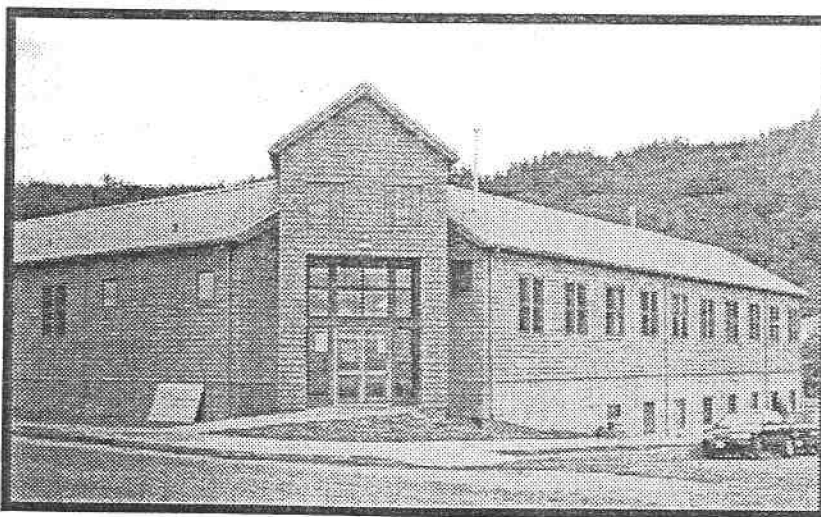


1997-98 Annual Report

Oregon State University Hatfield Marine Science Center July 1998



The new Astoria Seafoods Laboratory is officially dedicated July 15, 1998.

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1997-98 Annual Report

Oregon State University

Hatfield Marine Science Center

Director's Message

Lavern Weber, Director

Just a year after the dedication of our remodeled Public Wing, we have been selected for the honor of being a Regional Coastal Ecosystem Learning Center. Our thanks go to Vicki Osis, Sea Grant Marine Education Specialist, for being the driving force behind this selection. We are already receiving benefits from this affiliation with Coastal America through cooperating federal agencies. The dedication of the Coastal Learning Center this May hosted a number of university, state and federal dignitaries.

The Astoria Seafood Lab was completed this past year, as well as the Seafood Consumer Center, constructed adjacent to the Seafood Lab. On July 15 we will dedicate both of these facilities in Astoria, with former Senator Mark Hatfield as keynote speaker. Dr. Michael Morrissey, Director of the Seafood Lab, is taking on part-time duties as Director of the Duncan Law Seafood Consumer Center.

This past year I took on additional duties as half-time Associate Dean of the College of Agricultural Sciences. This shift in some of my responsibilities allows me to reacquaint myself with the main campus and has several very significant and positive impacts upon the Hatfield Marine Science Center. One of these was that Sea Grant has taken the major responsibility for the Coastal Ecosystem Learning Center (the Public Wing). They have put considerable effort into this with resources from the Sea Grant Director's office. The other positive event was to have Dr. Gil Sylvia become the new Superintendent of the Coastal Oregon Marine Experiment

Station. Both of these changes are providing new insights and increased vitality for our activities on the coast for Oregon State University.

The signing of a Joint Project Agreement between Oregon State University and the National Marine Fisheries Service is a major accomplishment. This allows our joint activities to continue and lets OSU faculty currently occupying space in NOAA's facilities to remain for at least a five-year period. The NMFS is developing plans for additional facilities at the Center and there may be an opportunity for OSU to occupy some of this increased space. Most important in this joint agreement is the continuation of joint research programs.

The U.S. Fish and Wildlife Service Oregon Coastal Refuges office is enlarging their staff at the Center this year. This is a wonderful facility that monitors and protects our coastal refuges. The HMSC appreciates their generosity in sharing their beautiful seminar room with the rest of us.

At OSU it seems that faculty and staff keep adding responsibilities since Measure 5. The Guin Library at the Center is no exception. Janet Webster, our librarian, has been given administrative responsibility for the Maps and Government Documents group at the Valley Library in Corvallis. Unfortunately, our library's collection is on hold because of budgetary constraints.

Winter has been taking its toll on the roof of our 22-year-old Education building. This summer the wood shake roof is being replaced with concrete tile as was done to the original building. We are very pleased with this upgrade before one of our major winter storms could breach the old roof.



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Public Wing

Public Wing Renovation

Bill Hanshumaker, Marine Education Specialist

Barely a year ago, the Hatfield Marine Science Center re-opened its doors to the public. Since then, the Public Wing has both educated and entertained over 200,000 visitors. People from all walks of life were introduced to the research efforts from OSU and the affiliated state or federal agencies.

This year, Oregon Sea Grant assumed direct responsibility for the Public Wing. Sea Grant's support of research and their programs of education, communication and extension create an ideal infrastructure for the ongoing development of the Public Wing. NOAA and other governmental agencies are also contributing to our mission of supporting the rational use and conservation of marine and coastal resources.

Another part of our mission is to promote an understanding of how scientific research interprets

the natural patterns that shape our world. Visitors are encouraged to see, hear and touch patterns from nature in the Pattern Garden, as an introductory experience before moving into the Research Gallery. Exhibitry in the Research Gallery is organized by scale, beginning with global and regional issues before ranging down to the eye level and microscopic perspectives.

While showcasing the methodology and results of marine research is a primary objective, the Public Wing also serves as a social laboratory to expand our research base in public education. One investigation recently examined how best to maximize the donation system in order to avoid admission charges. Another researcher has examined learning that occurs in the Pattern Garden and its effectiveness as an introduction to the Research Gallery. All of the computer-mediated exhibits are subjected to a formative evaluation process. Other ongoing investigations include identifying visitation patterns and their exhibit preferences.

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 educa-

tion. 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. In November 1997, Oregon Sea Grant assumed management of the Public Wing of the Hatfield Marine Science Center. Jay Rasmussen, Associate Director and Extension Sea Grant Program Leader, is located at the HMSC.

Ken Hilderbrand: Seafood Processing Specialist

As a member of the steering committee for the Seafood HACCP Alliance, Ken reports that the Alliance has forged a working alliance of regulatory agencies, industry, and academia and written, published and recently revised a HACCP training curriculum which FDA is using as the "equivalence" standard for training required by its new seafood safety regulation in 21CFR sec 123.10. The Alliance has developed a training "protocol" which the Association of Food and Drug Officials (AFDO) is using to organize industry training and issue a "Certificate of Course Completion" to each student attending AFDO certified courses.

As of December 1997, 17 domestic and 2 international trainer training courses qualifying 584 trainers to teach AFDO-certified HACCP courses have been held. These instructors have held (as of November 25, 1997) 251 domestic and 19 international industry courses training 5993 students to meet the requirements of 21CFR sec 123.10 of FDA's seafood safety regulation. By the end of 1997 an additional 13 courses will be held training about another 400 students. In addition there probably have been, as a direct result of SHASC activity, over 100 "FDA equivalent" courses taught by other agencies, organizations, and individuals resulting in another 3000 students meeting FDA training requirements.

The Alliance assembled a compendium of published seafood processes dealing with safety issues and publish it on-line in a searchable WWW format. It probably contains 80 or 90% of all relevant seafood safety-related research conducted in the last 20 years. It is intended to be a supplement to FDA's own "Fish and Fishery Products Hazards and

Controls Guide." It is primarily the work of Robert J. Price, University of California Davis.

Ken has surveyed, compiled, and published a list of research priorities needed in order to develop information the industry needs to meet FDA's seafood safety regulations. He has been active in all the projects of the SHASC including acting as chairperson of the "research needs" and "protocol" committees. He has also, in 1997, personally helped teach two domestic and two international trainer training courses and one basic course for all Oregon Department of Agriculture Food Inspectors. He has also produced, and published electronically several model seafood HACCP plans and Sanitation Standard Operating Procedures worldwide.

His involvement in HACCP training and preparation of HACCP models resulted in a major policy decision by the Food and Drug Administration to allow "grouping" of products into a single HACCP plan even though the regulation itself did not allow grouping of products with different critical limits. The situation involved fish-smoking firms which might have dozens of different sizes and species of products with different brining and cooking times requiring dozens of specific HACCP plans and all the pre and post HACCP plan work necessary to meet the requirements of the regulations. He suggested that all the process parameters for different products be listed on a "process schedule" and incorporated into a single HACCP plan. The FDA agreed to allow it.

