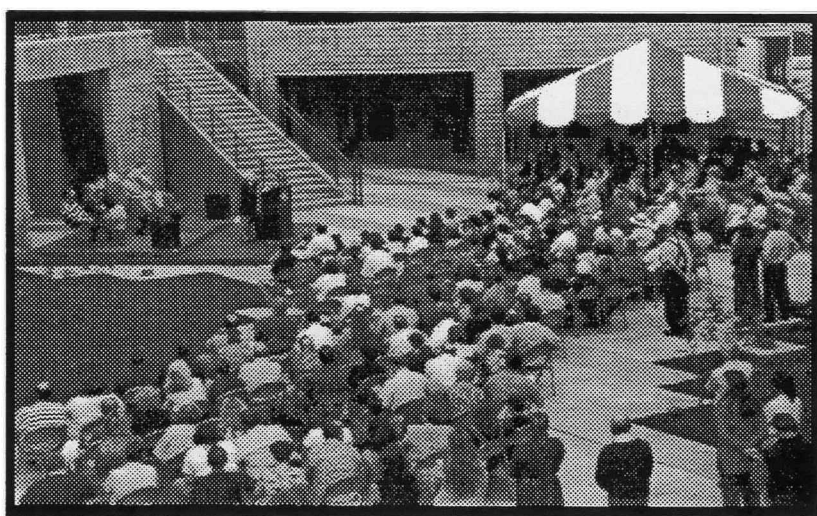


1998-99 Annual Report

Oregon State University Hatfield Marine Science Center June 1999



The new Duncan Law Seafood Consumer Education Center is officially dedicated July 15, 1998.

Contents

Director's Message...1

I. Public Outreach/Extension

- Visitor Center...2
- Extension Sea Grant...2
- Oregon Pacific Area Health Education Center...4

II. Research

- College of Oceanic & Atmospheric Sciences Ship Operations...5
- Hatfield Marine Science Center Independent Researchers...5
- Neurophysiology Group, Pharmacy...7
- Coastal Oregon Marine Experiment Station...7
- Cooperative Institute for Marine Resources Studies...13
- Environmental Protection Agency...15
- Oregon Department of Fish and Wildlife...16
- National Marine Fisheries Service, Alaska Fisheries Science Center...18
- National Marine Fisheries Service, Northwest Fisheries Science Center...19
- National Oceanic & Atmospheric Administration VENTS Program...22
- United States Fish and Wildlife Service...23

III. Education/Administration

- Guin Library...24
- Scholarships...24

IV. Appendices

- Statistics...25
- List of Volunteers...26
- List of Donors...27
- Publications...28
- Budget...34

This page intentionally left blank

1998-99 Annual Report

Oregon State University

Hatfield Marine Science Center

Director's Message

Lavern Weber, Director

Although the roof on the Education Building was redone, this past year's growth has been primarily in programs rather than in physical facilities.

The Visitor Center under Sea Grant's guidance has had growing attendance. The emphasis on the educational programs associated with research is being well received. We have been given some additional private funds for internships and progress has been made toward researching the effectiveness of specific display formats and techniques. The addition of a Visitor Center Manager brings our support back up to the level during Don Giles' tenure.

We have completed the remodeling contract with the U.S. Department of Housing & Urban Development. Through a generous memorial gift, the auditorium has been named the Jeanette Bertea Hennings Auditorium. During the last summer, we had support from the Vents Program for the live auditorium broadcast of the New Millennium Observatory (NeMO) off the Oregon coast. This proved very popular and demonstrates the power of collaboration with our on-site cooperating agencies. The NeMO program brings data on geophysical, geochemical and microbial activities associated with the volcanic activities off our coast.

One of the things the HMSC can be very proud of is our activities within the community. The food share drive has established a regular tradition of Soup and Bread Tuesdays, with chefs from a number of different agencies stirring the pot during February and March to raise money for the hungry in our county.

Safety at the Center was a definite focus this past year. Our chlorination system was outmoded and unsafe and was replaced with a safer, more efficient system. Training, safety equipment and practice drills were provided to deal with our confined space in the 800,000 gallon seawater storage tank. OSHA visited the Center and leveled some fines, but the outcome was to spur us to greater compliance and more ongoing concern for safety issues.

We have established a weather station at the Center whose data is displayed and updated constantly on the web. The station can be accessed at <http://weather.hmsc.orst.edu/>.

One of the larger events was the grounding of the New Carissa at both Charleston and then again at Waldport. There was great concern about oil contamination of our seawater system. The Newport EPA came to our rescue, doing double duty and monitoring our intake very carefully. No contamination of our seawater system occurred, much to the relief of all our investigators who use our seawater. All our thanks go to the crew at EPA! They have also developed protocols for monitoring such events should they occur in the future.

Donations for graduate student research continue to come in. This June the HMSC will give almost \$95,000 in graduate student scholarships and awards at the Mamie Markham Symposium on June 4.

The Astoria Seafood Lab and Consumer Center has been very busy settling into their new facilities and developing programs for both facilities. In addition to their regular research activities, the Surimi School, given annually by the Lab. This course has also been taught in Bangkok and Paris, encompassing a wide national and international student body.



2030 South Marine Science Drive
Newport, Oregon 97365-5296

Telephone 541-867-0100

TDD 541-867-0339

Fax 541-867-0138

Internet: directors.office@hmsc.orst.edu

Web Page: <http://hmsc.orst.edu>



Visitor Center

Bill Hanshumaker, Marine Education Specialist

Oregon Sea Grant's mission at the Hatfield Marine Science Center's Visitor Center is to create a unique, dynamic environment for lifelong exploration and discovery. Our aquariums and exhibitry focus on how scientific research enables management and appreciation of coastal and marine resources. Responding to public requests for more aquariums, this year we installed eight new tanks displaying algae and animals that are currently subjects of research at the HMSC. The popular touch tank was also expanded to accommodate additional visitors and school groups.

Volunteers were essential to the educational success of many programs. Public interpretation occurred continuously at the octopus and touch tanks. Volunteers and interns offered guided estuary and dock walks from Memorial Day through Labor Day. Together, volunteers provided thousands of hours of quality public education. This year we initiated an evening speaker program, inviting researchers to present the results of their investigations to volunteers and the general public. Spanning such diverse topics as tsunamis, whales, geology, and underwater volcanoes, these talks informed hundreds of interested coastal residents.

During this past year, Sea Grant has made

significant progress in its long-term planning efforts for the Visitor Center. Looking three years to the future, exhibit development and other educational activities are coordinated to take advantage of local events such as professional conferences and scientific expeditions. For example, the Visitor Center, working in concert with NOAA's Vents Program "New Millennium Observatory (NeMO)" provided visitors with the opportunity to connect with scientists while at sea. Through auditorium presentations, the Web and email, interested individuals experienced the excitement of scientific discovery in a near-real time interaction. On a seasonal basis, the Visitor Center shifted its emphasis, focusing on subjects as diverse as coastal hazards, whales and resource management. Exhibitry in the Pet Project area of the Research Gallery, the Resource Room, and the demonstration area was changed to interpret topics of current public interest, such as the grounding of the *New Carissa*.

The Visitor Center also serves as a social laboratory, used to investigate the effectiveness of our educational endeavors. Exhibitry is undergoing statistical analysis to determine preference by different demographic groups. Responding to visitor comments that indicated difficulties finding the Visitor Center, Sea Grant funded research investigating the effectiveness of existing signage. This information is being used in a larger cooperative signage effort throughout South Beach.

Extension Sea Grant

Jay Rasmussen, Extension Sea Grant Program Leader

The goal of the National Sea Grant Program to enhance appropriate use of ocean and coastal resources is carried out in our state by Oregon Sea Grant. The outreach education called for in Federal Sea Grant legislation is conducted through the Extension Sea Grant program (ESG) in Oregon.

The mission of ESG's program is to educate Oregonians by delivering research-based, objective information to help them solve problems, develop leadership, and manage resources wisely. To carry out this role with coastal and marine clientele, the Extension Sea Grant program has a team of marine agents and specialists affiliated with the OSU Extension Service

and located in coastal communities, at the Hatfield Marine Science Center and on campus, whose goals are to:

- Identify and prioritize emerging community education issues and information needs of the industry
- Transfer knowledge to individuals and groups who can use it to solve problems or capitalize on opportunities
- Teach and encourage people to apply this knowledge to their situation
- Develop working relationships with other organizations so that the educational program impact is maximized
- Increase the proficiency of Extension faculty to develop and deliver relevant issue-based education
- Encourage the adoption and implementation of coastal education programs by other Extension

professionals throughout the state and nation

- Stimulate researchers to generate knowledge needed to resolve coastal and marine challenges
- Gather relevant research-based information about coastal and marine resources and issues

Some of the areas of focus include commercial fisheries, seafood technology, sustainable aquaculture, business and community development, coastal ecosystems and habitats, coastal natural hazards, fishing vessel safety, and marine and cultural education. Many agents and specialists conduct their own research projects and collaborate with Sea Grant researchers, the Coastal Oregon Marine Experiment Station, and the Extension Service.

Each year Extension Sea Grant effectively reaches thousands of people—from fishing industry leaders to school children—through workshops, classes, conferences and other educational delivery mechanisms.

Ken Hilderbrand, Seafood Processing Specialist

Ken Hilderbrand has refocused his educational programs from Hazard Analysis Critical Control Point (HACCP) to Sanitation Standard Operating Procedure (SSOP) in 98/99. Both acronyms represent parts of the Food and Drug Administration's (FDA) new December 1997 seafood safety and sanitation regulations titled "Procedures for the Safe and Sanitary Processing and Importing of Fish and Fishery Products."

The HACCP part of the regulation required training in HACCP concepts and conducting a food safety hazard analysis and implementing a HACCP "plan" whenever one or more food safety hazards were identified. By working with the Seafood HACCP Alliance (industry, government, and academia) in 1997/1998, Hilderbrand helped develop training manuals and deliver training programs so that virtually all US processors have met FDA's requirements.

With the initial HACCP training and planning job almost complete, Hilderbrand has shifted his attention to the second part of the FDA regulations. This part of the regulation requires that all seafood processors monitor and keep records on sanitation procedures and encourages industry to write an SSOP. In the latter part of 1998 it became apparent to the FDA from their routine inspections, that industry performance on sanitation requirements was inadequate. With that in mind, Hilderbrand

developed a series of five SSOP training classes, got FDA and ODA (Oregon Department of Agriculture Food Safety Division) to cosponsor them, and with some help from his colleague at the University of California at Davis, trained almost 100 processing firm employees in the principles and practice of SSOPs. The classes drew students from Eureka California to Olympia Washington.

Hilderbrand has developed some model SSOP plans and record keeping systems and will continue to work with the Seafood HACCP Alliance to formalize SSOP training materials.

Vicki Osis, Marine Education Specialist

The Marine Education program delivers marine science programs to teachers and youth. The programs are based at the Hatfield Marine Science Center and offer teachers workshop and graduate level courses that may be applied to an M.S. in Science Education. Youth Programs include day camps, field trip programs, and special events, such as career exploration programs. This past year the following programs were delivered to these audiences:

Four day camps served 80 youngsters. During these four-day programs the campers investigated estuaries, rocky tidepools, sandy beaches and coastal forests. Marine biology, coastal processes and terrestrial ecology are taught through hands-on investigations. During the week the campers built their own tidepools in the seawater tanks and stocked them with beach creatures. They cared for their animals throughout the week and shared their mini-ecosystems with their parents on the last day of camp.

School field trip programs served 6,000 students. These programs offer estuary investigations, marine biology labs that introduce students to various groups of animals including arthropods, intertidal creatures, anatomy (squid dissections) and a variety of outdoor habitat investigations.

Teacher training programs included four graduate courses that apply to the Master's in Science Education.

The Global Learning and Observations to Benefit the Environment (GLOBE) Program is an international program that trains teachers to monitor the environment and post their data on the Web. The Oregon Teachers Workshop was held here and teachers were linked with international partner

schools to share their GLOBE project. Along this same line, leadership was provided for the CoastNet estuary water quality monitoring program. The coast-wide network of teachers monitors estuary water quality and at the annual student symposium, students give presentations on their monitoring work. They also developed a poster for the symposium, which was placed on display in the Center's Visitor Center.

The Rocky Intertidal Tidepool Volunteer Program was continued this past year to encourage the conservation of intertidal resources. A network of volunteer organizations has been developed and

funded through a collaborative effort with the Department of Land Conservation and Development Commission. The volunteers work the busy summer low tides at popular beaches to help visitors enjoy this unique habitat while preserving the resource that draws them to the beach.

Through collaborative efforts with the Sea Grant Marine Education program at the Virginia Institute of Marine Science, a web site was established to serve as a clearinghouse of marine web sites suitable for teachers.

Oregon Pacific Area Health Education Center

Steven Carr, Director

With cutting-edge programs and community collaborations, the Oregon Pacific Area Health Education Center (AHEC) is addressing the current gaps in availability and access to health care for rural and underserved populations. Since 1973, the Oregon Pacific AHEC has focused on the training and distribution of health professionals in an eight-county region (Lincoln, Linn, Benton, Tillamook, Polk, Yamhill, Clatsop and Columbia) as the chief means of making primary care more accessible to Oregonians in the Oregon Pacific AHEC region. Now, a much broader approach to addressing gaps in available or accessible health care includes looking at how entire communities work as a system to provide health and social services, and providing workable solutions.

They have held Community Health Development Initiatives in all of their counties which brought together providers and consumers to talk about health and social service needs. These initiatives included doing both regional and local "systems" analysis of the potential impact of the Y2K bug on health care providers in rural areas; and looking at patient out-migration as part of the relationship of community economic development and health care access or availability. Oregon Pacific AHEC has begun working to build regional approaches to addressing HIV/AIDS by working with

the Oregon Health Division, the Multicultural HIV/AIDS Alliance of Oregon, Health Departments and Community-Based Organizations (CBOs) to unite efforts to develop sustainable funding streams for HIV/AIDS services. Their work with the Hispanic populations has included being actively involved with the training of non-Hispanic providers to reduce cultural competency and language barriers, and work with Hispanic groups to improve health care access. Oregon Pacific AHEC is currently conducting a regional need assessment to identify health issues and provider needs that will require AHEC's involvement over the next few years.

From their central location at the Hatfield Marine Science Center, they also conduct region-wide programs for exposing young people to health careers; coordinate rural rotations for medical, nursing, physician assistant, and dental students; and offer continuing education courses over Oregon ED-NET to physicians, nurses, emergency medical technicians and other allied health professionals.

The Oregon Pacific AHEC Board of Directors will be holding a strategic planning meeting that will invite providers from every county to be part of the planning process. As they move toward helping health care organizations and providers improve their capacity to provide services for the uninsured, underserved and rural residents, they are developing innovative ways to bring stakeholders to the planning tables.

