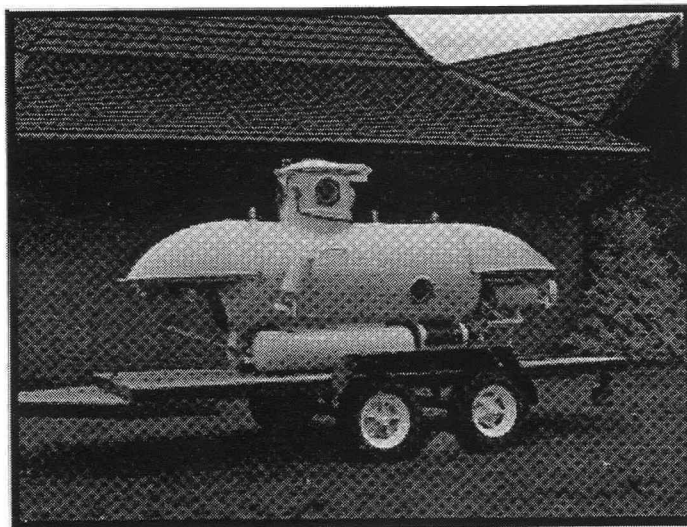

1999-2000 Annual Report

Oregon State University Hatfield Marine Science Center July 2000



The new yellow submarine catches visitors' attention in front of Visitor Center.

Contents

Director's Message. . .2

I. Public Outreach/Extension

- Visitor Center. . .7
- Extension Sea Grant. . .8

II. Research

- College of Oceanic & Atmospheric Sciences Ship Operations. . .9
- Hatfield Marine Science Center Independent Researchers. . .9
- Coastal Oregon Marine Experiment Station. . .12
- Cooperative Institute for Marine Resources Studies. . .17
- Environmental Protection Agency. . .19
- Oregon Department of Fish and Wildlife. . .20
- National Marine Fisheries Service, Alaska Fisheries Science Center. . .21
- National Marine Fisheries Service, Northwest Fisheries Science Center. . .23
- National Oceanic & Atmospheric Administration VENTS Program. . .28
- United States Fish and Wildlife Service. . .29

III. Education/Administration

- Scholarships. . .30
- Guin Library. . .31

IV. Appendices

- Statistics. . .32
 - List of Volunteers. . .33
 - List of Donors. . .34
 - Publications. . .35
 - Budget. . .40
-

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1999-2000 Annual Report

Oregon State University

Hatfield Marine Science Center

Director's Message

Lavern Weber, Director

This past winter of 1999-2000 we started the new millennium, highlighted by mud slides across Highway 101, essentially closing off coastal traffic north and south of Newport. This left Newport with only boat access to the west and one highway (34 or 20, depending on the slides) open to the east.

Associated with the new millennium was the "New Millennium Observatory" whose work was supported with direct information from the *R/V Thompson* to our auditorium. This was received well by researchers and the public at the HMSC Visitor Center. Sea Grant has also been instrumental in installing a low-power radio system which describes HMSC programs and research. Sea Grant has collaborated with the National Marine Fisheries Service to put in a new large tank in our Visitor Center with information about sablefish. We have also added to our educational program with a yellow submarine donated to the HMSC by the Oregon Museum of Science and Industry (OMSI).

Under the leadership of Bori Olla and contributions from OSU, NMFS and EPA, a Distinguished Marine Science Colloquium was formed and has been extremely well received. We thank Bori for his efforts in this and we want to continue this in the future. This is in addition to our regularly scheduled seminars throughout the year.

The Cooperative Institute for Marine Resources Studies (CIMRS) has a new Director, Dr. Clare Reimers, and we are looking forward to increased

activities between OSU and NOAA participants at the Center. We are in the midst of a search for two scientists: one in marine fish ecology and one in population genetics, welcome additions to the COMES. We also welcome a new graduate student scholarship to our list of funding opportunities for students at the HMSC, with the Anja Robinson Fellowship. This supports students in the field of shellfish aquaculture.

This spring we were given a five-year review by the OSU Research Office. Although this is a five-year review, this is the first external review the HMSC has had during my 23-year tenure at the Center. You will find the reviewers' comments in the section below. Two of the review team were directors of other marine labs, one a chief of a federal research facility, and the fourth and chair is a director of a research unit at OSU. The Director hopes the review will be useful in bolstering certain programs at the HMSC. Within that review, mention was made of the Guin Library as a highlight of the Center. The Guin Library has kept up with the expanding library information technology. One of the key areas is ORBIS, a unified library catalog system making over 7 million books available to our researchers.

We have had a number of changes in our physical plant, with a new physical plant manager, Randy Walker; moving the physical plant shops from the RSF building to the west wing of the main building; and continuing a concerted emphasis on safety both in the shops and throughout the Center. Another safety item was new lighting to our after-hours Visitor entrance.

(continued next page)



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OREGON STATE
UNIVERSITY

Bruce Mate has contributed a boat storage shed to the Center through funds from the Marine Mammal Endowment.

One of the really neat things about working at the Center is the generally high morale and enthusiasm for the Center and its activities. There are a number of events that help create this positive attitude, such as the annual picnic, golf tournament, volunteer potluck, Christmas potluck, Rogue Brewery reception for the HMSC, blood drives, the Soup Kitchen to

raise money for the Lincoln County Food Share, and the establishment of a clean-up day with over 40 individuals participating. The clean-up day was aimed at getting rid of invasive species; however, we found that most plants here are invasive species, so we somewhat limited our work to beautification.

Overall it has been a great year and we are looking forward to continued progress.

Five-Year External Review Report - April 4-5, 2000

First Report

The External Review Panel for the Oregon State University Hatfield Marine Science Center met on April 4-5, 2000. The Panel included Dr. Russel Meints, Director of the Center for Gene Research and Biotechnology at Oregon State University; Dr. Lynda Shapiro, Director of the Oregon Institute of Marine Biology of the University of Oregon; Dr. A. O. Dennis Willows, Director of the Friday Harbor Laboratories of the University of Washington; and Dr. James Winton, Chief of the Fish Health Section at the Western Fisheries Research Center.

Following an introductory breakfast with Dr. Wilson C. Hayes, Vice Provost for Research and Ms. Peggy Lowry from the Research Office, the Panel was driven to the HMSC by Dr. Meints. During the course of the day, the Panel met with Dr. Lavern Weber, Director of the HMSC and with selected staff representing the various Federal, State and University entities housed at the Center. This day proved exceptionally informative and the Panel was able to develop several shared impressions about the HMSC. These include:

1. With few exceptions, the physical plant of the HMSC represents a state-of-the-art facility for marine research in its broadest sense. The combination of geographic location, oceanographic cruise staging and ship berthing, modern laboratory and office space, on-site faculty and student housing and an outstanding library offer no serious limitations to

the ability to conduct high quality basic and applied research, teaching and outreach within the various disciplines of marine science. With the exception of comments about the rapid availability of short-term faculty housing and the need for satellite links to the teaching program on campus (see recommendations below), the impressions of the Panel and the comments received suggested the HMSC offers an unusually attractive and productive environment in which to work.

2. The scope and scale of the various programs housed at the HMSC is virtually unique. The combination of a large Federal research presence, several State and Federal management agencies and strong University extension and outreach programs are dominant factors in the type of work conducted at the HMSC. The presence of these diverse entities was judged by the Panel as offering both important opportunities and a potential liability. The opportunities involve the stated desire of scientists in the various State and Federal agencies to collaborate with University faculty to further the research, teaching and outreach programs. A liability involves their overwhelming presence relative to the modest support from the University for the basic science and teaching programs as discussed below.

3. A third impression was the obvious enthusiasm of the staff at the HMSC for the facility and the scientific and educational potential available at the Center. However, there was a shared perception that Oregon State University was failing to take advantage of these opportunities for a variety of reasons that included: a lack of direct budgetary support for the research and teaching programs at the HMSC, a lack of a shared vision as to the mission

of the Center, and a perception by faculty on the Corvallis campus that the distance to Newport provided a major impediment to research or teaching and compromised the academic advancement of scientists located at the HMSC.

4. It appeared to the Panel that the HMSC had grown to its present form largely through circumstance and in the absence of a clear vision or substantial funding from Oregon State University. This is due, in part, to the nature of the federal funding that supported the major expansion of the Center's physical plant and that drives a significant amount of the current research agenda, the lack of a single entity at Oregon State University with ownership of the marine science program, and the need for the Director of the HMSC to spend a considerable amount of time seeking outside funds to support the operations and programs of the Center as well as serving as a facilities manager for the increasing federal presence at the HMSC.

5. Dr. Weber has proven to be an exceptionally effective Director in the absence of adequate resources from the University. The Panel was impressed with all that he has accomplished and this effectiveness was generally reflected in the positive comments received from those at the Center and on campus. His success is due, in large part, to his strong personal commitment to the HMSC and his unfailing belief that the Center offers a unique opportunity for excellence. The impending retirement of Dr. Weber will require Oregon State University to recruit a replacement and the Panel believes that the University must use this opportunity to address many of the issues raised in the Review. While it will be challenging to find a person as effective as Dr. Weber in the role he has been given, this recruitment also provides an important opportunity to define a new vision for the Center and develop a cohesive program that will assist the HMSC in achieving its enormous potential and enhancing the stature of Oregon State University in the marine sciences.

The second day of the Review was spent on the Corvallis Campus. Following a breakfast meeting with Dr. John Byrne, past President of Oregon State University and Dr. George Keller, past Dean of Research, the Panel met with Deans, Chairs and interested faculty members from the College of Agriculture, College of Pharmacy and College of Science. Absent were the Dean of the College of Oceanic and Atmospheric Sciences and the Director

of the Oregon State University Sea Grant Program [The Associate Director for Oregon Sea Grant, Jay Rasmussen, met with the Panel the day before.] These discussions reinforced the impressions of the previous day and provided input to the following recommendations that are grouped to reflect common themes. The Panel recognizes the difficult budgetary climate in which Oregon has placed its institutions of higher education and has tried to provide recommendations that are relatively inexpensive to implement. Nevertheless, it will be difficult for the HMSC to realize its full potential without the commitment of additional resources from Oregon State University.

