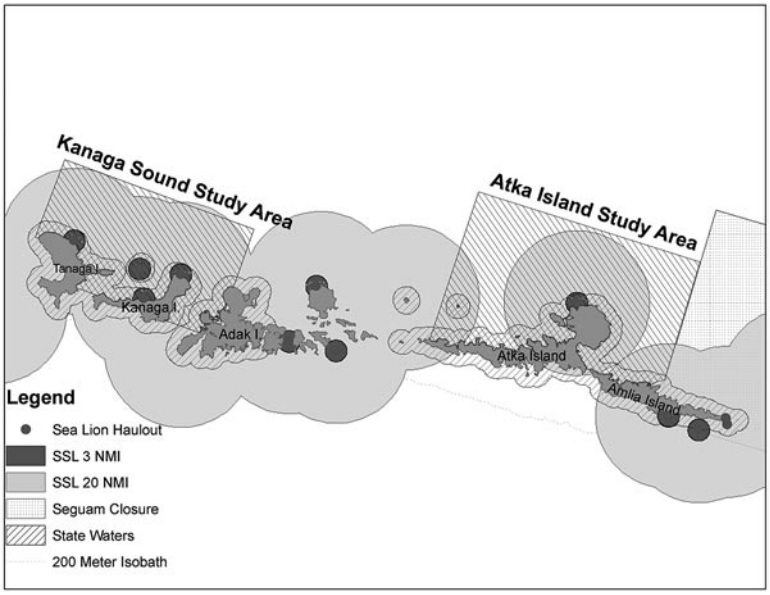

Figure 2. Proposed 2006 AICASS study sites within the Central Aleutian Islands.

cial fishing vessel's appropriateness as an acoustic sampling platform; 2) opportunistically collecting acoustic data of pollock distribution around two sites, Kanaga Sound and Atka Island (Fig. 2); and 3) direct acoustic and biological data sampling at one of the study sites. To verify the acoustic data and to support the study, 1,000 metric tons (t) of pollock was allocated to be harvested within an area that included waters within 20 nautical miles (nmi) to 3 nmi of Steller sea lion haulouts.

A SONAR-self noise test was conducted on 15 February 2006 to assess the noise characteristics of the vessel and determine the optimum vessel speed for conducting the survey. An engine speed of 1,200 rpm was determined to be optimal for acoustic surveying resulting in a survey speed between 6 and 8 knots and a signal-to-noise ratio of at least 10:1. The acoustic system calibration followed standard sphere calibration protocols and were conducted prior to and post study to ensure system reliability. Sphere calibration showed that the system was stable during the duration of the survey. These tests, therefore, allowed us to conclude that the acoustic data from the *Muir Milach* were of sufficient quality for abundance estimation.

Opportunistic acoustic data were collected by the *Muir Milach* within two proposed study sites during the Pacific cod (*Gadus macrocephalus*) fishing season in February 2006. In consultation with the fishing vessel captain and upon review of the opportunistic acoustic data, a survey area inside the Atka Island study site, east of North Cape, Atka Island and west of Kasatochi Island, was selected because the area had the highest observed densities of pollock and had less area closed to fishing due to proximity to Steller sea lion haulouts.

The primary factor thought to affect the ability to survey from small vessels in the Aleutian Islands in the winter months is the weather. Between 13 March and 6 April 2006 the winds were primarily southerly, between 90° and 270°, and hourly average wind speed ranged from 0.5 kts to 20.9 kts with a median and mean of 5.9 kts and 6.9 kts respectively

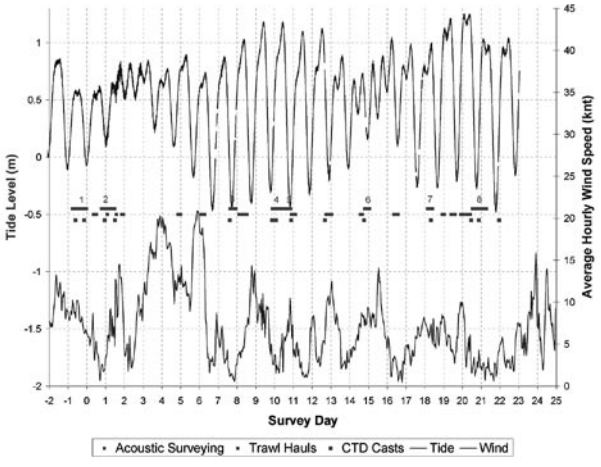

Figure 3. Weather and tide fluctuations relative to survey activities. Wind speed and tide data from Adak, Alaska, station ADKA2 – 9461380 (NOAA 2006).