College of Oceanic and Atmospheric Sciences - Ship Operations

Frederick J. Jones, Marine Superintendent

The College of Oceanic and Atmospheric Sciences (COAS) operates the 185-foot Research Vessel (R/V) *Wecoma* and the 36-foot R/V *Sacajawea*. Oregon State University is one of 20 vessel-operating institutions in the University-National Oceanographic Laboratory System. The Ship Operations office and pier facility is located at the Hatfield Marine Science Center and both vessels' haling port is Newport, Oregon.

The R/V *Wecoma* is owned by the National Science Foundation (NSF) and operated by OSU under a cooperative agreement. The ship carries a crew of 12 and a science complement of up to 18.

In 1999 *Wecoma's* 177 days of scheduled operations are funded by the National Science Foundation (41 days), National Oceanic & Atmospheric Administration (72 days) and Office of Naval Research (64 days). Operations include work by researchers from the University of Washington, Lamont-Doherty Earth Observatory, the Naval Air Warfare Center, the Pacific Marine Environmental Laboratory (NOAA), the Alaska Fisheries Science Center (NOAA) and Oregon State University. In addition

to Newport, port calls will include Seattle, WA, and both Kodiak and Dutch Harbor, Alaska.

The R/V *Sacajawea* is owned by OSU and funded by a combination of University funding for the fixed costs of the vessel and user charges for the variable costs. The vessel is designated by the U.S. Coast Guard as an Oceanographic Research Vessel and is capable of supporting education and research in bays and estuaries as well as near coastal waters. Use of the R/V *Sacajawea* continues at a reasonably high level with the primary users being researchers for COAS, Zoology and NOAA's Northwest Fisheries Science Center at the HMSC. The vessel continues to support the HMSC Marine Education program and a variety of research activities at the Center.

A Packard Foundation grant to researchers in OSU's Zoology Department includes funding for a new, more capable vessel to replace the *Sacajawea* and a request for proposal has been issued. Delivery of the new vessel is anticipated in early 2000.

Visiting vessels scheduled to tie up at the COAS Ship Operations Pier during 1999 include the R/V *New Horizon* from Scripps Institution of Oceanography, Lamont-Doherty Earth Observatory's R/V *Ewing*, University of Washington's R/V *Thompson*, U.S. Coast Guard Cutters *Alert* and *Steadfast* and the U.S. Army Corps of Engineers Dredge *Yaquina*.

Independent Researchers

John Chapman: Global Climate Change

The July 1998-1999 was another busy year for John. He is organizing surveys of nonindigenous estuarine species in southern Alaska and Puget Sound to be conducted again this summer and has submitted proposals to conduct similar surveys in the Columbia River Estuary, Coos Bay, Humboldt Bay, and San Diego Bay. The objectives of this research are to identify the source latitudes, and introduction mechanisms of greatest risk, and the estuaries most vulnerable to initial invasion. He is analyzing their past and present distributions in northeast Pacific estuaries for this research project.

John will be working with Billie-Jo Smith of Toledo High School again this summer on an introduced species problem funded by the Partners in Science Program. The project titled "What Did Columbus See?" will involve experiments to test whether species populations on opposite sites of the Atlantic are indeed reproductively viable as would be predicted if they have been introduced. He is

also writing the chapter on gammaridean amphipod taxonomy for the upcoming 4th edition of "Light and Smith's Manual: Intertidal Invertebrates of Central California and Oregon"

Presentations/Abstracts/Posters since 1997:

1998, Invited Paper [Carlton, J. T. and J. W. Chapman] (Global Climate Change and Introduced Marine Species) Global Climate Change/Biological Invasions Workshop (Hal Mooney organizer) Stanford University, San Francisco, California, 4-5 April, 1998.

1999, Invited Paper. (Climate and nonindigenous peracaridan crustaceans in northern hemisphere estuaries), National Conference on Marine Bioinvasions, Massachusetts Institute of Technology, Cambridge MA, 24-27 January, 1999.

1999, (Climate and global patterns of peracaridan crustacean introductions) Pacific Estuary Society, Hatfield Marine Science Center, Newport, OR April 1999, [Boese, B. L., H. Lee II, J. Chapman and J. Jones] (Effects of flood conditions on intertidal populations of native and introduced amphipods of Yaquina Bay)

Jill Grover: Feeding Ecology

In 1998-99, research focused on identifying the effect of the anomalous El Niño ocean conditions of 1997 on early-juvenile Pacific hake, *Merluccius productus*. This was done by examining the diet of age-0 hake that were collected off California in spring 1997 and specimens from comparable collections in spring 1995 (a non-anomalous year). Additionally, the diets of age-0 and age-1 hake that were collected together in the same hauls, during El Niño conditions in the fall of 1997, were examined. While the distributions of age-0 and age-1 hake do not usually overlap, these collections afforded an opportunity to look for evidence of trophic neutrality, competition, and/or cannibalism.

During the El Niño year, diet differed from that seen during a non-anomalous year. Differences were seen in the number and size of prey, and taxa that were ingested. Considering the co-occurring year classes during fall of the El Niño year, diet overlap and cannibalism were both observed. A portion of the El Niño research was supported by Oregon Sea Grant funding.

Gayle Hansen: Marine Algal Taxonomy

For the 1998-99 academic year, Gayle Hansen, marine botanist, has been working on three projects that concern marine plant biodiversity. The first two of these are inventories of the benthic marine algae or seaweeds of Oregon and of Alaska. For each of these studies, only pre-existing collections of marine algae held by the herbaria around the world are inventoried. The advantage of working on historical collections is that data is then available on the occurrence of species both geographically and temporally. In both areas, specimens are available from the mid 1800s to recent collections in 1999. The major goal of the Oregon project is to provide a listing of seaweed occurrences over time so that areas with diminishing biodiversity can be investigated and conserved. The Alaskan project, on the other hand, will provide the groundwork, not only for conservation projects, but also for a future illustrated Marine Flora of Alaska. The Oregon project is funded through the OSU Research Council and the Oregon Sea Urchin Commission, while the Alaskan

database has been supported by the US National Science Foundation.

In addition to these studies, Gayle has also taken part in a third project that involved surveying introduced species in Alaska. Funded by Sea Grant and Alaska's RCAC, the purpose of this survey was to determine if non-indigenous species have been brought into the Port Valdez/Prince William Sound area by shipping (oil tankers) and/or by aquaculture. With zoologists from the Smithsonian Environmental Research Center, the University of Alaska, and HMSC handling the animals, Gayle sampled the seaweeds, seagrasses, and marine lichens in Prince William Sound last summer and analyzed them for possible introductions. The results from her survey showed that two major trends occurred. Recognizable non-indigenous species (with spotty distributions worldwide) were only found near aquaculture facilities. These introductions appeared to have been co-transported into the area with imported aquaculture species.

On the other hand, recognizable introductions were not common in harbors and ports. Instead, these areas contained predominantly widespread cosmopolitan species. This situation appeared to be related to shipping. Since most widespread species are also common in fouling communities such as on the hulls of ships, it seemed likely that these species had been transported around the world via boat for years, possibly since shipping first began. These multiply-introduced species are now widespread and appear "naturalized" in the Prince William Sound harbors. Most often, they cannot be distinguished in terms of population structure from native species. Hence, both shipping and aquaculture have caused the importation of alien marine plant species into Prince William Sound. The impact of these species on the native vegetation will be investigated in future studies.

As a final part of this year's projects, Gayle (along with Martha Apple from Corvallis) hosted the 13th Northwest Algal Symposium on May 14-16 in Yachats, Oregon. About 90 scientists attended the three days of excellent talks, posters, field trips, and glorious gourmet food.

Marine Ecology: Cynthia Trowbridge

Cynthia Trowbridge was appointed a Research Assistant Professor in the Zoology Department in 1996. She spent the last two years at the Gatty Marine Laboratory, University of St Andrews, Scotland, investigating the changes in host-plant use by herbivorous sea slugs that feed on the introduced green algal pest *Codium fragile* ssp. *tomentosoides* (common name "oyster thief" or "dead man's fingers"). She documented the invasion patterns of ssp. *tomentosoides* and ssp. *atlanticum* on Scottish shores, reviewing historical land-use and shore-use practices that predisposed the region to being

invaded by exotic seaweeds. Cynthia also cultured the sea slugs through their long-lived planktotrophic larval phase and investigated the cues that induce larval settlement and metamorphosis; her work represents the third time a species in the order has been cultured successfully through its planktotrophic larval phase and through metamorphosis. This is also the first time in which chloroplast acquisition by ascoglossan sea slugs has been demonstrated. In January 1999, Cynthia had a short-term contract with CSIRO/CRIMP (Centre for Research on Introduced Marine Pests) to investigate the recent incursion of *C. fragile* ssp. *tomentosoides* on Australian shores and to advise the government of their management options.

Neuroscience Group

George Mpitsos and John Edstrom

George Mpitsos and John Edstrom are conducting a number of modeling studies aimed at understanding the information neurons use to communicate with one another. Some of this work is being extended using linear process theory in collaboration with Prof. Ron Mohler in the Department of Electrical and Computer Engineering at the main OSU campus in Corvallis.

Mpitsos and Edstrom are developing a new project, MatheMatrix, to provide a free, internet-based resource for teaching and learning mathematics in elementary schools. The aims of MatheMatrix are to improve the ability of teachers to work with each student, to diagnose student progress in learning standards-based math, to allow students to progress across grade-levels and benchmarks as best fits their particular needs and abilities, and to foster a closer working partnership between work at school and at home.

Coastal Oregon Marine Experiment Station

Gilbert Sylvia, Superintendent

The Coastal Oregon Marine Experiment Station (COMES) encompasses faculty, students, and facilities at the Hatfield Marine Science Center and the Astoria Seafood Laboratory. The year 1998-1999 was highly successful and marked continued growth of the Station. COMES began in 1988 as a counterpart to the inland agricultural experiment stations — its mission was to conduct applied research on coastal and marine issues beneficial to the citizens of Oregon and the Nation. Under the leadership of Lavern Weber and an advisory board chaired by Captain Barry Fisher, the Station began with three faculty and a handful of graduate students. Nine years later the Marine Experiment Station has grown to include 12 faculty, 55 graduate students, and approximately \$2 million annually in external grants and funds.

The research programs of COMES encompass six primary areas: Aquaculture (Chris Langdon and Anja Robinson), Fish Disease (Robert Olson and Paul Reno), Fisheries Science (David Sampson and Steve Berkeley), Marine Mammals (Bruce Mate), Marine Economics and Marketing (Gilbert Sylvia), and Seafood Science and Engineering (Ed Kolbe, Michael Morrissey, Jae Park, Haejung An). While each of these programs includes many individual research projects, each program has a unique focus. Many of these are collaborative projects including researchers from different disciplines and departments, and partnerships with industry and state and federal government including National Marine Fisheries Service and Oregon Department of Fish and Wildlife. COMES also helps sponsor workshops and conferences which further the mission of the Station in supporting wise use of marine resources.

Aquaculture - Chris Langdon and Anja Robinson

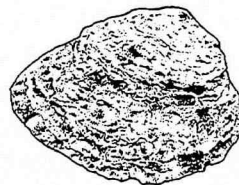
In 1998, the main focus of the COMES Aquaculture Program at the Hatfield Marine Science Center was the USDA-funded Molluscan Broodstock Program (MBP). About 300 families of Pacific oysters were produced. Research assistant Dave Jacobson and crew planted these families at commercial test sites along the West Coast, from Prince William Sound, Alaska, to Tomales Bay, California. The top performing families from the test site in Tomales Bay were used as broodstock in spring 1998 to produce a second generation of MBP families that were planted in Washington and Oregon. The performance of this generation, compared to that of offspring from non-selected oysters, will allow them to evaluate the impact of the genetic selection program.

Graduate student Chris Brooks hopes to be able to predict the performance of planted MBP families based on their performance as juveniles in the nursery. Graduate student Ebru Onal found that spray-dried, heterotrophically-cultured algae could be used as a complete replacement for living algae in diets for marine mussels. In future research, she will determine whether juvenile oysters can be successfully cultured on spray-dried algae to reduce labor costs and improve the reliability of MBP seed production.

National Coastal Research Institute-supported research on the co-culture of the Red abalone and dulse (*Palmaria mollis*) focused on optimizing growth of juvenile abalone in the co-culture system. Research assistant Ford Evans and graduate student Carl Demetropoulos worked with a commercial abalone farm in Hawaii to ensure successful technology transfer. An economic model was developed by Ford Evans to help industry evaluate the commercial value of the co-culture approach.

With support from the international Organization for Economic Cooperation and Development, Chris Langdon was able to spend about a month at the IFREMER laboratories in Brest, France, to work on microencapsulated diets for oysters. Funds from the Marine Research Institute, Norway, and a Mamie Markham award to graduate student Umur Onal

supported his research on microparticulate feeds for marine fish larvae. Umur Onal uses zebra fish as a model species in these studies and the Norwegians are hopeful that some of his results will be applicable to the culture of cod larvae.



Fish Disease: Paul Reno and Robert Olson

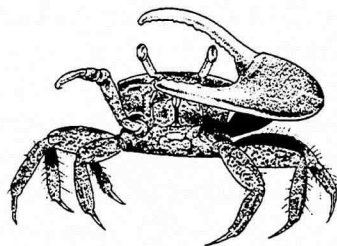
Virulence Studies of Viruses: Kyoung Chul Park has continued his studies on what factors are involved in causing certain strains of viruses to kill fish while other similar strains don't (National Sea Grant Technology Grant). The current focus is on two factors. The first is a factor in serum of apparently healthy trout which inhibits the ability of the virus to replicate. Further characterization of this substance indicates that it requires the divalent cation magnesium to be effective, and that the ability to inhibit virus growth in cell culture is limited to some trout and Pacific salmon cell lines, but that inhibition does not occur in the most commonly used cell line from chinook salmon. He also found that if some strains of virus were grown in cell culture for longer periods, they lost their capacity to resist the serum inhibitor. This may explain while virus grown for long periods in cell culture become avirulent in fish.

A second factor in virulence, related to the above experiments, is the number of times the virus has been grown in cell culture. Preliminary evidence by others had indicated that if the virus was grown several times in cells first, it would lose virulence. In an extensive experiment, Kyoung determined that the virulence of the virus for brook trout was undiminished even after several cycles of replication in cells. Kyoung is currently evaluating what changes, if any, have occurred in the genome of the viruses treated by growing in cells, whole fish, or in the presence of trout serum. We anticipate that changes at the level of the genome may explain some of the unusual results found in these experiments.

Hamdi Ogut has finished the laboratory portion of his experiments designed to determine how fish diseases are transmitted. He is currently analyzing the extensive data generated in these experiments and is writing a computer program to allow him to construct mathematical models of the disease process in populations of fish.

Tim Miller-Morgan has changed course and has begun on another epidemiologic research effort in the lab. He is working on a project funded by the Western Regional Aquaculture Committee (USDA) to determine the pattern of pathogen distribution in wild and cultured salmonids in the Western U.S. Data on fish diseases in feral and hatchery-reared fish are currently being gathered from state and federal agencies throughout the West. The data will be analyzed to determine whether the presence of pathogens in hatchery fish is correlated with the development of disease in wild fish in the areas where cultured and wild fish coexist and where infected stocks may have been planted into waters where pathogens were not present.

