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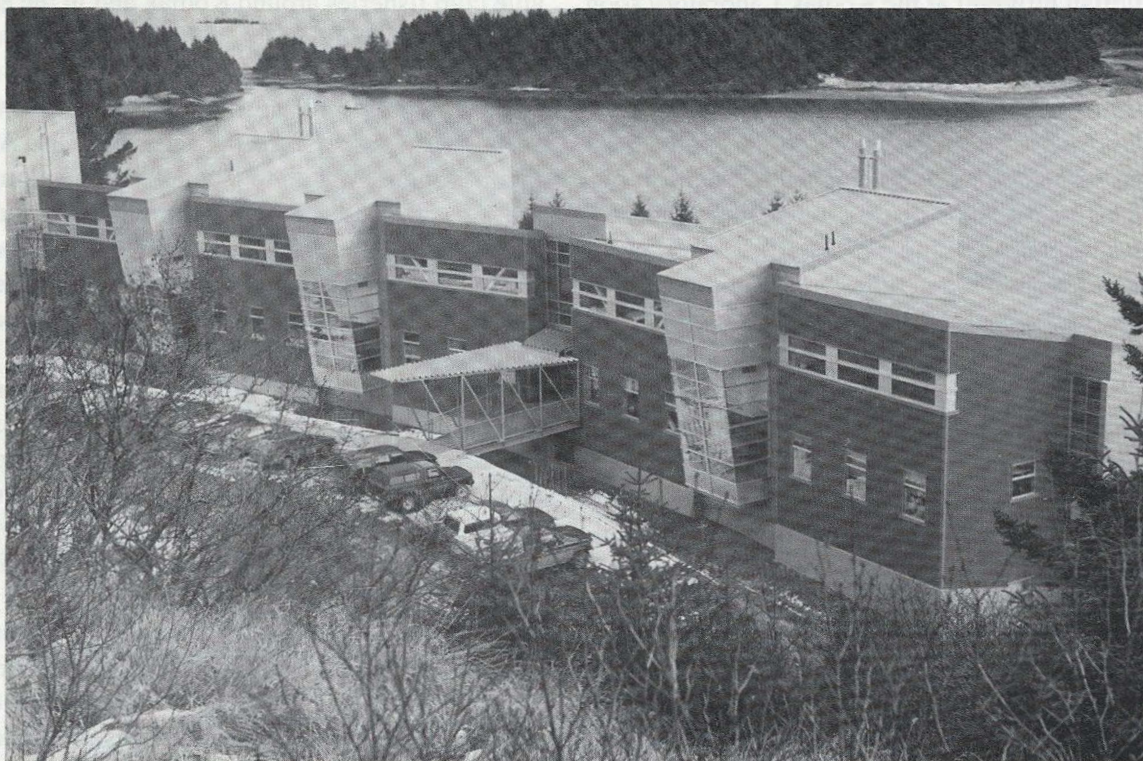
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The Kodiak Fisheries Research Center on Near Island sits on seven acres overlooking Trident Basin.

Kodiak Laboratory Moves to New Research Facility

By Robert Otto

In October 1998, National Marine Fisheries Service (NMFS) personnel from the Alaska Fisheries Science Center (AFSC), the Alaska Regional Office (ARO), and the Northwest Fisheries Science Center (NWFSC) moved into new office and laboratory facilities at the Kodiak Fisheries Research Center (KFRC) on Near Island in Kodiak, Alaska. The \$19.4 million-research facility is owned by the Kodiak Island Borough and leased to NMFS, the National Park Service, the Alaska Department of Fish and Game (ADF&G), and the University of Alaska. The Kodiak Fisheries Research Center was conceived as a means of providing much-needed office and laboratory space for fisheries research in Kodiak within a common location, thereby facilitating interaction among NMFS, University of Alaska, and ADF&G scientists along with the participation of

visiting scientists for the enhancement of further research.

At the NMFS level, the Kodiak Fisheries Research Center houses portions of five programs. The ARO's Kodiak Office of the Sustainable Fisheries Division disseminates information concerning regulations, openings, closures, and the progress of fisheries. The AFSC's Kodiak field office of the North Pacific Groundfish Observer Program debriefs observers upon their return from fishing vessel trips to gather information on the species and size composition of the catch and to ensure that data were properly collected and recorded. The AFSC's National Marine Mammal Laboratory (NMML) will occupy the building seasonally to conduct specialized biological research on harbor seals and Steller sea lions. The AFSC's Resource Assessment and Conservation En-

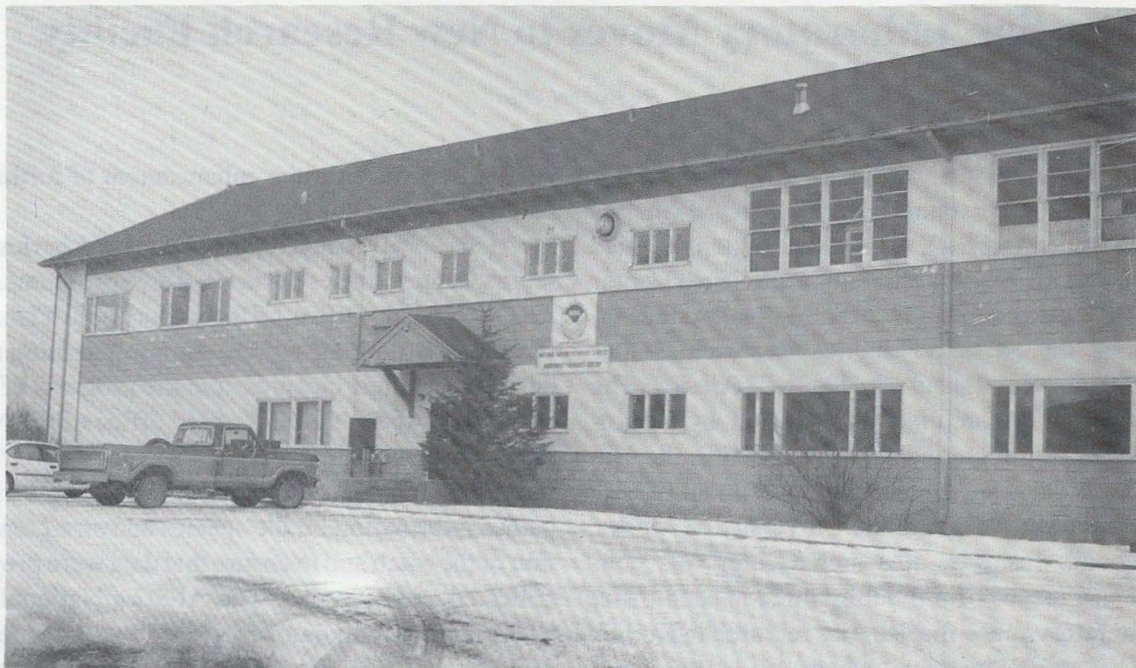
gineering Division (RACE) plans to begin a groundfish program at the Kodiak Laboratory soon. The NWFSC's Resource Enhancement and Utilization Technologies (REUT) Laboratory develops and tests improved methods of processing seafood. The AFSC's Shellfish Assessment Program conducts and reports results of surveys designed to establish time series estimates of the distribution and abundance of crabs and other commercial shellfish resources in Alaska. The program is the largest component of NMFS research in the building and the largest research program at the new facility.

Background

Kodiak is home port to an active fishing fleet with a long history of interest in fishery research. It has served as a base for marine research carried out by the University of Washington, the U. S. Navy, and several nations including Japan, Poland, and Russia. With the establishment of salmon research and management programs in the early 1930s, Kodiak became an important base for Federal fisheries activities. In 1940, a special act of Congress funded a king crab exploratory fishing and research program

that was instrumental in developing extremely valuable crab fisheries around Kodiak and in the eastern Bering Sea. Exploratory fishing and research for shellfish in the Gulf of Alaska provided part of the basis for establishing large shrimp fisheries as well as scallop fisheries. The North Pacific Shellfish Assessment Program moved to Kodiak in 1971 along with portions of the Juneau Exploratory Fishing and Gear Research Program and the Ketchikan Fish Products Technology Laboratory. The AFSC's Shellfish Assessment Program and the NWFSC's Utilization Research Laboratory were housed in the U.S. Coast Guard Support Center in the early 1970s and the NMFS Enforcement Program in the Gibson Cove facility. With the passage of the Fisheries Management and Conservation Act in 1976, the development of enormous groundfish fisheries in the Gulf of Alaska and Bering Sea made a NMFS research facility in Kodiak a strategic necessity

The value of fishery products landed annually in Kodiak has ranked Kodiak as one of the nation's top three ports in each of the past 10 years. By consequence, development of adequate research facilities was seen as a means to foster needed biological re-



The Shellfish Assessment Program was housed in the U.S. Coast Guard's Kodiak Support Center from the early 1970s until October 1998.



A large, oval aquarium is used for display, education, and research.

search on species that provide much of U.S. landings. Support from the Kodiak community for developing continued fisheries research at both the state and Federal level has been strong. The City of Kodiak donated 7.1 acres of land on Near Island in 1986 for the construction of the University of Alaska's Fishery Industrial Technology Center (FITC) and reserved an additional 17 acres for further development of fisheries research facilities on an expanded campus. The Kodiak Island Borough managed the financing and construction for the Kodiak Fisheries Research Center on approximately 7 of these 17 acres. Ground-breaking ceremonies, graciously sponsored by Kodiak native corporations, took place in June 1996. The Aleutiq Museum provided anthropological consulting for the proper investigation and removal of artifacts from a small prehistoric site.

Buildings and Laboratories

The KFRC was designed to provide a multi-agency marine research facility that would foster marine fishery research as well as serve as a resource for providing educational opportunities to the

Kodiak community as a whole. The facility consists of three buildings: a pump house, housing for visiting researchers and students, and the main building, which includes offices, laboratories and special purpose areas. Located on Near Island within the City of Kodiak on a tract of land between Trident Way and Trident Basin, the KFRC is connected to the City of Kodiak by a single arch bridge. All buildings were designed by ECI/Hyer - NBBJ Associated Architects in concert with five additional specialized firms. Design criteria included consideration of blending with the natural landscape, optimizing views, and a southern exposure to maximize use of scarce daylight in winter. The building was also designed to fit in with the general architecture of the community and the adjacent FITC. The site is hilly and covered with a mixture of spruce forest and meadows of salmon berry, grass, ferns, and wildflowers. The site descends from a maximum of 196 feet to sea level on Trident Basin. Footings for the first floor of the main building are at 85 feet. The main building, 70-stall parking lot, and visiting scientist's quarters are all between the 80 and 100 ft contours. The site, along with the islands on

the seaward side of Trident Basin, provides protection from tsunamis that can accompany earthquakes in the region.