The Seafood HACCP Alliance, and each individual on the steering committee, was awarded Vice President Al Gore's National Performance Review "hammer" award for "contribution to building a government that works better and costs less." Without help from the Seafood HACCP Alliance, the FDA would not have met their goal of implementing the new seafood safety regulations by December 18, 1997.

The Sea Grant part of the alliance activity is funded by a National Sea Grant Program Initiative Grant which is managed by the University of Florida. Also represented on the SHASC is USDA's Gary Jensen, Aquaculture Specialist, from the Cooperative Research, Education, & Extension Service.

The goal of "Seafood Quality and Safety" work plan was to have all Oregon Seafood Processors meet the requirements of the FDA's regulations by the deadline of December 18, 1997. This goal has essentially been met. Over 95% of seafood processing firms have complied with the regulation and

they probably account for 99.99% of production. Whether or not the industries HACCP plan will be judged to be adequate or not will be something that will not be known until the end of 1998 at the earliest.

Vicki Osis: Marine Education Specialist

Vicki prepared a proposal and secured designation as an Ecosystem Learning Center through the Coastal America office. Dedication ceremonies were held May 8. Hatfield joins a network of other centers that educate the public on coastal resources. Coastal America is a partnership among federal state and local governments and private alliances to address coastal environmental problems. Federal partners include Agriculture, Environmental Protection Agency, Department of Interior and all branches of the military. Federal partners' resources will be available to assist education efforts at the Hatfield Center.

She collaborated with the South Slough Estuary Sanctuary to secure a grant from the Governor's Watershed Enhancement Board. The two-year grant continues the work with coastal high school teachers on monitoring water quality in coastal estuaries.

The GLOBE Workshops is an international environmental monitoring program that involves science teachers from elementary through high school. Sea Grant is a franchise site for the GLOBE program. The first workshop will be held on the OSU campus July 6-11. Twenty-five teachers are registered.

A low-power radio unit to deliver tidepool conservation information has been installed at Seal Rock. This project is a pilot to determine if low power radio is an effective means to deliver information to beach visitors. During the summer of 1998 an intern will work at Seal Rock to gather information from visitors as to the effectiveness of low-power radio to deliver the messages.

Ongoing programs: The school program attracted 6,000 students. This is the same number as last year. The Summer Day Camp programs are all filled and several have waiting lists.

New summer education programs for families have been scheduled for summer 1998. The new programs will be a pilot to see how field excursions and hands-on labs will be utilized by the visitors to the Public Wing.

Oregon Pacific Area Health Education Center

Kathy Phipps, Director

In 1989, the Oregon Legislature responded to a collaborative grassroots effort involving local Oregon communities and the Oregon Health Sciences University by approving a legislative package to address the acute and chronic shortage of health care professionals in rural Oregon. Included in the package were funding and support for a Statewide Area Health Education Centers (AHEC) Program. The goal of the AHEC effort is clear: To make primary health care more accessible to all Oregonians by improving the training and distribution of health professionals throughout the state.

Oregon Pacific AHEC is the center which serves northwest Oregon. Housed within the Hatfield

Marine Science Center, Oregon Pacific AHEC takes a three-pronged approach to improving access to health care. We work with health care providers before, during and after their professional training to encourage them to practice, or continue practicing, in medically underserved areas.

The "before" effort consists of exposing young people to health career possibilities. We sponsor a variety of "Grow Your Own" activities; i.e., programs aimed at encouraging students from rural and medically underserved areas to pursue a health career in such an area. These activities include a health careers summer camp, teacher inservice trainings, and health career program development awards for public high schools.

"During" activities involve providing rural training and education opportunities for individuals now studying to become health care professionals. These include clerkships for health professions students (including medical students and nursing, physician

assistant and allied health students), as well as rural rotations for resident physicians.

In the "after" phase, Oregon Pacific AHEC helps practicing professionals keep their skills and knowledge up-to-date by providing accessible continuing education to health providers in rural areas. By teaming with professional faculty and local health care facilities, we have been able to offer continuing education courses over Oregon ED-NET to physi-

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' hailing port is Newport, Oregon.

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 1998 *Wecoma's* 220 days of scheduled operations are funded by the NSF (70 days), NOAA (91 days) and ONR (59 days). Operations include work by researchers from the State University of New York, University of Hawaii, University of Washington, Woods Hole Oceanographic Institution, the Naval Oceanographic Office, the Pacific Marine Environmental Laboratory (NOAA), the Alaska Fisheries Science Center (NOAA), and Oregon State University. Port calls include Eureka, CA., Kodiak and Dutch Harbor, AK in addition to Newport.

A new Dynacon deep-sea traction winch was installed in December, 1997 and is capable of handling up to 10,000 meters of either 0.680" electro-mechanical cable or 9/16 3x19 wire rope. This winch expands WECOMA's capabilities to handle large, towed instruments such as deep-sea cameras and sidescan sonar equipment. Additional new equipment, including a "chirp" echo sounder, a new winch instrumentation system and a new, portable articulating crane will be purchased during the year.

R/V *Sacajawea* is owned by OSU and funded by a combination of state funding for the fixed costs of

cians, nurses, emergency medical technicians (EMTs), and other allied health professionals. In addition, we provide support for the initial training of EMTs from rural areas.

the vessel and user charges for the variable costs. The vessel is documented by the USCG 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 from both COAS and NOAA's Northwest Fisheries Science Center at HMSC. The vessel continues to support the HMSC Marine Education program and a variety of research activities at the Center. Efforts continue to seek a larger, more capable vessel to replace *Sacajawea* and support the growing level of coastal research by both COAS and HMSC researchers. Vessels using the expanded pier facility include R/V *New Horizon* from Scripps Institute of Oceanography, NOAA Ship *Brown*, Corps of Engineer Dredge *Yaquina*, USCG Cutters *Alert* and *Orcas*, Canadian War Ships *Chaleur* and *Miramichi*, R/V *Point Sur* from Moss Landing Marine Laboratory, M/V *Ocean Alert* (under charter to Monterey Bay Marine Research Institute) and the F/V's *Excaliber* and *Olympic* (charter with NOAA-NMFS).

Independent Researchers

John Chapman: Global Climate Change and Biological Invasions of Estuaries

1997-1998 was a busy year for John. He organized and participated in surveys of introduced non-indigenous marine and estuarine species of Port Valdez, Prince William Sound, Alaska and San Francisco Bay, California. He was featured as an estuarine ecologist in the ODFW video *Estuaries: Oregon's Coastal Treasures*. In addition, he made presentations on the following topics at national or international meetings and submitted two manuscripts that have been accepted for publication.

- Biological invasions of northeast Pacific estuaries at Western Regional Panel, National Invasive Species Council, Portland State University, Portland, OR, 7-8 July 1997.
- Disturbance effects may limit nonindigenous species in Northeast Pacific Estuaries at American Fisheries Society, Monterey, CA, 28 August 1998.
- Risk of ballast water introductions of nonindigenous species to Prince William Sound, Alaska at International Zebra Mussel Conference, Sacramento, California 16-19 March 1998.
- Risk assessment of West Coast waters at International Zebra Mussel Conference, Sacramento, California 16-19 March 1998.
- Global climate change and introduced marine species at Global Climate Change/Biological Invasions Workshop (Hal Mooney organizer) Stanford University, San Francisco, California 4-5 April 1998.
- Cryptogenic marine algal species in Port Valdez, Alaska: How did they get there? at Northwest Algal Symposium and Pacific Estuarine Research Society Joint Meeting, Camp Casey, Whidby Island, 29-31 May 1998.
- Flood effects on native and exotic amphipod populations in Yaquina Bay, Oregon at Northwest Algal Symposium and Pacific Estuarine Research Society Joint Meeting, Camp Casey, Whidby Island, 29-31 May 1998.
- Update on introduced aquatic species of the Pacific Coast at Pacific Fisheries Legislative Task Force, North Bend, Oregon, 30 May 1998.

Jill Grover: Feeding Ecology

Research on the feeding ecology of early-juvenile Pacific hake, *Merluccius productus*, that was begun last year, continues. Pacific hake is the most abundant commercial fish species off the west coast of California, Oregon and Washington, although year classes exhibit hundredfold variation in abundance. Much of the variability in recruitment takes place during the first four months of life. As a result, knowledge of the early ecology of Pacific hake is critical to understanding the dynamics of this species.