Recommendations designed to enhance communication between the HMSC and the various Colleges and Departments in Corvallis in order to develop a cohesive vision for the Center

1. The Vice Provost for Research should form a committee of Deans, Department Chairs, Sea Grant, etc., that will visit the HMSC and work with the Director and senior University, Federal and State agency staff at the HMSC to develop a coherent vision for the Center including the recruitment of Dr. Weber's successor. This should include a formal plan for reaching identified goals and encouraging replacement faculty positions in the various departments be filled by those who could work at the HMSC (at least part-time). The Vice Provost for Research should accompany this group on visits to Newport (at least annually) to become familiar with opportunities and present staff there with a tangible measure of interest. This "working group" of Deans and Chairs with marine interests should also define priority areas in their units of scholarship, research and teaching which overlap and which could be supported at the HMSC. The goal is to glue together a program focus in marine science that includes the HMSC. New faculty appointments that emerge need NOT automatically reside at Newport, only be deeply interested. Some/all will grow at OSU to be HMSC constituents.

2. Consider creation of an interdisciplinary Marine Ecology (or Marine Sciences) program with regular meetings (including beer and wine) to develop multi-investigator initiatives across departmental lines. This could result in highly competitive proposals for submission to granting agencies and might eventually lead to an interdisciplinary degree in Marine Biology. These meetings could also be used to review progress of the working group

chaired by the Vice Provost for Research and to provide faculty members an opportunity for input into the future directions of the HMSC.

3. The HMSC should consider creation of a Development Advisory Board led by someone like Mark Hatfield. This Board could consist of about 20 people with a passion for the Center. They should be drawn from local enterprises with fundraising potential. This Board would seek to develop an endowment for the teaching and research programs at the HMSC. Place this high on the OSU Development list of agendas—it has much potential.

Recommendations designed to enhance educational opportunities

1. A short, intense research experience for senior undergrads at the HMSC would be invaluable, transformational and probably the most important experience of their lives at OSU. Consider making this possible by investing in undergraduate research apprenticeships.

2. All marine science programs at OSU should, for the sake of graduate program quality, require graduate students to include a quarter of intense training experience at a field station or on shipboard.

3. Encourage scientists in the State and Federal laboratories to seek affiliate faculty status in appropriate University Departments and to link up with campus faculty in support of graduate student stipends, undergraduate research opportunities and extension activities at the HMSC. These Federal researchers expressed interest in funding such collaborations and are also available to teach courses on a limited basis.

4. Develop a series of seminars/short courses to be presented at the HMSC for students, the general public (the Seatuaqua Program) and improved science education for K-12. These should be team-taught in conjunction with academic staff from campus whenever possible.

5. Encourage campus faculty members to give more seminars at the HMSC.

Recommendations designed to enhance infrastructure at the Center

1. Enhance the use of satellite/internet links between the HMSC and Corvallis so that students in residence at the HMSC can take some of the required

academic courses without commuting to Corvallis. Such links would also provide opportunities for students and faculty at both the HMSC and Corvallis to sit in on seminars offered at the other campus. [Such facilities already exist at the HMSC and have been used for this. The problem has been financing the cost of such broadcasts.]

2. Continue to emphasize the importance of support for the HMSC library. Federal and State agencies that use the facility should be expected to contribute to its operation. The library is an exceptional resource that can serve as the focal point for activities at the entire Center.

3. Investigate ways to obtain additional short-term faculty housing to encourage visits by faculty from Corvallis. Possible approaches include long-term rental of condos or apartments in Newport, seeking additional private donations and identifying some private or corporate entities that might be interested in trading access to housing and HMSC facilities (e.g., 1 month per year) in exchange for capital to buy facility. Companies to solicit include Tektronix, H-P, TI, etc.)

4. Establish a capital equipment fund to replace aging equipment at the Center.

Second Report

The Hatfield Marine Science Center (HMSC) is an excellent facility for marine science and education, built primarily by the efforts of Lavern Weber. The outreach and "K-graduate" educational programs are national models, and provide OSU with a powerful link to the public. The undergraduate and graduate education programs are outstanding and serve OSU students in a wide range of majors. The applied science research programs are spotty. Some are clearly excellent by any standards, while others bring less to OSU. The Center is not used much for basic research in coastal marine science.

Recommendations

1. **Strengthen the applied science program** by instituting a rigorous program of review. There is a widely-held belief, apparent here as well as at many universities, that "soft" scientists (whose programs are supported entirely by outside funding), since they provide funds rather than use them, should not

be subject to the same review process expected of university-supported faculty. This policy often results in marginalization of outstanding scientists, and permits the retention of other scientists whose reputations do not benefit the university.

The actual review process should be designated by the departments in which these scientists hold courtesy appointments. Criteria might include (a) overhead contributions averaged over a three-year period that at least cover all costs, and (b) at least one first-authored publication per year, in journals approved by the supporting departments. At certain intervals, the opinions of qualified outside reviewers should be sought.

The extension program built around the applied science programs should be continued. It would be difficult to improve it.

2. Develop a basic science program in marine coastal science that utilizes the marvelous facilities at the HMSC. Whatever history has prevented this in the past, it is time to begin anew and build a strong link between basic science on the main campus and the HMSC.

This decade is being regarded widely as a time of opportunity for the environmental sciences, which have traditionally been regarded as instrumentation-limited. Advances in computer science, molecular science and medical science have provided exciting new tools that allow environmental scientists to ask questions that could not have been approached even ten years ago.

Funding will become more available because the environmental problems of the next several decades will force it. This year's proposed budget includes significant increases for environmental science research. Given that a very large proportion of the US population lives on a coast, it is reasonable to assume that the increased funding will provide specifically for coastal marine sciences.

Opportunities exist on campus in that faculty lines are open in several academic departments that might support basic research in marine science. While these lines are not under the control of the research office, support and encouragement in the form of setup opportunities can encourage the development of a strong coastal marine science

program that will utilize the existing facilities of the HMSC.

A Visiting Scientist or Postdoctoral Scholar Program, for scientists hosted in Corvallis and utilizing the HMSC facility, could help to foster the development of a coastal marine program. NSF's IGERT program should be explored as a way to encourage interdepartmental training of coastal marine scientists.

3. The College of Oceanic and Atmospheric Sciences did not participate in the site visit. At one time, College faculty were in residence at the HMSC, but this practice was discontinued, perhaps because a strong programmatic link between the College and the HMSC was not maintained. Encourage partnership, especially in view of the new national interest in nearshore oceanographic processes. The HMSC could provide facility support for strong existing OCE programs in coastal oceanography. The College could and should be a major component of any new program development in coastal marine science.

4. When Lavern Weber retires, consider replacing him with two people: a director who resides in Corvallis and who is responsible for program development, encouragement of cooperation and coordination with main campus units, and general facility oversight; and an assistant or associate director who resides at the HMSC and who is responsible for day-to-day operation of the HMSC.

In summary, the perception that 50 miles is a great distance is just that — a perception. Many of my colleagues commute that distance daily. The distance isn't the problem though the perception may be a symptom of it. The HMSC is a marvelous facility supporting some excellent programs. It is fully or mostly occupied, but it is not fully integrated with the main campus and thus does not serve OSU as well as it might. The HMSC could become the focus of a strong, centralized program in coastal marine science that unites many separate programs in Corvallis, and links them to the programs and facilities at the HMSC.

I remain amazed at what Lavern has built despite the absence of a solid academic mandate from Corvallis. Rather than worrying about why the mandate never developed, I would take advantage of a number of open faculty lines to encourage its development now.

Extension Sea Grant Visitor Center

Jon Luke, Manager

The Hatfield Marine Science Visitor Center celebrates its 35th year of introducing basic concepts of oceanography and marine science to the general public. Since 1965, over 9.5 million people have visited. The remodeled Visitor Center under the program leadership and administration of Oregon Sea Grant continues to serve the nation, state, and university as a model for enhancing the public's understanding of science and marine education. The remodeled Visitor Center serves as a model for enhancing the public's understanding of science and the challenge of interpreting scientific research in a meaningful manner. Researchers at Oregon Sea Grant, OSU, and the affiliated state and federal agencies at Hatfield Marine Science Center (HMSC) use this valuable platform for programs and projects to bridge the information gap between scientific research and the general public. In turn, the public has a better tool to learn about the science investigations going on in the field and in the laboratory.

Many exhibits use current technology to reveal the dynamic research being conducted by over 200 scientists associated with the many agencies housed at the Center. Rather than teaching general concepts of marine science, the Visitor Center generates an understanding of and appreciation for coastal and marine scientific research. The Visitor Center works toward educating the public on why and how we study the ocean, in addition to what we know about the marine environment.

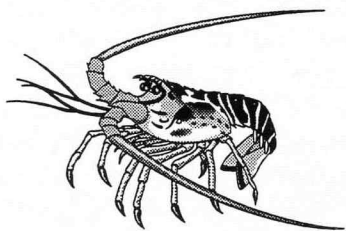
The theme "Searching for Patterns in a Complex World" was developed to aid in understanding a fundamental process in science. The theme is reinforced throughout the exhibits to challenge people and encourage them to continue thinking about and observing patterns after their visit. This year we added a new tool to make this theme more apparent to the visitor with the development of an award-winning four-minute video called "Searching for Patterns." This video will be played regularly in our auditorium to reinforce the exhibit theme and organizational layout.

Two new audio exhibits add another dimension. Working with Extension Sea Grant specialist Bruce DeYoung, the Visitor Center is experimenting with the innovative uses of low power radio technology. By tuning their radios to 1610 AM as they approach the Center, visitors hear a welcome from Senator Mark Hatfield and other recorded messages highlighting services, programs, and exhibits. The second, an outdoor audio exhibit called InfoMotion, is triggered by a motion sensor that cues a recorded message. The InfoMotion installed on the new eye-catching yellow submarine explains the development of oceanographic technologies for "ground truthing" studies and research.