The Main Building

The main building of the KFRC contains offices, laboratories and support areas. The building is designed so that laboratory and display areas that are fed by running seawater or involve moving large samples (sea lions, bears, totes of fish) are located on the first floor. Areas for offices, general laboratory work, computer operations, conferences, and the W. F. Thompson Memorial Library are located on the second floor. The W. F. Thompson Memorial Library (1,800 sq ft) maintains about 16,000 volumes of fishery journals, books and other publications. This is the only technical fishery library in western Alaska and serves scientists from NMFS, the University of Alaska, and the ADF&G as well as the Kodiak Island Borough school system and the general public.

The main building of the new Kodiak facility is equipped with an emergency generator, so that long-term experiments are not disrupted by a failure of the seawater system during power outages. The building's braced steel frame is designed to withstand an earthquake of approximately magnitude 8. The building contains an ample foyer and conference room area, numerous educational displays, a large, oval, freestanding aquarium, and a touch tank so that students may handle intertidal organisms representing the major marine invertebrate phyla. The building also houses an extensive museum collection

containing the most common species of crabs, shrimps, marine snails, bivalves, and a variety of fishes.

NMFS occupies the largest space in the building and accounts for 80% of building usage (Table 1). Within NMFS, the RACE Shellfish Assessment Program is the largest user (Table 2) and occupies 33 % of the buildings net area. The Shellfish Assessment Program conducts and reports results of surveys designed to establish time series estimates of the distribution and abundance of king, snow, Tanner, and hair crabs in the eastern Bering Sea (EBS); investigates biological processes and interactions with the environment to estimate growth, mortality, and recruitment of crabs to improve the precision and accuracy of forecasting stock dynamics; and identifies and tracks potential pathogens in the dominant shellfish stocks. Results of surveys and special purpose research are documented and disseminated in status of stock reports, reports to industry, and formal scientific publications. Data are managed and archived in a scientific database accessible by NMFS and NOAA scientists, other researchers, and the public. Program information is frequently used by the fishing industry to plan their operations.

The Shellfish Assessment Program has 19 offices (2,170 sq ft) that include 21 work stations and comprise 27% of the program's area. Laboratory and field storage areas are 16 % of the program's area, followed by laboratories (12 %) and diving facilities (10%). The diving area contains a filling station that includes a compressed air and cascade system as well as a nitrox system, in addition to areas for the wash

Table 1. Allocation of space among tenants (net square feet) in the Kodiak Fishery Research Center based on architectural design (ECI Hyer/NBBJ)

Group	Net Sq Ft	%	Allocated Common	Total	Occupancy %
Alaska Department of Fish and Game	1,010	4.1	527	1,537.1	6.2
National Park Service	783	3.1	409	1,191.7	4.8
University of Alaska	1,518	6.1	792	2,310.3	9.3
National Marine Fisheries Service	13,065	52.4	6,819	19,883.9	79.8
Common use areas	8,547	34.3			
Total	24,923	100.0	8,547	24,923	100.0

The general seawater laboratory is designed for experiments requiring large containers.



Center biologists Brad Stevens and Eric Munk examine a Tanner crab in the KFRC seawater laboratory.

down and repair and storage of gear. The remainder of the Shellfish Program area is taken by the museum-collections room, general office support and computer support areas, and the W. F. Thompson Library.

Laboratories make up 33% of the net square footage in the facility's main building (Table 3). Two well ventilated necropsy rooms are immediately adjacent to a loading dock for handling large animals and bulk samples of fish. Necropsy rooms are equipped with stainless steel tables and protected electrical outlets that allow for total wash down. They are also located next to a large walk-in freezer for specimen storage. There is an electron microscope laboratory, a large instructional laboratory, as well as general laboratory space for utilization research, water chemistry, shellfish research, and aging fish. The shellfish laboratory includes a small isolated area for microscopy. A video analysis laboratory contains equipment for computer-mediated editing and quantification of images, an increasingly

more important part of our underwater and at-sea data gathering efforts. Extensive use of video cameras are planned for monitoring experiments in the seawater laboratory as well.

The Seawater Laboratory Complex

The seawater laboratory complex is one of the most desirable features of the new Kodiak facility. The complex consists of a seawater system, large open laboratory, three cold rooms, a water quality laboratory, and a food preparation laboratory. The complex is immediately adjacent to the shellfish laboratory and microscope room in order to facilitate examination of cultured or experimental animals. The shellfish laboratory, the UAF instructional laboratory, and the downstairs display area are fed from the complex's seawater system as well.

The seawater system starts with intakes and pumps described below. From the pump house, raw seawater is pumped to the top of an obelisk-like tower at the northeast end of the building. This tower

Table 2. Allocation of space dedicated to the National Marine Fisheries within the Kodiak Fisheries Research Center.

National Marine Fisheries Group	Net Sq Ft	Building %
Resource Assessment and Conservation Engineering	8,149	32.7
Resource Ecology and Fishery Management, Observer Program	1,248	5.0
Utilization Research Laboratory	2,269	9.1
National Marine Mammal Laboratory	1,279	5.1
Alaska Regional Office, Sustainable Fisheries	120	0.5
NMFS Totals	13,065	52.4

is the highest point in the building and gravity flow distributes seawater within the building as necessary. Some of the water passes through sand filters and some is left unfiltered. Filtered seawater is frequently desirable for experimental purposes and in areas such as aquariums where control of species composition and avoidance of fouling organisms is essential. Unfiltered seawater is used where more natural systems are to be duplicated and where it is desired to maintain filter feeders such as clams or tunicates. All laboratories are supplied with one filtered and two unfiltered seawater lines. Each unfiltered line is used for 2 weeks and then allowed to become anoxic before being back-flushed with fresh water and reconditioned with saltwater. This procedure is meant to control fouling on the inside of the lines. Outflow is either through floor drains or piped through an ozone contact system for disinfection. The ozone system is critical for research involving known, potentially epizootic pathogens that may be implicated in king, Tanner, and snow crab population dynamics. All portions of the seawater laboratory and the cold rooms are also served by freshwater for wash down and low pressure air for oxygenation.

The general seawater laboratory and the three associated cold rooms are designed to conduct experiments in a controlled environment that are easily cross-correlated or verified through observations and experiments conducted in adjacent bays or ocean areas. The three cold rooms (each 150 sq ft) are intended to provide strict temperature control for at least three levels in experiments conducted in small to medium-sized containers. They also offer obvious

advantages relative to controlled photoperiod or other variables where strict isolation is desirable. The general seawater laboratory is intended for much larger experiments where control is not as critical or where experiment-specific devices are constructed to provide environmental controls. The laboratory has an open design allowing for many tanks or experimental units to operate. The seawater laboratory opens to the gear loft and then to the exterior through large garage type doors and the entire area is fork lift compatible. This feature allows even large tanks to be manipulated and is especially intended to allow experimental animals to be transported from ship-board to the laboratory in large containers. The intent is to minimize stress caused by handling of unanesthetized wild animals. Currently we are beginning experiments on the reproductive biology of Tanner crabs in the seawater laboratory. The experiments are designed to augment underwater observations that have been carried out by divers, using ROVs (remote operated vehicles), sled-mounted cameras, or submarines.

The Pump House

The pump house at the new Kodiak research facility is located on Trident Basin and is fed by two siphon intake lines that draw water from screened intakes located at 15- and 25-m depths on the bottom of Trident Basin. Four 40-hp pumps can provide a maximum flow of nearly 1,200 gallons per minute (gpm), but normal operations call for one or two pumps at 300 to 600 gpm with remaining pumps in reserve. Reserve pumps can also be used to reverse

flow through an intake line in order to "chase the pig," a process to clean the lines. (The pig is later retrieved by divers.) All of the water-contact pump parts are Teflon or Teflon-coated, and all water lines are PVC plastic. The pumps overcome a static head of about 180 ft to the top of a tower at one end of the main building. The tower contains sand filters and the major lines for the seawater distribution system. The seawater return line also passes through the pump house and carries water from two sources to a subtidal outfall. Most water will return from tanks and aquaria that contain relatively low densities of native animals from Kodiak and hence will not need treatment. Water from tanks containing diseased or exotic organisms will be passed through an ozone contact system before being returned to the sea. The latter procedure prevents introduction of organisms or pathogens to Trident Basin or surrounding waters. The ozone generator is capable of decontaminating up to 500 gpm of contaminated effluent.

Visitor Housing

Housing for visiting scientists consists of a building along the entry driveway that contains two 2-bedroom and four single-bedroom apartments. Housing is operated by the University of Alaska but is available to those visiting and working with the NMFS on a space-available basis.

Summary

The KFRC consolidates NMFS research and management programs in Kodiak and makes them more accessible to the fishing industry and the public. The KFRC was made possible through the community's long history of interest in fishery research. Information dissemination and ready access to an adequate technical library are important educational as-

Table 3. Laboratories within the Kodiak Fishery Research Center.

Group	Description	Net Sq Ft	%
ADF&G		1,010	11.6
	Chemistry & Ageing Laboratory	690	7.9
	Necropsy Laboratory	320	3.7
UAK		1,203	13.8
	Instructional Laboratory	1,003	11.5
	Electron Microscope	200	2.3
NMFS		3,058	35.1
	Utilization Research	1,559	17.9
	Shellfish Laboratory	675	7.7
	Video Analysis Laboratory	310	3.6
	NMML Necropsy Room	514	5.9
Common		3,440	39.5
	General Seawater Laboratory	2,485	28.5
	Cold rooms	450	5.2
	Seawater control room	255	2.9
	Food Preparation Laboratory	150	1.7
	Water Quality Laboratory	100	1.1
Totals		8,711	100.0

sets. The new building has alleviated long-standing deficiencies in previous facilities which lacked a seawater system and adequate laboratory space, both essential for biological research. Research is intended to improve knowledge of fishery resources leading to better forecasts of abundance, evaluation of environmental concerns, and the potential for resource development. Improved knowledge of early life history is a particular focus of the seawater laboratory and will serve both to improve stock assessment and evaluate the potential for aquaculture or stock enhancement. The new Kodiak facility also meets needs for a base of operations for field research, expanding management and observer coordination in groundfish fisheries and timely cooperation with the ADF&G on shellfish surveys and fishery management decision-making.