The resurrection of studies on the microsporidian parasite of Dungeness crabs has occurred by dint of the interest of Hal Amogan, a graduate student in the Department of Microbiology. Hal has started a project to determine the taxonomic status of the pathogen by studying the sequence of the small subunit RNA of the ribosome and will be trying to work out the components of the genome of the organism and its structure.



A flurry of activity was generated last summer by the detection of the virus responsible for hemorrhagic septicemia of trout (VHS) in populations of gadids collected in Washington and imported to Oregon. The virus was shown to be the North American strain of the virus which can cause extensive mortalities in a variety of marine species. Preliminary experiments showed that the virus could cause high mortality in chinook salmon as well as gadids. Follow-up work was curtailed due to lack of funding.

Marine Fisheries: Steven Berkeley

During 1998-99, Steve Berkeley continued his Sea Grant-funded research on the effects of fishing-induced age truncation on reproductive potential and recruitment in black rockfish. Results to date indicate that young fish spawn later in the year than older fish and these young fish produced very few surviving juveniles. This is of particular concern because fishing has resulted in a significant reduction in the proportion of older fish in the population. Laboratory rearing experiments were continued this year with assistance from a new graduate student, Colin Chapman. Results of the 1998-99 rearing experiments confirmed that larvae of older females have a significantly higher proportion of lipid, which suggests that these larvae are more fit than those of younger fish. Steve's previous graduate research assistant, Stephen Bobko, accepted a position at Old Dominion University as head of their fish aging laboratory. Results of this research were presented at the American Fisheries Society Larval Fish Conference.

Steve and his new research assistant, Gonzalo Castillo, began a pilot study to determine the feasibility of using a survey of pelagic juvenile sablefish to index year class strength. This project involves sampling offshore along three transect lines from Eureka, CA to Westport, WA between April and June. Investigation of the temporal variation in time of spawning by different age classes was continued. Otoliths from young-of-the-year juveniles are being examined to determine the time of year during which successful spawning took place. Results of this research should help improve the accuracy of stock assessments for this important commercial species.

Steve also continued his research on pelagic longline fisheries in the Atlantic and Gulf of Mexico. The objective of this research is to determine differences in feeding behavior between target species (yellowfin tuna and swordfish) and incidental species (marlins, sailfish, bluefin tuna and juvenile swordfish), that will allow fishermen to modify their gear or fishing methods to reduce bycatch. Results of this research were presented to the NMFS, Highly Migratory Species Advisory Committee.

Steve and graduate student, Bill Pinnix, continued their research on the impact of environmental variability and climate change on growth and re-

cruitment in sablefish. This research, part of a larger National Science Foundation/NOAA research program called Global Ocean Ecosystems Dynamics (GLOBEC) hopes to determine how global climate change will affect the ecosystem and fishery resources of the northeast Pacific. Significant inter-annual differences in early growth rate of sablefish have been documented from archived otolith collections, and the link with environmental conditions is being explored. Preliminary results of this research were presented at the Eastern Pacific Ocean Conference.

Steve continued to serve as technical advisor for the U.S. Commissioners to the International Commission for the Conservation of Atlantic Tunas. He also continued to work with the American Fisheries Society (AFS) spearheading the society's efforts to encourage action to rebuild the severely overfished populations of Atlantic bluefin tuna and Atlantic swordfish. Steve took over as president of the Marine Fisheries Section of AFS in 1998.

Bruce Mate: Marine Mammals

Dr. Mate continued his studies of whale behavior and migration using satellite-monitored radio tags. Nine blue whales were tagged off the coast of California in the fall of 1998. Tracking periods ranged from 1-167 days and covered distances ranging from 63-12,075 km. These tagging efforts provided detailed information regarding movements of blue whales during their summer/fall feeding cycle off the California coast, as well as migratory timing and route information as they traveled south along the coast of Baja California and further to a possible reproductive area 230 miles west of Costa Rica.

Eleven humpback whales were tagged off Maui, Hawaii, during the winter of 1999. Tracking periods ranged from 16-60 days (so far) and covered distances ranging from 1179-9750 km. Humpback whales were tracked earlier in their breeding season than in previous years (February vs. April) to further our understanding of inter-island movements in Hawaii. A lot of individual variation was apparent in whale movements, with some animals ranging widely around all islands and others staying in fairly localized areas. At the time of report preparation, two whales were migrating north of the islands en

route to their summer feeding grounds. Trajectories show both whales heading toward British Columbia.

Shore-based counts of gray whales passing Yaquina Head, Oregon, were conducted between December 1998 and mid-June 1999 to document both the south and north-bound migration. Observers reported information concerning group size, numbers passing per hour, and distance from shore to compare with a similar study conducted from 1978-1981.

Dr. Mate, research assistants Barbara Lagerquist and Sharon Nieukirk, and marine mammal artist Pieter Folkens designed and published a waterproof marine mammal stranding guide for enforcement agencies and the general public.

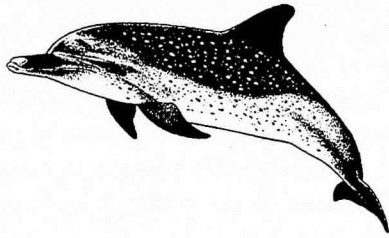
In July-August 1999, Dr. Mate will tag blue whales off southern California and track them to fall feeding areas off the southwest Baja Mexico coast.

In December 1999, Dr. Mate anticipates tagging humpback whales in Hawaii to compare movements of whales arriving on the breeding ground early in the winter with those arriving late (data obtained from previous years). He hopes to determine the residency time for whales in Hawaii, and whether animals arriving at different times of the year are from different feeding stocks.

In January 2000, Dr. Mate anticipates further humpback tagging along the Antarctic Peninsula in cooperation with scientists of the Chilean Antarctic Institute. He hopes to track whale movements within their feeding habitat during the austral summer, and examine the relationship between these movements and available prey distribution information as well as physical and biological oceanographic conditions. Dr. Mate also hopes to identify migration routes from the summer feeding grounds in the Antarctic to the winter breeding and calving areas.

Three of Dr. Mate's graduate students are continuing their oceanography doctoral programs. Kate Stafford is continuing to document the seasonal occurrence of blue whales throughout the Pacific Basin using acoustic information. Mark Baumgartner is currently developing a proposal to characterize right whale habitat in the North Atlantic. Daniel Palacios conducted his first season of research during the late summer and fall of 1998,

examining the distribution and abundance of coastal spotted dolphins in the Eastern Tropical Pacific. His next field season will concentrate on cetaceans around the Galapagos Islands.



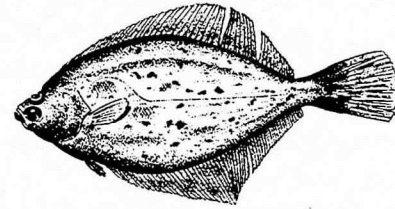
Three new staff joined the marine mammal program: Lori Cloniger Sweeney is the new development director, Deborah Goldstein is a research assistant helping with program administration, and Ladd Irvine is providing general assistance to the entire marine mammal staff.

Marine Fisheries: David Sampson

Dr. Sampson continued his research on Oregon's marine fisheries for groundfish. During the year he served on the Scientific and Statistical Committee of the Pacific Fishery Management Council and on the National Research Council's Committee to Review Individual Fishing Quotas, which submitted its report to Congress in December. For the summer months Dr. Sampson moved to England with his family and he telecommuted from an office at Portsmouth University's Centre for the Economics and Management of Aquatic Resources, where he worked previously as a Research Associate. While in England he participated in a stock assessment workshop, organized by the International Council for the Exploration of the Seas and held in Aberdeen, Scotland. During the autumn he taught the upper division course "Dynamics of Marine Biological Resources." During the autumn and winter Dr. Sampson began working on an assessment for the Pacific Fishery Management Council of the stock of petrale sole off the US west coast.

During the year one of Dr. Sampson's students successfully defended his PhD thesis on spawning site selection by Columbia River chinook salmon. Dr. Sampson's current graduate students are conducting research on the following topics: the influence of data uncertainty on groundfish stock assessments; the suitability of cooperative fishery management in Thailand; oceanographic influences on the

survival of Columbia River salmon; factors to consider for pelagic fisheries management; rockfish food habits and feeding ecology; age validation for west coast sablefish; and using fish plant workers to collect stock assessment data.



Resource Economics: Gil Sylvia

Research during the past year has concentrated on seafood marketing, fisheries management and policy, and aquacultural development. Outreach and public service has been directed at improving fisheries management (member of the Science and Statistical Committee of the Pacific Fisheries Management Council), publishing and presenting marketing and management research for industry, and assisting west coast industry and agencies in developing cooperative and cost-effective fisheries research. Many of these interdisciplinary projects include close cooperation with the Astoria Seafood Laboratory, the OSU Department of Bioresource Engineering, Oregon Department of Fish and Wildlife, and economists and biologists of the National Marine Fisheries Service.

Research projects include: 1) bioeconomic modeling of the Pacific pink shrimp fishery; 2) evaluating the role of intrinsic seafood quality for improving fishery management; 3) determining incentives for successful scientists/fishermen research cooperation; 4) diversifying aquaculture to include tourism and recreation; 5) determining optimal donation strategies to support marine outreach education; and 6) developing product quality and marketing strategies for the albacore tuna industry.

He is in his second year of conducting two Sea Grant-sponsored projects. The first study is a cooperative project with the Oregon Department of Fish and Wildlife and the Astoria Seafood Laboratory, focusing on the economics of the Pacific pink shrimp industry. This research includes an evaluation of the costs and benefits of finfish excluder devices, the relationship of shrimp quality, fishing, and processing strategies, and development of a bioeconomic

model of the fishery. The second project is being conducted in cooperation with the Astoria Seafood Laboratory and evaluates the economic and marketing potentials for using 1) HACCP-based quality systems, 2) super-chilling storage and transportation systems, and 3) time-temperature monitoring devices for value-added harvesting and processing of Pacific whiting and albacore tuna.

These research projects have generated over \$500,000 in extramural funding and are supporting nine graduate students (2 Ph.D. and 5 Masters' candidates) from the Departments of Agricultural and Resource Economics, Marine Resource Management, and Fisheries and Wildlife.



Astoria Seafood Laboratory
Michael Morrissey, Director

The OSU Seafood Laboratory (SFL) is part of the Coastal Oregon Marine Experiment Station and is located in Astoria. The mission of the laboratory is seafood research, graduate training, and transfer of information to the seafood industry.

Research activities over the past year have included:

Value-added products. Research continues in the area of fish sauce from Pacific whiting by-products and the use of high hydrostatic pressure in oyster products. Radio frequency heating is also being investigated as a seafood processing tool.

Outreach involved hosting the Pacific Albacore Tuna Marketing Conference in early March and the Seventh Annual OSU Surimi School in April. A visiting professor at the Seafood Laboratory is Dr. Yeung Choi from Gyeong Sang University (Korea) who will be working at the Laboratory until September. Graduate students who completed their degrees in Food Science & technology were Jin Shan Shie and Ozlem Akpinar.

The OSU-SFL has continued its expansion over the past decade and currently has three faculty, two technicians and fifteen researchers including graduate students, post-docs and visiting professors working on various research projects. Federal funds were received through the U.S. Dept. of Agriculture (USDA) with matching funds from the State of Oregon to construct the new facility in Astoria. This new \$3.2 million facility was completed in the Fall of 1997 and OSU faculty and graduate students moved into the facility in October. The building is 21,000 sq. ft. and has OSU County Extension, Oregon Department of Fisheries & Wildlife and the Oregon Trawl Commission as tenants. The new seafood laboratory component is approximately 15,000 sq. ft. including a biochemistry, microbiology and seafood engineering laboratory. A product development lab will complement a state-of-the-art pilot plant and processing equipment.

The new \$1.4 million Duncan Law Seafood Consumer Education Center (SCC) was completed in the summer of 1998. Funds were received from the Federal Economic Development Agency and Oregon Economic Development Commission. The mission of the SCC is to address issues in consumer education, training, research and information and will be run as a private venture with oversight of the SCC Board. The facility is a 9,500 sq. ft. building located beside the OSU-SFL and contains a fully-equipped demonstration kitchen, meeting room, and retail center. The mainstay of the SCC will be The Seafood School which will provide professional and non-professional culinarians a center for hands-on education and training. The SCC will work closely with the OSU-SFL in several areas including product development. The new OSU-SFL and SCC will allow them to expand their capabilities in seafood research and help industry meet the changing needs of the consumer in both domestic and foreign markets.

Cooperative Institute for Marine Resources Studies

Lavern Weber, Director

The Cooperative Institute for Marine Resources Studies of Oregon State University is currently involved with the NOAA/PMEL Vents Program, the National Marine Fisheries Service Northwest Fisheries Science Center, and the NOAA/NOS GLOBEC Program.

VENTS Program

Acoustic Monitoring

On January 25, 1998 CIMRS staff detected intense seismicity in the northeast Pacific Ocean using NOAA's T-phase Monitoring System that accesses the U.S. Navy's Sound Surveillance System (SOSUS). The initial activity was located on the summit and southern flank of Axial Volcano on the central Juan de Fuca Ridge, approximately 300 miles west of Cannon Beach, Oregon. The seismic activity lasted twelve days and included over 8,000 detected earthquakes.

Geophysical Monitoring

In response to the detected seismic activity, the NSF/RIDGE and NOAA/Vents Program organized a short, seven-day expedition to Axial Volcano using the OSU Ship R/V *Wecoma* in February 1998 in the worst possible sea conditions. Data from this cruise gave researchers an idea of the magnitude of the

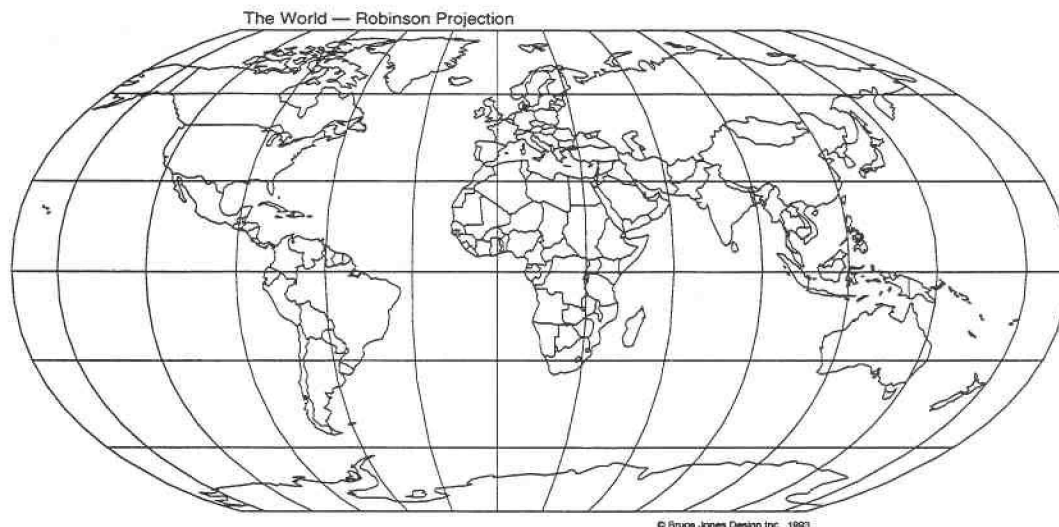
event on the seafloor. Then in the summer seafloor observations from two cruises, one with the submersible *Alvin* and one using the ROPOS remotely operated vehicle, confirmed a dike eruption of more than 50 km.