The initial objective of this research was to document the dietary transition from copepod prey to euphausiid prey. To this end, early-juvenile hake that were collected off California in the spring of 1995 were examined. However, the availability of comparable samples that were collected during the anomalous El Niño conditions of 1997 provided a valuable opportunity: To examine how El Niño oceanographic anomalies effect early-juvenile Pacific hake, during a critical stage in the determination of year-class strength. Oregon Sea Grant funding supports the El Niño portion of this study.

Gayle Hansen: Marine Algal Taxonomy

For the past year, Dr. Hansen has been involved mainly in two ongoing projects in marine algal taxonomy. The first is a study of the introduced marine and estuarine species of Prince William Sound, Alaska, funded through the Regional Citizens Advisory Council of Valdez, Alaska. The second, an inventory and biogeographic survey of the seaweeds and seagrasses of Oregon, has been funded by the OSU Research Council.

In a collaborative study to examine the risk of introduced species occurring in Prince William Sound, Alaska, a number of scientists from OSU and the Smithsonian gathered in Port Valdez, an area well-known for tanker traffic and for the off-loading of ballast water, to search for introduced species. She examined the seaweeds and seagrasses collected during this meeting and provided an updated checklist of the marine macrophytes of the area. Although few newly introduced species were discovered, nearly 50% of the algae examined were

found to be extremely widespread in boreal areas, and 20% to have distributions that extended to the southern hemisphere. These widespread species are considered "cryptogenic," since they have hidden origins, and they are thought to have a high probability of being introduced into at least a part of their range by humans. Recent studies have shown that many of these taxa have excellent natural dispersal capabilities but that many also can foul the ship hulls and/or survive in ballast water. It seems likely that the broad ranges of these cryptogenic species have been created by both natural and anthropogenic means. This year, the team will return to Alaska to search all of Prince William Sound for introductions, but they will target aquaculture facilities. Many of the most invasive species worldwide had been brought in to new areas for this purpose, and it is important to include these facilities as well in our assessment of risk.

In a second project, Dr. Hanson began an inventory of the seaweeds and seagrasses of Oregon in order to map the biodiversity of these very important species along the coast in order to pinpoint areas where pollution and other human-related

factors may have influenced species richness. Rather than just base the study on newly collected plants, she is also using data available on over 7,000 voucher specimens of marine algae kept by the university herbaria at OSU, UCB, UW, WWU, and UBC. These dried specimens, gathered in Oregon since the late 1800s, provide a wealth of information on the distribution and biology of the species that is often overlooked. Information from the labels of these historical specimens and from new collections is being recorded in a relational database. Once the database is complete, it will be possible to map the marine macrophyte biodiversity. After adding in data on substrate, salinity, temperature, pollution, etc., it will also be possible to target areas for study and determine the probable causes of low or high species diversity. When all of this is finished, recommendations for conservation will be made to appropriate state agencies and each will be given a copy of the database.

Neuroscience Group

George Mpitsos, Don Campbell, John Edstrom

The Neuroscience Group (George Mpitsos, Don Campbell and John Edstrom) carries out basic research into the function of nervous systems. Specific projects span the range of neurobiology from the molecular basis of cellular electrical signals to the behavior of whole animals. Don Campbell investigates the role played by different subtypes of ion channels in determining the specific electrical signal generated by single nerve cells.

George Mpitsos studies interactions among groups of nerve cells in experiments on molluscan nervous systems. He and John Edstrom use computer simulations to model the behavior of networks of interconnected cells. This work is aimed at understanding the mechanisms underlying self-organization

and parallel distributed processing of information.

The Neuroscience Group is also working on the MathNet project. This project, conceived and directed by George Mpitsos, is working on learning tools to involve parents, students and educators in a coordinated effort to improve mathematics education of elementary school children. To log onto the MathNet web page, contact Dr. Mpitsos at gmpitsos@slugo.hmsc.orst.edu.

Coastal Oregon Marine Experiment Station

Gilbert Sylvia, Superintendent

Aquaculture: Chris Langdon and Anja Robinson

The main focus of the COMES aquaculture program over the last year has been the USDA-funded Molluscan Broodstock Program (MBP). About 200 families of Pacific oysters have been produced at the Hatfield Marine Science Center and planted along the West Coast from Prince William Sound, Alaska, to Tomales Bay, California. In the fall of 1997, we determined the growth and survival of the first generation of MBP oysters planted in Tomales Bay that had reached market size. Final weights of the fastest growing families were about twice those of the slowest growing families. The top performing families were used as broodstock in spring 1998 to produce a second generation of MBP families. Microsatellite genetic analysis of MBP broodstock oysters by Dr. Mike Blouin of Oregon State University was used to identify and eliminate genetic contamination of selected broodstock families.

DNA analysis by Dr. Pat Gaffney of the University of Delaware has also been used to determine the genetic purity of Kumamoto oysters in a joint project with Dr. Anja Robinson, COMES, funded by the National Oceanic and Atmospheric Administration's (NOAA) Saltonstall-Kennedy program. Most of the verified Kumamoto oysters have now been distributed to West Coast hatcheries to enhance their Kumamoto stocks.

National Coastal Resources Institute-supported research on the co-culture of red abalone and dulse (*Palmaria mollis*) focused on measuring various culture parameters so as to predict the maximum abalone stocking densities that can be sustained by dulse production. A pilot-scale experiment indicated that juvenile abalone grew well when fed on dulse in the co-culture system. Research assistant Ford Evans and graduate student Carl Demetropoulos have been working with commercial abalone farms in California and Hawaii to ensure successful technology transfer.

Funding from the Saltonstall-Kennedy program has supported research on the development of microencapsulated diets for fish larvae in conjunc-

tion with National Marine Fisheries Service researchers Dr. Mike Rust and Dr. Rick Barrows. Graduate student Umur Onal has used zebra fish as a model fish species in these studies and has found that a gelatin-alginate, spray-bead particle type is the optimal delivery vehicle for larval diets. The Norwegian government has funded a project here to apply this microparticulate technology to rearing cod larvae.

Fish Disease: Paul Reno and Robert Olson

During the last year, they have concentrated their efforts in two main areas. The first is trying to determine what factors enable fish viruses to kill their victims (virulence). For this study, Kyoung Chul Park, a Ph.D. student in Microbiology, has been trying to evaluate how inhibitory substances in fish serum affect virus replication. He has determined that serum from rainbow trout, coho salmon and chinook salmon, but not brook trout or Pacific herring, have inhibitors which can inactivate virus up to a serum dilution of 1:1,000. The inhibitor is not antibody or interferon, nor is it apparently a lectin; it is not inducible by injecting fish with Ips, a known stimulator of antibody activity. Further characterization of the inhibitor indicates that it has a molecular weight of approximately 100,000 daltons, is stable at 5° C, and may require divalent cations for activity. Furthermore, he determined that the ontogeny of the inhibitor (it is not present until the fish are 3-4 months old) correlates strongly with the increasing resistance to virus disease which is noted in trout at about that age. He will continue to characterize the inhibitor during the coming year, as well as look at the relationship between virulence and resistance to inhibitors.

The second focus has been on the epidemiology of fish diseases in wild and cultured populations. Hamdi Ogut, a Ph. D. candidate in Fisheries & Wildlife, has been performing laboratory experiments with viral and bacterial pathogens of salmon and trout to attempt to delineate the factors which contribute to the dissemination of pathogens in populations and whether disease occurs as a consequence. He has determined that for IHN virus, exposure leads to the ability to transfer the pathogen to susceptible fish within one day, but for bacterial

pathogens, this does not occur for several days, indicating that the bacterial pathogen can more effectively cause disease than IHN virus. At a holding density of 1 fish/ 2 L the virus was transmitted, but at a density of 1 fish/ 6L no pathogen transfer occurred. Using these types of laboratory-based values, Hamdi will be constructing models to describe the dynamics of disease and pathogen transfer in populations and apply the models to fish in hatcheries and also to wild fish.

On the infectious front, they have also dabbled in coliform testing for a commercial oyster grower. Lastly, Tim Miller-Morgan, a Ph.D candidate in comparative medicine in the College of Veterinary Medicine, has been attempting to determine the etiology of idiopathic gaseous exophthalmia (popeye) in rockfish and other species of fish held in the public wing here at HMSC as well as at the Oregon Coast Aquarium. This disease apparently is not related to the popeye seen when fish are raised from the depths, because it develops months or years after capture. It is surmised that the disease may be caused by an imbalance of the oxygen-generating system of the pseudobranch. Technical difficulties have hampered testing of this hypothesis thus far.