The HMSC Visitor Center is one of eleven Coastal Ecosystem Learning Centers designated by Coastal America. Exciting informal education programs conducted at the Center exemplify the kind of cooperative programming encouraged by Coastal America. For example, during the summer months, the Visitor Center focuses on the deep sea. In cooperation with National Oceanic and Atmospheric Administration's (NOAA) VENTS program and Oregon Sea Grant, the Visitor Center hosts the New Millennium Observatory. Aboard a NOAA research vessel, an educator chronicles daily events through email and digital images on a web page. The information is used for two daily presentations in our auditorium. Visitors are encouraged to ask questions that are sent back out to sea to be answered the following day. The Visitor Center organizes an ongoing speaker series that is associated with the seasonal programming themes. Once or twice a month, researchers present their results in the Visitor Center's auditorium. Previous themes include Marine Mammals, Coastal Hazards, Resource Management, and Marine Ecosystems. This year a new theme program was developed in conjunction with the Biological Colloquium on Invasive Species held at OSU.

With the generous support of Wiancko Foundation we developed new internship opportunities for university students. The interns gain valuable experience in public education and interpretation and create projects that advance and improve the services we offer in the Visitor Center.

One of the most unique aspects of the HMSC Visitor Center is its commitment to evaluating the effectiveness of public science education in both formal and informal settings. For example, a study on the "Demographic Popularity of Four Types of Computer-Mediated Exhibits" was completed this year. Two Wiancko scholarship students completed studies this year as well: one on the effectiveness of the interpretive text for the Chaos exhibit; the second study evaluated pre- and post-visit educational materials for school groups.



Ken Hilderbrand: Seafood Processing

Ken Hilderbrand's continuing work with the SHA (Seafood HACCP Alliance) as a member of the Steering and Editorial Committees has resulted in the publication of a new training manual "Sanitation Control Procedures for Processing Fish and Fishery Products." This publication is available for \$25 from the University of Florida at PO Box 110409, Gainesville FL, 32611-0409. The SHA is a voluntary organization of academia, seafood industry, and regulatory agencies which has developed training programs for the seafood industry. These programs are intended to help industry comply with FDA's "Safe and Sanitary Processing and Importing" regulations which took effect in December of 1997.

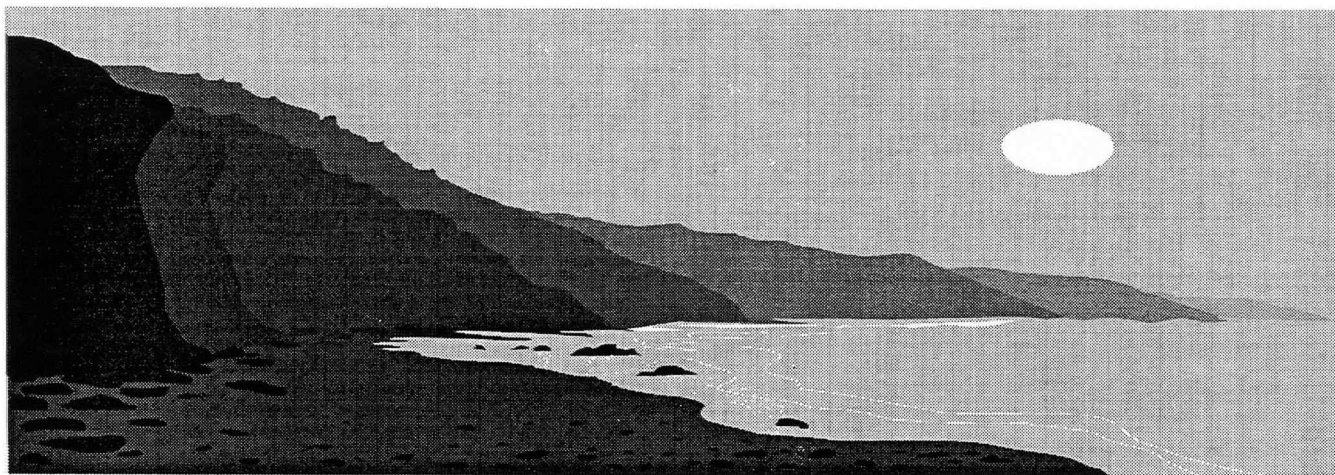
Vicki Osis Marine Education Specialist

The marine education program delivers marine science programs to teachers and youth. The programs are based at the Hatfield Marine Science Center and offer teacher workshops, and graduate level courses that may be applied to an MS in Science Education. Youth programs include day camps and school field trip programs to the center.

The Sea Grant Marine Education Program was a partner this year with the School of Oceanography for the National Ocean Sciences Bowl. This is a competition based on the National Science Bowl that bring teams of high school students together for competition in oceanography topics.

1999 was the launch of a new watershed and stream monitoring project NW RIVERNET funded by the Howard Hughes Medical Institute. Fifteen high school teachers were recruited, provided a week-long workshop and supplied with kits of sampling equipment for their projects. The annual COASTNET student estuary water quality symposium was held with 75 students participating from 8 schools. The event featured a poster session and presentations by the students.

The Sea Grant Marine Education Program was designated a GLOBE Franchise site and as such will be providing training to teachers to involve their students in environmental monitoring and sharing their data with schools both nationally and internationally.



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 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 2000 *Wecoma's* 187 days of scheduled operations are funded by the NSF (101 days), NOAA (65 days) and ONR (21 days). Operations include work by researchers from the University of Washington, NOAA and Oregon State University. In addition to Newport, port calls will include several in Honolulu, Hawaii.

R/V Sacajawea is owned by OSU and funded largely by user charges. The vessel is designated 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. *R/V Sacajawea* supports a variety of research pro-

grams including those of COAS, Zoology, Ocean Engineering, NOAA's Northwest Fisheries Science Center and the Oregon Department of Fisheries and Wildlife at HMSC. The vessel also supports the HMSC Marine Education program.

The *R/V Elakha*, 54 feet overall, is currently being built by Rozema Boat Works, in Mt. Vernon, WA and should be in operation around 01 August 2000. *Elakha* will replace the SACAJAWEA and will provide increased capabilities. Funding for the vessel came from a Packard Foundation grant to Professors Jane Lubchenco and Bruce Menge of the Zoology Department, the OSU Research Office and the College of Oceanic and Atmospheric Sciences (COAS). The name *Elakha* comes from the Native American Chinook Jargon word for sea otter. The name continues OSU's tradition of honoring Native Americans through the use of Native American names for the University's research vessels. For more information regarding the *Elakha* see <http://www.oce.orst.edu/Vessels/martech/ElakhaHome.html>

Visiting vessels scheduled to tie up at the COAS Ship Operations Pier during 2000 include NOAA's *R/V Brown*, the U.S. Coast Guard Cutter *Cowslip*, Monterey Bay Aquarium Research Institute's *R/V Western Flyer* and the Canadian vessel the *R/V Ricker*.

Independent Researchers

John Chapman - Nonindigenous Species

This last year, several previously accepted papers finally appeared in print and several other papers were accepted for publication. His major activities have been to participate in surveys for nonindigenous species in south central Alaska, Puget Sound and Willapa Bay, Alaska, classical genetics experiments on introduced amphipods in Europe and North America and continued studies with Todd Miller and Gonzalo Castillo (Ph.D. students).

Todd surveyed nonindigenous crustaceans of Humboldt Bay, California as a hobby while completing his masters thesis on molt stages in crabs. He was the first to discover the dreaded green crab there, which he promptly published. They have already published two papers together on molluscs. Todd is working on a third introduced mollusc paper and they have a fourth in the works. They have at least three papers together on introduced peracaridan crustaceans including an introduced amphipod known previously only from the southern hemisphere and another known previously only

from the Atlantic.

Predicting "What's Next?" has remained among the most difficult problems in invasion ecology. He discovered global patterns of invasions that may allow such predictions for estuaries and oceans. Three general patterns were revealed from analysis of nonindigenous species (NIS) surveys of San Francisco Bay, Coos Bay, Yaquina Bay, Washington and Alaska and from the work with Todd in Humboldt Bay and from extensive analysis of literature on other areas of the world (impossible without massive efforts by Janet Webster and Susan Gilmont). Most invading species are from a narrow range of latitudes, of a few regions in the world, the most intensely invaded areas of the world export few invading species and many of the same invading species invade over and over. These patterns of invasions closely match physiological/ecological conditions that can be predicted from variations in climate among geographical regions. This work may allow us to discover why species come from particular areas, why certain regions and ecosystems are more vulnerable to invasion than others, what landscape alterations limit or increase the potentials for invasions and what we can do to limit or respond to invasions.

A third major accomplishment this last year concerns the research on the impact of 500 years of introductions in estuarine ecosystems. Toledo High biology teacher, Billie-Jo Smith and John completed cross breeding viability experiments on the gammaridean amphipod *Corophium volutator* (Pallas, 1758) last summer that reveals this species to be introduced to the east coast of North America. These results shed light on what Columbus saw on his first crossing of the Atlantic and where he made the fateful change of course that, perhaps, saved his life and resulted in the European rediscovery of North America. (HMSC Seminar "What Did Columbus See?" planned for this fall.) It was a very good year.

Jill Grover, Larval Ecology

Research into the effects of anomalous El Niño ocean conditions on early-juvenile Pacific hake, *Merluccius productus*, continued through 1999-2000. The most recent analyses focused on identifying the effect of a second consecutive year of El Niño conditions, 1998, on early-juvenile hake. This was done through an examination of the diet of young-of-the-year hake that were collected in spring 1998, off California. Comparisons were made with specimens collected in 1997, the previous El Niño year, and with specimens from parallel collections made during 1995, a year of non-anomalous ocean conditions.

The two El Niño years were characterized by different levels of productivity in late winter and early spring. Not surprisingly, both diet and the size distribution of early-juvenile hake suggest that the signature of the El Niño, and its impact on hake year-class survival, was quite different in the two years, 1997 and 1998.