In a timely initiation, NeMO (New Millennium Observatory), a new multi-disciplinary project centered at Axial Volcano began its first year with the placement of several arrays of seafloor and water-column instruments, time-lapse cameras, and sampling collection systems for seafloor microbes. This multi-year project will perform chemical, hydrographic, biologic, and geologic time-series studies of Axial.

With the enhanced ability to transmit data and images from ships at sea, an interactive web link will continue to be featured at the Hatfield Marine Science Center during the return to Axial this summer as part of the project in cooperation with Sea Grant. This web link provided close to real-time information to educators, students, and researchers on the results of each day's activities during the cruise, and also provided answers to specific questions from a land-based audience.

FY 98/99 Accomplishments:

- Confirmation of the eruption of Axial Volcano, Juan de Fuca Ridge and publication of collected papers on Axial in Deep-Sea Research II
- Initiation of multi-disciplinary, multi-year project, NeMO at Axial Volcano
- Development of six new portable hydrophones for year-long deployment in the Atlantic Ocean
- High-resolution sonar survey over the Heceta Bank off central Oregon



1998-1999 Provide Advice and Assistance to the NMFS to Improve Stewardship of West Coast Groundfish

Gil Sylvia and Robert W. Schoning

The overall purpose is to work closely with state, regional, and federal fisheries organizations, fishing industry, environmental entities, congressional members and staff, international fisheries interests, and other involved constituents to develop approaches to improve research, management, and abundance of West Coast groundfish.

Specific thrusts include: (1) developing and disseminating knowledge for improving the design and implementation of cooperative fisheries science, (2) determining how qualitative information from fishermen can be used in planning and conducting West Coast groundfish research and assessments, and (3) creating a workshop design for an international conference to explore methods and experience in other countries, with various industry/ government cooperative efforts and organizations in research, for possible application to the West Coast. In addition, various activities to improve communication, coordination, and cooperation among government scientists and constituents were to be conducted.

Activities have included holding informal weekly wide-ranging discussions with fishermen in a Newport waterfront coffee shop, and providing overall planning and supervision of a port interview project (PIP) with fishermen in several ports to collect information on occurrences and observations at sea for possible use in research and management.

Considerable time and effort were devoted to finalizing the written proceedings from the Groundfish Research for the Future Conference held in Portland July 16-17, 1998. The some 100 attendees with widely varying interests participated actively in productive discussions leading to pointed recommendations and calls for action for various groups. Positive results are anticipated. Publication is imminent.

There were many written exchanges and a number of conference calls regarding the potential international conference on industry/government cooperative and coordinated groundfish research

tentatively slated for Oregon early in 2000. Much discussion is still needed about purpose, scope, participants, funding, and post conference commitments.

Frequent contact has been maintained with several industry leaders to obtain and to provide advice and to exchange information of mutual interest for common benefit. Correspondence between government, industry, and others has been developed, commented on, and responded to. Requests have been made for suggestions on improving informal working relationships between scientists and industry members. There is still considerable room for productive improvement.

Several PFMC public meetings have been attended during which very useful discussions were held with attendees and plans for activities developed.

The limited federal funding and staffing for West Coast groundfish research continue to plague scientists, managers, and fishermen. Innovative approaches to using landing overages and special fishing activities to fund needed research while expanding fishermen involvement are being tried or are under consideration.

A senior/graduate level class entitled Science, Management, and the Real World of Marine Fisheries was taught Winter term at OSU in Corvallis.

Progress continues with the Electronic Fish Catch Logbook project by the NWFSC in cooperation with scientists, industry, and other interested parties. Comments have been offered regarding communication, coordination, and cooperation.

Participation as courtesy faculty in OSU Fisheries and Wildlife Department deliberations and as a board member of COMES in its meetings have continued. Appointment to the Department long-range planning committee was accepted.

There have been many discussions with the new program manager of the NWFSC FRAM Division on program direction, staffing, interfacing with and responding to continuing crises.

Environmental Protection Agency Office of Research and Development Pacific Coastal Ecology Branch

Walt Nelson, Branch Chief

The Newport EPA research laboratory is part of the Western Ecology Division located in Corvallis, Oregon. The research mission of the Coastal Ecology Branch is developing procedures to assess the cumulative and interactive effects of human activities on the ecological resources of coastal watersheds, particularly estuaries, of the Pacific Northwest.

The high rate of human population growth in the Pacific Northwest is subjecting estuaries and coastal watersheds to many anthropogenic stresses. The amount of this stress will continue to increase as population growth continues and the Northwest further develops economically. Stressors which jeopardize the ecological sustainability of estuarine and coastal watershed resources include watershed alterations (e.g., urbanization, land use alteration, road construction, agriculture and forestry practices) such as increased nutrient and sedimentation loads, habitat loss and alteration (e.g., landfill and dredging), planned and unplanned biotic introductions, pollution, anthropogenic-caused algal blooms, and extreme natural events such as floods, droughts, and disease and pest outbreaks. Determining the effect of stressors is complicated by the fact that they have different ecological effects and act at various, often overlapping, spatial and temporal scales.

The specific research area focus for the Coastal Ecology Branch is to define ecological processes and to develop and evaluate models to predict stress-response relationships for Pacific Northwest estuaries at a range of spatial and temporal scales. The research seeks to evaluate how specific estuarine habitats respond to a range of potential stressors which may lead to habitat alteration, seeks to under-

stand the influences of these stress factors at spatial scales from local to regional, and seeks to develop indicators of ecological condition which may be used to evaluate estuarine status across multiple spatial scales. Current projects include research on:

- Estuarine biota-habitat relationships
- Responses of estuarine keystone species to multiple abiotic stressors
- Factors controlling distribution of native and exotic seagrass species
- Coastal shoreline development impacts on estuarine landscape dynamics
- Effects of the nonindigenous seagrass *Zostera japonica* on inorganic nutrient flux in the Yaquina bay estuary
- Range expansion and reproductive ecology of *Zostera japonica*, a non-native eelgrass in Yaquina bay
- The impact of disturbance, suspended sediments, and changes in watershed uses on seagrass habitats
- Evaluation of watershed versus oceanic nutrient inputs to Pacific Northwest estuaries
- Development of estuarine condition indicators, including growth dynamics of English sole
- Spatially explicit population models to evaluate estuarine stress effects

Research activities include large-scale (within and among estuaries) field studies and laboratory investigations of relationships between stressors and effects. Research staff has increased to 16 federal employees, 3 postdoctoral fellows, and 16 technical and clerical contract support staff.

The Coastal Ecology Branch cohosted the Pacific Northwest Estuaries Conference which was held at HSMC April 15-18, 1999. The conference attracted papers from throughout the region and provided an assessment of the current status of research on outer coast estuaries of the Pacific Northwest.



Oregon Department of Fish and Wildlife

Marine Resources Program Neal Coenen, Program Director

Staff members of the Department of Fish and Wildlife's Marine Resources Program are located in the Newport headquarters and in Astoria and Charleston field offices with seasonal staff at all ports along the coast. Staff includes about 35 year-round coastal employees and up to 50 seasonal employees.

Downsizing and reorganization is presently underway within the Marine Resources Program. Beginning July 1, 1999, MRP will drop species-oriented programs and form into three major functional program sections: Resource Assessment and Analysis, Resource Monitoring and Sampling, and Data Services. The new organization will have a more flexible workforce and will focus on fewer, high priority, tasks. The MRP will continue to support a full commercial licensing and point of sale recreational services.

The fishing industry and the Department continued to grapple with a growing array of West Coast groundfish issues. The Pacific Fishery Management Council has recommended significant reductions in harvest of several important species of groundfish based on updated stock assessments. Emerging strategies include consideration of an industry sponsored buy-back program to remove excess effort, allocation between groups, and more conservative measures for protecting salmon and groundfish species and their habitats. Bycatch and discard of trip-limit managed species and essential fish habitat are major issues, given the requirements of the Sustainable Fisheries Act of 1996.

The Oregon Legislative Emergency Board added \$120,000 to MRP's budget to conduct cooperative studies with the fishing industry. Staff's response to the crisis has been to help improve information through new at-sea research projects and expanded dockside sampling. The staff has initiated at-sea studies to compare pot and longline gears with the objective of developing a new survey tool for sable-

fish and deepwater rockfish. The study is being conducted with the cooperation of the fishing industry using chartered fishing boats, and with assistance of National Marine Fisheries Service. Keith Matteson, ODFW project leader for the study, is responsible for organizing and carrying out the field work and analysis.

Staff also began a new cooperative Depth Specific Sampling project with National Marine Fisheries Service and select members of the fishing industry. The field phase of the Enhanced Data Collection Program was completed in December of 1998. Field observations of groundfish bycatch and discard were made between 1995-98 to evaluate impacts of different groundfish trip limits. The study was done in cooperation with the Oregon Trawl Commission and fishing industry. Preparation of the observer and enhanced logbook database will be completed in late summer of 1999.

Shore-based Pacific whiting fishery sampling continues. Hal Weeks left his job as Whiting Fishery Coordinator and Pelagic/Bycatch Project Leader to take a job as an Oregon Sea Grant extension agent specializing in groundfish. Steve Parker joined our staff in April 1999, filling Hal's vacant position. In addition to whiting fishery coordination, Steve will be working on selected projects to evaluate bycatch reduction devices and to conduct field studies to look at ways of improving groundfish assessments. Marion Mann was hired as project biologist in a limited duration appointment to assist Steve with at-sea research during the summer of 1999.

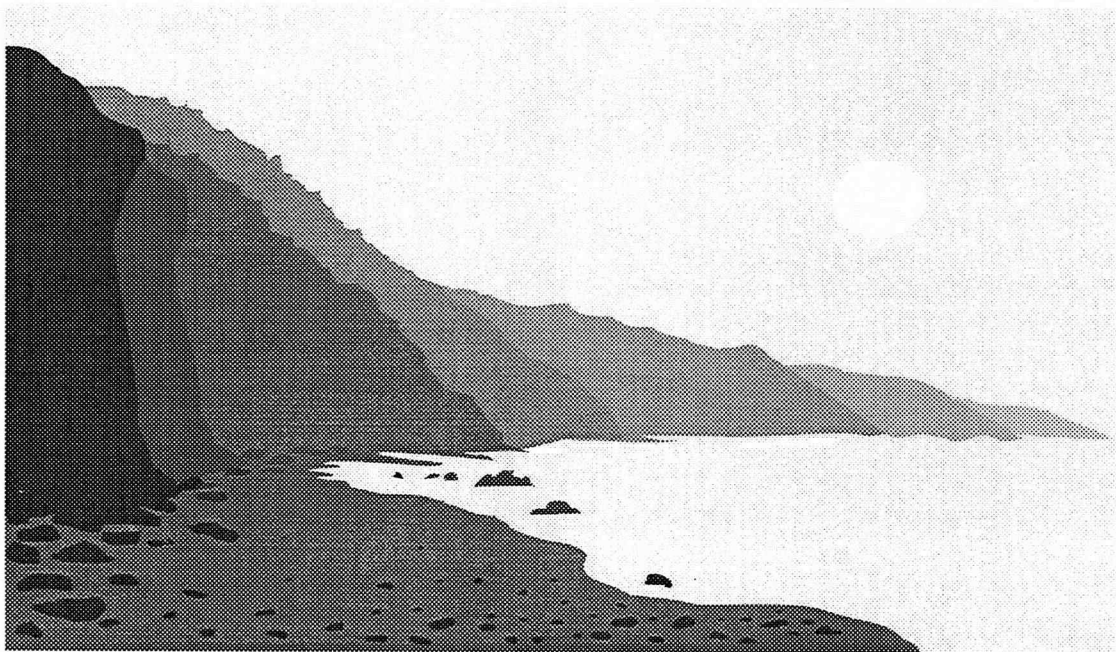
The rapid development of live fish and fresh fish markets has led to dramatically increased fishing effort under groundfish open access (non-limited entry hook and line) fishery. Concerns have been raised over the potential for local depletion of fish resources, size and maturity of fish caught in the nearshore. Staff continued mapping of Oregon's nearshore reef resources in 1998-99. Reefs off central Oregon were mapped and sampled in 1998. MRP's Marine Habitat Project will be mapping areas off of the southern Oregon coast using swath bathymetry techniques in 1999. The study is designed to compare three methods of sea-floor mapping, comparing swath bathymetry, side-scan sonar, and Roxann. One or two methods will be selected to continue mapping other areas along the Oregon Coast.

Biological surveys using chartered boats and volunteers are planned for reef areas from Depoe Bay to Cape Falcon in 1999. Bill Miller joined our staff as an assistant project biologist. Bill will be doing biological sampling on nearshore reef fishes and will also do age determination of black rockfish and other species.

The Ocean Salmon Program (OSM) continued to monitor ocean fisheries, primarily for chinook stocks, which provide the most opportunity for commercial and recreational harvesters. Staff has been preparing for selective coho recreational fisheries in 1999. They will monitor and evaluate this Oregon Plan mass marking initiative for hatchery coho. A small ocean test fishery for marked coho was approved for the 1999 season by the Pacific Fishery Management Council, National Marine Fisheries Service, and Oregon Fish and Wildlife Commission. Jody White joined the OSM staff and will assist on the Pacific Salmon Treaty Oregon coastal chinook field studies, sampling design and technical analysis. He will also work with staff to develop and at-sea ocean salmon research project under the Oregon Plan. OSM is also restructuring its port sampling program to add additional sampling objectives for recreational groundfish and more year-round sampling periods.

Cooperative work continued with Oregon State University and University of Oregon at Oregon Institute of Marine Biology graduate students and staff to assist in studies of ecology and population dynamics of finfish and invertebrates, and fisheries economics. Graduate students Vicki Hoover and Charmaine Gallagher worked with OSU's Gil Sylvia and with Bob Hannah and Steve Jones from ODFW staff on Master's projects investigating the economics of shrimp fishing. These cooperative projects are funded by Sea Grant and orchestrated through OSU's COMES unit.

Finally, MRP staff revised commercial fishing rules with two separate staff reports being prepared and presented before the Fish and Wildlife Commission. The commercial crab summer fishery was restricted with a trip limit and reduced summer quota to prevent volume fishing on softshell crab. In separate action, the Commission adopted rules to allow fishers to fillet fish on board their boats as a service to customers. In addition, reporting and fish transportation rules were revised to accommodate the new live fish fishery and to reduce risk of introducing exotic species or fish diseases into state waters.