Marine Fisheries: Steven Berkeley

During 1997-98, Steve Berkeley expanded his Sea Grant-funded research project on the effects of fishing-induced age truncation on reproductive potential and recruitment in black rockfish. Results of his first year's research indicated that young fish spawned 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. Steve, with assistance from graduate student Steve Bobko, also began laboratory rearing experiments in 1998 to determine if the higher survival rate is a result of better fitness of the larvae of older fish or is a result of the time of spawning. Both Berkeley and Bobko presented papers at the 1998 Western Groundfish Conference summarizing results of this research.

Steve and his research assistant Tom Rippetoe continued their research on the biology of West Coast sablefish. This project involves, among other things, at-sea sampling and tagging aboard research and commercial fishing vessels. Berkeley and Rippetoe presented the results of this research at the

1998 Western Groundfish conference. Investigation of the temporal variation in time of spawning by different age classes was also begun. 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 at the 1997 meeting of the International Commission for the Conservation of Atlantic Tunas (ICCAT) and at the 49th International Tuna Conference in Lake Arrowhead, California.

Steve also began another major research effort on the impact of environmental variability and climate change on growth and recruitment 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. Another graduate student, Bill Pinnix, will be helping Steve with this research.

Steve continued to serve as technical advisor for the U.S. Commissioners to ICCAT. Results of his studies on bluefin tuna stock structure were presented at a special ICCAT symposium in Madrid, Spain. He also continued to work with the American Fisheries Society (AFS) spearheading the society's efforts to encourage action to rebuild the severely overfished Atlantic bluefin tuna population. Steve will take over as president of the Marine Fisheries Section of AFS in 1998.

Bruce Mate: Marine Mammals

The implantable satellite-monitored radio tags developed in 1996-97 were applied successfully to humpback whales during 1997-98. One tagged whale was tracked 7,953 km in 79 days as it traveled from Hawaii to Unimak Pass, Alaska, and across the length of the Aleutian Island Chain to the Kamchatka Peninsula of Russia. This is the first documentation of the migration route for any humpback from one critical habitat to another (reproductive areas to foraging areas). The travel to Alaska takes four weeks at a fairly constant speed of 6 km/hr. The subsequent travel to Kamchatka is the first connection of Hawaiian animals to the northwest North Pacific and has stock identity implications. The results of this research were reported to the World Marine Mammal Conference in Monaco (January 1998). It will also be seen in a *Discovery Channel* special and featured in *National Geographic*.

An additional ten humpback whales were tagged in southeast Alaska with an improved version of the tag. Three OSU students stayed in the region for two months after tagging to conduct follow-up observations. There were no signs of infection. One tag lasted 148 days, a new longevity record for any telemetry device on large whales. There was so much food for the whales in Chatam Straits and Frederick Sound that these animals did not travel far all summer. One whale was tracked long enough that it began its winter migration toward Hawaii.

Due to severe El Niño conditions, the proposed tagging of blue whales in Mexico and the Eastern Tropical Pacific was cancelled. In late March, seven humpback whales were tagged off the southern tip of Baja, California Sur, Mexico, and nine humpback whales were tagged in April off the island of Maui, Hawaii. The hope is to eventually identify the summer foraging areas and migration routes of humpback whales reproducing in various parts of the North Pacific. It is a common notion that the whales which breed in Hawaii migrate to Alaska. The truth is that whales feeding in Southeast Alaska and the Gulf of Alaska go to Hawaii in the winter, but they probably account for only 20-40% of the whales in Hawaii. Where the others go is a complete mystery, although it is suspected that many may go to the Aleutian Islands or the Bering Sea. Photo-

identification projects usually used to identify whales are too dangerous and expensive in such remote areas.

In the fall of 1998 Dr. Mate anticipates tagging blue whales off the coast of southern California to discover where North Pacific blue whales breed and calve in winter. He also hopes to tag right whales off the coast of Argentina to discover where they feed.

One graduate student, Kelly Rossbach (dolphin population biology), received a master's degree in Wildlife and two Ph.D. students were accepted into the Oceanography program: Kate Stafford and Mark Baumgartner. Students did an outstanding job in their presentation of their marine mammal research at professional meetings. Kate Stafford received an award for the best student paper in the Bioacoustics Section of the Acoustic Society of America. Daniel Palacios received an award at the World Marine Mammal Science Conference for the best poster presentation. Kelly Rossbach received an award for the best poster by a master's student at the same meeting. Graduate students are currently working on the use of satellite sensors to describe the physical and biological properties of whale and dolphin habitats and detect seasonal abundance of many endangered species with acoustic arrays.

Marine Fisheries: David Sampson

Dr. Sampson continued his research on Oregon's marine fisheries for groundfish. During the year he presented results from his Sea Grant research at the Wakefield Symposium on Stock Assessment Models for the 21st Century in Anchorage, Alaska. He served on a stock assessment review panel for the Pacific Fishery Management Council, was appointed to the National Research Council's Committee to Review Individual Fishing Quotas, and presented a seminar on "the Anatomy of a Groundfish Stock Assessment" to several fishing industry audiences. He also continued to serve on the Scientific and Statistical Committee of the Pacific Fishery Management Council and as associate editor for the North American Journal of Fisheries Management. During the winter Dr. Sampson taught the upper division course "Marine Fisheries" to 14 students and team-taught a new course on "Fishery Stock Assessment Methods" to ten students.

Dr. Sampson's current graduate students are conducting research on the following topics: the influence of data uncertainty on groundfish stock assessments; criteria for selecting appropriate stock assessment models; spawning site selection by Columbia River chinook salmon; the suitability of cooperative fishery management in Thailand; oceanographic influences on the survival of Columbia River salmon; age validation for West Coast sablefish; the concentration of fishing fleets under individual fishing quotas; factors to consider for pelagic fisheries management; rockfish food habits and feeding ecology; and using fish plant workers to collect stock assessment data. Two of Dr. Sampson's students finished their master's degree during the year.

Resource Economics: Gilbert Sylvia

Research during the past year has focused on seafood marketing, fisheries management and policy, aquacultural-based tourism, and public sector donation systems. 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.

Ongoing projects include: 1) bioeconomic modeling of the Pacific whiting fishery; 2) evaluating the role of intrinsic seafood quality for improving fishery management; 3) developing dynamic portfolio models for seafood processing; 4) determining incentives for successful scientists/fishermen research cooperation; 5) diversifying aquaculture to include tourism and recreation; 6) determining optimal donation strategies to support marine outreach education; and 7) developing product quality and marketing strategies for the albacore tuna industry.

Two new Sea Grant projects have recently been initiated. The first project is a cooperative study 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 will include an evaluation of the costs and benefits of finfish excluder devices, the relationship of shrimp quality and 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 will evaluate 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 of extramural funding and are supporting nine graduate students (2 Ph.D. and 7 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:

- Seafood Waste. Waste water research included the use of membranes to remove proteinaceous compounds in the waste and recover bioactive components in surimi wash water. Research on protein hydrolysates has also shown the efficacy of this processor utilization of solid wastes.
- Surimi research. Different starches were tested in surimi-based seafood, cryoprotection studies, and pasteurization parameters of surimi based seafood.
- Biotechnology in seafood science. The cloning of a fish cystatin gene (a protease inhibitor) and its expression in yeast cells is research in progress.
- Seafood safety. Research focused on the determination of histamine levels in albacore tuna under different handling methods and the establishment of processing parameters for pasteurization of surimi-based seafood products and oysters.
- Value-added products. Work has begun on

different value-added products such as fish sauce made from whiting and oyster products.

Outreach involved the 6th annual OSU Surimi School that is held in Astoria the last week of March each year. Visitors undertaking research at the laboratory included: Min-Sung Cho, a M.S. student from the Department of Food Science, National Pukyong of Pusan University, Pusan, Korea from Sept 1997 - Feb 1998 and Jose Luis Hurtado a Ph.D. student from the Instituto Del Frio Consejo Superior de Investigaciones Cientifica in Madrid, Spain from Aug 1997 - Oct 1997. Graduate students completing their Food Science and Technology degrees at the Seafood Lab were: Fugen Li, M.S. and Jin Shan Shie, M.S.

New Facility and Seafood Consumer Center

The OSU-SFL has expanded rapidly over the past five years and currently has three faculty, two technicians and ten 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 \$1.5 million Duncan Law Seafood Consumer Education Center is currently under construction and will be completed 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 Astoria Seafood Institute 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 Seamount 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. The character of the seismicity is very similar to that observed at CoAxial Segment and the northern Gorda Ridge, both episodes that were later confirmed to be eruptive events.