Gayle I. Hansen, Marine Botany

For the 1999-2000 academic year, Dr. Gayle Hansen, a marine botanist, has been working on projects that concern marine plant biodiversity in the North Pacific.

The first two of these are comprehensive inventories of the benthic marine algae or seaweeds in Oregon and Alaska. For both of these projects, only pre-existing archived collections of seaweeds are cataloged. These collections, held by various university and museum herbaria around the world, are primarily pressed seaweed specimens. The taxonomy of each specimen is checked and then the label data, including the species name, herbarium, and date and site of collection are recorded in a relational database. The advantage of working with historical collections is obvious: the final data includes information on the occurrence of species not just geographically but temporally as well. In both areas, specimens are available from the mid 1800's to recent collections in 2000. The major goal of the Oregon project is to provide a list of seaweed species occurrences over time so that areas with diminishing biodiversity can be investigated and conserved. The Alaskan project,

on the other hand, will provide the groundwork, not only for conservation efforts, but also for a future illustrated *Marine Flora of Alaska*. The Alaskan project is funded through the US National Science Foundation, while the Oregon project is supported jointly by the OSU Research Council, the Oregon Sea Urchin Commission, and the Oregon Department of Fish and Wildlife.

In order to examine the over 12,000 Oregon and Alaskan specimens cataloged this year, Dr. Hansen has had to travel extensively. This year she has visited the herbaria at Harvard University, the New York Botanical Garden, the University of Michigan, the University of Alaska at Fairbanks, and the National Park Service in Anchorage and Seward. Next year, she will travel to the University of California at Berkeley and to the University of Washington.

A third project this year involved morphological and biogeographic studies of the wide-spread filamentous red algal genus *Ceramium*. In collaboration with the Korean phycologist, Tae Oh Cho, two papers were completed: (1) a monograph on 8 species of *Ceramium* known from Oregon and (2) a taxonomic description of *Corallophila*, a new red algal genus closely related to *Ceramium*.



Cynthia Trowbridge (Research Assistant Professor, Zoology/HMSC), Marine Ecology

Cynthia Trowbridge investigates the invasion ecology of the exotic, green algal pest *Codium fragile* ssp. *tomentosoides* (common name "oyster thief" or "dead man's fingers"). After documenting the invasion patterns on New Zealand and Scottish shores, Cynthia is now working on N.W. Irish and S.E. Australian shores where the exotic alga has encroached upon the range of native congeners and conspecifics. Furthermore, she is now studying the interactions of *C. fragile*, its grazers, and its competitors in the alga's parental range – on Japanese shores. In spring 2000, Cynthia spent 5 weeks at the *Misaki Marine Biological Station (Univ. Tokyo)*, collaborating with a pre-eminent Japanese opisthobranch biologist. Other professional activities include three invited symposium talks for the: (1) Asian – Pacific Phycological Forum, *Chinese University of Hong Kong*, (2) Society of Integrative and Comparative Biology, and (3) American Malacological Society / Western Society of Malacologists. Cynthia served as a *Member-At-Large* (1999-2000) and is now the *Treasurer-Elect* (2000-2002) for the Western Society of Malacologists. She has also spent considerable time this year as a reviewer for grants (NERC), journals (*Journal of Chemical Ecology*, *Marine Ecology Progress Series*, *Marine Biology*, *Biofouling*, *Hydrobiologia*, *Veliger*), and PhD theses (*Univ. New South Wales*). In addition, Cynthia taught two HMSC summer courses: COAST/Pathfinder (1999) and Phycology (2000). Appointed in 1998 as an *Adjunct Professor* at *University of Texas – El Paso*, Cynthia joined other UTEP faculty for her third year supervising undergraduate research projects during the fall field course at CEDO (Center for the Study of Deserts and Oceans) in Puerto Peñasco, Sonora, Mexico.

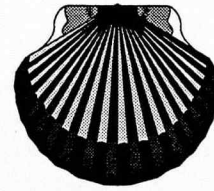
Coastal Oregon Marine Experiment Station

Gilbert Sylvia, Superintendent

Steven A. Berkeley: Marine Fisheries

During 1999-2000, Steve Berkeley continued his Sea Grant-funded research on the effects of fishing-induced age truncation on reproductive potential and recruitment in black rockfish. Laboratory rearing experiments were continued with assistance from graduate student, Colin Chapman. Preliminary results of these experiments confirm the hypothesis that older females produce larvae that are more fit than those of younger females. Colin presented these results at the Western Groundfish Conference in Sitka, AK. Steve and his research assistant, Gonzalo Castillo, continued their pilot study to determine the feasibility of using a survey of pelagic juvenile sablefish to index year class strength. This project involves sampling offshore along three transect lines from Eureka, CA to Westport, WA between April and June. The very promising results of the first year's survey were presented by Berkeley at the Western Groundfish Conference. Investigation of larval and juvenile growth rates and the temporal variation in time of recruitment was continued using otoliths from young-of-the-year juveniles. 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. Steve was appointed to the NMFS Highly Migratory Species Advisory Committee in 1999. Steve and graduate student, Bill Pinnix, continued their research 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. Significant inter-annual differences in

early growth rate of sablefish have been documented from archived otolith collections, and the link with environmental conditions is being explored. Some results of this research were presented at the Western Groundfish Conference. Steve is currently president of the Marine Fisheries Section of the American Fisheries Society (AFS). Steve, who serves on the Governing Board of AFS, has been spearheading the society's efforts to encourage action to rebuild the severely overfished populations of Atlantic bluefin tuna and Atlantic swordfish.



Chris Langdon and Anja Robinson - Aquaculture

In 1999, the main focus of the COMES Aquaculture program at HMSC was the USDA-funded Molluscan Broodstock Program (MBP). The purpose of this program is to develop superior oyster broodstock for the West Coast shellfish industry. About 400 families of Pacific oysters have been produced. Research assistants Dave Jacobson, Ford Evans, Sean Matson and crew have planted these families at commercial test sites along the West Coast, from Prince William Sound, Alaska, to Tomales Bay, California.

The top performing families from the test site in Tomales Bay were used as broodstock in spring 1998 to produce a second generation of MBP families that were planted in Washington and Oregon. The performance of this second MBP generation, compared to that of offspring from non-selected oysters, indicates that oyster yield is a strongly heritable trait and that MBP's approach should lead to significant improvements through genetic selection.

Last year, Anja Robinson worked with a commercial grower to evaluate the potential of the Alsea Bay for shellfish culture. Recently, this bay has been certified for shellfish culture in an attempt to broaden the economic base of the coastal community of Walport. Despite a slow start, preliminary results are promising.

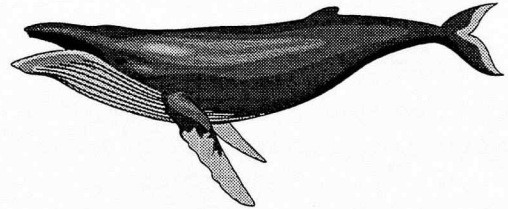
Cultured live phytoplankton feeds for shellfish are expensive and time-consuming to produce. With

support from the Markham Foundation, graduate student Ebru Onal has evaluated a new inexpensive commercial product, consisting of spray-dried, heterotrophically-cultured algae, as a complete replacement or supplement for living algae in diets for Manila clams. Preliminary results indicate that a high proportion of a living algal diet can be replaced with the spray-dried product without reduction in clam growth.

Abalone aquaculture has great commercial potential in Oregon, providing an alternative to kelp can be found as a suitable abalone food. Research of graduate student Carl Demetropoulos (supported by Oregon Sea Grant and donations from a private abalone company) has focused on optimizing the culture of dulse (*Palmaria mollis*) as a food for abalone. This OSU-developed technology is being used in a multi-million dollar, start-up abalone farm in Hawaii. A joint patent application between OSU and the Hawaiian farm for a fast growing strain of dulse was submitted to the U.S. patent office in winter 2000.

A new graduate student, Blaine Griffen, joined the team last year. He is working on a joint project with Ted DeWitt of HMSC/EPA to study the feeding physiology of mud shrimp. Mud shrimp are very abundant in Oregon's estuaries and may have a major impact on phytoplankton concentrations due to their suspension-feeding activities. Their burrowing activities are also responsible for huge losses of shellfish habitat in Oregon's estuaries as mud shrimp soften the substrate, burying oysters and clams.

On the West Coast, rearing commercially important marine species, such as sablefish, in offshore cages or in land-based systems may become increasingly important in meeting our food demands, as natural fish stocks decline and fishing becomes more limited. The Markham Foundation supported research of graduate student Umur Onal on microparticulate feeds for marine fish larvae. Rearing marine fish larvae is very difficult and satisfactory artificial feeds will be important for the development of marine fish aquaculture on the West Coast, U.S.



Bruce Mate - Marine Mammals

Dr. Mate continued his studies of whale behavior and migration using satellite-monitored radio tags. Twenty-three blue whales were tagged off the coast of California during July and October 1999. Tracking periods ranged up to 228 days and covered distances up to 11,000 km. These tagging efforts provided detailed information regarding movements of blue whales during their summer/fall feeding cycle off the California coast, as well as migratory timing and route information as they traveled south along the coast of Baja California. Although one whale traveled to a possible reproductive area 230 miles west of Costa Rica, many went into the Sea of Cortez (Gulf of California), entering earlier and staying much longer than anyone expected.

Thirteen humpback whales were tagged off Maui, Hawaii, during December, 1999, and February 2000. Tracking continues for some whales after 159 days. Humpback whales were tracked earlier in their breeding season than in previous years (December vs. February) to further our understanding of inter-island movements in Hawaii. A lot of individual variation was apparent in whale movements, with some animals ranging widely around all islands and others staying in fairly localized areas. We tracked tagged whales leaving Hawaii in January, confirming that many whales have short residency time there and suggesting a much larger population uses the islands than previously thought. Whales migrated to SE Alaska and the Aleutians.