AUKE BAY LABORATORY (ABL)

ABL Research Redefines Oil Toxicity Paradigms About Oil and Fish

Research by ABL's Habitat Program over the past decade has produced a new perspective on the toxicity of oil to fish. In the 1970s, ABL researchers determined that crude oil in water was toxic to fish at concentrations of 1-4 parts per million (ppm). This research was the basis for water quality standards for oil in Alaskan waters, the most stringent standards in the United States. Research by ABL scientists in the 1990s, however, now indicates that oil is much more toxic to fish than previously believed. Instead of toxicities in the ppm range, ABL research has observed toxicities in the parts per billion (ppb) range.

These new understandings about oil and its effect on fish have evolved from a suite of long-term studies of the *Exxon Valdez* oil spill. First, the Alaska Department of Fish and Game (ADF&G) measured elevated salmon egg mortalities in oiled salmon streams in Prince William Sound (PWS) for 4 years following the spill. The egg mortalities represented new damage from persistent oil—an unprecedented finding compared to other oil spills. ABL field efforts in 1995 detected significant quantities of oil alongside streams in PWS. Stream deltas had not been

cleaned in 1989 because it was thought that cleaning would cause physical damage to the spawning habitats of salmon. Oil was not expected to invade spawning redds in significant quantities and was not expected to persist. By the mid-1990s, oil continued to be detected in a variety of habitats in PWS, and chemical fingerprinting of the compounds continued to identify the source as the 1989 *Exxon Valdez* oil spill. Further, chemical fingerprinting also identified the persistent fractions of oil as being predominantly the heaviest ringed aromatic components of crude oil and also the most toxic.

The sensitivity of eggs to low concentrations of this persistent oil fraction was confirmed in a series of long-term tests conducted at ABL's Little Port Walter Field Station. Deformities were readily evident in emergent fry which had been exposed months earlier as eggs to ppb concentrations of PAHs (polynuclear aromatic hydrocarbons). Sensitivity to oil concentrations this low was unprecedented, but these toxic fractions had never been used in prior long-term tests. The long-term effects were also surprising: normal-looking fry from eggs exposed to oil were tagged and released to the marine environment, and delayed effects on growth and survival were measured when the adults returned to their natal watershed. Of adults exposed as eggs to 19 ppb total PAH, 40% fewer than controls returned a year later.

The ABL's oil toxicity studies have far-reaching relevance, particularly for urbanized watersheds

and estuaries of the coastal United States. In urbanized waterways, many coastal habitats have continuous input of hydrocarbons due to runoff as development continues. Of the 9,692 miles of United States coastline outside Alaska, over two-thirds are considered urban. Studies in the literature estimate that, on a per capita basis, the United States spills, on average, about a quart of oil per person per year. Fifty million people spill more than 12 million gallons of oil per year, which is equivalent to the *Exxon Valdez* spill. Unfortunately, that quantity is spilled this year, next year, and the years following. Given the high toxicity of PAHs to eggs, chronic input of hydrocarbons into streams, bays, and estuaries may limit recruitment of fish populations far more than was previously supposed.

By Jeep Rice.

Science Symposium Marks Tenth Anniversary of *Exxon Valdez* Oil Spill

The 10th anniversary of the *Exxon Valdez* oil spill was marked by a symposium in Anchorage, Alaska, on 23-26 March. The symposium was sponsored by the Oil Spill Trustee Council to present the results of 10 years of Federal and state research on the effects of the 1989 spill in Prince William Sound. The results of 13 ABL studies (see 1995/95 and 1996/97 AFSC Biennial Reports for detailed discussions) were presented. Two AFSC scientists from the Auke Bay Laboratory chaired technical sessions: Jeep

Rice on Long Term Effects to Salmon and Jeff Short on Fate of Oil. The results of the Trustee's research was critical to answering questions concerning long-term persistence of oil, toxicity effects at parts-per-billion (not parts-per-million, as previously assumed) concentrations, and sensitivity to oil at different life stages of marine organisms in Prince William Sound. The results of the ABL studies are relevant not only to Alaska and Prince William Sound, but also to other areas where chronic oil discharges (such as parking lot run-off) can enter water bodies that provide habitat for vulnerable life stages of aquatic organisms. Because they could lead to regulatory changes, these studies have national significance and have attracted national attention from both the media and scientists.

By Jeep Rice.

Green Sea Urchin Growth Rates Studied

Using an analytical protocol developed in the ABL's Image Analyses Laboratory, growth rate measurements from calcein-marked green sea urchin jaws were successfully completed on a total of 120 marked urchin jaws recovered from a sample of 1,382 jaws examined. This study, part of a larger project led by the U.S. Geological Survey (USGS) to research the recovery of near-shore vertebrate predators injured by the *Exxon Valdez* oil spill, relates to the influence of oil on green sea urchin growth. The purpose of the study was to see if there is a relation between sea otter populations

feeding on urchins at oiled and un-oiled sites in Prince William Sound.

Investigators from Coastal Resource Associates of Vista, California, initially marked groups of urchins in 1997 from oiled and nonoiled sites in Prince William Sound by immersion in solutions of calcein. The calcein is then metabolized and deposited in the calcified parts of the urchin. Urchins were then returned to the collection sites. Later, researchers collected random samples of urchins from both locations and prepared jaws for analyses. These samples were examined under ultraviolet-equipped microscopes in ABL's Image Analyses Laboratory to identify fluorescent calcein marks (which appear as bands) and to measure growth of the urchins with a computerized digitizer equipped with a low-light ccd (charge-coupled device) video camera.

Percentages of marked urchins analyzed at the ABL in eight blind sample lots provided by Coastal Resource Associates ranged from 0% in one lot to 40.0% in another. Measurements of total jaw length and distance from end of jaw to the calcein mark (growth since marking) were recorded from each marked urchin jaw. Hard copies of total length and mark distance were made from annotated digital images. Soft copies of these images were saved to zip disks. In addition, total jaw size measurements and distance to mark measurements were saved to a database provided by Coastal Resource Associates. All data, photos, and samples were returned to Coastal Resource Associates for further data analysis. This pro-

gram was supported by the USGS and Coastal Resource Associates to fund a technician to help detect and measure marked urchins. Results are pending analysis by Coastal Resource Associates scientists.

By Donald Mortensen.

Effects of Domestication On Predator Avoidance, Growth, Predation Success, and Marine Survival in Stocks of Chinook Salmon

The state of Alaska has sought to decrease negative effects of salmon enhancement by establishing a genetic management policy that minimizes hatchery and wild stock interaction by regulating hatchery siting and stock transfers. However, domestication within the hatchery may still cause divergence from the wild donor population. In response to increasing concern about the genetic effects of cultured salmonid fishes on natural populations, ABL's Marine Salmon Investigation program is conducting a series of experiments using stocks of chinook salmon native to Southeast Alaska. Experiments include research projects designed to examine the effects of domestication, if any, on Alaskan spring chinook stocks. Performance of fourth generation progeny from two hatchery stocks of chinook salmon at Little Port Walter are being compared with the offspring of wild chinook from the same donor stocks. These studies should provide valuable information regarding the nature and degree of

domestication selection in these populations.

Parallel studies will be conducted on these two spring chinook stocks. The Little Port Walter Hatchery Chickamin River stock resulted from a small collection of broodstock in 1976 (eight females, nine males). The LPW Unuk River stock was also started in 1976, but has had periodic infusion of wild gametes. Comparisons are being made between the hatchery stocks and the progeny of wild chinook collected from the Chickamin in 1996 and the Unuk in 1998. Our first experiment is a series of experimental trials to measure the ability of hatchery and wild chinook salmon to avoid predation by Dolly Varden char. The second experiment evaluates differences in freshwater culture performance, including presmolt survival and growth, in the hatchery environment. The third experiment examines smolt predatory efficiency. The final evaluation will be the measurement of marine survival, and size and age at maturity of coded-wire tagged smolts from hatchery and wild groups.

The results of the Chickamin River predation trial indicate no significant differences between groups in the ability to avoid predation in the testing environment. Results of the freshwater performance trials show similar growth and survival rates among groups through smolting. No results are yet available on the predatory efficiency of smolts. Final data on the marine performance will be collected over the next 7 years. The Unuk River study, initiated in 1998, will follow a similar design with predation trials, culture performance experiments, and the re-

lease of coded-wire tagged smolts. We hope to expand this work to include other testing environments and more chinook salmon stocks currently used for enhancement in Southeast Alaska.

By John Joyce, Alex Wertheimer, and John Thedinga.

Survival and Straying of Pink Salmon Measured Using Recoveries of Coded-Wire Tags and Thermally-Induced Otolith Marks

Pink salmon fry (1994 brood-year) from Auke Creek, Alaska, were marked with coded-wire tags (CWT) and thermally-induced otolith marks to investigate the effects of tagging on survival and straying, and to estimate straying rates to local watersheds. Fish having both CWT and marked otoliths had significantly lower survival than did untagged, otolith-marked fish. There was no difference in survival rates between fish both tagged and otolith-marked and the wild fry with CWT only. Early-run pink salmon had lower observed straying rates than did late-run fish. Straying of CWT fish was not significantly different than that of otolith-marked fish. We were able to document movement of pink salmon between Auke Creek, Gastineau Hatchery, and other streams within a 14-km radius of Auke Creek.

By Donald Mortensen, Alex Wertheimer, Jacek Maselko, and Sidney Taylor

ABL Sablefish Tag Recovery Program

Processing sablefish tag recoveries and administration of the reward program continued during 1998. About 710 tags for 1998 have been received so far, compared to a total of 732 in 1997.

As in 1997, about 39% of the fish recovered in 1998 had been at liberty for more than 10 years. The four fish at liberty the longest were all tagged in Chatham Strait, southeastern Alaska, in 1973 and recovered in Chatham Strait in 1998. Tagging continued on the 1998 NMFS sablefish longline survey, with 3,495 adult sablefish tagged and released.

Otoliths from six known-age sablefish (i.e., fish tagged with anchor tags as juveniles) were recovered during 1998, bringing the total otolith collection of these fish to 87. A manuscript describing the initial findings of this study was accepted for publication by *Fishery Bulletin* in 1998.

Otoliths from two more oxytetracycline (OTC)-marked fish were recovered during 1998; in all, otoliths have been collected from 70 of these fish since the marking was done in 1988. We are hoping to begin reading these otoliths this year.