Geophysical Monitoring

In response to the detected seismic activity, the NSF/RIDGE and NOAA/Vents Program organized a short, seven-day expedition to Axial Seamount using the OSU Ship *RV Wecoma*. The cruise began

on February 9, 1998 in the worst possible sea conditions. Despite constant winds in the 25-40 knot range and seas of 10-18ft., the response team managed to stage nearly continuous CTD-rosette operations. A total of 16 vertical CTD casts were made during the cruise. Temperature anomalies of over 0.15°C and high light attenuation values were measured. The intensity of the hydrothermal plumes indicated greatly elevated discharge rates at the seafloor relative to previous surveys of this same region in 1996 as well as last summer.

The NOAA Vents Program, in collaboration with academic and Canadian scientists, has been funded by Sea Grant and the West Coast National Undersea Research Center to conduct interdisciplinary investigations at the summit of Axial Volcano using the ROPOS remotely operated vehicle in August 1998. Several arrays of seafloor and water column instruments that were in place during the event will also be recovered in July-August, 1998. The data from these instruments and the ROPOS expedition will be able to positively verify the event as eruptive or not.

Hydrothermal Emissions

Of the 16 hydrocasts taken aboard the RV *Wecoma* at Axial Seamount, fifteen priority samples were analyzed by CIMRS technical staff that would characterize the plumes detected while at sea. Maximum helium-3 enrichments were found at ~1400 meters depth, somewhat deeper than past event plumes. Additional samples will be analyzed before the summer field season to better target areas of scientific interest for the ROPOS expedition at Axial Seamount.

An enormous amount of interest from the public was generated by the Axial seismic event in January. More than 21,000 hits on the Axial web site were made during the first week it was online. There exists now an enhanced ability to transmit data and images from ships at sea that will allow for a daily updated web site. During the cruises of the summer of 1998, CIMRS and NOAA Vents Program staff in cooperation with the Teacher at Sea Program will have an "interactive" web link from the RON BROWN to the web which will be featured at the Hatfield Marine Science Center in August.

GLOBEC PILOT MONITORING PROGRAM of CLIMATE CHANGE OFF OREGON

This new project monitors the hydrography,

nutrients, chlorophyll, and zooplankton along two transects off the central Oregon Coast (44.6° and 43.2°N) where regular hydrographic sampling programs have existed in the past. Five cruises per year collect data that will provide both a basis for retrospective analysis of coastal ocean conditions in the northeast Pacific and the temporal context for subsequent process studies, i.e., enable the variability of physical and biological processes observed for only one to two years to be related to the phase of the El Niño Southern Oscillation (ENSO) cycle.

FY 97/98 Accomplishments:

- Detection of and response to Axial Seamount seismic event
- Complete bathymetric coverage of the Gorda Ridge with Sea Beam 2100
- Development of seven new portable hydrophones for year-long deployment in the eastern tropical Pacific
- Successful prototype deployment of extensometer array using JASON submersible
- Collection of monitoring data providing regional oceanic effects of the 1996 El Niño

Advice and Assistance to the NMFS to Improve Stewardship of West Coast Groundfish

Dr. Lavern Weber and Robert W. Schoning

The basic purpose is to work closely with various state and federal fisheries organizations, fishing industry, environmental entities, congressional members, and other interested constituents to develop approaches to improve research, management, and abundance of West Coast groundfish resources.

Recent assessments of some important species have indicated sharp declines in abundance with resulting severe harvest reductions. It is important that all interested parties communicate, coordinate, and cooperate in individual and joint efforts to improve the situation.

Efforts have emphasized and resulted in more frequent frank and open discussions among scientists, harvesters, and managers. Advice has been sought and received from interested constituents. More varied and cooperative research projects using chartered industry vessels with extensive

involvement of fishers in all aspects of the projects have been planned and initiated.

Essential data for assessments of many stocks is limited and inadequate. Concerted efforts have been made to obtain and include more information from the fishers' experience, observations, and extensive time on the ocean. A special Port Interview Project will gather such information quarterly from a core of volunteer longtime fishermen from five ports: one in Washington, three in Oregon, and one in California. The data will be integrated into stock assessment analysis as appropriate.

Environmental Protection Agency Office of Research and Development Coastal Ecology Branch

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 access 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-

Meetings have been held locally with regional and national agency officials and congressional members to alert them to problems and to obtain their support for expanded activities and more innovative solutions. The concept of using special allocations of fish to fund additional priority research will be tried in mid-1998.

A conference is scheduled for July to review all ongoing groundfish research projects and to obtain agreement on priority projects for the immediate future. Widespread interest and planning participation are encouraging.

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 understand 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
- 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
- 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.

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 Astoria and Charleston field offices. Staff include about 35 year-round coastal employees and additional seasonal help. Neal Coenen, Program Director, returned after a temporary assignment in Portland to facilitate the Department's strategic planning efforts.

Reorganization continued within the Marine Resources Program, with the retirement of Jerry Butler, Marine Finfish Program Leader. Beginning July 1, 1998, MRP will drop species lines and will consist of three major program units: Resource Assessment and Analysis, Resource Monitoring and Sampling, and a Data Services unit. It is hoped the new organization will have a more flexible workforce and that efficiencies will be created in sampling and data services.

Administration continued to support their full commercial licensing service and point of sale recreational service. The point of sale system will be converting over to a new computer system in 1998. Carol Ells joined the Administrative unit as a half-time clerical assistant. Rebecca Fuller transferred from the Department's Northwest Region to fill a licensing and office specialist position.

The changes in the Pacific Coast groundfish fishery management coupled with a strong El Niño precipitated a crisis in the groundfish industry. The Pacific Fishery Management Council recommended significant reductions in harvest of several important species of groundfish based on updated stock assessments. By-catch and discard of trip limit managed species continued to be of concern. The state Emergency Board added funds 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 at-sea and dock-side programs research and sampling programs. MRP began by conducting pot survey of sablefish off the Oregon coast in 1997. Plans are being developed to continue with a comparison of pot, longline, and possibly trawl methods in 1998 with the objective of developing a new survey tool for sablefish and

deepwater rockfish.

Shore-based Pacific whiting fishery sampling continued, and staff continued the enhanced data collection study in cooperation with the Oregon Trawl Commission. Staff also began a new cooperative Port Interview Project with National Marine Fisheries Service and select members of the fishing industry. Port biologists will interview trawl skippers to gather information about environmental changes, changes in fishing practices, and other events that may have influenced catch rates and species composition.

The rapid development of a live fish and fresh fish markets has led to a 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 initiated studies to take a closer look at Oregon's nearshore reef resources in 1998. They will be mapping and doing biological sampling of key reef areas in addition to sampling the sport and commercial fisheries that depend on them. A draft management plan will be sent out for public review in 1998.

Their kelp/reef studies changed emphasis this year, as insufficient kelp was produced for experimental harvest under the Division of State Lands experimental kelp lease project. They will continue to monitor southern Oregon kelp beds with aerial photography into the near future.

With the help of several contributors, the Department contracted with Jerry Alto to produce a video on Oregon's estuaries. The video should be complete and available for distribution later in 1998.

Ocean Salmon Program continued to monitor ocean fisheries, primarily for chinook stocks, which continue to provide opportunities for commercial and recreational harvesters. Staff have been preparing for potential selective fisheries monitoring and evaluation under a new mass marking initiative for hatchery coho.

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, as well as studies of introduced species. Vicki Hoover, a former Department employee, recently started a graduate program to look at the economics of shrimp fishing, and will be working with OSU's Gil Sylvia and with Bob Hannah and Steve Jones from ODFW staff.

National Marine Fisheries Service

Fisheries Behavioral Ecology Program,

Alaska Fisheries Science Center

Bori L. Olla, Program Manager

Experimental Bycatch Studies

The major expansion of experimental facilities to support their new initiative in bycatch research is now fully operational. This expansion includes large experimental pools in which seawater can be cooled to duplicate temperatures that adult fish species from northern California to Alaska occupy throughout the year and a uniquely designed apparatus that can simulate stresses imposed by trawling. Recent results have shown that: 1) light intensity plays a major role in determining whether walleye pollock and sablefish can avoid net-entrapment (at light levels too low to detect net meshes post-capture mortality increased significantly in walleye pollock); 2) elevated surface temperatures which matched those that are present during summer and early fall in Northwest waters played a significant role in increasing mortality by magnifying the effects of simulated trawling stress in sablefish; 3) biochemical assays for plasma cortisol and lactate indicate clear stress responses to trawling and temperature in sablefish; these measures can ultimately be used for at-sea evaluation of post-capture responses and survival potential. These results demonstrate that 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

Recent experimental studies have focused on the behavioral decisions individual fish make that depend on their internal state, e.g., health or condition and the context of their environment, e.g., the location of food and predators. Behavioral compromises or trade-offs are often necessary to balance different ecological requirements. Hungry fish, for example, may be more likely than well-fed fish to risk encounters with a predator if it might increase the chances of obtaining food. Revealing these

contrasting responses helps us to understand the priorities of individuals and better predict the spatial distribution and the probability of survival as environmental conditions vary.