National Marine Fisheries Service

Fisheries Behavioral Ecology Program,

Alaska Fisheries Science Center

Bori L. Olla, Program Manager

Experimental Bycatch Studies

Laboratory investigations have been conducted on the behavioral and physiological effects of stress induced by towing and the potential for recovery in marine fish. Capture by towing in the cod-end of a trawl is simulated using a unique temperature-controlled seawater tow tank that was designed and constructed at the HMSC. Recovery is measured in large experimental tanks that are supplied with seawater that can be cooled to duplicate temperatures that adult fish of commercially important species, including walleye pollock, sablefish and halibut may reside at throughout the year from northern California to Alaska. Results to date have shown that: 1) the ability for walleye pollock to orient in nets and to avoid the meshes of a towed net depend on light intensity and ability to detect the net in both laboratory and under field conditions; 2) entrainment of walleye pollock in net meshes produces mortality, while sablefish and halibut show a robust ability to recover from the stress imposed by trawling and net entrainment; 3) the effects of capture stress are magnified by elevated seawater and air temperatures that fish may encounter during capture during summer in the northeastern Pacific Ocean. Differences observed in vulnerability to capture stress and post-capture recovery among species thus far studied would indicate that generalizations across species lines would not be appropriate. Efforts to better define post-capture survival and recovery of marine fish must include consideration of differences among species, seasons and thermal regimens.

Influence of Environmental Factors on Behavior

The behavior and physiology of fishes is often greatly modified by changes in temperature. Because most fishes are ectotherms, their body temperature rapidly equilibrates to the surrounding water temperature. This is especially true for small-bodied juveniles. Warmer temperatures tend to accelerate many physiological processes, such as metabolism and growth. If temperature conditions change, fish can exhibit a simple bioenergetic response, with behavior corresponding to internal shifts in physiological rates. In this case, general swimming activity would be expected to increase as water temperature rises and decrease as temperature falls. Alternatively, fish can respond to temperature changes by showing avoidance behavior. In this case, swimming activity would be expected to increase with either a rise or fall in temperature as fish attempt to move out of the undesirable temperatures.

These two mechanisms, passive bioenergetic response or active avoidance, were tested with juvenile sablefish and walleye pollock in a series of experiments. Since an increase in temperature would elicit increased activity levels under either scenario, experiments tested responses to a decrease in water temperature. Groups of fish were held at ambient temperatures (about 12°C) prior to experiments, then placed in large (2.5 x 2.5 x 2.5 m) temperature-controlled observation tanks. They were videotaped at night and during the day to determine diel patterns of activity and responses to temperature change. Ambient or warm temperatures were maintained throughout the first day of observation. Then temperatures were lowered to 3°C over a 3-4 hour period, and observations continued for another two days. Temperatures were then raised back to ambient levels for the final two days.

The results revealed interesting differences between the two species. In warm water, sablefish had a clear diel pattern in activity, then tended to be highly active during the day and nearly quiescent at night. The introduction of cold water caused avoidance behavior and disrupted the diel pattern, with fish becoming much more active at night than they

were when warm temperatures were present. Walleye pollock, in contrast, did not display an apparent avoidance of cold water but rather exhibited a passive bioenergetic response. Their activity pattern was not disrupted by the change in temperature. Both species returned to their initial activity patterns when temperatures returned to the ambient level.

The responses we observed appear to correspond with the natural behavior of the two species. Juvenile walleye pollock occupy a variety of temperatures with much plasticity in their movement across thermoclines or other thermal gradients. Sablefish, however, remained in the upper water layers where temperatures would be warmest and, at least off the Oregon coast, appear to avoid temperatures $<10^{\circ}\text{C}$. Sablefish have extremely rapid growth rates and presumably high energy demands. Avoidance of cold temperatures may be essential to continue the high consumption rates and rapid physiological processing needed to sustain these growth rates.

Visual Capabilities of Juvenile Fishes

Experiments have been conducted in a continuing effort to examine how ambient light influences the ability of juvenile walleye pollock and sablefish to feed, school and avoid predators. The specialized infrared monitoring systems developed for this research have allowed experimentation with these fish under the full range of light levels which they encounter at various depths in the ocean, day or night. For example, experiments with juvenile walleye pollock have demonstrated how the response of this fish to predators changes with ambient light level. When there is sufficient light to see

other members of a group, juvenile walleye pollock form cohesive schools as a means to mitigate predator risk. However, in the absence of light, when fish cannot see one another, they become agitated and swim more rapidly in the presence of predators. This causes them to disperse and therefore become more vulnerable to predation. Such information helps us understand and predict the spatial distribution of juvenile fishes.

Experiments of the role of light in behavior are also aiding in the design of experiments to explore the interactions between fish and commercial fishing gears, with the goal of reducing bycatch. For example, preliminary experiments are under way to examine how light affects the ability of juvenile walleye pollock to negotiate their way through the codend of a trawl. Although commercial fishing frequently occurs at night or at depths where light may limit fish behavior, little is known about the role of light in the reaction of fish to gear. Subsequent experiments may address such questions as: how does the stress associated with passage through a trawl influence the ability of juvenile fish to feed, school and avoid predators? The answer to such questions will prove crucial in understanding the efficacy of strategies aimed at reducing the retention of undersized fish by commercial fishing gear.

National Marine Fisheries Service

Northwest Fisheries Science Center

I. Administration (Bruce McCain, NWFSC Facilities Manager, Mary Craig, Administrative Staff)

Progress continues to be made towards constructing a new building on NOAA property located northeast of their current facilities. They anticipate that construction will begin in 2001. An environmental compliance audit was conducted by a NOAA contractor, and, thanks to the hard work of NOAA and OSU staff, the auditors reported only one minor finding.

II. Environmental Conservation Division (ECD) (Mary Arkoosh, Ethan Clemons, Anna Kagley, Robert Snider, and Coral Stafford)

Research conducted by the staff of the ECD at the HMSC continues to focus on interrelationships among host resistance, environmental stressors (e.g. pollution), and infectious pathogens. Previous research showed that exposure to pollutants can lead to defects of the immune system and an increase in disease susceptibility in juvenile chinook salmon (*O. tshawytscha*). Whether pollution influences natural disease outbreaks in host populations, including salmon, is currently unknown. Recent

studies of natural fish populations by other researchers have demonstrated that infectious disease-induced mortality can significantly affect the structure of a host population, for example, by reducing its numbers.

To understand the impact of disease in salmon populations, the prevalence of pathogens in various populations of juvenile salmonids is being evaluated. Their initial studies examined juvenile fall chinook salmon from several Oregon coastal estuaries. Preliminary studies revealed that selected bacterial, parasitic, and viral agents are integral components in all systems studied, although their intensities and prevalences varied.

They now have extended their studies to include salmon with different life histories (juvenile coho salmon, which move rapidly through estuaries, as well as juvenile chinook salmon, which spend up to several weeks in estuaries) and they have expanded their spatial scale to include salmon populations from Washington and California coastal estuaries. They have included the measurement of other physiological parameters of salmon such as growth, bioenergetics, and diet as well as various estuarine measurements (contaminants, temperature, salinity, dissolved oxygen and pH). The investigation of these physiological and environmental variables will help to determine how they may contribute to pathogen prevalence, disease, and survival of juvenile Pacific salmon.

III. Fish Ecology Division (NWFSC: Bill Peterson, Bob Emmett, Kym Jacobson; CIMRS: Cheryl Morgan, Leah Feinberg, Greg Krutzikowsky, and Julie Keister)

Fish Ecology Division staff at the HMSC are all members of the Estuarine and Ocean Ecology Program. They investigate the complex ecological linkages among important anadromous and marine fishery resources and their habitats in the Pacific Northwest. Particular emphasis is placed on utilizing an ecosystem-based approach to investigate the myriad biotic and abiotic factors that control growth, distribution, health and survival of important fish species and on the processes driving population fluctuations.

A multi-year monitoring program involving at-sea sampling 2-3 times per month at sampling stations 1, 3, 5, and 10 miles west of Newport was continued under the leadership of Dr. William Peterson. This monitoring program was initiated in 1996 and uses the *R/V Sacajawea* as its research platform. Temperature and salinity measurements are made and samples are taken for later analysis of phytoplankton (as chlorophyll). Plankton tows are made to estimate abundance of species of zooplankton and fish eggs and larvae. These data will be compared to sampling of a similar nature conducted in the 1970s in order to determine if the coastal marine ecosystem has changed over the past 20 years. The underlying hypothesis driving the present work is that the distribution and abundance of plankton off Oregon has changed as a result of the climate regime shift which occurred through the North Pacific in 1977.

Another program involves predator/prey studies with forage species off the coasts of Oregon and Washington. Because Northern anchovy are the primary alternative prey of juvenile salmon, program scientists conducted monthly ichthyoplankton sampling off the coast of southwest Washington to index timing and duration of anchovy spawning. More intensive sampling along the coasts of both states was conducted during the peak spawning period. Spawning biomass was estimated using an egg-production method.

IV. Fishery Resource Analysis and Monitoring Division (FRAMD)

Groundfish Program (Cyreis Schmitt, Ray Conser, Sharon "Ronnie" Hunt, Paul Crone, Jean Rogers, Tonya Builder, Dan Kamikawa, Milly Gist, Waldo Wakefield, Kevin Piner, Jim Bottom, Mary Craig, and Bruce McCain) and Ageing Unit/PSMFC/ODFW (Marion Mann, Jennifer Menkel, and Bruce Pedersen)

The Groundfish Program has 13 scientists at HMSC comprising a multi-disciplinary team with expertise in fishery biology and ecology, stock assessment, mathematical modeling, statistics, computer science, and field sampling techniques. Three additional members of this Program are

stationed at the NWFSC in Seattle. The Program is growing, and has added five new staff members to address its research needs. The goals of the Program are to improve understanding of West Coast groundfish population dynamics and their ecosystems; to utilize this knowledge, in concert with state and other partners, to assess West Coast groundfish stocks; and to aid the groups that manage West Coast marine fisheries. In addition to conducting stock assessments, program scientists provide review and oversight for assessments carried out at other West Coast laboratories; develop and evaluate improved fishery stock assessment methods and computer modeling techniques; conduct biological studies and habitat investigations of key West Coast fish species to better understand life history characteristics and essential fish habitat requirements, respectively. They also serve on domestic and international committees and teams that address general stock assessment and fishery management issues, including serving in advisory roles for the Pacific Fishery Management Council.

During the past year, Program scientists initiated the first in a new series of coast-wide slope surveys using chartered commercial fishing vessels. The objectives of these surveys are to characterize the relative abundance and distribution of the slope species complex; to verify the feasibility of using West Coast commercial trawlers for this work; and to test and evaluate new methods and technologies for data acquisition and recording. Staff also carried out stock assessments for two species in the deep-water complex (shortspine thornyhead and sablefish). The Groundfish Management Team of the Pacific Fishery Management Council used both assessments in its recommendations for harvest guidelines for sablefish and shortspine thornyhead.

Much of the Program's research involved collaboration with academia, state fishery agencies, other NOAA elements, and the fishing industry. Collaborative research efforts were carried out in projects (i) comparing longline and pot gear in deep coastal waters (with Oregon Department of Fish and Wildlife); (ii) interviewing commercial fishers in selected ports to provide insights into what they observe at sea (with ODFW and OSU); (iii) surveying juvenile sablefish using chartered industry vessels to assess recruitment (with OSU and industry); (iv) examining the ability of seafood plant workers to collect biological samples (with OSU, ODFW and industry); (v) seafloor mapping of

Heceta Bank off Oregon (with NOAA's Pacific Marine Environmental Laboratory); (vi) assessing sablefish discard survival rates in the bottom trawl fishery (with the University of Washington); and (vii) obtaining information on the biological characteristics of selected marine species from various depths, as part of a cooperative effort with selected fishers from key West Coast fishing ports (with industry and ODFW).

The Ageing Unit, consisting of three scientists, is a cooperative effort among the Pacific States Marine Fishery Commission, ODFW, and the Groundfish Program. The primary goal of the Unit is groundfish age determination. The resulting age data are a critical component in stock assessments.

Salmon Analysis Program (Lead Scientists: Tom Wainwright and Pete Lawson)

The FRAM Salmon Assessment Team consists of two scientists located at HMSC in Newport, and five scientists in Seattle at the NWFSC. The team works toward integrating the scientific basis for NMFS' management of sustainable ocean salmon fisheries under the Sustainable Fisheries Act (SFA), and recovering threatened and endangered Pacific salmon species under the Endangered Species Act (ESA). The Team's efforts at the HMSC focus on developing and applying salmon population dynamics models that integrate environmental change with land, hatchery, and harvest management issues in evaluations of salmon production and risks to populations. Current efforts include a spatially-explicit habitat-based model of coho salmon in the Alsea River. Future work will involve other species and a broader geographic context. Aspects of this work are conducted in collaboration with the Oregon Department of Fish and Wildlife; Oregon State University; the US Forest Service, Pacific Northwest Research Station; the Pacific Northwest Coastal Ecosystems Regional Study (PNCERS), the Pacific States Marine Fisheries Commission (PSMFC), the Pacific Fishery Management Council, and the University of Washington.

National Oceanic and Atmospheric Administration

**Pacific Marine Environmental Laboratory
Ocean Environment Research Division
Stephen Hammond, Division Leader**

The Ocean Environment Research Division (OERD) of NOAA's Pacific Marine Environmental Laboratory is in its fifteenth year of research focused on determining the oceanic impacts and consequences of submarine hydrothermal venting. The program directs most of its efforts toward achieving an understanding of the chemical and thermal effects of venting along the northeast Pacific seafloor spreading centers on the North Pacific Ocean. The understanding obtained from this relatively isolated system will eventually be extended to a prediction of the impact of seafloor hydrothermal systems on the global ocean. Since 1984 OERD has used the Hatfield Marine Science Center in Newport, Oregon, as a base of operations for studies of hydrothermal venting. The benefits of HMSC proximity to the offshore working grounds, and close collaboration with the Cooperative Institute of Marine Resources Studies (CIMRS) at the HMSC, has produced world-class research that contributes to the understanding of hydrothermal vent systems and their environmental impact.

In September, 1998, Vents scientists, in a partnership with NSF, Sea Grant, and NURP, began the establishment of a long-term seafloor observatory (the New Millennium Observatory or NeMO). The NeMO site includes the entire summit caldera of Axial Volcano, including the area of the eruption. The month-long research cruise to NeMO on the NOAA Ship Ronald H. Brown, which carried the highly sophisticated deep water remotely operated vehicle (ROV), ROPOS, proved to be the most successful international, interdisciplinary Vents seafloor program to date. The January eruption at Axial was verified and intensely surveyed during the cruise. Fluids from hydrothermal vents created by the eruption were sampled and it was discovered that all samples of the fluids contained high-temperature bacteria. A multitude of wide-ranging instruments were deployed at the eruption site to continuously monitor geological, chemical and biological changes resulting from the eruption cycle.