Table 1. Summary of 2006 AICASS surveys.

Survey	Dates	Survey Day	Spacing (n.mi.)	Number of Transects	Survey Area (n.mi.^{2})
2	14-15 Mar.	1	1.5	18	180
4	23-24 Mar.	9	1.5	18	180
5	24 Mar.	10	0.5	7	9
6	28-29 Mar.	14	1.0	12	72
7	1 Apr.	19	1.0	12	72
8	3-4 Apr.	21	1.5	18	180

(Fig. 3). Between 13 March and 6 April, the maximum daily wind gusts exceeded 30 kts for 19 of the 25 days and exceeded 50 kts for 9 of the 25 days. Surveying and commercial fishing were suspended from 16 March through 17 March due to high southeasterly winds with gusts exceeding 50 kts. Although other strong wind events occurred during the survey period, they did not affect the ability of the vessel to fish or conduct surveys.

Of eight acoustic surveys, six were successfully conducted between 14 March and 4 April 2006 (Table 1). The area from North Cape of Atka Island to Koniuji Island (~1 degree longitude) was surveyed three times while a smaller subset of this area was surveyed on three other occasions. The three larger surveys (180 nmi^2 with transect spacing at 1.5 nmi) were conducted in the beginning (Survey 2), middle (Survey 4), and end (Survey 8) of the study period. Survey 5 was conducted parallel to the shelf break and covered only 9 nmi^2 (with transects spaced at 0.5 nmi). This survey provided data useful for geostatistical analyses. Surveys 6 and 7 covered 72 nmi^2 with 1.5 nmi transect and occurred in the middle of the large survey area coincident with the highest density of pollock. All survey transects were designed to sample 5 nmi offshore after the shelf break (181-m isobath) and 1 nmi inshore from the shelf break. To reduce survey time, an adaptive strategy was implemented, and transects were ended when it was determined that pollock sign was no longer encountered along a transect. Small trawl tows (<10 t) were conducted during the surveys to identify acoustic sign. Between survey periods the vessel was allowed to fish commercially until it reached capacity (~165 t). The catch was then delivered to the Adak Fisheries fish processing plant on Adak Island. Biological samples including length, weight, maturity, otoliths, and fin clips were collected from both the verification and commercial tows. Physical oceanographic data were also collected throughout the survey using a Sea-bird conductivity-temperature-depth (CTD) system.

Between 14 March and 4 April 2006 six successful surveys were completed resulting in relatively precise estimates of biomass for the survey area over time. Survey 2, conducted 14-15 March, provided a biomass estimate for pollock of 8,910 t. The biomass estimate for subsequent surveys were lower (although not statistically significantly lower for Survey 4) and dropped significantly after Survey 4 to a low of 2,845 t for the final survey (Table 2, Fig. 4, Fig. 5, and Fig. 6)

In total, 965 t of fish were harvested during this study, the majority of which (97% or 935 t) were