Sablefish tags recovered during the 20 years of cooperative and domestic longline surveys are being used to estimate the commercial tag reporting rate. Return rates of research and fishery-caught tags are compared, with the assumption that all research-caught tagged fish are observed (reported). So far it appears that the reporting rate

over all areas and years is about 30%.

By Nancy Maloney.

Adaptive Sampling of Slope Rockfish in the Gulf of Alaska

Preliminary results are now available for an experimental bottom trawl survey of slope rockfish conducted in August 1998. This experiment, which used the chartered factory trawler *Unimak Enterprise* in the Gulf of Alaska northeast of Kodiak Island, was a cooperative effort between scientists of ABL's Groundfish Assessment program and the University of Alaska Fairbanks, Juneau Center, School of Fisheries and Ocean Sciences. The study was directed at three important commercial species: Pacific ocean perch, shortraker rockfish, and rougheye rockfish. Methods of this study were first reported in the July-August-September 1998 issue of the *AFSC Quarterly Report*.

Briefly, the study's objective was to determine if a new survey methodology, adaptive sampling, would provide improved estimates of abundance for slope rockfish when compared with simple random sampling, which has been the standard design for all previous trawl surveys of rockfish in this region. Adaptive sampling is a technique not widely used in fisheries, but previous research has indicated that for clustered populations, such as those observed for many rockfish species, it may have benefits over simple random sampling. The experiment focused on two study ar-

reas which were divided into strata, and each stratum was initially sampled by conducting bottom tows at random locations. This was followed by an adaptive phase, in which a systematic pattern of closely spaced tows was made around the random tows in each stratum that showed high catches of rockfish. Estimates of rockfish abundance were computed for each stratum based on just the random tows, and also on two adaptive estimators that incorporated data from both the random and the adaptive tows. Contrary to initial expectations, preliminary adaptive sampling results for Pacific ocean perch showed only modest gains in the precision of abundance estimates when compared with random sampling. These results, however, appeared to be highly dependent on the stratification pattern that was used. For shortraker and rougheye rockfish, adaptive sampling found a substantially larger abundance in one stratum than did random sampling, whereas in the other stratum, the two methods showed almost identical results. Further studies on the efficacy of adaptive sampling for surveying rockfish abundance will be conducted in June 1999 using a chartered trawler off Yakutat, Alaska.

By Dave Clausen.

NPAFC Symposium Planned

The North Pacific Anadromous Fish Commission (NPAFC) Symposium "Recent Changes in Ocean Production of Pacific Salmon" will be held in Juneau on

1-2 November 1999 following the NPAFC annual meeting also held in Juneau this year. The symposium committee, including Dr. Y. Ishida from the Fisheries Agency of Japan, Dr. V. Radchenko from TINRO in Vladivostok, Russia, Dr. D. Noakes from the Department of Fisheries and Oceans in Nanaimo, British Columbia, and Dr. J. Helle (Chairman) from the Auke Bay Laboratory, met in Vancouver during the research coordination meetings in March to select oral and poster presentations from submitted abstracts. Up to six oral presentations from each country were selected and more than 40 posters were approved.

By Jack Helle.

NATIONAL MARINE MAMMAL LABORATORY (NMML)

Gray Whale Workshop

The National Marine Fisheries Service (NMFS) sponsored a review of the status of the eastern North Pacific stock of gray whales (*Eschrichtius robustus*). The workshop was held by the National Marine Mammal Laboratory (NMML) in Seattle on 16-17 March 1999. Thirty-seven people attended. The review concluded the 5-year assessment of the stock following the June 1994 delisting from the List of Endangered and Threatened Wildlife. Based on

the continued growth of this population (rising at 2.5% per year; currently at an estimated 26,600 individuals) and the lack of evidence of any imminent threats to the stock, the participants recommended to continue this stock's classification as nonthreatened. Other reports presented at the workshop showed that the widely reported delay in the southbound migration and unusually high levels of strandings in Mexico this year were not significantly different from other years. Those attending the workshop concluded that abundance monitoring should continue and that, ideally, research should continue on human impacts to critical habitats. This stock's annual migrations along the highly populated coastline of the western United States and its concentration in limited winter and summer areas may make it particularly vulnerable to impacts from commercial or industrial development or local catastrophic events.

By Dave Rugh and Marcia Muto.

Pinniped Predation on Endangered Salmonids

NMML staff are completing laboratory analysis of harbor seal and sea lion food habits in the Columbia, Umpqua, and Ozette Rivers in preparation for the workshop "Assessing Impacts of Pinniped Predation on Endangered Salmonids" scheduled for 21 - 23 April in Newport, Oregon. The objectives of the workshop are 1) to evaluate methods of estimating consumption of ESA (Endangered Species Act)-listed

salmon and 2) to evaluate salmon life history models for evaluating the impact of measured predation on the recovery of listed fish runs. At the workshop NMML staff will present the reports "Food habits of harbor seals in the lower Columbia River" and "Prey consumption estimates for harbor seals in the lower Columbia River" and the draft reports "Food habits of harbor seals from Umpqua River" and "Food habits of harbor seals, California sea lions and Steller sea lions at Ozette River."

An interesting aspect of the studies of harbor seals at the Umpqua River has been the potential harbor seal predation on the endangered Umpqua River cutthroat trout. Scat collections from autumn of 1997 were cleaned and the prey remains were identified. Samples contained a few salmonid otoliths and identifiable bone. There was no indication of feeding on cutthroat trout, although a number of the samples contained bone of salmonids which could not be identified to species. In a collaborative effort, the Northwest Fisheries Science Center (NWFS) extracted DNA from those bone samples and has been able to provide species identifications in almost all of the samples. The extraction of DNA from prey remains is an important new tool which aids in distinguishing between species and perhaps even stocks of salmonids in studies along the West Coast.

By Bob DeLong

Steller Sea Lion Prey and Foraging Studies

Scientists from NMFS and the U.S. Fish and Wildlife Service (USFWS) conducted an echo integration-midwater trawl survey for Steller sea lion (*Eumetopias jubatus*) prey at three sites in Alaska waters during 2-25 March 1999 aboard the USFWS vessel *Tiglax* for a total of 23 sea days. The area of operations included the Kiska, Kasatochi, and Ugamak rookeries and waters surrounding these sites.

A total of 401 km of transects were run at the three sites, 276 km during the day and 125 km at night. At Kiska, Kasatochi, and Ugamak 40%, 100%, and 90% of the transects were completed, respectively. Long-line sets or midwater trawls were not conducted due to rough weather. One neuston surface tow was made to verify echosign, verifying the presence of larval fish. Preliminary estimates suggest that midwater biomass was greatest at Ugamak rookery and declined to the west, but these data remain to be analyzed. Additionally, oceanographic seabird and marine mammal sighting data were recorded throughout the trip, all of which are currently being analyzed.

The cruise was moderately successful, though rough weather conditions were more prevalent than in past trips. The vessel and crew performed admirably during periods of stormy weather. The vessel continues to provide an excellent platform for winter work.

By Kathryn Chumbley.

RESOURCE ASSESSMENT & CONSERVATION ENGINEERING (RACE)

GROUNDFISH ASSESSMENT: Continued Participation in ADF&G Seasonality Study of Marmot Bay

Members of the RACE Division participated in the third phase of an Alaska Department of Fish and Game (ADF&G) seasonal bottom trawl study of Marmot Bay off Kodiak and Afognak Islands in the Gulf of Alaska (GOA) 7-17 January 1999 aboard the ADF&G research vessel *Resolution*. The primary purpose of the study, which includes sampling already completed in June, August and October 1998 and additional sampling periods scheduled for March and June 1999, is to document seasonal trends in depth and inshore/offshore distribution of crab and groundfish resources including Tanner crab (*Chionoecetes bairdi*), Pacific cod, walleye pollock, arrowtooth flounder, flathead sole, rock sole, yellowfin sole, and skates. Additionally, the seasonal nature of the sampling design will provide quantitative measures of changes in cooccurrence of the demersal groundfish and crab complex, document the changes in distribution of Pacific cod relative to Federal and state waters, and document intra-annual changes in the distribution of Tanner crab as-

sociated with maturation. Along with these objectives, the ADF&G invited AFSC scientists to conduct ancillary studies including specimen collections, food habit studies, research in seasonal gonad development, and size-at-maturity for selected species.

Thirty-one bottom trawl samples were completed during the January sampling period with the ADF&G standard 400-mesh eastern survey trawl at depths ranging from 35 to 250 m. All catches were sampled and processed to obtain species composition by weight for all components of the catch. Length frequencies were obtained electronically for all commercial groundfish species. Additionally, 960 stomachs, 863 ovaries, and 986 otoliths were taken from the major groundfish species occurring in the study area.

By Eric Brown.

Fishing Gear-Sea-floor Impacts Workshop

A 2-day workshop on AFSC seafloor research in Alaska was held on 27-28 January 1999 in Seattle at the AFSC. Participants included fisheries scientists from the ABL and the RACE and REFM Divisions. The objectives of the workshop were to 1) review current and planned trawling impact research in the Aleutian Islands region (AI), eastern Bering Sea (EBS) and the Gulf of Alaska (GOA); 2) review current and planned acoustic seabed classification research in the EBS and GOA; 3) discuss the utility and performance of underwater video

and trawls for research data collection; and 4) discuss future program directions.

Bottom trawl impact studies

The specific objectives of the AFSC's bottom trawl impact studies were to document long-term and short-term effects on both physical (e.g., grain size distribution, organic carbon concentration) and biological (population and community) parameters, as well as to review historical fishing effort. Study areas consisted of soft and hard bottom habitat in the Aleutian Islands (Seguam Pass), the EBS (Bristol Bay), and the GOA (Dixon Entrance and Kodiak and Kruzof Islands). Methodologies included the study of short-term effects of experimental fishing and more chronic effects of commercial activity by comparing heavily fished and unfished areas. Sampling gear included benthic grab samplers, modified research trawls, and both towed and submersible-mounted underwater video systems.

Evidence for trawling-related effects identified by individual studies included physical disturbances such as displacement of boulders, persistent scour marks, reduction of mean grain size, and elevated organic carbon levels. Observed effects on biological populations were mixed although there was an overall result demonstrating that megafauna populations in shallow, naturally-disturbed areas are sensitive to trawling. Certain emergent epifauna (e.g., some sponges, anthozoans, bryozoans) and biogenic substrate (snail shells), were reduced in abundance or damaged, affecting available

structural habitat. Motile epifauna, on the other hand, was generally unaffected with a few exceptions. *Asterias*, displaying opportunistic tendencies, increased in abundance, while snails and snail eggs were reduced. Community-level effects were reduced biological diversity and increased patchiness of sedentary taxa. Overall, the ecological interpretation of these findings is hindered by the lack of basic information about affected taxa.