Other specific accomplishments during the FY 1998 field season included:

- Vents scientists mounted an expedition to sample hydrothermal vents along the super-fast spreading Southern East Pacific Rise between 5° and 32° south latitude. This cruise included time-series sampling of vent fields previously sampled in 1994 and 1997, as well as sampling of additional previously explored sites in the region. The results of this cruise will contribute significantly to understanding global variation in mid-ocean ridge fluid chemistry.

- A survey of Heceta Bank using a multibeam sonar system was conducted in May, 1998. The purpose of the survey was to investigate the geology of groundfish habitats off the Oregon Coast and was conducted in conjunction with the Northwest Fisheries Science Center and Oregon State University Sea Grant. The data reveal rich details of the geologic structures that form the bank which forms a diverse structural habitat for local groundfish populations. These data are expected to be the first collected in what is envisioned to be a major new research collaboration between NMFS and OAR focused on critical fish habitat.

- Effects of time-variable currents on the transport of heat from a vent were examined using a combined modeling and field-data analysis approach. Tidal currents, particularly, cause water to pass back and forth over vents with the result that venting results in irregular, patchy hydrothermal plume distributions in the water column. This model study helps to quantify, for example, errors in estimates of vent field heat flux based on such under-sampled plume data.

- The influence of ridge crest topography in steering flow was evaluated using a three-dimensional time-dependent numerical model of baroclinic circulation. Oscillatory currents are rectified and intensified near the sea floor by ridge topography. The model shows that tidal forcing cannot be responsible for the observed mean circulation that characteristically flows in opposite directions on each side of the ridge. Instead, oscillatory forcing at lower frequencies seems to be the cause, the most probably forcing mechanism being variable pressure gradients caused by the passage of atmospheric storms over the site.

U.S. Fish and Wildlife Service Oregon Coastal Field Office

The Oregon Coastal Field Office of the U.S. Fish and Wildlife Service (Service) supports employees from the National Wildlife Refuge Division and the Division of Ecological Services. The refuge personnel are responsible for the operations and management of six National Wildlife Refuges (NWRs) spanning the Oregon coastline. These refuges include three estuarine refuges (Bandon Marsh, Nestucca Bay and Siletz Bay), two marine refuges (Three Arch Rocks and Oregon Islands) and a small old-growth forest refuge at Cape Meares. Currently, Oregon Coastal Refuges has four employees and will soon add a fifth position. Refuge personnel focus on four priorities: land acquisition; habitat management and restoration; biological surveys, monitoring, and research; and environmental education and outreach. The latter focus area will improve markedly this year with the recent addition of an outdoor recreation planner to the staff. In addition, a bioplanner assigned to the regional office staff in Portland is now stationed at the Oregon Coastal Field Office to assist with coastal land acquisition planning.

Oregon Coastal Refuges has a very active land acquisition program with ongoing acquisitions at Siletz Bay and Nestucca Bay NWRs and proposed refuge expansions and acquisitions at Nestucca Bay, Bandon Marsh and Oregon Islands NWRs. The Nature Conservancy (TNC) has purchased Crook Point, a 134 acre headland in Curry County and is holding the property for the Service for inclusion in Oregon Islands NWR. A 2.3 million dollar Land and Water Conservation Fund appropriation was recently received which will allow the Service to purchase Crook Point from TNC this summer. The Service is acquiring the area to provide further protection for the Mack Reef Unit of Oregon Islands NWR. The offshore rocks, reefs and islands adjacent to Crook Point support the second largest concentration of nesting seabirds in Oregon, with over 200,000 birds from March through October including a breeding colony of Leach's storm-petrels numbering 87,000 birds. The headland also contains rare plants, archaeological resources and unique geological formations.

The Service is currently conducting the environmental review process to expand the existing 304 acre Bandon Marsh NWR by adding up to 600 acres. Congressional legislation allowing the expansion of

this refuge passed and, upon successfully completing the review process, acquisition will begin. The Service has the potential to acquire approximately 400 acres of lowland pasture which can be restored to tidal saltmarsh. This would be the largest such restoration in the Pacific Northwest. An environmental review process is also underway to expand Nestucca Bay NWR by acquiring up to 320 acres at Neskowin Marsh. This unique wetland contains a variety of freshwater wetland types such as bogs and fens, some of which are exceedingly rare on the Oregon coast. The Nature Conservancy has already purchased over half of the marsh and is holding the land for resale to the refuge.

Projects that have been accomplished in 1998 include completion of the beach access stairway at Coquille Point in Bandon, installation of additional interpretive panels at Coquille Point, reforestation of a sizable tract of upland and riparian planting and fencing of a stream on Nestucca Bay NWR, and deployment of regulatory buoys around Three Arch Rocks NWR for added protection of seabirds and marine mammals.

Annual wildlife surveys included the monitoring of nesting seabirds (esp. common murre colonies), peregrine falcons, bald eagles, Aleutian Canada geese, black brant, and wintering waterfowl. Special studies were continued on the status of black brant in Oregon's estuaries and anadromous fish use of Siletz Bay, Nestucca Bay and Neskowin Marsh wetlands. The latter study is being done in cooperation with the Confederated Tribe of Siletz Indians and the U.S. Forest Service.

Ecological Services staff in the office are charged with advancing conservation objectives throughout coastal watersheds. Ecological Services responsibilities include implementing the protection and recovery mandates of the Endangered Species Act, assisting in the implementation of the Northwest Forest Plan, and providing technical assistance to Federal, State, and local conservation and restoration efforts. Ongoing activities include western snowy plover recovery, restoring water quality and habitat function in coastal watersheds, recovery of late successional forest species, and conservation and restoration of sensitive habitats such as estuaries, coastal strand, and wetlands.

All of the staff of the Oregon Coastal Field Office were involved in the response to the *New Carissa* grounding and subsequent spill. Staff involvement ranged from a week to several months and is continuing.

Guin Library

Janet Webster, Librarian

As part of Oregon State University's Information Services, the Guin Library houses the library collection as well as being the focal point for network and media facilitation. Information Services faced a severe budget deficit this year which affected the Guin Library in several ways. The Library's \$12,000 book budget was cut entirely until late winter when some funds were reinstated. The student budget of \$6,200 was threatened, but survived. Support services from the Valley Library were restricted as staff was cut there. The Libraries have been fiscally very conservative this year, and

have learned new ways of doing things. But, much important work has not been completed or even started due to lack of staff. For the Guin Library, this deficit is reflected in the collection — material not being purchased or not being added in a timely manner. The budget appears to be under control for 1998/99, but will not be adequate to meet all the demands of users until new monies are allocated. Journals pricing continues to spiral upwards at an average of 10% annually while the collection budget remains stagnant.

The Guin Library staff provides excellent service even in the face of the daunting economic outlook.

Awards and Scholarships

Curtis & Isabella Holt Marine Education Fund for 1999-2000 - Henry LaVigne - "Field trip programs for K-12" and Amy Windrope - "Coastal Erosion at Neskowin"

Walter G. Jones Memorial Scholarship for 1999 Shin-Hee Kim - "Hydrostatic pressure to shuck oysters"

Mamie Markham Research Awards for 1999-2000

- Hal Amogan, Microbiology (\$9,500)
"Investigations into *Nadelspora canceri* genome"
- Yeung Choi, Food Science & Technology (\$8,500)
"New surimi processing method"
- Haian He, Food Science & Technology (\$9,187)
"Use of high hydrostatic pressure to shuck oysters"
- Umur Onal, Fisheries & Wildlife (\$7,000)
"Artificial diets for altricial fish larvae"
- Ebru Onal, Fisheries & Wildlife (\$5,000)
"Spray-dried algae as oyster food"
- Blaine Griffen, Fisheries & Wildlife (\$5,616)
"Biology of burrowing mud shrimp"
- Scott Hecht, Entomology (\$8,335)
"Uptake and accumulation of nonylphenol through food chains"

- Gabriela Montaña, Fisheries & Wildlife (\$6,880) -
"Age determination of red sea urchins"
- Bill Pinnix, Fisheries & Wildlife (\$9,615) -
"Effect of environmental variability on sablefish growth"

Lylian Brucefield Reynolds Scholarship for 1999-2000

Colin Chapman - "Effect of maternal age on offspring survival"

Barbara Schwantes Memorial Fellowship Fund for 1999-2000 - Colin Chapman (\$500) - "Effect of maternal age on offspring survival"

Bill Wick Marine Fisheries Award for 1999-2000

Yong Woo Lee - "Influence of oceanic conditions on euphausiids" and Colin Chapman - "Effect of maternal age on offspring survival"

Statistics

Student Enrollment

<u>Winter/Fall</u>	<u>Class</u>	<u>Winter</u> <u>1998</u>	<u>Fall</u> <u>1998</u>
FW 407/507	Seminar	13	11
FW 431/531	Dynamics of Marine Biological Resources	NA	18
FW 465/565	Marine Fisheries	18	NA
FW 494/594	Diseases & Parasites of Marine Fish & Invertebrates	11	8
FW 497/597	Aquaculture	13	11
FW 498/598	Aquaculture Lab	10	6
<u>Spring</u>		<u>1998</u>	<u>1999</u>
Bi 450/451	Marine Biology	22	16
<u>Summer</u>			
FW 408	Northwest Wetlands	NA	15
FW 408	Project GLOBE	NA	15
FW 499/599	Intertidal Ecology	NA	15
FW 508	Salmonid Disease Workshop	20	NA
FW 508	Pathfinder/COAST Workshop	NA	30
FW 599	Aquaculture	NA	15
FW 599	Environmental Issues & Public Policy	13	NA
FW 599	Field Ichthyology	10	NA
FW 599	Coastal Biology	13	NA
FW 599	Coastal Processes	NA	15
OC 508	Marine Mammals of North Pacific	15	NA

Public Wing Visitors

Since opening, June 1965*= 9,443,104

*Closed for renovation project on May 29, 1995 and
reopened May 17, 1997

May 17, 1997 through May 31, 1998 = 212,607

June 1, 1998 through May 31, 1999 = 137,819

Number of students in scheduled school group visits = 6,000

HMSC Visitor Center Volunteers

1998-99 Volunteers

Frank Aicher
Karon Alter
Joy Anderson
Laura Anderson
Bonnie Bahn
Marlene Bellman
Sandie Berry
Bob Bickford
Peggy Bickford
James Bones
Gerald Boyd
Joyce Browning
Lois Bunse
Helen Cahill
Philip Carbone
Gert Carey
Jane Carr
Lula Carroll
Raymond Carroll
Prudy Caswell-Reno
Trish Cehrs
Ray Clark
Karl Clinkinbeard
Annette Clinkinbeard
Beryl Czuleger
Tom Czuleger
Don DeLisle
Mary DeLisle
Stuart Didter
Charlotte Dinolt
Kathleen Dobson
Jim Donaldson
Carl Ehrman
Mildred Ehrman
Theresa Farrell
Katherine Fernald
Kay Floyd
Helen Frank
Fonte Gassner
Shirley George
Diana Gring
Ferol (Dee) Hadden
Kenneth Hatch

Althea Hatch
Sara Hodges
Wayne Hoffman
Kathleen Holt
Ralph Irvin
Sonia Irvin
Paula Jones
Clyde Kellay
Donald Kennedy
Margaret Kennedy
Derian Kilgore
Nancy Kromer-Miller
Sig Lambek
Yvette Lambek
Jamee Lawless
Steven Lund
Frank Lush
Susan Lynds
Leslie Lythgoe
Robert Madsen
Patty Martin
Sue Martin
Barbara Mate
Alline McAlister
Curt McCann
Patricia McCann
Patricia McChesney
Donna McCoy
Serena McCoy
Walt McNeal
Patricia Modde
Maxine Moodie
Bill Moore
Joanne Moore
Terry Morse
Polly Muller
Kenneth Nevar
Sue Nevar
Nattinee Nipataruedi
Dorothy Olson
Ed Osterman
Jack Owens
Kennith Parks

Mary Emma Parks
Robert Patee
Sylvia Pauly
Bonnie Pazdalski
Walt Pazdalski
Isabella Potter
Dolores Reed
Donna Reynolds
John Roberts
Suzanne Roberts
Walter Roehmer
Margaret Roehmer
Howard Rubin
Christy Sallee
Gerti Schramm
Denise Schrock
Lorraine Shewbert
Elfrieda Sinclair
Chet Stark
Rex Stephenson
Edwin Swartz
Christine Tomsik
Larry Tyler
Wendi Van Tine
Van Vanderbeck
Marit Vike
Joe Voelkel
Mary Voelkel
Rachael Wahl
Mike Walters
Helen Wellman
Jack Whipple
Jane Whipple
Glen Williamson
Marie Williamson
Sue Wilson
Jack Woods
Rosayln Woods

Donor Honor Roll

1998-1999 Annual Gifts

Erna Blair**
William & Bonnie Brod*
Helene Bronson
Gretchen Brooks*
A. C. Burlingham
Eugene & Susan Bureson
Richard & Carol Burton*
Rick Carver*
Bertha Cutress
Brent & Sharon Dalrymple*
Donald & Ann Davis
Dr. & Mrs. Irving Dayton*
Robert & Mary Devine*
George Ditsworth
Agnes Dresch*
Gail Elliott
Claude Elmore*
Will Emery*
Allan A. H. Espino
Barry & Carol Fisher
Pauline Flanagan
Crawford & Jean Graham
John Hennessey
P. Sydney Herbert*
Thomas & Roberta Hutton
Ralph and Sonia Irvin*
Carmen Jones
Ernest & Duchess Josi*
Mavis Kasmeyer**
Darian Kilgore*
William Kimball*
Karen Krebbs*
Maurice Kring*
Darell & Nona Lord**
Luke & Ann McIlvenny
Joan Martin*
Donald Miller*
Sharon Nieukirk
Richard & Valerie Nichols
Norman Noakes*
Northwest Aquatic Sciences

Robert & Jerryann Olson
Jay Owens/Penny Applegate*
Richard & Carol Palmer*
Louis & Sheila Quick*
Betty Roake-Charnock
Verne & Lorene Reiersen**
Sumner & Adele Rodriguez*
Jean Starker Roth*
M. Verne Rupp**
David & Nancy Scharff*
Audrey Skallerud**
Richard & Margie Sleeter*
Calvin & Marilyn Smith*
Meg Schmitt Smith*
Lavern Weber
Janet Gray Webster
Betty Ziehm

* = Marine Mammal Research Endowment

** = Thomas Payne Blair Memorial

Publications

An, Haejung

An, H. 1998. Proteolytic activities in salmon muscle and its inactivation for quality assurance. In: Proceedings of the Fourth International Symposium on the Efficient Application and Preservation of Marine Biological Resources. Kangnung, Korea.

Ben-Gigirey, B., C. Craven and H. An. 1998. Histamine formation in albacore muscle analyzed by AOAC and enzymatic methods. *J. Food Sci.* 63(2): 210-214.