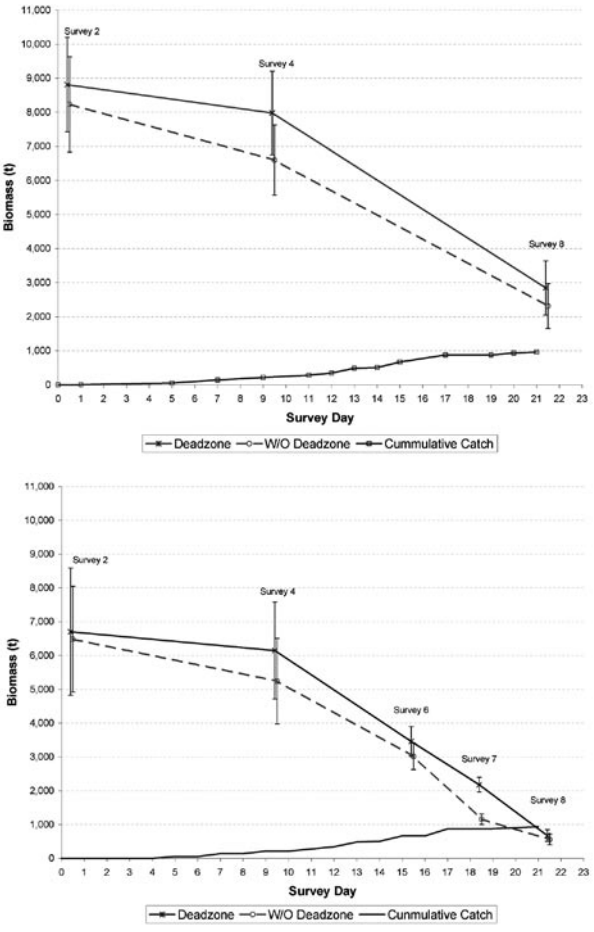

Figure 4. Pollock abundance estimation and cumulative catch for large (top) and small (bottom) survey areas. Note error bars are $\pm 1.96 \times E_i \times B_i$.

Table 2. Abundance estimation for 2006 AICASS surveys.							
Survey	Area (n.mi.^{2})	Deadzone (Y/N)	Biomass (t)	Relative Precision (E_i)	High Biom. (t)	Low Biom. (t)	Density (t / n.mi.^{2})
2	180	N	8233.8	8.67%	9632.5	6835.1	45.7
2	180	Y	8809.9	8.04%	10198.4	7421.4	48.9
2	72	N	6484.5	12.29%	8046.1	4922.9	90.1
2	72	Y	6706.6	14.32%	8589.2	4824.0	93.1
4	180	N	6600.4	7.96%	7630.1	5570.7	36.7
4	180	Y	7980.2	7.87%	9210.6	6749.8	44.3
4	72	N	5246.4	12.31%	6512.6	3980.2	72.9
4	72	Y	6149.8	11.89%	7582.5	4717.1	85.4
5	9	N	890.8	5.29%	983.2	798.4	99.0
5	9	Y	1036.6	4.75%	1133.1	940.1	115.2
6	72	N	3015.0	6.64%	3407.4	2622.6	41.9
6	72	Y	3458.5	6.44%	3894.9	3022.1	48.0
7	72	N	1159.0	6.83%	1314.2	1003.8	16.1
7	72	Y	2179.7	5.05%	2395.4	1964.0	30.3
8	180	N	2313.6	14.51%	2971.6	1655.6	12.9
8	180	Y	2845.2	14.24%	3639.0	2051.4	15.8
8	72	N	559.2	14.32%	716.1	402.3	7.8
8	72	Y	677.0	12.96%	848.9	505.1	9.4