Gear testing for trawl impact studies

Three new gear types have been evaluated for use in AFSC gear impact studies. One of these, a depth-regulating video sled for high relief areas (TACOS or towed automatically compensating observation system) proved functional in extreme current areas. However, its capability to collect quantitative data is uncertain. Another project involved the evaluation of three USBL (ultra-short baseline) acoustic systems for trawl positioning. Two of these (Nautronix ATS II and ORE Trackpoint II Plus) proved sufficiently accurate for real-time trawl positioning. Finally, underwater laser line scan systems (LLSS) appear capable of providing useful biological assessment data in areas too turbid for conventional video systems, albeit at a relatively high cost. In addition, data quality of LLSS is limited by sea state, depth of field, and target motion.

Seabed classification

Research on acoustic seabed classification addresses the new Sustainable Fisheries Act man-

dates to characterize essential fish habitat (EFH). Another motivation for this type of research is to improve the precision of fish abundance estimates with habitat-based stratification of research trawl surveys.

The overall objective for the studies presented at this workshop was to evaluate Quester Tangent Corporation (QTC) technology for background data collection during routine AFSC survey operations (e.g., acoustic and trawl surveys). Individual studies are being conducted to identify an optimum classification scheme (i.e., determine optima for frequency, number of bottom type classes, algorithms to extract shape parameters, and calibration sites), produce seafloor maps, determine operational limits, and establish survey designs. Work conducted between 1997 and 1998 in the EBS simultaneously collected digitized echo returns with a QTC ISAH-S system at two different frequencies (38 and 120 kHz) along a 14,000-km track. A bottom type map generated from the 120 kHz data will be used for preliminary EFH analyses. The 38kHz data were of poor quality, due to unidentified interference. A new dual frequency data set will be collected during the 1999 field season, with shipboard quality assurance/quality control and redundant hardware systems.

Research on the operational limits of the QTC View with a hull-mounted transducer was conducted in the GOA in 1997. Speeds between 3 and 12 knots did not significantly affect the QTC View classification performance, and no depth effect was observed for depths less than at least 230 m.

Classification performance was, however, negatively impacted by bottom slopes greater than 5 to 8 degrees. A quantitative relationship was also established between survey effort (to estimate quantity of fish habitat) and seafloor heterogeneity. It clearly indicated that compromises between effort and classification precision are necessary.

The performance of a prototype rawl-mounted acoustic-video system will be evaluated during the 1999 GOA groundfish survey. The impetus for seabed classification under this configuration are 1) to overcome the limitations of slope and depth as identified by the research conducted in 1997, 2) directly relate fish abundance and bottom type, and 3) obtain improved spatial resolution of seafloor types.

Video studies of fishing gear effects

The video portion of the workshop focused on the role of video in fishing gear impact studies and the potential for automated image processing. Some generalizations from the discussions of video cameras and trawls as sampling devices were 1) choice of video or trawls as the primary sampling gear in these studies likely reflects the past experience of the principal investigators; 2) both gears have been successfully used to collect relative abundance data for invertebrates; 3) video has inherently greater spatial resolution than trawls; 4) trawls effectively sample multiple taxa, while it is advisable to limit video data collection to a single taxon during each viewing of the tape; 5) video is useful for calibrating trawl sam-

pling efficiency; 6) processing of video images to extract data is time-consuming and costly; 7) relatively slow tow speeds are required to count and identify targets with video, effectively reducing data collection efficiency; 8) poor image quality at slow playback speeds with analog video systems is improved somewhat with digital systems; 9) video systems cannot directly collect biomass data; 10) hardware and software incompatibilities currently limit automated video processing options; 11) fish burial, avoidance of artificial light and variable water clarity can introduce bias/error in video data, while gear avoidance, herding and escapement under the footrope are similarly problematic for trawls; and 12) it is frequently difficult to specify taxonomy, ages and size of targets in video images.

Long-term direction

A discussion of the long-term direction of AFSC gear impact studies called for: 1) the development of a prioritized research plan, to include fixed gear studies, potential gear design issues and recovery processes; 2) consideration of second generation studies to evaluate ecological implications of effects attributed to bottom trawls, including basic studies of affected invertebrate species, and 3) a concerted effort to investigate automated video processing options used in other disciplines (e.g., medicine and the military) via a personal services contract.

By Bob McConnaughey.

MIDWATER ASSESSMENT: Echo Integration-trawl Survey of Walleye Pollock in the Southeastern Aleutian Basin near Bogoslof Is- land, February-March 1999

The Hokkaido National Fisheries Research Institute (HNF) and the National Research Institute of Fisheries Engineering (NRIFE) of Japan conducted an echo integration-trawl survey of walleye pollock in the southeastern Bering Sea aboard the Japanese research vessel *Kaiyo maru*. The Midwater Assessment and Conservation Engineering (MACE) program at the AFSC has conducted this survey annually since 1988; in 1999 MACE collaborated with the HNF and NRIFE aboard their vessel because the NOAA ship *Miller Freeman* was in dry dock for repairs. Leg 1 (1-12 February) began in Dutch Harbor, and leg 2 (21 February- 4 March) began in Kodiak, Alaska. The primary cruise objective was to determine the distribution and abundance of pollock that spawn in early March in the Bogoslof Island area. The survey design consisted of north-south parallel transects at 10 nautical miles (nmi) spacing on leg 1, and 10 or 5 nmi spacing on leg 2 depending on fish distribution. During leg 1, pollock were encountered along the southern ends of transects, near the Aleutian Islands, especially in the Samalga Pass area northeast of the Islands of Four Mountains. During leg 2, distribution was similar, but pollock aggregations appeared

to be larger and more concentrated than during leg 1. Abundance appeared similar to that in winter 1998. Pollock caught in the six midwater trawls made during leg 1 had lengths ranging from 42 to 65 cm; those caught in the eight hauls made during leg 2 had lengths ranging from 39 to 67 cm. Hauls made on the easternmost transects north of Akutan Island caught smaller pollock (length modes between 42-45 cm) than those in the central and western part of the survey area (length modes 53-57 cm for males, and 55-59 cm for females). Average gonadosomatic index (GSI) for mature female pollock increased from 12.6 during leg 1 to 16.1 during leg 2.

By Chris Wilson.

RESOURCE ECOLOGY & FISHERIES MANAGEMENT (REFM)

STATUS OF STOCKS AND MULTISPECIES ASSESSMENTS:

Pacific Whiting Assessment

AFSC scientists, working in collaboration with Canadian researchers at the Department of Fisheries and Oceans (DOF) Pacific Biological Station, completed an assessment of the coastal Pacific whiting stock. In summer 1998, NMFS and the DOF con-

ducted a cooperative acoustic survey of Pacific whiting. Because information from the survey was considered essential for evaluating current stock status, the whiting assessment was delayed from the usual assessment cycle so that survey results could be used. To coordinate scientific advice, the 1998-99 assessment was submitted to a joint Canada-U.S. technical review that satisfied the requirements of both the U.S. Pacific Fishery Management Council (PFMC) and the Canadian Pacific Stock Assessment Review Committee (PSARC). The Review Group meeting was held in White Rock, British Columbia, during 17-18 February 1999.

The assessment indicated that the whiting stock is at moderate abundance. Stock biomass increased to a historical high of 5.7 million metric tons (t) in 1987 due to exceptionally large 1980 and 1984 year classes, then declined as these year classes passed through the population and were replaced by more moderate year classes. Stock size has been stable over the past 4 years at 1.7-1.8 million t. The mature female biomass in 1998 is estimated to be 37% of an unfished stock. Although 1998 stock size is near a historical low, it is close to average stock size under current harvest policies. The exploitation rate was below 10% prior to 1993, then increased to 17% during 1994-98. Total U.S. and Canadian catches have exceeded the ABC (allowable biological catch) by an average of 12% since 1993 due to disagreement on the allocation between U.S. and Canadian fisheries.

An evaluation of Pacific whiting harvest policy led to the rec-

ommendation that the 40-10 option, the default harvest policy of the PFMC, be considered for whiting. The 40-10 option results in similar harvest rates as the hybrid F policy used previously for whiting, and may improve economic performance of the fishery by dampening variability in harvests. An appendix to the assessment described a meta-analysis of whiting stock-recruit relationships. Results indicated that the genus *Merluccius* may be less resilient to fishing than other gadoids. A Bayesian decision analysis produced estimates of FMSY (fishery maximum sustainable yield) in the F40%-F45% range, depending on the degree of risk-aversion.

The 1999-2000 Pacific whiting OY (optimum yield) of 290,000 t coastwide (232,000 t for the United States) was adopted by the PFMC in March 1999. The OY was based on 1) an F40% SPR (spawning biomass per recruit) proxy for FMSY, 2) a 40-10 adjustment because mature female biomass is slightly below 40% of its unfished level, 3) the average of the OYs for 1999 and 2000, 4) and an 80% U.S. share of the total catch.

By Martin Dorn.

Stock Assessment Video

James Ianelli assisted Dr. Ray Hilborn of the University of Washington in teaching a week-long course on Bayesian Stock Assessment Methods. The 17 participants included 8 scientists from the AFSC, 6 from the NWFSC, and 3 graduate students from the University of Washington. The course emphasized

hands-on application of Bayesian methods and modern approaches to the precautionary principle and risk aversion. The course was funded by the AFSC and the NWFSC. Due to the demand for this type of information, a set of video tapes from the course is being produced for distribution to interested parties.

Stock Assessment Software

The REFM Division continues to actively participate in developing and implementing software applications for analyses of North Pacific fish stocks. This work is partly funded by NMFS Headquarters as part of a national initiative to develop common software applications for fisheries stock assessments and is in coordination with members of the Northeast Fisheries Science Center (NEFSC) and the NWFSC. A key issue is to modernize software (C++ is at the core of the numerical methods) and encourage the use of models that adequately deal with uncertainty. These issues are critical to the success of conservation recommendations made to fishery management councils. One aspect of the work is to develop a common base model with a user-friendly interface that will be broadly applicable to many fisheries situations.