Berkeley, Steven

Berkeley, S.A. and R.E. Edwards. 1998. Factors affecting billfish capture and survival in longline fisheries: potential application for reducing bycatch mortality. ICCAT Coll. Vol. Sci. Papers. SCRS/97/63. 17p.

Nemerson, D., S.A. Berkeley, and C. Safina. Testing spawning site fidelity in Atlantic bluefin tuna. *Fish. Bull.* (in press).

Chapman, John

Cohen, A., C. Mills, H. Berry, M. Wonham, B. Bingham, B. Bookheim, J. Carlton, J. Chapman, J. Cordell, L. Harris, T. Klinger, A. Kohn, C. Lambert, G. Lambert, K. Li, D. Secord and J. Toft, 1998., Puget Sound Expedition: A rapid assessment survey of non-indigenous species in the shallow waters of Puget Sound, Washington State Department of Natural Resources, Olympia, Washington, 37 pp.

Chapman, J. W. (In Press). Climate and non-indigenous species introductions in northern hemisphere estuaries, 14 pp. In E. Muckle-Jeffs, (ed.) *International Zebra Mussel Conference Proceedings*, Sacramento CA, March 1998.

Chapman, J. W. and T. M. Miller (In Press). The odd Northeast Pacific records of *Arctica islandica* (Linnaeus, 1767) are bait. *Festivus*.

Miller, T. M., E. V. Coan and J. W. Chapman (In Press). Return of the nonnative *Laternula marilina* to the Northeastern Pacific, *The Veliger*.

Environmental Protection Agency

Boese, B.L., R.J. Ozretich, J.O. Lamberson, R.C.

Swartz, F.A. Cole, J. Pelletier and J. Jones. 1999. Toxicity and phototoxicity of mixtures of highly lipophilic PAH compounds in marine sediment: Can the SPAH model be extrapolated? *Arch. Environ. Contam. Toxicol.* 36: 270-280.

Cifuentes, L.A. and P.M. Eldridge. 1998. A mass- and isotope-balance model of DOC mixing in estuaries. *Limnology and Oceanography* 43: 1872-1882.

Cifuentes, L.A., R.B. Coffin, J. Morin and P.M. Eldridge. 1998. Particulate organic matter in the Gulf of Mexico estuaries - implications for net heterotrophy. In T.S. Bianchi, J.R. Pennock and R.R. Twilley (eds.), *Biogeochemistry of Gulf of Mexico Estuaries*, John Wiley & Sons, pp. 239-268.

Hannach, G. and A.C. Sigleo. 1998. Photoinduction of UV-absorbing compounds in six species of marine phytoplankton. *Marine Ecology Progress Series*

Larned, Scott. 1998. Nitrogen- versus phosphorus-limited growth and sources of nutrients for coral reef macroalgae. *Marine Biology* 132: 409-421.

Lawrence, John M., B.D. Robbins and Alexander Bazhin. 1998. Phenotypic plasticity in *Strongylocentrotus droebachinensis* at Pertopavlovsk-Kamchatsky. In Mooi and Telford (eds.) *Echinoderms*: San Francisco. Balkema, Rotterdam.

Power, J.H. and E.B. Moser. 1999. Linear model analysis of net catch data using the negative binomial distribution. *Can. J. Fish. Aquatic Sci.* 56: 191-200.

Roelke, D.L., P.M. Eldridge and L.A. Cifuentes. 1999. A model of phytoplankton competition for limiting and non-limiting nutrients: implications for development for estuarine and near-shore management schemes. *Estuaries* 22: 92-104.

Sigleo, A.C., Neal and Spector. In press. Phytoplankton pigments at the Waddell-Scotia confluence: Implications for remote sensing. *J. Plankton Research*

Swartz, Richard C. In press. Consensus sediment quality guidelines for PAH mixtures. *Environmental Toxicology and Chemistry*

- Tunberg, B. and W.G. Nelson. 1998. Do climatic oscillations influence cyclical patterns of soft bottom microbenthic communities on the Swedish west coast? *Marine Ecology Progress Series* 170: 85-94.
- Young, D.R., M. Becerra, D. Kopec and S. Echols. 1998. GC/MS analysis of PCB congeners in blood of the harbor seal *Phoca vitulina* from San Francisco Bay. *Chemosphere* 37(4): 711-733.
- Young, D.R., D.T. Specht, P.J. Clinton and H. Lee II. 1998. Use of color infrared aerial photography to map distributions of eelgrass and green macroalgae in a non-urbanized estuary of the Pacific Northwest, U.S.A. In B. Petosky (ed.), *Proceedings of the Fifth International Conference on Remote Sensing for Marine and Coastal Environments*. ERIM International, Inc. Ann Arbor, MI. II: 37-45.
- Young, D.R., R.J. Ozretich, Roberts, Brinken and Taganov. In press. Evaluation of polynuclear aromatic hydrocarbon (PAH) contamination of Lake Baikal and Angara River. *Journal of the Russian Academy of Sciences*.
- Young, D.R., D.T. Specht, B.D. Robbins and P.J. Clinton. In press. Delineation of Pacific Northwest SAVS from aerial photography: natural color or color infrared film? In *Proceedings of the American Society of Photogrammetry and Remote Sensing*, May 17-21, 1999.
- Fox, David**
Fox, D.; M. Amend, A. Merems, B. Miller, and J. Golden. 1998. 1998 nearshore rocky reef assessment. Newport, OR: Oregon Department of Fish and Wildlife. 54p
- Grover, Jill**
Grover, J.J., D.B. Eggleston and J.M. Shenker. 1998. Transition from pelagic to demersal phase in early-juvenile Nassau grouper, *Epinephelus striatus*: Pigmentation, squamation, and ontogeny of diet. *Bull. Mar. Sci.* 62: 97-113.
- Eggleston, D.B., J.J. Grover and R.N. Lipcius. 1998. Ontogenetic diet shifts in Nassau grouper: Trophic linkages and predatory impact. *Bull. Mar. Sci.* 63: 111-126.
- Hansen, Gayle I.**
Foster, Michael S., Gayle I. Hansen and Yost U.L. Amrein. 1999. History of the Western Society of Naturalists. Santa Barbara Museum of Natural History: Contributions in Science, Number 2. 42 pp.
- Hilderbrand, Kenneth**
Price, Robert J. & Kenneth S. Hilderbrand Jr. "Model Sanitation Standard Operating Procedures" University of California Sea Grant Program. Publication No. UCSGEP 98-3W; November 1998 <http://seafood.ucdavis.edu/HACCP/SSOP/ssop2.htm>
- Hilderbrand, Kenneth S. Jr. "Hot Smoked Fish Company HACCP Plan", Oregon State University Extension Sea Grant Program. Publication No. ORESU-I-97-001. Revised 6/20/97. <<http://www-seafood.ucdavis.edu/haccp/plans/hotsmk.htm>>.
- Hilderbrand, Kenneth S. Jr. "Oysters, Pacific Coast, Shucker with Wet Storage, Generic HACCP Plan". Oregon State University Extension Sea Grant Program. Publication No. ORESU-I-97-002. Revised 7/23/97. <<http://www-seafood.ucdavis.edu/haccp/plans/oysteror.htm>>.
- Hilderbrand, Kenneth S. Jr. "Brand Shrimp Company HACCP Plan, Cooked and Peeled Shrimp". Oregon State University Extension Sea Grant Program. Publication No. ORESU-I-97-004. Revised 6/20/97. <<http://www-seafood.ucdavis.edu/haccp/plans/shrimp.htm>>.
- Hilderbrand, Kenneth S. Jr. "Sanitation Standard Operating Procedures (Lox)". Oregon State University Extension Sea Grant Program. Publication No. ORESU-I-97-003. Revised 2/22/96. <<http://www-seafood.ucdavis.edu/haccp/ssop/lox.htm>>.
- Hilderbrand, Kenneth S. Jr. "Seafood Waste Management Bibliography". Oregon State University Extension Sea Grant Program. Publication No. ORESU-I-97-005. Revised 4/7/97. <<http://www-seafood.ucdavis.edu/Pubs/compost.htm>>
- Langdon, Christopher**
Buchal, M., J. Levin, and C. Langdon. 1998. Dulse *Palmaria mollis* as a settlement substrate and food for the Red Abalone *Haliotis rufescens*. *Aquaculture* 165:243-260.
- Smith, M. and C. Langdon. 1998. Manila clam aquaculture on shrimp-infested mudflats. *J. Shellfisheries Research* 17:223-229.

- Buchal, M. and C. Langdon. 1998. Evaluation of lipid spray beads for the delivery of water-soluble materials to a marine suspension-feeder, the Manila clam *Tapes philippinarum* (Deshayes 1853). *J. Aquaculture Nutrition* 4:265-284.
- Langdon, C. and M. Buchal. 1998. Comparison of lipid-walled microcapsules and lipid spray beads for the delivery of water-soluble, low-molecular weight materials to aquatic animals. *J. Aquaculture Nutrition* 4:275-284.
- Lowe, Roy**
- Springer, P.F., and R.W. Lowe. 1998. Population, Distribution, and Ecology of Migrating and Wintering Aleutian Canada Geese. Pages 425-434 in D.H. Rusch, M.D. Samuel, D.D. Humburg, and B.D. Sullivan, eds. *Biology and Management of Canada Geese*. Proceedings of the International Canada Goose Symposium, Milwaukee, Wisconsin.
- Marine Mammal Group**
- Anderson, S.P. and M.F. Baumgartner. 1998. Radiative heating errors in naturally ventilated air temperature measurements made from buoys. *J. Atmospheric & Oceanic Technology* 15:157-173.
- Beavers, S.C. and F.L. Ramsey. 1998. Detectability analysis in transect surveys. *J. Wildlife Management* 62(3): 948-957.
- Davis, R.W., G.S. Fargion, L.N. May, T.D. Leming, M.F. Baumgartner, W.E. Evans, L.J. Hansen and K. Mullin. 1998. Physical habitat of cetaceans along the continental slope of the north-central and western Gulf of Mexico. *Marine Mammal Science* 14: 490-507.
- Fiedler, P., S. Reilly, R. Hewitt, D. Demr, V. Philbrick, S. Smith, W. Armstrong, D. Croll, B. Tershey, B. Mate. 1999. Blue whale habitat and prey in the Channel Islands. *Deep-Sea Research II* 45: 1781-1801.
- Mate, B.R., R. Gisiner and J. Mobley. 1998. Local and migratory movements of Hawaiian humpback whales tracked by satellite telemetry. *Can. J. Zoology* 76: 863-868.
- Munoz-Hincapie, M.F., D.M. Mora-Pinto, D.M. Palacios, E.R. Secchi and A.A. Mignicci-Giannoni. 1998. First osteological record of the dwarf sperm whale in Colombia, with notes on the zoogeography of *Kogia* in South America. *Revista de la Academia Colombiana de Ciencias Exactas, Fisicas y Naturales*. 22(84): 433-444.
- Palacios, D.M. 1998. (Abstract). Bottlenose dolphins of the Galapagos Islands: an offshore ecotype with an inshore component? Page 47 in Proceedings XXIII Reunion Internacional para el Estudio de los Mamiferos Marinos, Sociedad Mexicana para el Estudio de los Mamiferos Marinos, Xcaret, QR, Mexico.
- Weller, R.A., M.F. Baumgartner, S.A. Josey and J.C. Kindle. 1998. Atmospheric forcing in the Arabian Sea during 1994-1995: Observations and comparisons with climatology and models. *Deep-Sea Research II* 45: 1961-1999.
- Morrissey, Michael**
- Benjakul, S., T.A. Seymour, M.T. Morrissey and H. An. 1998. Characterization of proteinase recovered from Pacific whiting surimi wash water. *J. Food Biochem.* 22: 1-16.
- Huang, L. and M.T. Morrissey. 1998. Fouling of membranes during microfiltration of surimi wash water: roles of pore blocking and surface cake formation. *J. Membrane Sci.* 144: 113-123.
- National Marine Fisheries Service, Fisheries Behavioral Ecology Program**
- Olla, B.L., M.W. Davis and C.H. Ryer. 1998. Understanding how the hatchery environment represses or promotes the development of behavioral survival skills. *Bull. Mar. Sci.* 62(2): 531-550.
- Olla, B.L., M.W. Davis and C.B. Schreck. 1998. Temperature magnified postcapture mortality in adult sablefish *Anoplopoma fimbria* Pallas after simulated trawling. *J. Fish Biol.* 53(4): 743-751.
- Ryer, C.H. and B.L. Olla. 1998. Shifting the balance between foraging and predator avoidance: The importance of food distribution for a schooling pelagic forager. *Env. Biol. Fishes* 52: 467-475.
- Ryer, C.H. and B.L. Olla. 1998. Effect of light on juvenile walleye pollock shoaling and their interaction with predators. *Mar. Ecol. Prog. Ser.* 167: 215-226.
- Ryer, C.H. and B.L. Olla. (in press) Light-induced changes in the foraging success, behavior and size-selectivity of two planktivorous fish. *Mar. Ecol. Prog. Ser.*

- Sogard, S.M. and B.L. Olla. 1998. Contrasting behavioral responses to cold temperatures by two marine fish species during their pelagic juvenile stage. *Environ. Biol. Fishes* 53: 405-412.
- Sogard, S.M. and B.L. Olla. 1998. Behavior of juvenile sablefish, *Anoplopoma fimbria* (Pallas) in a thermal gradient: Balancing food and temperature requirements. *J. Exp. Mar. Biol. Ecol.* 222:43-58.