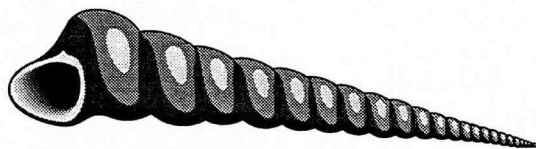
Shore-based counts of gray whales passing Yaquina Head, Oregon, were conducted between December 1999 and will continue into mid-June 2000 to document both the south and north-bound migrations.

As in the previous year, the whales are farther offshore and later, compared with a similar study conducted from 1978-1981. Record numbers of gray whales died last year and this year looks to be even worse. Many dead whales appear malnourished. Recovery from whaling has occurred. Whale numbers may be approaching (or exceeding) carrying capacity, as prey biomass may be declining in the Bering Sea.

Dr. Mate, research assistant Barbara Lagerquist, and marine mammal artist Pieter Folkens designed and published a waterproof marine mammal guide for the Eastern North Pacific which will soon be available at the HMSC bookstore. In October, Dr. Mate will tag blue whales off southern California and track them to fall feeding areas off the southwest Baja Mexico coast, which will be filmed by the BBC for a fall 2001 documentary series.

In January 2001, Dr. Mate anticipates tagging humpback whales along the Antarctic Peninsula in cooperation with scientists of the Chilean Antarctic Institute. He hopes to track whale movements within their feeding habitat during the austral summer, and examine the relationship between these movements and available prey distribution information as well as physical and biological oceanographic conditions. He also hopes to identify migration routes from the summer feeding grounds in the Antarctic to the winter breeding and calving areas. This work had to be postponed in 2000 due to Chilean budget issues. Right whales will be tagged in both the North Atlantic and Bering Seas this summer and fall.

Three of Dr. Mate's graduate students are continuing their oceanography doctoral programs. Kate Stafford is continuing to document the seasonal occurrence of blue whales throughout the Pacific Basin using acoustic information. Mark Baumgartner will be characterizing right whale habitat with Dr. Mate during July and August cruises in the North Atlantic. Daniel Palacios conducted surveys in April and May 2000 around the Galapagos Islands to examine how oceanography affects the distribution and abundance of marine mammals in the Eastern Tropical Pacific.



Paul Reno and Robert Olson - Fish Disease

Virulence Studies of Viruses: Kyoung Chul Park has continued his studies on factors involved in virus virulence (National Sea Grant Technology Grant). The current focus is on two factors. The first is a factor in serum of apparently healthy trout which inhibits the ability of the virus to replicate. Further characterization of this substance, which had previously indicated that the cell lines which are used as well as the species from which the serum was derived could affect the virus killing, indicated that the most important factor was not associated with the serum itself. He found that the overriding factor in determining how extensive the inhibition was the density of the cells in which the virus was grown. This may explain the marked variability in this phenomenon that previous researchers had found. Kyoung is currently evaluating what changes, if any, have occurred in the genome of the viruses treated by growing in cells, whole fish, or in the presence of trout serum. Preliminary results indicate that there were very few differences in genome composition related to the way the virus was grown and virulence in fish. This further argues for extragenomic causes for variations in virulence. Most likely, these are environmental in nature.

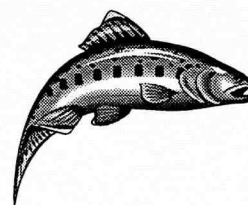
Hamdi Ogut has finished the laboratory portion of his experiments designed to determine how fish diseases are transmitted. He is currently analyzing the extensive data generated in these experiments and is writing a computer program to allow him to construct mathematical models of the disease process in populations of fish. Hamdi is also putting his modeling expertise to use by working on a project funded by the Western Regional Aquaculture Committee (USDA) to determine the pattern of pathogen distribution in wild and cultured salmonids in the Western U.S. Data on fish diseases in feral and

hatchery-reared fish are currently being gathered from state and federal agencies throughout the West. The data will be analyzed to determine whether the presence of pathogens in hatchery fish is correlated with the development of disease in wild fish in the areas where cultured and wild fish coexist and where infected stocks may have been planted into waters where pathogens were not present. We are concentrating on whirling disease of trout in North-eastern Oregon, Nevada, and California to see how, and whether, the pathogen has spread over the years 1960 to present.

The resurrection of studies on the microsporidian parasite of Dungeness crabs has occurred by dint of the interest of Hal Amogan, a graduate student in the Department of Microbiology. Hal has started a project to determine the taxonomic status of the pathogen by studying the sequence of the small subunit RNA of the ribosome and has worked out the sequence of the r-RNA. His effort indicates that the parasite is most closely related to *Ameson michaelis*, a microsporidian parasite with few morphological characteristics in common with *Nadelspora canceri*. He has also recently acquired preliminary data which indicated the number of chromosomes in the genome of the organism is between 8-11, and will be trying to determine if the chromosomes have histone genes as do eukaryotic cells or no histones as prokaryotic cells.

Tim Miller-Morgan has reconfigured his efforts to be more in line with his interests: health of aquatic animals in public aquaria. He will be changing his project to involve the design of a Fish Health Management Strategy for public (and private) aquaria. This will involve the design and implementation of a database for health monitoring, husbandry, and maintenance.

We have become more heavily involved in performing diagnostic work (with the able assistance of Tim Miller-Morgan) for public aquaria, including the Oregon Coast Aquarium and the Portland Zoo. This has been intriguing and interesting work with, in many instances, much intellectual meandering required for diagnosis of disease problems.

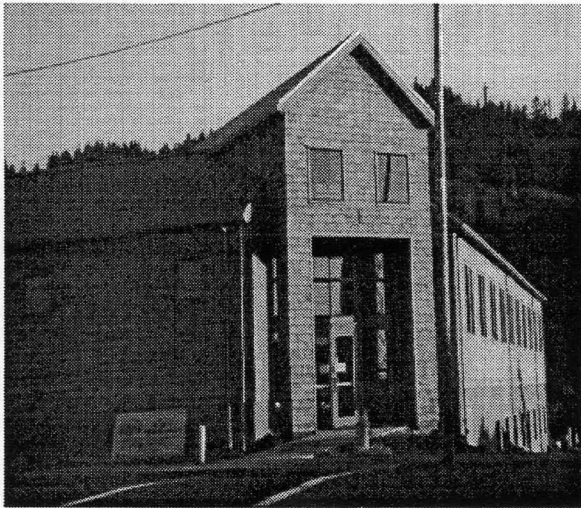


David Sampson - Population Dynamics

Dr. Sampson's research on Oregon's marine fisheries for groundfish is focussed on two general areas: (1) stock assessment and fisheries management issues, and (2) fishermen's behavior, particularly fishing strategies and choice of fishing locations. During the summer he completed, on behalf of the Oregon Department of Fish and Wildlife, an assessment for the Pacific Fishery Management Council of the stocks of petrale sole off Northern California, Oregon, and Washington. In the autumn the assessment was reviewed and accepted by Pacific Fishery Management Council. Throughout the year Dr. Sampson, with help from Research Assistant Claire Wood, continued a project, funded by Oregon Sea Grant, that is analyzing Oregon trawl logbook data to develop quantitative measures of fishing strategy. Dr. Sampson formally presented results from this research at the World Conference on Natural Resource Modeling (Halifax, Nova Scotia) and at the International Symposium on Spatial Processes and Management of Fish Populations (Anchorage, Alaska). He also gave presentations about the project at a Science Center seminar and to the Board of Directors of the Fishermen's Marketing Association.

During the autumn Dr. Sampson taught the upper division course "Marine Fisheries" to 16 students. The class, which was broadcast to Corvallis from the Science Center using a tele-video system, was split about equally between students in Corvallis and ones in residence at the HMSC. During the year one of Dr. Sampson's students successfully defended his MS thesis, "A critical examination of the ageing method for sablefish (*Anoplopoma fimbria*) from the U.S. West Coast using edge analysis and Oxytetracycline." Dr. Sampson's current graduate students are conducting research on the following

topics: the influence of data uncertainty on ground-fish stock assessments; the suitability and stability of systems for cooperative fishery management; oceanographic influences on the survival of Columbia River salmon; factors to consider for pelagic fisheries management; rockfish food habits and feeding ecology; and using fish plant workers to collect stock assessment data.



Astoria Seafood Laboratory
Michael Morrissey, Director

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

Research activities over the past year have included:

- Value-added products. Research continues in the area of fish sauce from Pacific whiting by-products and the development of value-added products from oysters.
- Seafood safety. Work is continuing on the pasteurization of surimi products and a new product on the use of high hydrostatic pressure for the destruction of *Vibrios* in oysters.
- Seafood processing. Radio frequency heating is also being investigated as a seafood processing tool as well as high-pressure technology. Ozone is also being investigated as a processing tool to prolong the shelf-life of different seafood products.

Outreach involved co-hosting the Shellfish Growers Association Meeting in early March and the eighth Annual OSU Surimi School in April. Visiting

professors at the Seafood Laboratory are Dr. Yeung Choi from Gyeong Sang University (Korea) who was here for the year, Dr. Insoo Kim (Korea) who was here for six months and Dr. Jirawat Yongsawatdigul (Thailand) for 4 months. Graduate students who completed their degrees in Food Science & Technology were Christina DeWitt (Ph.D), Michelle Shuer Shiu (M.S.), Ari Wendel (M.S.) and Kannapon Lopetcharat (M.S.), and Wonnop Visessanguan (Ph.D), Jassvinder Kaur (Ph.D.).

The OSU-SFL has continued its expansion over the past decade and currently has three faculty, three technicians and twelve 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 and a state-of-the-art pilot plant and processing equipment.