Other activities include adapting software developed in Iceland for the multispecies situation in the Bering Sea. This model allows for explicit details about fish growth through bio-energetic models in addition to linkages between species and different areas.

During this quarter, Dr. Bjarte Bogstad visited the AFSC and gave a seminar to discuss the implementation. He is a leader in applying multispecies models to Barents Sea fish and marine mammal populations. This initiative requires different stratification schemes from the generally used INPFC statistical areas and involves recompiling both survey and fishery data along newly defined biological domains.

By James Ianelli.

U.S. Groundfish Fisheries Observer Program

During the quarter, 200 observers were trained, briefed, and equipped for deployment to fishing and processing vessels and shoreside plants in the Gulf of Alaska, Bering Sea, and Aleutian Islands region. They sampled aboard 226 fishing and processing vessels and at 17 shoreside processing plants. The observers were trained or briefed in various locations. The AFSC Observer Program in Seattle briefed 67 observers who had prior experience. The University of Alaska Anchorage (UAA) Observer Training Center briefed 98 observers, and another 30 first-time observers were trained there. At the field office in Dutch Harbor, two more observers were briefed; three were excused from briefing because they had just completed a cruise successfully and were returning immediately to the field. The first quarter 1999 observer workforce thus consisted of 15% new observers and 85% experienced observers.

The Observer Program conducted a total of 73 debriefings during the first quarter of 1999. One debriefing was held in Kodiak, 4 in Dutch Harbor, 18 in Anchorage, and 50 in Seattle. No debriefings are conducted at the UAA.

In 1999, implementation of the expanded Community Development Quota (CDQ) program and the recent American Fisheries Act (AFA) continued. The CDQ program was developed for the purpose of allocating fishery resources to eligible western Alaska communities to provide the means for starting or supporting regionally-based commercial fishery activities or related businesses. The CDQ program was initiated in 1992 with walleye pollock and expanded to include fixed-gear halibut and sablefish in 1995. In 1998, the program was further expanded to include multiple species (MS) of groundfish and crab (MSCDQ). NMFS is responsible for monitoring the groundfish (including pollock and sablefish) and halibut CDQs, and the state of Alaska is responsible for monitoring crab CDQs.

The AFA, enacted by Congress in late 1998, made changes to the pollock fishery in the Bering Sea and Aleutian Islands. These changes included reallocation of fish between industry segments, provided for the formation of fishing cooperatives, and increased observer coverage levels on some components of the fleet. The offshore component of the fleet has organized a fishing cooperative and is operating in a manner similar to CDQ. Vessels which participate in both CDQ and AFA cooperatives have been allotted

specific amounts of fish by their management groups. Thus, individual vessels know their limits before they start fishing and can adjust their fishing and processing practices to maximize the return from those fish.

The MSCDQ and AFA catch-accounting for offshore processors is based entirely on data collected by observers and, unlike the open access fisheries where observer data is used to manage a fleet-wide quota, industry participants in the MSCDQ and AFA fisheries require individual accounting of fish harvested in each haul or set. This change has required Observer Program staff to develop special selection criteria and training requirements for observers, develop new sampling strategies and regulations to enhance the observers' working environment, and develop changes for the program's data collection and data management software systems.

By Bob Maier.

Socioeconomic Assessments Program

During this quarter, Center economists have been involved in activities supporting the Pacific and North Pacific Fishery Management Councils (PFMC and NPFMC, respectively) and in other cooperative efforts within the agency and beyond.

Council Activities

1. Cost Recovery Program for the IFQ and CDQ Plan - A Center economist assisted Alaska Regional Office staff in preparing the analysis of the proposed IFQ cost

recovery plan. Due to higher priorities for NMFS, the IFQ cost recovery plan will not be implemented before the start of the 1999 IFQ fishery.

2. Reasonable and Prudent Alternatives for the Alaska Pollock Fisheries - Economic analysis was prepared for the proposed reasonable and prudent alternatives (RPA). The RPAs are intended to prevent the BSAI and GOA pollock fisheries from jeopardizing Steller sea lion stocks and adversely impacting their critical habitat. The NPFMC is scheduled to take final action on the analysis in June.

3. NPFMC Socioeconomic Data Committee - Center economists continued to assist the committee in identifying the following: 1) the types of economic data to be collected, 2) data collection methods, 3) measures of economic performance that would assist the Council and NMFS in meeting their fishery conservation and management responsibilities, and 4) changes in recordkeeping and reporting requirements that would assist in obtaining economic data. The committee met in January and prepared a report for the February Council meeting. The Council accepted the committee's recommendation to initiate an amendment that would require at-sea processors to complete the Alaska Commercial Operators Annual Report (ACOAR). The ACOAR is a reporting requirement for all seafood processors under state of Alaska jurisdiction. It provides weight, price, and value data both for exvessel products and for processed products. If approved, the amendment would

require all processors to provide this information annually. In addition, the Council recommended that the committee work with the Alaska Fisheries Information Network (AKFIN) Steering Committee to improve the ACOAR and other data collection programs.

4. NPFMC Bycatch Reduction Programs - A Center economist assisted NPFMC committees to further develop a halibut mortality avoidance program (HMAP) and a vessel bycatch account program (VBAP). In February, the Council asked HMAP proponents to submit detailed proposals for analysis. The Council expects to receive at least one proposal in April. The Council asked NMFS and industry to discuss monitoring and other implementation issues for a VBAP.

5. American Fisheries Act (AFA) - Center economists assisted the Alaska Regional Office in addressing AFA implementation issues and initiated efforts to assess the effects of the factory trawler cooperative that occurred as the result of the AFA. The Council will make recommendations to address different aspects of the AFA during the next 2 years.

6. Community Development Quota (CDQ) Program - The Center has initiated a study of the Alaskan pollock and groundfish CDQ programs to determine the amount and the form in which CDQ holdings provide value to CDQ groups and their partners. The study will include a comparative analysis of contractual arrangements that CDQ groups used to lease quotas. It will also examine the way that CDQ partners utilize quota to complement their

other fishing and processing activities. The project is an integral part of the Center's efforts to augment economic data on the groundfish fisheries, and it should also provide useful information to policy makers designing future CDQ programs both in the United States and abroad.

7. PFMC Groundfish Management - A Center economist 1) prepared materials for and participated in the PFMC's Allocation Committee January meeting in Portland; 2) served as the Groundfish Management Team (GMT) representative to the stock assessment review meeting for Pacific whiting, held in White Rock, British Columbia; 3) participated in the GMT meeting in Newport, Oregon; 4) participated in a workshop addressing appropriate harvest rates for West Coast groundfish stocks in Monterey, California; 5) served on a panel discussing economic and social issues, as part of a larger forum on future management of West Coast rockfish stocks in Monterey; 6) created a new series of fish ticket and annual summary data files for the period 1984-98 and provided them to an economist at the Southwest Fisheries Science Center (SWFSC); 7) revised spreadsheet models of limited-entry fishery participation used in evaluating inseason progress to reflect the fishery's new structure adopted for 1999; 8) provided the PFMC with an overview of the 1998 limited-entry, fixed-gear fishery for sablefish; 9) updated the model for projecting the three-tiered fishery to include 1998 participation; 10) developed an assessment of management options for the 1999 three-tiered fishery; 11) de-

veloped a series of tables summarizing rockfish participation, with particular emphasis on bocaccio, which is in need of a rebuilding plan and potentially significant fishery revision; 12) conducted a comparison of rockfish species poundages in PacFIN and in the CALCOM database maintained in California, and identified a data error in the latter; 13) provided information on active vessels (with owner contacts) that have sufficient power/size to serve as platforms for upcoming survey activities; and 14) met with members of the Northwest Region's Fishery Permit Office staff to discuss ways of improving data quality and usefulness.

Other Cooperative Activities

Center economists have participated in the following cooperative activities: 1) the ongoing development of programs to collect and model economic data for the Pacific Coast and Alaska commercial fisheries; 2) the efforts of the NMFS Excess Capacity Working Group to develop a plan to address the problem of excess fishing capacity; 3) the development of a NMFS budget initiative to improve substantially the social science capabilities of the agency; 4) the development of Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) reauthorization proposals; 5) the review of the NMFS science quality assurance proposal; 6) the development of standards for sustainable fisheries; 7) efforts to improve the guidelines for regulatory flexibility analysis; 8) the first meeting of the "Western Regional Seafood Markets and Fisheries Management"

working group, sponsored by the U.S. Department of Agriculture and the region's Land Grant University Experiment Stations; 9) the work of the NMFS Pacific Salmon Working Group; 10) the statistical analysis of localized depletion of Atka mackerel in the Aleutian Islands management areas; 11) the development of maximum likelihood procedures to value recreational halibut and salmon fishing in Alaska using data from a rank-ordered stated preference survey; and 12) the review of research proposals and manuscripts.

The activities associated with the Alaska groundfish fishery cost, earnings, and employment data collection program include the following: 1) Center economists met with several industry members (owners, managers, controllers, and association representatives) to discuss the collection of economic data and review draft surveys; 2) drafts of five industry sector surveys were revised; 3) progress to date, plans for future work, and both theoretical and empirical issues were discussed at a workshop for the project's advisory committee; and 4) efforts continued to develop methods to verify the data that will be collected in the cost, earnings and employment survey of participants in the Bering Sea-Aleutian Islands pollock fishery.

By Joe Terry.

Age and Growth Program

Estimated releases of production ages for January to March 1999 were 236 rex sole, 390 northern rock sole, 870 arrowtooth

flounder, 1,091 Pacific whiting, 791 Pacific ocean perch for a total of 3,378. Also 978 were tested, 785 were updated, and 37 were examined and determined to be unreadable. The program has recently hired three new age-readers.

By Dan Kimura.

Resource Ecology and Ecosystems Modeling Program: Activities and Research Results

Stomachs collected totaled 13 for the eastern Bering Sea and 966 for the Gulf of Alaska. Fishery observers performed no at-sea scans of fish stomach contents in the Bering Sea. Laboratory analysis was performed on 1,101 stomachs from the Bering Sea, 541 from the Aleutian Islands area, and 720 from the Washington-Oregon-California coast areas. One observer returned with stomach samples collected from the Bering Sea. Three classes of observers were trained for stomach collection.