They examined trade-offs in foraging behavior and predator avoidance in juveniles of two species that possess contrasting life histories, sablefish and walleye pollock. Early juvenile sablefish are generally restricted to the neustonic layer of the water column, where they exhibit extremely rapid growth rates. On the other hand, young juvenile walleye pollock display a greater vertical range of movement through the water column, and have much slower growth rates than sablefish. We predicted that the energetic requirements necessary to support such rapid growth in sablefish could make them risk-prone, i.e., their motivation to feed would supersede their motivation to avoid predators. In contrast, they predicted that walleye pollock, with their lower energy needs, would be more cautious when confronted with potential predation.

The results generally supported their predictions. Sablefish were much less responsive to the threat of predation and recovered quickly in contrast to walleye pollock, which in some cases did not return to pre-threat levels of behavior for more than an hour following the threat. Because of the reduced responsiveness of sablefish, there was no apparent effect of hunger or condition on behavior of this species. However, for walleye pollock, reduced food availability apparently increased their risk-taking, since they exhibited rapid recovery to the threat imposed by a predator.

The flexibility of behaviors observed in these experiments suggests that risk-taking is influenced by the life history of the species, body condition or hunger level of the individual and the social environment (presence or absence of conspecifics).

Visual Capabilities for Juvenile Fishes

Prior laboratory experiments have addressed how light influences the vertical distribution of larval and fishes. While these studies continue, over the last several years efforts have begun to examine how ambient light influences the abilities of juvenile walleye pollock and juvenile sablefish to feed, school and avoid predators. These studies have necessi-

tated the construction of new experimental infrared monitoring systems to allow for the study of fish under extremely low visible light levels. Feeding experiments have shown that although juvenile walleye pollock and sablefish are able to feed upon planktonic prey in the darkness, both are more successful when there is adequate light for visually mediated foraging. The threshold for visual feeding juvenile walleye pollock indicates that they typically capture prey by using vision during the day even at considerable depths, but must resort to nonvisual foraging at night. Juvenile sablefish possess a visual foraging threshold which is two orders of magnitude higher than that for walleye pollock, demon-

strating that they are less well adapted for visual foraging at night or at depth, which may be responsible for their not making the extensive daily vertical migrations which are typically observed in juvenile walleye pollock.

These investigations are laying the ground work for future expansion of bycatch research, since establishing a basic understanding of how light influences the behavior of juvenile fishes is a prerequisite to evaluating how light levels influences juvenile responses to entrapment by commercial trawl gear and how this may impact basic survival capabilities.

National Marine Fisheries Service Northwest Fisheries Science Center

Salmonid Ecosystem Analysis Program Bruce McCain, Program Coordinator

Introduction (Bruce McCain, NWFSC Facilities Manager; Mary Craig and Laurie Muth, Administrative Staff)

In October, the Northwest Fisheries Science Center (NWFSC) underwent an organizational restructuring, creating a new division, called the Fish Ecology Division (FED), and reassigning some personnel from one division to another. This resulted in three divisions now represented at the Newport Laboratory. The number of staff in each include: Fish Ecology (3), Fishery Resource Analysis and Monitoring Division (FRAMD) (12), and Environmental Conservation Division (ECD) (3). Each division is assisted by scientists from other groups at the HMSC; the Fish Ecology and Environmental Conservation Divisions each have two scientists with Oregon State University (OSU) as part of the Cooperative Institute for Marine Resources Studies (CIMRS), and the Fishery Resource Analysis and Monitoring Division has three personnel from the Oregon Department of Fish and Wildlife (ODFW) in the Ageing Unit.

Progress was made towards constructing a new building on NOAA property. The building will be used primarily for offices for the expanding programs of the NWFSC at the HMSC. A joint project agreement between OSU and the National Marine Fisheries Service (NMFS) has been signed. This agreement supports the long-term commitment of

both our organizations to conduct collaborative research and provides formal arrangements for us to share space and other facilities. Also, a contract to complete a facility program requirements study has been issued, and a contract to explore various building design options will be issued soon. We hope we can begin the building process over the next several months.

Environmental Conservation Division (Mary Arkoosh, Ethan Clemons, and Anna Kagley)

Recent research conducted by the staff of the ECD at the HMSC focused on interrelationships among host resistance, environmental stressors (e.g. pollution), and infectious pathogens. Previous research showed that exposure to pollutants can lead to immunosuppression 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 (reduced 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. The most pervasive pathogens were *Nanophyetus salmincola*, *Renibacterium salmoninarum*, and an erythrocytic

cytoplasmic virus.

Currently, they have extended their studies to include salmon with different life histories (juvenile coho salmon as well as juvenile chinook salmon) and we have expanded our 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.

Fish Ecology Division (NWFSC: Bill Peterson, Bob Emmett, and Kym Jacobson; CIMRS: Cheryl Morgan 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. The division emphasizes 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 to 3 times per month at sampling stations located 1, 3, 5, and 10 miles west of Newport was continued under the leadership of Dr. William Peterson. The underlying hypothesis driving this work is that the distribution and abundance of plankton off Oregon has changed as a result of the climate regime shift which occurred throughout the North Pacific in 1977. The monitoring program began 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. In order to determine if the coastal marine ecosystem has changed over the past 20 years, these data will be compared to sampling of a similar nature conducted

in the 1970's.

The results of this monitoring program from the past year demonstrated that ocean conditions in 1997 off Newport were "normal" early in the season: upwelling was initiated with an early spring transition (late-March); this was followed by a boom in zooplankton production during April—copepod densities were the highest that have ever been observed for that time of the year. However, biological production slowed during the first week of May due to a weakening in upwelling and remained low throughout the rest of the summer. A brief but strong upwelling event occurred from 12 July through 19 August with little biological response; after that, upwelling ceased altogether. As a result of weak upwelling, sea surface temperatures on the continental shelf warmed from 12 to 17° C (May until mid-July), cooled to 10° C during the five-week upwelling period, then abruptly warmed in late August to a record temperature of 18.5°C. This is warmer by 1 degree than any observation made during the 1983 El Nino event. Zooplankton abundances were low during most of the summer due to lack of upwelling and influx of offshore warm water.

Ocean conditions in 1998 continue to show signs of effects of the El Nino event. Surface waters continue to be warm (13°C in late May) and zooplankton numbers remain low with most of the individuals being species which are common in offshore waters rather than species typical of productive nearshore species.

Fishery Resource Analysis and Monitoring Division (FRAMD)

Groundfish Analysis Program (Ray Conser, Jon Brodziak, Paul Crone, Jean Rogers, Tonya Builder, Milly Gist and Dan Kamikawa)

The Groundfish Analysis Program has seven scientists at HMSC comprising a multi-disciplinary team with expertise in fishery biology and ecology, stock assessment, mathematical modelling, statistics, computer science, and field sampling techniques. The goals of the program are to improve understanding of West Coast groundfish population dynamics and their ecosystem, and to utilize this knowledge to provide technical support for assess-

ment and management of West Coast marine fisheries. Program scientists conduct stock assessments, provide review and oversight for assessments carried out at other West Coast laboratories, and serve in advisory roles for the Pacific Fishery Management Council. They also serve on domestic and international committees and teams that address general stock assessment and fishery management issues. Areas of current research emphasis are: 1) improved fishery stock assessment methods and computer modelling techniques; 2) enhanced fishery monitoring, particularly through at-sea observation and data collection; 3) biological studies to better estimate vital rate parameters; and 4) survival studies of discarded bycatch.

During the past year, program scientists conducted research on the development of indices of abundance from fishery logbook data; on better understanding Dover sole growth; on incorporating the effects of the bathymetric demography of the deepwater complex into stock assessments; and on developing cooperative sampling programs with the fishing industry. They also carried out stock assessments for sablefish, shortspine thornyheads, longspine thornyheads, and Dover sole. The miscellaneous rockfish complex off the west coast was assessed the previous year. For some of these species, this research suggested significant population declines and current fishing levels that are not sustainable. Based on this work, the Pacific Fishery Management Council has reduced fishery quotas in order to foster the recovery of these populations.