The new \$1.4 million Duncan Law Seafood Consumer Education Center (SCC) was completed in the summer of 1998. Funds were received from the Federal Economic Development Agency and Oregon Economic Development Commission. The mission of the SCC is to address issues in consumer education, training, research and information and will be run as a private venture with oversight of the SCC Board. The facility is a 9,500 sq. ft. building located beside the OSU-SFL and contains a fully-equipped demonstration kitchen, meeting room, and retail center. The mainstay of the SCC is The Seafood School which provides professional and non-professional culinarians a center for hands-on education and training. The SCC works 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

Clare Reimers, Director

Jessica L. Waddell, Administrative Program Specialist

The OSU/NOAA Cooperative Institute for Marine Resources Studies (CIMRS) has now completed its eighteenth year. Established in 1982 under a Cooperative Agreement, CIMRS brings together university and agency expertise to address science and management issues relating to fisheries, ecosystem health, aquaculture, oceanography, marine-technology and related fields. In January 2000, CIMRS came under new leadership when Dr. Clare E. Reimers was appointed CIMRS Director. Dr. Reimers, formally at Rutgers University, is a chemical oceanographer whose active research program is often multidisciplinary. Dr. Reimers has faculty status within the College of Oceanic and Atmospheric Sciences. Efforts are underway to broaden the Institute's base of support, and the numbers of faculty, students and NOAA scientists conducting research projects within CIMRS.

The cooperative research projects supported in FY 99-00 totaled over \$2.9M and were from two NOAA research offices. Highlights are presented below.

Oceanic and Atmospheric Research Office/Pacific Marine Environmental Laboratory *Ocean Environment Research Division/VENTS PROGRAM*

Acoustic Monitoring (Dr. Robert Dziak, Matt Fowler, Andy T.K. Lau, Dr. Haru Matsumoto, Paul Will)

Over a year ago, on January 25, 1998, CIMRS staff detected intense seismicity in the northeast Pacific Ocean using NOAA's T-phase Monitoring System that accesses the U.S. Navy's Sound Surveillance System (SOSUS). The initial activity was located on the summit and southern flank of Axial Volcano on the central Juan de Fuca Ridge, approximately 300

miles west of Cannon Beach, Oregon. The seismic activity lasted twelve days and included over 8,000 detected earthquakes. A "ground-truthing" cruise on the RV Thompson using the ROV ROPOS confirmed a lateral dike eruption. Coincident with the eruption was measurable subsidence of the Axial caldera. Axial Volcano has been quiet for over a year now, leading investigators to believe that the 1998 eruption was a major magmatic event and a culmination of an eruption cycle. Data from acoustic extensometers, measuring horizontal distance on the rift axis, corroborate this hypothesis. The collection of results from investigations of the Axial eruption has been published (*Geophysical Research Letters* Vol. 26 No. 23/24).

Geophysical Monitoring (Andra Bobbitt, Dr. William Chadwick, Susan Merle)

NeMO (New Millennium Observatory) a new multidisciplinary project centered at Axial Volcano is in its second year. This project has established several arrays of seafloor and water-column instruments, time-lapse cameras, and sample collection systems for documenting chemical, biological, hydrographic and geologic changes in and around the Axial caldera. Real-time camera and sensor data from the NEMO Net was transmitted successfully for part of the year until interrupted by a faulty modem. When CIMRS scientists were at sea servicing the observatory in 1999, an interactive Web link to the support ship was featured at the Hatfield Marine Science Center in cooperation with Sea Grant. This web link provided close to real-time information to educators, students, and researchers on the results of each day's activities during the cruise, and also provided answers to specific questions from a land-based audience. The link was very popular, and it will be expanded for public outreach during the summer field season of 2000.

Marine Mammal Acoustics (Dr. David Mellinger, Sharon Nieukirk, Kate Stafford)

In order to acoustically monitor areas of the world ocean not covered by existing fixed hydrophone arrays, CIMRS and PMEL scientists have developed autonomous moored hydrophones to record acous-

tic energy from both underwater seismic activity as well as that from whale calls. These instruments are capable of recording frequencies from 1 - 20,000 Hz, and depending on the sampling rate, can record data for over a year before servicing is required. The hydrophones are designed to be deployed as an array of independent instruments whose geometry can be determined by the needs of the experimenter in order to localize acoustic sources of interest.

Four autonomous moored hydrophones were placed in the Gulf of Alaska in October 1999 with the specific goal of detecting blue, fin, humpback and northern right whales in this region. These hydrophones are scheduled to be recovered in August, 2000. In collaboration with NMFS/AFSC, two more hydrophones will be moored off of Kodiak, AK, during the August cruise.

In March 2000, as part of a collaborative effort with investigators from Woods Hole Oceanographic Institution and Lamont Doherty Earth Observatory, six Atlantic portable hydrophones were recovered and redeployed for another year of data recording. Preliminary analysis of the data revealed numerous calls from over four species of whales. No previous data exists for this area of the mid-Atlantic Ridge for marine mammal acoustics. Development of a software program that employs acoustic filters to recognize and select specific whale calls from the recorded data is a goal of future funding.

Hydrothermal Emissions (Leigh Evans, Ron Greene)

Analysis was completed on pre- and post-eruptive water-column samples from Axial Volcano. In contrast to the three previously detected eruptions, no discrete on-axis event plume was detected on the Axial response cruise eighteen days following the eruption. A low helium/heat plume that was detected in February 1998 was completely absent in July-August and September 1998 water-column samples and replaced by high helium/heat ratios. The complexity and anomalous character of this eruption in terms of event plumes and helium/heat ratios will continue to be studied in relation to other similar eruptions.

National Marine Fisheries Service/Northwest Fisheries Science Center

Fish Ecology (Leah Feinberg, Dr. Marcia House, Julie Keister, Greg Krutzikowsky, Cheryl Morgan, Jackie Popp-Naskov; Grad. Student, Todd Miller)

The U.S. GLOBEC project continued its funding of a multiyear monitoring program of the central Oregon shelf ecosystem. FY 99-00 efforts targeted two species of euphausiids in order to correlate population density and distribution with ocean temperature and phytoplankton biomass. CIMRS staff participated in several short-duration survey cruises covering the region from Newport to Crescent City; analysis of the MOCNESS net samples and additional experimental studies on the targeted species are being conducted by CIMRS research assistants. In a jointly funded project investigating salmon pathogens, U.S. GLOBEC funding will provide support for a CIMRS Faculty Research Associate in microbiology to study the viruses and bacteria found in juvenile salmon off southern Oregon and northern California.

CIMRS is also providing support for a graduate student in Fisheries and Wildlife to participate in a newly funded project on the distribution and trophic interactions of juvenile salmonids and associated taxa off the northern California and Oregon coasts, concentrating on the diet of forage fish, i.e., sardines, smelt, herring. CIMRS research assistants participate in and coordinate collection cruises for these fish from Newport to northern California, conduct analysis of stomach contents of juvenile salmon and identify parasites in these fish.

Fishery Resource Analysis and Monitoring (Nicole Nasby, Graduate Student)

Partial support for a graduate student in OSU's Marine Resource Management Program has been provided under a collaborative project with NOAA to integrate old fishery databases with new seafloor imagery of the topography and bottom type of Heceta Bank, Oregon, an important and previously studied commercial fish habitat. Habitat characterization combined with detailed, quantitative fish surveys will provide commercial fishermen and regulators with a greater understanding of the factors required for accurate stock assessments.

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

Walt Nelson, Branch Chief

The Newport EPA research laboratory is part of the Western Ecology Division, located in Corvallis, Oregon. The research mission of the Pacific Coastal Ecology Branch is developing procedures to assess the cumulative and interactive effects of human activities on the ecological resources of 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 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 focus for the Coastal Ecology Branch is to define ecological processes and to develop and evaluate models to predict stress-response relationships for Pacific Northwest estuaries at a range of spatial and temporal scales. The research seeks to evaluate how specific estuarine habitats, and particularly sea grasses, 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 ecological engineering species to multiple abiotic stressors
- Factors controlling distribution of native and exotic seagrass species
- Coastal shoreline development impacts on estuarine landscape dynamics
- Effects of the nonindigenous seagrass *Zostera japonica* on inorganic nutrient flux in the Yaquina Bay estuary
- Range expansion and reproductive ecology of *Zostera japonica*, a non-native eelgrass in Yaquina Bay
- The impact of disturbance, suspended sediments, and changes in watershed uses on seagrass habitats
- Evaluation of watershed versus oceanic nutrient inputs to Pacific Northwest estuaries
- Development of estuarine condition indicators, including growth dynamics of English sole

Research activities include large-scale (within and among estuaries) field studies and laboratory investigations of relationships between stressors and effects. Research staff has increased to 16 federal employees, 5 postdoctoral fellows, and 16 technical and clerical contract support staff.

Coastal Ecology Branch assisted the 5th National Tribal Conference on Environmental Management, which was cosponsored by the US EPA, by providing tours of the Newport laboratory.



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 at Astoria and Charleston field offices (Brookings office to open the summer of 2000) with seasonal staff at all ports along the Oregon coast. Staff includes about 40 year-round full-time employees and up to 50 seasonal employees. We suffered the loss of one of our leading biologists, Neil Richmond, in an unfortunate research related diving accident. The community in North Bend established memorial and education funds for Neil Richmond and Neil and Bonnie Richmond's children. – contact Jim Golden for details.

Marine Resources Program (MRP) is organized into four sub-programs including: Administration, Resource Assessment and Analysis, Resource Monitoring and Sampling, and Data Services. Administration has experienced the biggest change in staffing with the departure of Tray Harley and Bonnie Bahn. Lori Parker was hired as the new office manager and MRP is actively recruiting for a public service representative and an office specialist. The MRP continued to support a full marine commercial licensing and point-of-sale recreational services. The Pacific Fishery Management Council (PFMC) continued to recommend additional restrictions on groundfish species as well as restrictions and impact assessment on ESA listed salmonid stocks. Canary rockfish and lingcod became new species of concern and were determined to be overfished. Additional limited-duration funding was added to MRP's budget during the 1999-01 biennium to assist the Department in collecting data and conducting studies to improve the information base needed for management of groundfish. Several seasonal aides and a new biologist were hired as MRP mobilized to step up monitoring of groundfish stocks and conduct at-sea research. Research projects were focused on improving stock assessments and are balanced between nearshore and offshore resources and issues. Carla Sowell was recently hired to provide sampling support out of the ports of Brookings, Gold Beach, and Port Orford, and to assist in

nearshore research studies on groundfish. Research initiatives for groundfish include: 1) studies of modified trawl gear designed to safely eliminate unwanted bycatch or restricted species; 2) a study designed to collect and validate length and age at maturity of several rockfish species and petrale sole – information needed to improve stock assessments; 3) a retrospective study of genetic collections of rockfish taken off the Oregon coast and new pilot study using microsatellite DNA techniques – to identify stock structure; 4) a lingcod handling stress and mortality study; 5) a pilot survey for juvenile rockfish in the nearshore; 6) a nearshore juvenile rockfish survey; 7) and a fixed gear survey pilot project in which hook and line and other gears will be used to sample different depth and habitat zones on Orford Reef. Planning for this work began in 1999 with most of the projects set to occur in 2000. In addition to these new studies, MRP staff continued to map and conduct at-sea biological sampling of nearshore reefs.