Ecosystem Considerations in Fisheries Management: Linking Ecosystem Management Goals with Ecosystem Research

The international symposium on Ecosystem Effects of Fishing was held by the International Council for the Exploration of the Sea (ICES) Scientific Committee on Ocean Research (SCOR) during 6-19 March 1999 in Montpellier, France (see Items section in this issue). The symposium provided an opportunity to

present a poster (soon to be made available on the AFSC web site) describing the following proposal regarding linking ecosystem management goals and ecosystem research. This year we will begin to implement a revision of the Ecosystem Considerations document that provides information to the groundfish plan teams of the NPFMC. The revision will expand and standardize some of the content of the Ecosystems Consideration document to more clearly highlight the status of ecosystem-based management efforts and the status and trends of various parts of the ecosystem. These changes and additions would accomplish several goals:

1. Track ecosystem management efforts and their efficacy.
2. Track changes in the ecosystem that are not easily incorporated into single-species assessments.
3. Bring results from ecosystem research efforts to the attention of stock assessment scientists and fishery managers.
4. Provide a stronger link between ecosystem research and fishery management.

As fishery management organizations incorporate more ecosystem-oriented thinking into management, there is a need for more clearly defined ecosystem-oriented management goals, as well as the tools necessary for managers to attain those goals. Parallel to this must be the expansion of the scientific advice to management beyond traditional single-species stock assessment

advice. A broad spectrum of ecosystem research currently conducted by GLOBEC (Global Ocean Ecosystem Dynamics) and GLOBEC-like groups includes habitat research, ongoing trophic interactions work, and long-term monitoring of noncommercial species. Although the ultimate goal is to have quantitative predictions from this research to guide management, these research efforts already serve as indicators of ecosystem status and trends. The indicators can provide an early warning system for managers, signaling human- or climate-induced changes that may warrant management action. These indicators can also serve to track the success of previous ecosystem-oriented management efforts. The NPFMC has started to include some of this ecosystem research information in an ecosystem considerations document that accompanies the traditional stock assessment reports. The expansion of the document will include ecosystem status and trend information and will link management actions with ecosystem observations.

The NPFMC has explicitly stated the following ecosystem management goals:

1. Maintain biodiversity consistent with natural evolutionary and ecological processes, including dynamic change and variability.
2. Maintain and restore habitats essential for fish and their prey.
3. Maintain system sustainability and sustainable yields for human consumption and

nonextractive uses.

4. Maintain the concept that humans are components of the ecosystem.

The new ecosystems document will contain two classes of ecosystem indicators: ecosystem management indicators and ecosystem status indicators. The ecosystem management indicators will measure performance towards meeting the stated ecosystem management goals. These indices will have the advantages of providing early signals of direct human effects on ecosystem components that might warrant management intervention and will provide evidence of the efficacy of previous management actions, such as the efficacy of the Bering Sea bottom trawl closures in areas of increasing diversity of benthic fauna. Ecosystem status indicators will provide measures of ecosystem status and trends and serve the dual purposes of 1) bringing the results of ecosystem research efforts to the attention of stock assessment scientists and fishery managers, which will provide stronger links between ecosystem research and fishery management, and 2) bringing together many diverse research efforts into one document, which will spur new understanding of the connections between ecosystem components and the possible role that climate, humans, or both may have on the system.

Symposium on Ecosystem Effects of Fishing

Charles Fowler of the National Marine Mammal Laboratory and Anne Hollowed and Patricia Livingston of the Resources Ecology and Fishery Management Division attended the symposium "The Ecosystem Effects of Fishing" held 15-19 March in Montpellier, France. The meeting was organized and sponsored by the International Council for the Exploration of the Sea (ICES), the Scientific Committee on Oceanic Research (SCOR), and the French Institut de Recherche pour le Développement (IRD) with further support, sponsorship, and funding from over a dozen other organizations worldwide. The focus of this symposium was 1) the scientific documentation of the effects of fishing on marine communities and ecosystems, 2) the methodology and means of measuring such effects, and 3) the translation of information to practical application in management. Both posters and invited papers were arranged in these categories. The papers will be published as a special ICES volume.

Anne Hollowed was an invited speaker and made an oral presentation in the topic session on quantification of fisheries impacts on ecosystems. The title of her presentation was "Are multispecies models an improvement on single species models for predicting fishing impacts on marine ecosystems?" by Anne B. Hollowed, Nicholas Bax, Richard Beamish,

Jeremy Collie, Michael Fogarty, Patricia Livingston, John Pope, and Jake Rice. The paper provides a review of a variety of modeling approaches used to quantify impacts of fishing on marine ecosystems throughout the world, with an overview of applications of multispecies models as tools for evaluating impacts of fishing on marine communities. Several marine ecosystems exhibit evidence of dramatic shifts in species composition. In many ecosystems these shifts can not be attributed to predation pressure alone; climate forcing is often required to explain the observed trends in fish production. The authors review the strengths and weaknesses of a variety of multispecies modeling approaches and their ability to evaluate the causal mechanisms underlying dramatic shifts. This comparison provides a basis for evaluating the role of fishing in marine ecosystems. Specifically, the authors illustrate that model outcomes regarding potential impacts of commercial fishing can be influenced by the model specification, the degree of aggregation of the species, the specification of interactions, and assumptions regarding future levels of recruitment variability. The short-term (5-10 year) predictive capability of multispecies models is difficult to assess because of the complicated nature of species interactions. The authors encourage the development of ecosystem models that incorporate climate forcing and predator-prey interactions.

In addition to coauthoring the above paper, Patricia Livingston

coauthored "Ecosystem effects of fishing on boreal ecosystems: Examples from the Barents Sea, Iceland, Newfoundland and the Bering Sea," presented by Sigurd Tjelmeland with coauthors George Lilly, Vidar Wespestad and Olav Rune Godø. The paper characterizes the species dominance, predation, and fishing patterns in the respective boreal ecosystems and discussed the strong impacts that oceanographic events may have on recruitment with possible implications for management. Pat also coauthored the poster, "Ecosystem effects of fishing in the eastern Bering Sea: insights from trophic mass balance assessments," coauthored with A.W. Trites, M.C. Vasconcellos, S. Mackinson, A.M. Springer, and D. Pauly. The poster summarizes some of the results of a collaborative ECOPATH/ECOSIM modeling effort in the eastern Bering Sea that was initiated to examine hypotheses about population changes in the Bering Sea from the 1950s to the 1980s, discussed in a previous quarterly report. Pat Livingston also presented her own poster "Ecosystem considerations in fisheries management: Linking ecosystem management goals with ecosystem research," which is discussed in more detail in the REFM contribution section of this quarterly report. The poster explains the proposed revision of the Ecosystem Considerations document that is part of the Stock Assessment and Fishery Evaluation report of the North Pacific Fishery Management Council, and gives examples of ecosystem status and



Japanese scientists visit the Snettisham Hatchery south of Juneau, Alaska. From left to right: Steve Reed, hatchery manager; Mr. Takehiko Ishiguro, National Salmon Research Center (NASREC), Sapporo; Mr. Fumihiko Tamiya, Salmon Management Section, Fisheries Agency of Japan, Tokyo; Dr. Tetsuichi Nomura, Chief, Fish Health Laboratory, Research Division, NASREC; and Eric Prestegard, principal hatchery investigator for sockeye salmon enhancement.

trend and ecosystem management indicators provided by AFSC scientists Lowell Fritz, Jon Heifetz, Jerry Hoff, Dan Holland, Bob McConnaughey, and John Sease, PMEL's Jim Overland, and Dave Witherell of the North Pacific Fishery Management Council.

Charles Fowler's poster presented an approach to fisheries management consistently applicable to individual species, multispecies groups, and ecosystems. This systematic approach uses other species as empirical examples of sustainability to integrate the effects of fishing and account for elements of complexity at all levels. Examples were provided for ecosystems in the Bering Sea, the northwest Atlantic

and southwestern Africa to show how the approach meets the requirements of management developed and documented in the literature.

By Charles Fowler, Anne Hollowed, and Patricia Livingston

Japanese Scientists Visit Auke Bay Lab

Three Japanese scientists visited the Auke Bay Laboratory (ABL) and other Juneau-area fisheries organizations including local hatcheries during 15-17 March 1999. The scientists were Tetsuichi Nomura and Takehiko Ishiguro from the National

Salmon Resources Center (NASREC) in Sapporo (formerly known as the Hokkaido Salmon Hatchery), and Fumihiko Tamiya from the Fisheries Agency of Japan (FAJ) in Tokyo. Nomura is chief of the Fish Health Section and Ishiguro is chief of the Enhancement Management Division at NASREC, while Tamiya is a budget management specialist for FAJ. The purpose of their visit was to gather information on several salmon issues including disease control technology, information on otolith marking, coded-wire tagging, radio tagging, hatchery management, salmon harvest management, effects of oil on salmon biology, lipid composition of immature

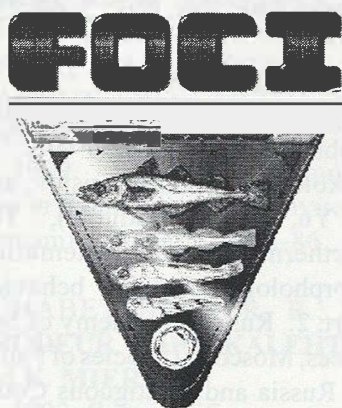
salmon at sea, and other related marine salmon concerns.

While in the Juneau area, the scientists visited the ABL, the Auke Creek experimental hatchery and fish counting weir, the Alaska Department of Fish and Game (ADF&G) Fish Pathology Laboratory, the ABL Image Analyses Laboratory, the ADF&G Tag Laboratory, ADF&G Headquarters staff, and Douglas Island Pink and Chum, Inc.(DIPAC) facilities at Gastineau and Snettisham Hatcheries, plus the DIPAC remote release site for cost-recover harvest at Amalga Harbor. Nomura and Ishiguro gave a seminar at the ABL on some of their research activities near the end of the visit. Also, Nomura will be participating in May aboard ABL's OCC chartered research cruise on the vessel *Great Pacific*.

Based on discussions with the scientists, reorganizational changes continue to occur within the FAJ. Along with the newly restructured NASREC, the number of federal salmon hatcheries in Hokkaido is scheduled to be reduced from 27 to 12 by transferring operation of many hatcheries to local fishermen cooperatives. This is similar to changes in Alaska, where state hatcheries are transferred to regional aquaculture associations that are operated by local fishermen. These transfers are complicated, however, by continued depressed prices paid to fishermen in both Japan and Alaska, especially for relatively low value pink and chum salmon. According to Nomura, the value of the salmon catch paid to Japanese fishermen has dropped from around 600 million yen in the 1980s to 400 mil-

lion yen in the 1990s, despite record harvest levels in recent years. Similar declines have also occurred in the exvessel value paid to Alaska salmon fishermen. In Japan, where most salmon hatchery production is chum salmon, another change appears to be a shift from chum salmon production to masu salmon production.