Much of the program's research involves collaboration with academia, state fishery agencies, other NOAA elements, and the fishing industry. Collaborative research efforts are carried out on i) sablefish maturity and migration (with Oregon State University and industry); ii) groundfish ageing (with Oregon Department of Fish and Wildlife and OSU);

iii) socioeconomic aspects of the groundfish fishery (with OSU); iv) stock assessment methods (with OSU); v) sablefish discard survival rates in the bottom trawl fishery (with the University of Washington); vi) fishery observer program (with ODFW and industry); and vii) survey methods using industry standard gear and vessels (with the UW and industry).

Salmon Analysis Program (Tom Wainwright and Pete Lawson)

The FRAMD Salmon Assessment Team was formed this year, with two scientists located at HMSC in Newport, and four 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 primarily concern Oregon coastal coho salmon, but future work will involve other species in 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 University of Washington, and the National Center for Ecological Analysis and Synthesis.

National Oceanic and Atmospheric Administration

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

The Ocean Environment Research Division (OERD) of NOAA's Pacific Marine Environmental Laboratory is in its fourteenth 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 HMSC, has produced world-class research that contributes to the understanding of hydrothermal vent systems and their environmental impact.

Accomplishments

- Another year in the annual time series of plume mapping over the Cleft segment was successfully completed, and for the first time in several years an extensive survey of plumes was conducted in the summit of Axial Volcano and along the north and south rift zones in the Juan de Fuca Ridge.
- A major expedition on the NOAA Ship *Ronald H. Brown* was funded to sample and place instruments on the summit of Axial Volcano. This effort is particularly important in light of the February 1998 volcanic event recorded by U.S. Navy hydrophones on the volcano.
- A circulation summary using current meter observations near the Juan de Fuca Ridge through 1993 was published, showing new features of topographic steering that determine the fate of hydrothermal plumes.
- Analysis of the real-time, U.S. Navy hydrophone data continued, including analysis of acoustic data for marine mammal vocalization.
- Instrument deployments included Volcanic System Monitors at Axial Volcano, and moorings for interdisciplinary study were deployed around South Cleft.
- High-performance numerical model results have clarified the reasons behind differences in hydrothermal measurements site-to-site and time-to-time, and offer the possibility of relating source conditions to water-column measurements.
- Camera tows were conducted at the North Gorda Site site and discovered that lava had erupted onto the seafloor during the previous year. This was the first successful deployment of a deep-sea camera system during a rapid response effort on the mid-ocean ridge.
- The Tsunami Project network of observational stations was expanded, along with implementation and testing of tsunami numerical models for the Pacific Disaster Center.

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

The Oregon Coastal Field Office located at the Hatfield Marine Science Center supports U.S. Fish and Wildlife Service (USFWS) 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 (NWR) 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 three employees that focus on four priorities: land acquisition, habitat management and restoration, biological surveys and monitoring and environmental education and outreach. Education and outreach activities will increase markedly soon

as an outdoor recreation planner will be added to the staff this summer. The USFWS Regional Office in Portland will be stationing a bioplanner in the Newport office at the HMSC to assist with land acquisition planning for the coastal refuge. The bioplanner will be joining the staff in July. Two additional personnel are scheduled to join the growing staff later this year.

Oregon Coastal Refuges has an active land acquisition program at Siletz and Nestucca Bay National Wildlife Refuges, as well as several other locations. One of the additional sites is Crook Point in Curry County, which has recently been purchased by The Nature Conservancy (TNC) and will be held for eventual repurchase by the USFWS for inclusion in Oregon Islands NWR. The Service is interested in acquiring the 134-acre headland area to provide further protection for the adjacent Mack Reef Unit of Oregon Islands NWR, as well as unique and rare plants and habitats that occur on the mainland. 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 consisting of 87,000 birds.

Projects that have been accomplished or will be initiated in 1998 include the completion of phase one of the Coquille Point Interpretive Project, development of an interpretive overlook on the headland above Cape Arago, reforestation of a sizable tract of upland 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 initiated on the fisheries

use of Siletz Bay 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.

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.

They have continued to experiment with electronic document delivery. Successful electronic loans have been made to the Seafoods Lab in Astoria as well as to a library in Chile. They are a net lender of materials to other libraries, responding to almost 1200 requests for articles or books this year. As more European libraries use electronic means to request items, usage to them has increased. Libraries in Mexico are also becoming more electronically sophisticated through the help of our staff and other west coast marine libraries.

Janet Webster, the Head Librarian, is currently serving as the president of the Oregon Chapter of the Association of College and Research Libraries. She also serves as Parliamentarian of the Oregon Library Association. She is working on a comprehensive bibliography of Yaquina Bay with funding from Oregon Sea Grant and the Environmental Protection Agency. It will be available at the HMSC web site —

<http://www.hmsc.orst.edu/library/yaquina.html>.

Janet has also assumed administrative responsibility for the maps and government documents collection at the Valley Library.

Awards and Scholarships

Curtis & Isabella Holt Marine Education Fund for 1998-99 - Erin Williams (\$5,500) - "Feasibility of low power radio in marine education"

Walter G. Jones Memorial Scholarship for 1998
Carl Demetropoulos (\$500) - "Enhanced production of Pacific dulse"

Mamie Markham Research Awards for 1998-99

- Michelle Shiu, Food Science & Technology (\$7,056)
"Use of high hydrostatic pressure for the oyster industry"
- Keith Klesk, Food Science & Technology (\$6,000)
"Optimum pasteurization methods for refrigerated surimi"
- Chris Brooks, Fisheries & Wildlife (\$1,000)
"Prediction of adult oyster growth rates from spat growth rates"
- Kyoung Chul Park and Hamdi Ogut, Microbiology (\$7,500)
"Equipment support for graduate research"
- Stephanie Connon, Microbiology (\$6,000)
"Culturing numerically dominant bacterioplankton species"

- Umur Onal, Fisheries & Wildlife (\$7,000)
"Development of microparticulate diets for altricial fish larvae"
- Ebru Onal, Fisheries & Wildlife (\$7,000)
"Evaluation of schizochytrium as a food for marine bivalve molluscs"
- Scott Pozarycki, Toxicology Program (\$3,600)
"Response of English sole head kidney phagocytes following carbaryl exposure"
- Yong Woo Lee, Fisheries & Wildlife (\$6,000)
"Influence of oceanographic factors on the growth of marine fish species"
- Vicki Hoover-Krutzikowsky, Fisheries & Wildlife (\$8,345) - "Shrimp grounds as important rockfish nursery habitat"

Lylian Brucefield Reynolds Scholarship for 1998-99
Joseph O'Malley (\$900) - "Measuring the ages of sablefish"

Barbara Schwantes Memorial Fellowship Fund for 1998-99 - Chris Brooks (\$500) - "Selection of fast-growing oyster broodstock"

Bill Wick Marine Fisheries Award for 1998-99
Stephen Bobko (\$2,500) - "Black rockfish reproductive potential and recruitment"

Statistics

Student Enrollment

<u>Winter</u>	<u>Class</u>	<u>1997</u>	<u>1998</u>
FW 407/507	Seminar	23	13
FW 431/531	Dynamics of Marine Biological Resources	34	NA
FW 465/565	Marine Fisheries	NA	18
FW 494/594	Diseases & Parasites of Marine Fish & Invertebrates	26	11
FW 497/597	Aquaculture	23	13
FW 498/598	Aquaculture Lab	24	10
<u>Spring</u>			
Bi 450/451	Marine Biology	22	22
<u>Summer</u>			
ATS 590	Metereology for Teachers	12	NA
FW 508	Salmonid Disease Workshop	NA	20
FW 508	Estuary Ecosystems	18	NA
FW 599	Introduction to Stream Ecology	15	NA
FW 599	Environmental Issues & Public Policy	NA	13
FW 599	Field Ichthyology	NA	10
FW 599	Coastal Biology	NA	13
OC 508	Marine Mammals of North Pacific	NA	15
OC 649	Biological Oceanography for Teachers	15	NA