The Ocean Sampling Project (formerly Ocean Salmon) continues to monitor and sample the recreational ocean boat fishery and the commercial troll salmon fishery. The project has expanded to cover more ports and time periods for the recreational ocean fishery, and has been working to integrate with the marine recreational non-salmonid finfish project to meet coastwide biological sampling objectives for lingcod, black rockfish, and a variety of other species. In addition, the project has implemented an intense charter ride-along program during the selective recreational coho fishery for the past two years and plans are underway for a third at-sea observer season in 2000. Jody White joined the OSM staff and will assist on the Pacific Salmon Treaty (PST) as Oregon's coastal chinook field studies coordinator, sampling design and technical analyst. He will work with MRP and other freshwater regional staff to evaluate spawning escapement, stock recruitment, and assessment tools for PST stocks (including central-north coast chinook) affected by treaty area fisheries. MRP integrated and expanded sampling to provide "year-round" coverage of recreational groundfish and salmonid fisheries. This action was taken to improve sampling efficiency, accommodate increased data needs, and manage affected stocks.

Cooperative work continued with Oregon State University (OSU) and University of Oregon's

Oregon Institute of Marine Biology (OIMB) graduate students and staff in studies of the ecology and population dynamics of finfish and invertebrates, and fisheries economics. Graduate students Vicki Hoover and Charmaine Gallagher continued working with Steve Jones from ODFW staff on master's projects investigating the economics of shrimp fishing. These cooperative projects are funded by Sea Grant and orchestrated through OSU's COMES unit. A new project studying the effects of handling on stress and mortality of lingcod will commence May of 2000. The project is in cooperation with OSU's Cooperative Fisheries Research Unit and National Marine Fisheries Service. Other cooperative projects with NMFS included a depth specific sampling project and work associated with the Cooperative Aging Unit. A collaborative industry, ODFW, and Oregon Trawl Commission project entitled the Oregon Enhanced Data Collection Project neared completion in 1999. The study was designed to look at the impacts of regulations on discard of groundfish species in the trawl fishery. Databases were checked and published the spring of 2000.

Oregon's marine commercial Dungeness crab fishery was prominent in 1999. The December 1999 – August 14, 2000 fishery will land a near-record 15 million pounds (sixth highest since the late 1940's)

National Marine Fisheries Service
Fisheries Behavioral Ecology Program,
Alaska Fisheries Science Center
Allen Stoner, Program Manager

Experimental Bycatch Studies

Laboratory investigations have been conducted on the behavioral and physiological effects of stress associated with capture by towing and hooking in commercially important marine fish including walleye pollock, sablefish and halibut. Capture by trawl gear or on a longline is simulated using unique temperature-controlled seawater tanks that were designed and constructed at the HMSC. Post-capture recovery of fish is measured in large temperature-controlled experimental tanks which duplicate temperatures experienced by fish inhabiting waters of northern California to Alaska through-

with a record ex-vessel value of almost \$30 million to Oregon fishermen. The increased stock abundance and harvest have also increased effort in numbers of boats and pots fished. This in turn has stimulated industry discussions over pot limits, landing limits, and changes in season opening dates – all designed to spread out the season's catch. Washington initiated a pot limit system in 1999. MRP, the fishing industry, adjoining states, and the Oregon Fish and Wildlife Commission continue to evaluate what, if any, changes should or can be made in this fishery.

Finally, MRP staff revised commercial fishing rules with two separate staff reports being prepared and presented before the Fish and Wildlife Commission. Additional restrictions were placed on the commercial live fish fishery including a size limit on four species of rockfish, cabezon, and greenling, and a prohibition on commercial fishing in Oregon's bays and estuaries and off jetties. The latter restriction does not apply to existing fisheries for herring, bait and Dungeness crab. In separate action, the Commission adopted modifications to our wildlife integrity rules, which are designed to reduce impacts of non-indigenous species. The rules prohibit importation of certain wildlife species, including fish and invertebrates.

out the year. Results to date have shown that: 1) walleye pollock towed in a net under dark conditions in the laboratory and the field are not able to orient or avoid meshes of the net, resulting in greater injury and death than under lighted conditions; 2) sablefish and halibut are less sensitive than walleye pollock to capture by towing or hooking; 3) elevated seawater and air temperatures magnify stress and mortality resulting from capture, with sablefish being less sensitive than halibut to elevated temperatures. Management of these fishery stocks should account for the probable increase in mortality of bycatch caught during seasons when ocean and air temperatures are elevated. Differences observed in vulnerability to capture stress and post-capture survival and recovery among species thus far studied indicate that generalizations across species are not appropriate.

Visual Capabilities of Juvenile Fishes

Experiments have been conducted in a continuing effort to examine how ambient light influences the ability of juvenile walleye pollock and sablefish to feed, school and avoid predators. Specialized infrared monitoring systems developed for this research have allowed experimentation with the fish under the full range of light levels which they encounter at various depths in the ocean, day or night. For example, although they are highly visual foragers, both juvenile walleye pollock and sablefish are capable of feeding upon planktonic prey in complete darkness. This capability may play a vital role in their feeding, growth and survival during periods of prolonged darkness, such as winter at high latitudes, or at depths where light is minimal.

Experiments on the role of light in behavior are also aiding in the design of experiments to explore the interactions between fish and commercial fishing gear, with the goal of reducing bycatch. Preliminary experiments have been completed which examine how light influences the ability of undersized walleye pollock to negotiate their way through the codend of a trawl. These experiments demonstrate that when fish can see the approaching net, they are herded along in front of it, but when they do pass through the net, they do so quickly, with limited mesh contact. In contrast, in darkness fish are unable to orient relative to the net and strike the mesh more frequently before through-passage, potentially resulting in greater injury. This suggests that the impact of through-passage upon undersized fish may vary with the time of day and depth at which the trawl is towed. Subsequent experiments will address such questions as: how does stress associated with passage through a trawl influence the ability of juvenile fish to feed, school and avoid predators? The answers to these questions will prove crucial in understanding and developing strategies aimed at reducing the retention of under-sized fish and minimizing the unintended impact of commercial fishing gear upon fish stocks.

Influence of Environmental Factors on Behavior

Larval and age-0 sablefish (*Anoplopoma fimbria*) reside in surface waters of the North Pacific during spring and summer. They typically occur offshore from the zone influenced by upwelling and thus may be susceptible to elevated temperatures associated with global warming. We are currently investigating a number of ecological responses to varied temperatures in conjunction with other

potentially interacting environmental variables such as food availability. In laboratory experiments, we measured growth rates under high and low ration levels and a range of temperatures from 6 to 24°C. With unlimited food growth increased as temperature increased, with a plateau at 14 to 22°C. A similar response was observed at low rations, although at lower overall growth rates. However, a severe decline in growth occurred for both ration levels at 24°C, and few fish survived the 3 week experiments. The upper thermal limit for growth in small sablefish coincides closely with their upper limit for survival, with a sharp demarcation between favorable growth conditions and intolerable temperatures.

In another set of experiments we measured the efficiency with which sablefish converted food into biomass on a dry-weight basis. We monitored consumption rates and growth of fish held at temperatures of 6 to 22°C and high or low ration levels, then calculated gross growth efficiency. There was a clear interactive effect of temperature with ration level. At *ad libitum* rations growth efficiency reached a plateau between 16 and 20°C and declined at 22°C, whereas at low rations growth efficiency was highest at 10°C. We also conducted behavioral observations in thermally stratified water columns, where fish conditioned to one of four ration levels were able to select among a broad range of temperatures. As ration level decreased, sablefish moved increasingly into colder water. This response is in agreement with an energy conserving strategy, whereby fish reduce their metabolic rates by reducing their body temperature when food levels are insufficient to support the energetic costs of higher temperatures. In the past 18 years, average monthly sea surface temperatures off Newport, Oregon exceeded 18°C only during the extreme El Niño year of 1997. These results suggest that local populations of juvenile sablefish are capable of tolerating and thriving under the 1 to 3.5°C increases in temperature predicted by global warming scenarios, with the critical caveat that sufficient food resources must be available. If, as some climate predictions suggest, global warming is accompanied by reducing upwelling and lower levels of primary production, increased temperatures may have negative consequences for sablefish and other species occurring in surface waters.

National Marine Fisheries Service

**Northwest Fisheries Science Center
Newport Research Station (NFS)**

Administration (Bruce McCain, NRS Facilities Manager)

Progress continues to be made towards constructing a new building on NOAA property located north-east of our current facilities. An architect has been selected, and a site survey, a soils study, an environmental assessment, and the preparation of a concept design are underway. Construction is scheduled to begin in the Spring of 2001.

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

Research conducted by the staff of the ECD at the HMSC continues to focus on interrelationships among host resistance, environmental stressors (e.g. pollution), and infectious pathogens. Previous research showed that exposure to pollutants can lead to defects of the immune system and an increase in disease susceptibility in juvenile chinook salmon (*O. tshawytscha*). Whether pollution influences natural disease outbreaks in host populations, including salmon, is currently unknown. Recent studies of natural fish populations by other researchers have demonstrated that infectious disease-induced mortality can significantly affect the structure of a host population, for example, by reducing its numbers.