By William Heard.



FOCI Staff Attend Limnology and Oceanography Meeting

Members of the Fisheries-Oceanography Coordinated Investigations program (FOCI) program attended the annual American Society of Limnology and Oceanography meetings in Santa Fe, New Mexico, on 1-5 February 1999. Jeff Napp, Rick Brodeur, Elaina Jorgensen of the AFSC, along with J.D. Schumacher and P.J. Stabeno, presented the paper "Are recent eastern Bering Sea ecosystem anomalies early evidence for climate change? What do records of

zooplankton biomass and species composition tell us?" Chris Baier (AFSC) and Napp presented the paper "Distribution, reproduction, and development of *Calanus marshallae* in the southeastern Bering Sea during three years of contrasting oceanographic conditions." Brodeur, Napp, and R. Schabetsberger presented the paper "Diel vertical migration, feeding selectivity, and prey distribution of juvenile walleye pollock at a productive frontal region in the Bering Sea." Brodeur and L. Ciannelli presented the paper "Bioenergetics of age-0 walleye pollock in a frontal structure of the Bering Sea."

AFSC Staff Participate in GIS Symposium

Bern Megrey, Ann Matarese, Susan Picquelle, Debbie Blood, Jan Benson, Daniel Nichol, Erika Acuna, Pamela Goddard, Gerald Hoff, Deborah Nebenzahl, Taina Honkalehto, Bob Lauth, Robert McConnaughey, Frank Morado, Frank Shaw, Gary Walters, Mark Wilkins, Harold Zenger, and Mark Zimmermann attended the First International Symposium on GIS in Fishery Sciences, in Seattle, Washington, during 2-4 March 1999. Also Blood, Brodeur, Matarese, Picquelle, and Benson presented a poster "Analysis of ichthyoplankton abundance, distribution, and species associations in the Northeast Pacific Ocean and Bering Sea."

PUBLICATIONS

- BARLOW, J., P. S. HILL, K. A. FORNEY, and D. P. DeMASTER.
1998. U.S. Pacific marine mammal stock assessments 1998. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SWFSC-258, 40 p.
- BRODEUR, R. D., B. FROST, S. R. HARE, R. C. FRANCIS, and W. J. INGRAHAM, Jr.
1999. Interannual variations in zooplankton biomass in the Gulf of Alaska and covariations with California Current zooplankton biomass, p. 106-135. *In* K. Sherman and Q. Tang (editors), Large marine ecosystems of the Pacific Rim: Assessment, sustainability, and management. Blackwell Science Ltd.
- BRODEUR, R. D., and M. T. WILSON.
1999. Pre-recruit walleye pollock in the eastern Bering Sea and Gulf of Alaska ecosystems, p. 238-251. *In* Proceedings of GLOBEC international marine science symposium on ecosystem dynamics.
- CARLS, M. G., S. D. RICE, and J. E. HOSE.
1999. Sensitivity of fish embryos to weathered crude oil: Part I. Low-level exposure during incubation causes malformations, genetic damage, and mortality in larval Pacific herring (*Clupea pallasii*). *Environ. Toxicol. Chem.* 18:481-493.
- FARLEY, E. V., Jr., and J. M. MURPHY.
1997. Time series outlier analysis: Evidence for management and environmental influences on sockeye salmon catches in Alaska and northern British Columbia. *Alaska Fish. Res. Bull.* 4: 36-53.
- FARLEY, E. V., Jr., and J. M. MURPHY.
1998. Response to a comment on time series outlier analysis. *Alaska Fish. Res. Bull.* 5: 69-73.
- FOWLER, C. W.
1998. Northern fur seals of the Pribilof Islands, p. 450-498. *In* Sokolov, V.E., A.A. Aristov, and T. Yu. Lisitzina (editors), The northern fur seal: Systematics, morphology, ecology, behavior, Part. 2. Russian Academy of Sciences, Moscow. (Species of Fauna of Russia and Contiguous Countries). *In* Russian.
- FUNK, F., T. J. QUINN II, J. HEIFETZ, J. N. IANELLI, J. E. POWERS, J. F. SCHWEIGERT, P. J. SULLIVAN, and C.-I. ZHANG (editors).
1998. Fishery stock assessment models. Alaska Sea Grant College Program, University of Alaska Fairbanks, AK-SG-98-01. 1,037 p.
- GERBER, L. R., W. S. WOOSTER, D. P. DeMASTER and G. R. VanBLARICOM.
1999. Marine mammals: New objectives in U.S. fishery management. *Rev. Fish. Sci.* 7:23-38.
- HEIFETZ, J., D. A. ANDERL, N. E. MALONEY, and T. L. RUTECKI.
1999. Age validation and analysis of ageing error from marked and recaptured sablefish, *Anoplopoma fimbria*. *Fish. Bull.*, U.S. 97:256-263.
- HEIFETZ, J., and T. J. QUINN II.
1998. Dynamics of a migratory fish population with applications to the management of sablefish, p. 219-243. *In* F. Funk, T. J. Quinn II, J. Heifetz, J. N. Ianelli, J. E. Powers, J. F. Schweigert, P. J. Sullivan, and C.-I. Zhang (editors), Fishery stock assessment models. Alaska Sea Grant College Program, University of Alaska Fairbanks, AK-SG-98-01.
- HOLLOWED, A. B., S. R. HARE, and W. S. WOOSTER.
1998. Pacific basin climate variability and patterns of northeast Pacific marine fish production, p. 89-104. *In* G. Holloway, P. Muller, and D. Henderson (editors), Proceedings 'Aha Huliko'a (Biotic impacts of extratropical climate variability in the Pacific), University of Hawaii, January 25-29, 1998. University of Hawaii, SOEST Spec. Publ.

KRIEGER, K. J., and D. H. ITO.

1999. Distribution and abundance of shortraker rockfish, *Sebastes borealis*, and rougheye rockfish, *S. aleutianus*, determined from a manned submersible. Fish. Bull., U. S. 97:264-272.

LIVINGSTON, P. A., and R. D. METHOT.

1998. Incorporation of predation into a population assessment model of eastern Bering Sea walleye pollock, p. 663-678. In F. Funk, T. J. Quinn II, J. Heifetz, J. N. Ianelli, J. E. Powers, J. F. Schweigert, P. J. Sullivan, and C.-I. Zhang (editors), Fishery stock assessment models. Alaska Sea Grant College Program, University of Alaska Fairbanks, AK-SG-98-01.

MOLES, A.

1999. Parasitism, feeding rate, and hydrocarbon uptake of pink shrimp *Pandalus borealis* fed a crude oil contaminated diet. Bull. Environ. Contam. Toxicol. 62:259-265.

PELLA, J. J., M. M. MASUDA and D. G. CHEN.

1998. Forecast methods for inseason management of the southeast Alaska chinook salmon troll fishery, p. 287-314. In F. Funk, T. J. Quinn II, J. Heifetz, J. N. Ianelli, J. E. Powers, J. F. Schweigert, P. J. Sullivan, and C.-I. Zhang (editors), Fishery stock assessment models. Alaska Sea Grant College Program, University of Alaska Fairbanks, AK-SG-98-01.

RALSTON, S., and J. N. IANELLI.

1998. When lengths are better than ages: the complex case of bocaccio, p. 451-468. In F. Funk, T. J. Quinn II, J. Heifetz, J. N. Ianelli, J. E. Powers, J. F. Schweigert, P. J. Sullivan, and C.-I. Zhang (editors), Fishery stock assessment models. Alaska Sea Grant College Program, University of Alaska Fairbanks, AK-SG-98-01.

SAEKI, K., M. NAKAJIMA, K. NODA, T. R. LOUGHLIN, N. BABA, M. KIYOTA, R. TATSUKAWA, and D. G. CALKINS.

1999. Vanadium accumulation in pinnipeds. Arch. Environ. Contamin. Toxicol. 36:81-86.

SCHABETSBERGER, R., R. BRODEUR, T. HONKALEHTO, and K. MIER.

1999. Sex-specific egg cannibalism in spawning walleye pollock: the role of reproductive behavior. Env. Biol. Fishes 54:175-190.

SHORT, J. W., K. A. KVENVOLDEN, P. R. CARLSON, F. D. HOSTETTLER, R. J. ROSENBAUER, and B. A. WRIGHT.

1999. Natural hydrocarbon background in benthic sediments of Prince William Sound, Alaska: Oil vs. coal. Environ. Sci. Technol. 33: 34-42.

TYNAN, C. T.

1999. Redistributions of cetaceans in the southeast Bering Sea relative to anomalous oceanographic conditions during the 1997 El Niño, p. 115-117. In: Freeland, H. J., W. T. Peterson, and A. Tyler (co-convenors), Proceedings of the 1998 Science Board Symposium on the impacts of the 1997/98 El Niño event on the North Pacific Ocean and its marginal seas. North Pacific Marine Science Organization (PICES), (PICES Sci. Rep. No. 10). Sidney, B.C., Canada.

TECHNICAL MEMORANDUMS¹

HILL, P. S. , and D. P. DeMASTER.

1998. Alaska marine mammal stock assessments, 1998. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-97, 166 p.

LAUTH, R. R.

1999. The 1997 Pacific West Coast upper continental slope trawl survey of groundfish resources off Washington, Oregon, and California: Estimates of distribution, abundance, and length composition. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-98, 284 p.

SEASE, J. L., J. M. STRICK, R. M. MERRICK, and J. P. LEWIS.

1999. Aerial and land-based surveys of Steller sea lions (*Eumetopias jubatus*) in Alaska, June and July 1996. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-99, 43 p.

PROCESSED REPORTS²

HILL, P. S., B. JONES, and D. P. DeMASTER (editors).

1998. Marine Mammal Protection Act and Endangered Species Act implementation program 1997. AFSC Processed Rep. 98-10, 246 p. Alaska Fish. Sci. Cent., 7600 Sand Point Way NE., BIN C15700, Seattle, WA 98115-0070.

BROWN, A., L. BRITT, and J. CLARK.

1999. FOCI field manual. AFSC Processed Rep. 99-01, not paginated. Alaska Fish. Sci. Cent., 7600 Sand Point Way NE., BIN C15700, Seattle, WA 98115-0070.

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