Public Wing Visitors

Since opening, June 1965*= 9,284,913

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

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

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

HMSC Public Wing Volunteers

1997-98 Volunteers

Frank Aicher	Christy Layton	Mary Voelkel
Joy Anderson	Frank Lush	Helen Wellman
Laura Anderson	Leslie Lythgoe	Jack Whipple
Sandie Berry	Patty Martin	Jane Whipple
Bob Bickford	Curt McCann	Sue Wilson
Peggy Bickford	Patricia McCann	Jack Woods
Janes Bones	Walt McNeal	
Gerald Boyd	Patricia Modde	
Joyce Browning	Maxine Moodie	
Helen Cahill	Bill Moore	
Jane Carr	Joanne Moore	
Prudy Caswell-Reno	Terry Morse	
Ray Clark	Kenneth Nevar	
Don DeLisle	Sue Nevar	
Mary DeLisle	Nattinee Nipataruedi	
Charlotte Dinolt	Dorothy Olson	
Kathleen Dobson	Ed Osterman	
Jim Donaldson	Jack Owens	
Carl Ehrman	Kennith Parks	
Mildred Ehrman	Mary Emma Parks	
Kay Floyd	Robert Patee	
Helen Frank	Sylvia Pauly	
Fonte Gassner	Bonnie Pazdalski	
Shirley George	Walt Pazdalski	
Diana Gring	Isabella Potter	
Craig Gring	Dolores Reed	
John Gring	Donna Reynolds	
Ferol (Dee) Hadden	Margaret Roehmer	
Althea Hatch	Walter Roehmer	
Kenneth Hatch	Howard Rubin	
Sara Hodges	Gerti Schramm	
Kathleen Holt	Denise Schrock	
Ralph Irvin	Lorraine Shewbert	
Sonia Irvin	Elfrieda Sinclair	
Paula Jones	Chet Stark	
Clyde Kellay	Christine Tomsik	
Donald Kennedy	Larry Tyler	
Nancy Kromer-Miller	Wendi Van Tine	
Sig Lambek	Van Vanderbeck	
Yvette Lambek	Joe Voelkel	

Donor Honor Roll

1997-1998 Annual Gifts

Animal Medical Care of Newport
Virginia Beardsley
Joe Blanton*
Jane Buell
A. C. Burlingham
Thomas Chandler
Duane & Gwendolyn Christensen
Lori Cooper
Richard & Elaine Crone
Bertha Cutress
Sarah Devine*
Cecil & Sally Drinkward*
Hollis Fishelson-Holstine
Barry & Carol Fisher
Crawford & Jean Graham
Ken and Althea Hatch
John Hennessey, Jr.
Bette Howard
Peggyann Hutchinson*
Robert & Virginia Jackson
Patricia Jensen*
Carmen Jones
Ernest & Duchess Josi*
Rebecca Julian*
Jasvinder Kaur
George & Joan Lammers*
Joan Martin*
Luke McIlvenny
Robert & Janet McPhee*
Christine Mitchell
Grant Mitman
Richard & Valerie Nichols
Norman & Judi Noakes*
Robert & Jerryann Olson
Matthew Prophet, Jr.
Sheila Quick*
Betty Roake-Charnock
Walter & Margaret Roehmer*
Carl & Sonia Schmitt*
John & Peg Scott*

Sea Lion Caves, Inc.*
Jack & Carol Shining*
Jean Shipman
Lorrin & Marilyn Tarlton*
Gary Telfer
Charlie & Andrea Tesch
Helen Townsend*
Lavern Weber
Norbert & Ann Wellman*
James Young*
Malcolm & Gloria Zirges

* = Marine Mammal Research Endowment Fund

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Budget	Unit	Sub-Total	Total
<u>Research Administration</u>			
Administration	379,655		
Public Wing Support	157,983		
Non-sponsored Research	32,450		
Non-sponsored Education	8,100		
Sponsored Research - Mpitsos	22,309		
Sponsored Research - Chadwick	218,898		
Sponsored Research - Chapman	29,925		
Sponsored Research - Campbell	149,910		
Sponsored Research - Other	<u>74,458</u>		
Total Research Administration		1,073,688	
Physical Plant			
State Support	365,842		
Federal Support	<u>236,263</u>		
Total Physical Plant		602,105	
Cooperative Institute for Marine Resources Studies (CIMRS)			
Sponsored Research	1,869,891	1,869,891	
College of Forestry			
Coastal Oregon Productivity Enhancement	150,000	150,000	
College of Oceanic & Atmospheric Sciences			
Ship Support/Operations	1,909,939		
Ship Scientific Equipment	<u>503,296</u>		
Total Ship Operations		2,413,235	
Education Programs			
Extension	49,958		
Sea Grant	76,052		
Sponsored Programs	60,413		
Self-Funded Programs	6,388		
Dept. of Education	<u>7,473</u>		
Total Education Programs		200,284	
Housing			
Self-Funded Operations	64,180	64,180	
Bookshop			
Self-Funded Operations	158,250	158,250	
Other			
Guin Library	262,968		
OSU Foundation	25,242		
Network Service	32,354		
Federal Agencies	<u>21,739</u>		
Total Other		342,303	
Construction Projects			
HMSC Public Wing	554,342		
HMSC Education Bldg	25,000		
Total Construction		<u>579,342</u>	
Total Hatfield Marine Science Center			\$7,453,278

Coastal Oregon Marine Experiment Station

Astoria Seafood Lab

Research Type

Seafood Laboratory Administration	150,446	
Experiment Station Non-Sponsored Research	309,442	
Self-Funded Research/Education	22,384	
Sponsored Research	<u>246,370</u>	

Total Astoria

\$728,642

Newport

Marine Branch Station - Admin	164,645	
Cost Share to Match Federal Funds	20,192	184,837

Marine Mammal Research - Mate

Marine Mammal Endowment	373,067	
Sponsored Research	131,750	
Non-sponsored Research	23,219	
Extension	28,914	

Total Marine Mammal Research

556,950

Marketing - Sylvia

Sponsored Research	71,443	
Non-sponsored Research	105,297	

Total Marketing

176,740

Fish Disease - Reno

Sponsored Research	23,767	
Non-sponsored Research	99,478	

Total Fish Disease

123,245

Fishing Analysis

P.I. - Sampson

Sponsored Research	151,668	
Non-sponsored Research	1,140	

152,808

P.I. - Berkeley

Sponsored Research	221,889	
Non-sponsored Research	0	

221,889

Total Fishing Analysis

374,697

Aquaculture

P.I. - Langdon

Sponsored Research	355,728	
Non-sponsored Research	18,664	

374,392

P.I. - Robinson

Sponsored Research	33,752	
Non-sponsored Research	5,375	

39,127

Total Aquaculture

413,519

Total Newport

\$1,829,988

Total Coastal Oregon Marine Experiment Station

\$2,558,630

BUDGET CONTINUED ON NEXT PAGE

Cooperating Agencies		
Environmental Protection Agency	2,369,000	
Oregon Department of Fish & Wildlife	3,092,000	
Oregon Pacific Area Health Education Consortium	400,000	
NOAA VENTS Program	2,200,000	
National Marine Fisheries Service, Northwest	2,058,000	
National Marine Fisheries Service, Alaska	675,000	
US Fish & Wildlife Service	<u>1,308,100</u>	
Total Cooperating Agencies		<u>\$12,102,100</u>

TOTAL BUDGET FOR HMSC

\$22,114,009

BREAKDOWN OF FUNDING SOURCES

% of Total

Direct State Funding				
HMSC	903,480			
COMES	<u>897,898</u>			
Total Direct State Funding		\$1,801,378		8%
Other State Funding				
Matching Funds (Endowments)	195,358			
COPE - College of Forestry	150,000			
Guin Library	262,968			
Research Office Sponsored Research	<u>7,212</u>			
Total Other State Funding		\$615,538		3%
Sponsored Research				
National Oceanic & Atmospheric Admin.	3,788,518			
National Science Foundation	1,758,167			
Housing and Urban Development	602,660			
US Dept of Agriculture	273,094			
Public Health Service	149,910			
Dept. of Defense	154,092			
National Coastal Research & Develop. Inst.	112,919			
Oregon Dept of Fish & Wildlife	86,656			
Oregon Dept of Education	5,971			
Extension Service	49,958			
Donations & Private Business	301,546			
Sub-contracts to other Universities	<u>18,162</u>			
Total Sponsored Research		7,301,653		33%
Other Funding				
Self-Funding Units	293,340			
Cooperating Agencies	<u>12,102,100</u>			
Total Other Funding		<u>12,395,440</u>		56%
TOTAL BUDGET FOR HMSC		\$22,114,009		100%