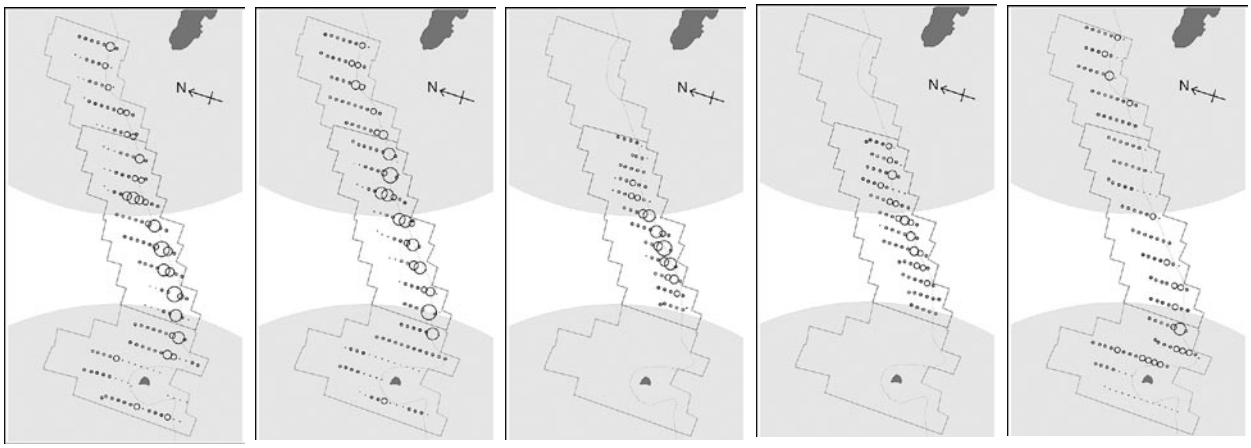

Figure 5. 2006 AICASS distributions of pollock. Figures from left to right correspond to Surveys 2, 4, 6, 7, and 8.

harvested from the smaller area covered in Survey 6 and 7. Most (77%) of the harvest (745 t) occurred after Survey 4 (Day 9). The pollock biomass apparently declined by 68% in the large survey area during the 3 weeks of the study. In the smaller "fished" area, the decline was estimated at 90%. The "unfished" region showed no significant difference in biomass estimates between Surveys 2 and 8. Further analyses are needed to evaluate the cause the decline in the fished area. A conservative estimate on the change in biomass over the study period is about 4,000 t—much greater than the amount of pollock caught. A trend in the maturity data shows that the pollock began to show signs of active spawning only

Figure 6. 2006 AICASS Survey 5 distribution of pollock.

at the end of the study period. This could indicate that fish were moving out of the area to spawn. This may account for some of the observed declines.

In short, the 2006 AICASS was successful. In addition to achieving its scientific objectives, this project fostered an excellent working relationship between NMFS, the Aleut Enterprise Corporation, and the fishing industry. Local participation and stakeholder involvement enhances NMFS' ability to provide responsible stewardship of this important marine resource. Future work should consider the expansion of this technique to survey more areas within the Aleutian Islands to determine the health and behavioral dynamics of this stock within Steller sea lion critical habitat.

An AFSC Processed Report on the results of this study is due out this year. For further information please contact Steve Barbeaux at Steve.barbeaux@noaa.gov.

By Steve Barbeaux

AGE AND GROWTH PROGRAM

AFSC Hosts Committee of Age Reading Experts

The AFSC again hosted the biennial CARE (Committee of Age Reading Experts) meeting for 2006. The meeting had 33 attendees. The chair for this meeting was Patrick McDonald from the Northwest Fisheries Science Center's ageing laboratory in Newport, Oregon. Starting with this meeting, Moss Landing Marine Laboratories will send a representative to all future CARE meetings. Dr. Gregor Cailliet, the head of the age reading effort at the Moss Landing Marine Laboratories presented age validation work performed by graduate students, mainly on rockfish, sharks and rays.

At the meeting, CARE returned to its roots, so to speak, with a day and a half focused on collaborative microscope work on such species as sablefish, canary rockfish, arrowtooth flounder, Pacific cod, Pacific whiting, petrale sole, and thornyheads. Although the tradition has been for the AFSC to host all CARE meetings, a special treat may be in store for the 2008 meeting. Shayne MacLellan of the Pacific Biological Station (PBS), Nanaimo, Canada, noted that the PBS would like to host the 2008 CARE meeting as part of the PBS 100th anniversary.

Production Figures

Estimated production figures for 1 January through 30 June 2006.

Species	Specimens aged
Yellowfin sole	393
Walleye pollock	1,246
Pacific cod	3,812
Sablefish	2,389
Atka mackerel	1,467
Pacific ocean perch	582
Northern rockfish	541
Rougheye rockfish	2,728
Dusky rockfish	111
Dark rockfish	50
Great sculpin	400

Total production figures were 13,719 with 3,227 test ages and 209 examined and determined to be unageable. This release of great sculpin ages are the first ages of this species from the Age and Growth Program.

By Dan Kimura