National Marine Fisheries Service, Northwest Fisheries Science Center

- Brown, D.W., B.B. McCain, B.H. Horness, C.A. Sloan, K.L. Tilbury, S.M. Pierce, D.G. Burrows, S.L. Chan, J.T. Landahl, and M.M. Krahn. 1998. Status, Correlations and Temporal Trends of Chemical Contaminants in Fish and Sediment from Selected Sites on the Pacific Coast of the USA. *Marine Pollution Bulletin* 37: 67-85.
- Clemons, E., Arkoosh, M.R., and Casillas, E. (1999). Enhanced superoxide anion production in activated peritoneal macrophages from English sole (*Pleuronectes vetulus*) exposed to polycyclic aromatic compounds. *Marine Environmental Research*, 47, 71-87.
- Low, L-L., B.C. Mundy, B.B. McCain, T.D. McIlwain, E.D. Anderson, and K. Sherman. Marine Resources: National Issues and Threats. IN: Mac, M.J. P.A. Opler, C.E. Puckett Haecker, and P.D. Doran. 1998. *Status and Trends of The Nation's Biological Resources*. Vol. 2:844-846. U.S. Department of the Interior, U.S. Geological Survey, Reston, VA.
- McCain, B.B., A.D. MacCall, R.L. Emmett, and R.D. Brodeur. Marine Resources: Pacific Coast Region. IN: Mac, M.J. P.A. Opler, C.E. Puckett Haecker, and P.D. Doran. 1998. *Status and Trends of The Nation's Biological Resources*. Vol. 2:814-823. U.S. Department of the Interior, U.S. Geological Survey, Reston, VA.
- Myers, M.S., L.L. Johnson, O.P. Olson, C.M. Stehr, B.H. Horness, T.K. Collier, and B.B. McCain. 1998. Toxicopathic hepatic lesions as biomarkers of chemical contaminant exposure and effects in marine bottomfish species from the Northeast and Pacific Coasts, USA. *Marine Pollution Bulletin* 37: 92-113.
- NOAA Hydrothermal Vents Group
- Chadwick, W.W., Jr., R.W. Embley and T.M. Shank. 1998. The 1996 Gorda Ridge eruption: geologic mapping, sidescan sonar, and SeaBeam comparison results. *Deep-Sea Res. II* 45(12): 2547-2570.
- Chadwick, W.W., T.K.P. Gregg and R.W. Embley. 1998. Submarine lineated sheet flows: a secondary lava morphology on subsiding lava lakes. *Bull. of Volcanology* (in press).
- Delaney, J.R., D.S. Kelley, M.D. Lilley, D.A. Butterfield, J.A. Baross, W.S.D. Wilcock, R.W. Embley and M. Summit. 1998. The quantum event of oceanic crustal accretion: impacts of diking at mid-ocean ridges. *Science* 281(5374): 222
- Embley, R.W., J.E. Lupton, G. Massoth, T. Urabe, V. Tunncliffe, D.A. Butterfield, T. Shibata, O. Onakno, M. Kinoshita and K. Fujioka. 1997. Geological, chemical and biologic evidence for recent volcanism at 17.5° East Pacific Rise. *Earth Planet. Sci. Lett.*, 153 (1/4): 131-148.
- Embley, R.W. et al. (NeMO98 Team). 1998. NeMO98: Using a remotely operated vehicle for interdisciplinary studies of a deep-sea eruption at Axial Volcano, Juan de Fuca Ridge. *Eos Transactions* (in press).
- Fox, C.G. and A. Bobbitt. 1999. NOAA Vents Program GIS Integration, Analysis and Distribution of Multidisciplinary Oceanographic Data, IN: *Marine and Coastal Geographical Information Systems*, D.W. Wright and D. Bartlett (eds.).
- Fox, C.G. and R.P. Dziak. 1998. Hydroacoustic detection of volcanic activity on the Gorda Ridge, February-March 1996. *Deep-Sea Res. II* 45(12): 2513-2530.
- Fox, C.G. and R.W. Dziak. 1999. Microseismic precursors to the April 1992 Cape Mendocino earthquake: implications for southern Cascadia subduction zone tectonics. *J. Geophys. Res.* (in press).
- Graham, D.W., L.M. Larsen, B.B. Hanan, M. Storey, A.K. Pedersen, and J.E. Lupton. 1998. Helium isotope composition of the early Iceland mantle plume inferred from the Tertiary picrites of West Greenland. *Earth Planet. Sci. Lett.*, 160: 241-255.
- Kelley, D.S., M.D. Lilley, J.E. Lupton and E.J. Olson. 1998. Enriched H₂, CH₄ and ³He concentrations associated with the 1996 Gorda Ridge eruptive event. *Deep-Sea Res. II* 45(12): 2665-2682.

- Lupton, John. 1998. Hydrothermal helium plumes in the Pacific Ocean. *J. Geophys. Res.*, 103(C8): 15, 853-15, 868.
- Lupton, J.E., E.T. Baker, N. Garfield, G. Massoth, R. Feely, R. Greene, and T. Rago. 1997. Tracking the evolution of a hydrothermal event plume using a RAFOS neutrally buoyant drifter. *Science*, 280: 1052-1055.
- Massoth, G.J., E.T. Baker, R.A. Feely, J.E. Lupton, R.W. Collier, J.F. Gendron, K.K. Roe, S.M. Maenner, and J.A. Resing. 1998. Manganese and iron in hydrothermal plumes resulting from the 1996 Gorda Ridge Event. *Deep-Sea Res. II* 45(12): 2683-2713.
- Moore, S.E., K.M. Stafford, M.D. Dahlheim, C.G. Fox, H.W. Braham, J.J. Polovina and D.E. Bain. 1998. Seasonal variation in Fin whale call reception at five SOSUS sites in the North Pacific. *Marine Mammal Sci.*, 14(3): 617-626.
- Perfit, M.R. and W.W. Chadwick, Jr. 1998. Magmatism at mid-ocean ridges: constraints from volcanological and geochemical investigations. *Geophys. Monogr. Series 106, Faulting and Magmatism at Mid-Ocean Ridges*, W. Roger Buck et al. (eds).
- Slack, P.D., C.G. Fox and R.P. Dziak. 1998. P-wave detection thresholds, Pn velocity estimates and T-wave location uncertainty from oceanic hydrophones. *J. Geophys. Res.* (in press).
- Tunnicliffe, V., R.W. Embley, J.F. Holden, D.A. Butterfield, G.J. Massoth, and S.K. Juniper. 1997. Biological colonization of new hydrothermal vents following an eruption on Juan de Fuca Ridge. *Deep-Sea Res.* 44: 1627-1644.
- Walker, D.A. and S.R. Hammond. 1998. Historical Gorda Ridge T-phase swarms: relationships to ridge structure and the tectonic and volcanic state of the ridge during 1964-1966. *Deep-Sea Res. II* 45(12): 2531-2546.
- Osis, Vicki**
- Smith, Susan and Vicki Osis. 1999. *Our Water World: 4-H Marine Science Discovery Project*. OSU Extension Service. 4-H 350L. July 1999
- Snively, Gloria and Vicki Osis. 1998. *Beach Explorations: A Curriculum for Grades 5-10*. Includes *Pacific Information Cards*. Oregon and Washington Sea Grant.
- Park, Jae**
- Lin, T.M. and J.W. Park. 1998. Solubility of salmon myosin as affected by conformational changes at various ionic strengths and pH. *J. Food Sci.* 63(2): 215-218.
- Park, J.W., J. Yongsawatdigul, and E. Kolbe. 1998. Proteolysis and gelation of fish proteins under ohmic heating. In: *Process-Induced Chemical Changes in Foods*, F. Shahidi, C-T. Ho and V.C. Nguyen (eds.) pp 25-34.
- Sampson, David**
- Crone, P.R. and D.B. Sampson. (in press). Evaluation of assumed error structure in stock assessment models that use sample estimates of age composition. IN: *Fishery Stock Assessment Models for the 21st Century*. Alaska Sea Grant College Program, University of Alaska Fairbanks.
- Helu, S.L., J.J. Anderson, and D.B. Sampson. (in press). An individual-based fishery model and assessing fishery stability. *Natural Resource Modeling*.
- Sampson, D.B. and Y. Yin. (in press). A Monte Carlo evaluation of the Stock Synthesis assessment program. IN: *Fishery Stock Assessment Models for the 21st Century*. Alaska Sea Grant College Program, University of Alaska Fairbanks.
- Sampson, D.B. and S.M. Al-Jufaily. 1999. Geographic variation in the maturity and growth schedules of English sole along the U.S. West Coast. *J. Fish Bio.* 54:1-17.
- Sylvia, Gilbert**
- Harms, J. 1998. Scientists, industry share more than they know. *Pacific Fishing*. October: 30-33.
- Larkins, S. and G. Sylvia. (in press). Firm-level hedonic analysis of U.S. produced surimi: implications for processors and resource managers. *Marine Resource Economics*.
- Larkin, S. and G. Sylvia. 1999. Intrinsic fish characteristics and intraseason production efficiency: a management level bioeconomic analysis of a commercial fishery. *American Journal of Agricultural Economics*. 81:29-43.

Trowbridge, Cynthia

- Trowbridge, C.D. 1998. Assessment of the spread of the introduced green macroalga *Codium fragile* ssp. *tomentosoides* on Australian shores: Interim Technical Report. CSIRO/Centre for Research on Introduced Marine Pests.
- Trowbridge, C.D. 1999. Assessment of the spread of the introduced green macroalga *Codium fragile* ssp. *tomentosoides* on Australian shores. Final Technical Report. CSIRO/Centre for Research on Introduced Marine Pests.
- Trowbridge, C.D. 1998. Ecology of the green macroalga *Codium fragile* (Suringar) Hariot 1889: Invasive and non-invasive subspecies. *Oceanogr. Mar. Biol. Ann. Rev.* 36:1-64.
- Trowbridge, C.D. 1998. Stenophagous, herbivorous sea slugs attack desiccation-prone, green algal hosts (*Codium* spp.): Indirect evidence of prey-stress models (PSMs)? *J. Exp. Mar. Biol. Ecol.* 230:31-53.
- Trowbridge, C.D. & C.D. Todd. 1999. The familiar is exotic: I. The green macroalga *Codium fragile* ssp. *atlanticum* on Scottish rocky intertidal shores. *Bot. J. Scot.* (in press).
- Trowbridge, C.D. & C.D. Todd. 1999. The familiar is exotic: II. The green macroalga *Codium fragile* ssp. *tomentosoides* on Scottish rocky intertidal shores. *Bot. J. Scot.* (in press).

Webster, Janet

- Webster, Janet G. 1998. Where are the whale books?: Evaluating and improving juvenile marine science collections. *Journal of Youth Services in Libraries* v.11(3):218-229.
- Webster, Janet G.. 1998. Theses and Dissertations for the Next Millennium. In *Electronic Information and Publications—proceedings of the 24th Annual*

OSU Programs at Hatfield Marine Science Center

<u>Research Administration</u>	<u>\$ Amount</u>	<u>Unit Sub-Total Total</u>
Administration	318,890	
Visitor Center Support	68,046	
Non-Sponsored Research (Markham)	70,663	
Non-Sponsored Education	2,800	
Sponsored Research-Chadwick	53,093	
Sponsored Research-Chapman	51,064	
Sponsored Research-Campbell	23,527	
Sponsored Research-Hansen	55,630	
Sponsored Research-Other	<u>114,544</u>	
Total Research Administration		\$643,713
<u>Physical Plant</u>		
State Support	330,489	
Federal Support	<u>243,797</u>	
Total Physical Plant		\$574,286
<u>Cooperative Institute for Marine Resources Studies (CIMRS)</u>		
Sponsored Research	941,383	\$941,383
<u>College of Oceanic & Atmospheric Sciences</u>		
Ship Support/Operations	2,126,707	
Ship Scientific Equipment	<u>116,817</u>	
Total Ship Operations		\$2,243,524
<u>Education and Extension Programs</u>		
Extension	200,458	
Sea Grant	111,452	
Sponsored Programs	120,001	
Self-Funded Programs	30,829	
Dept of Education	<u>59,096</u>	
Total Education Programs		\$521,836
<u>Housing</u>		
Self-Funded Operations	<u>65,023</u>	\$65,023
<u>Bookshop</u>		
Self-Funded Operations	<u>164,026</u>	\$164,026
<u>Other</u>		
Guin Library	269,626	
OSU Foundation	30,949	
Network Service	59,350	
Federal Agencies	<u>23,518</u>	
Total Other		\$383,443
<u>Construction Projects</u>		
HMSC Visitor Center	163,920	
HMSC Physical Plant Shop	<u>40,000</u>	
Total Construction		\$203,920
Total Hatfield Marine Science Center		\$5,741,153

BUDGET CONTINUED ON NEXT PAGE

Coastal Oregon Marine Experiment Station

Astoria

Program	Amount	Unit Sub-Total	Total
Seafood Laboratory Administration	182,451		
Experiment Station Non-Sponsored Research	303,674		
Self-Funded Research/Education	51,703		
Sponsored Research	<u>369,756</u>		
Total Astoria			\$907,584

Newport

Marine Branch Station - Admin	217,533		
Cost Share to Match Federal Funds	93,093	\$310,626	
Marine Mammal Research - <i>Mate</i>			
Marine Mammal Endowment	214,824		
Sponsored Research	34,002		
Non-Sponsored Research	24,288		
Extension	<u>39,661</u>		
Total Marine Mammal Research		\$312,775	
Marketing - <i>Sylvia</i>			
Sponsored Research	76,285		
Non-Sponsored Research	<u>87,350</u>		
Total Marketing		\$163,635	
Fish Disease - <i>Reno</i>			
Sponsored Research	243,348		
Non-Sponsored Research	<u>59,457</u>		
Total Fish Disease		\$302,805	
Fishing Analysis			
P.I. - <i>Sampson</i>			
Sponsored Research	185,720		
Non-Sponsored Research	10,013	\$195,733	
P.I. - <i>Berkeley</i>			
Sponsored Research	226,927		
Non-Sponsored Research	<u>500</u>	<u>\$227,427</u>	
Total Fishing Analysis		\$423,160	
Aquaculture - <i>Langdon</i>			
Sponsored Research	378,625		
Non-Sponsored Research	<u>85,649</u>		
Total Aquaculture		\$464,274	
Total Newport			<u>\$1,977,275</u>

Total Coastal Oregon Marine Experiment Station	\$2,884,860
--	-------------

BUDGET CONTINUED ON NEXT PAGE

Cooperating Agencies at Hatfield Marine Science Center

	\$ Amount	Total	% of Total
Environmental Protection Agency	2,794,253		21%
Oregon Department of Fish & Wildlife	3,092,000		24%
Oregon Pacific Area Health Education	414,000		3%
Vents Program - Federal	2,895,000		22%
Nat'l Marine Fisheries Service - NWFSC	2,300,000		18%
Nat'l Marine Fisheries Service - AFSC	675,000		5%
US Fish & Wildlife Service	<u>930,000</u>		<u>7%</u>
Total Cooperating Agencies		\$13,100,253	100%
<u>Funding Sources</u>			
<u>Direct State Funding</u>			
HMSC	806,888		
COMES	<u>1,064,008</u>		
Total Direct State Funding		1,870,896	9%
<u>Other State Funding</u>			
Matching Funds (Endowments)	220,223		
Guin Library	269,626		
Total Other State Funding		489,849	2%
<u>Sponsored Research</u>			
Nat'l Oceanic & Atmospheric Admin (NOAA)	2,976,297		
Nat'l Science Foundation (NSF)	1,367,862		
Housing and Urban Development (HUD)	163,920		
US Dept of Agriculture (USDA)	418,674		
Public Health Service	23,527		
Dept of Defense (DoD)	37,114		
Nat'l Coastal Research & Develop. Inst (NCRI)	141,985		
Oregon Dept of Fish & Wildlife (ODFW)	117,427		
Oregon Dept of Education (ODE)	59,096		
Extension Service	240,119		
Donations & Private Business	265,194		
Sub-Contracts from Other Universities	<u>59,605</u>		
Total Sponsored Research		5,870,819	27%
<u>Other Funding</u>			
Self-Funding Units	394,449		
Cooperating Agencies	<u>13,100,253</u>		
Total Other Funding		<u>13,494,702</u>	62%
Total Funding		\$21,726,267	100%

This page intentionally left blank