To understand the impact of disease in salmon populations, the prevalence of pathogens in various populations of juvenile salmonids is being evaluated. 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.

Studies have been extended to include salmon with different life histories (juvenile coho salmon,

which move rapidly through estuaries, as well as juvenile ocean-type chinook salmon, which spend up to several weeks in estuaries). The spatial scale has also been expanded to include salmon populations from Washington and California coastal estuaries. 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) have been included. 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.

In addition, ECD staff conducted a study of baseline conditions in estuaries at risk due to the M/V New Carissa oil spill near Waldport. Their study was designed to allow assessment of impacts to outmigrant juvenile salmon if the spill had spread.

Fish Ecology Division (NWFSC: Dr. William Peterson, Robert Emmett, Dr. Kym Jacobson, Dr. Ric Brodeur, Dan Bottom; CIMRS: Cheryl Morgan, Leah Feinberg, Greg Krutzikowsky, Jackie Popp-Noskov, Anders Roestad, and Julie Keister; OSU Graduate Students: Todd Miller and Jaime Gomez)

Fish Ecology Division staff at the HMSC are all members of the Estuarine and Ocean Ecology Program. The program is growing at present: two senior investigators joined the program this year (Dan Bottom and Dr. Brodeur) along with two CIMRS faculty research assistants (Popp-Noskov and Krutzikowsky). The group will add 7-9 new CIMRS staff members during 2000/01 for a total of 21 persons, making this the largest National Marine Fisheries Service unit at the Newport Research Station.

The group investigates the ecological linkages in the California Current and Columbia River plume, among zooplankton and fishes, including sardines, anchovy and herring with an emphasis on factors affecting Pacific salmon in the Pacific Northwest. Emphasis is placed on utilizing an

ecosystem-based approach to investigate the biotic and abiotic factors that control growth, distribution, health and survival of important fish species and on the processes driving population fluctuations. Ultimately, the ecosystem-based research will be applied to management of fish stocks off Oregon. Several research programs are in place which include both monitoring and process studies and all involve extensive collaboration with scientists from Oregon State University, Oregon Graduate Institute, Department of Fisheries and Oceans/Canada, NOAA/Northwest Fisheries Science Center/Seattle, and Humboldt State University.

A research program involving at-sea sampling 2-3 times per month at stations 1, 3, 5, 10 and 15 miles west of Newport was continued under the leadership of Dr. William Peterson. This program was initiated in 1996 and uses the R/V Sacajawea as its research platform. With funding from the Office of Naval Research — National Ocean Partnership Program, Leah Feinberg was hired to continue this work. At each station, temperature and salinity profiles are measured, and samples are taken for later analysis of nutrients and phytoplankton (as chlorophyll). Plankton tows are made to estimate abundance of species of zooplankton. These data have now been compared to data collected in the 1970s from the same locations. This analysis has shown a striking change in the structure of the pelagic marine ecosystem during the past decade. In the 1970s the ecosystem was composed of subarctic species. However, between 1992 and 1998, the ecosystem became dominated by a mixture of subtropical and subarctic species. During 1999 the ecosystem began to change back to a dominance of subarctic species. This change may signal the beginning of a new climate regime. Continued monitoring will resolve this issue over the next few years.

With funding from the U.S. GLOBEC program, Dr. Peterson has sampled zooplankton along five transects off Newport, Heceta Head, Coos Bay, Rogue River, and Crescent City, California. This work began in September 1998 in collaboration with six oceanographers from Oregon State University that are investigating physical oceanography and nutrient and phytoplankton dynamics along these same transects. The research is part of the Long-Term Observations Program of

U.S. GLOBEC and is designed to describe ocean conditions in the waters north and south of Cape Blanco as an aid to understanding factors affecting growth and survival of juvenile chinook and coho salmon in these waters. Julie Keister is responsible for cruise logistics and zooplankton sample analysis under this program.

With other funding from the U.S. GLOBEC Program, Dr. Peterson began study of the ecology and population dynamics of euphausiids in the waters north and south of Cape Blanco. Program staff are using both a 1-m MOCNESS system (to enable sampling of euphausiids within depth strata from the surface to 500 m depth) and a Hydroacoustics Technology Inc. acoustics system with four transducers (38, 120, 200 and 420 kHz). The acoustics system will be used to study relationships between physical features and euphausiid distribution, and spatial relationships between fishes and euphausiids. The acoustics work will be carried out by Anders Roestad; and the MOCNESS net samples will be the responsibility of Julie Keister. Additional new funding under this same award will allow Dr. Peterson to initiate evaluation of factors affecting population dynamics on euphausiids. This work will be carried out next year by Leah Feinberg and another person who will be hired.

Companion GLOBEC studies by Dr. Ric Brodeur, Dr. Kym Jacobson, and Robert Emmett are being conducted for the next 5 years to investigate distribution, abundance, growth, and condition of juvenile salmon. Determination of the associated pelagic nekton will provide clues regarding the relationship between oceanographic conditions and abundance and health of salmon during their first summer at sea. A companion study conducted by Dr. Cyndy Tynan will be done to evaluate ecosystem impact of top-trophic level predators (marine mammals and sea birds) on success of juvenile salmon in these diverse oceanographic habitats.

Another program involves predator/prey relationships among hake, mackerel and juvenile salmon off the coasts of Oregon and Washington under the leadership of Robert Emmett. Funding for this work has come from the Bonneville Power Administration. Cruises are conducted every 10 days off Willapa Bay, the Columbia River and

Cape Falcon; predators and prey are sampled with a Nordic 264 Pelagic Trawl (30-m wide by 20-m deep by 200-m length) at night to determine if hake and mackerel are significant predators on juvenile salmonids. The hypothesis being tested is that recent increases in abundances of predators explains some of the recent declines in juvenile salmonid abundances. Greg Krutzikowsky is responsible for analyzing the stomach contents of the predatory fishes.

Another major investigation is examining the correlation between salmon growth and survival and the unique physical and biological characteristics of the Columbia River plume. This work is also funded by the Bonneville Power Administration and is a collaboration with scientists from the Oregon Graduate Institute in Beaverton. Project scientists are asking a number of questions about the plume: Are juvenile salmon more abundant there than elsewhere along the Washington-Oregon coast? (Early sampling indicates they may be - more than half of the juveniles caught in June and September were netted in the plume). Are growth rates and overall weight and length higher in the plume? Do higher nutrient concentrations in the plume enhance food availability? Program scientists are collecting information on the distribution and abundance of salmon and other species in the upper water column, both in plume and coastal waters; these data will be related to ocean conditions and compared to data collected in the 1980s. Salmonid growth, condition, pathogen load, food habits, and prey fields are being measured and related to ocean conditions in and around the plume. Scientists involved with this work include Drs. Bill Peterson, Ric Brodeur and Kym Jacobson. Also, Cheryl Morgan developed and maintains the extensive Microsoft Access data base of physical and biological data and works with Dr. Peterson on analysis of zooplankton samples; Jackie Popp-Noskov analyzes juvenile salmon stomach contents under the supervision of Dr. Brodeur.

Dr Kym Jacobson is developing a unique program that is evaluating the ecology of disease and the importance of disease processes to affect popula-

tion ecology of salmon in the estuary and ocean environments. With funding from the Bonneville Power Administration and the U.S. GLOBEC Program, the potential contribution of salmon pathogens (viruses, bacteria and macroparasites) to growth and survival of salmon is being examined in ocean juveniles in the Northern California Current under the direction of Dr. Jacobson. The results will be related to condition of these same fish conducted by Fish Ecology scientists at the NWFSC in Seattle and compared to studies conducted in Oregon and Washington estuaries by scientists within the Environmental Conservation Division to gain a better understanding of the contribution of infectious agents to mortality. Dr. Marcia House is joining these efforts as a CIMRS Faculty Research Associate. Also under the direction of Dr. Jacobson, is an additional study funded by U.S. GLOBEC to incorporate macroparasite data of juvenile salmon off Southern Oregon and Northern California into trophic studies of the juvenile salmon food web. These data on parasite assemblages can provide long term feeding habit information for juvenile salmon, their predators and competitors, augmenting the group's ecosystem approach to understanding factors that contribute to salmon population fluctuations. An additional CIMRS Research Assistant will soon be hired to aid in these studies.

Fishery Resource Analysis and Monitoring Division (FRAMD)

Groundfish Program (Cyreis Schmitt, Michael Schirripa, Jean Rogers, Tonya Builder, Keith Bosley, Dan Kamikawa, Waldo Wakefield, Kevin Piner, Jim Bottom, Mary Craig, Carol Meissner, Jim Miller, and Bruce McCain); and Ageing Unit/ Pacific States Marine Fisheries Commission (PSMFC)/ Oregon Department of Fish and Wildlife (ODFW) (Marion Mann, Jennifer Menkel, Bruce Pederson, and Patrick McDonald)

Groundfish Program

The Groundfish Program consists of a multidisciplinary team with expertise in fishery biology

and ecology, stock assessment, mathematical modeling, statistics, computer science, and field sampling techniques. Additional members of this program are stationed at the NWFSC in Seattle. Together, they work to improve understanding of West Coast groundfish population dynamics and their ecosystems; to work collaboratively with states and other partners, to assess West Coast groundfish populations; and to aid resource managers in sustaining and enhancing West Coast marine fisheries.

In 1999, the NWFSC, in collaboration with other National Marine Fisheries Service centers, developed a draft comprehensive plan to guide research on West Coast groundfish for the next three to five years. The research plan is designed to identify the scientific information and approach needed to achieve National Marine Fisheries Service stewardship objectives. The draft plan recommends a high priority on conducting baseline assessments for all groundfish species, improving certainty in current assessments, and improving socioeconomic analyses. Public meetings attended by the general public, commercial fishers, and fishing industry representatives were held during spring 2000 to gather comments to be incorporated into the plan.

During 1999 and 2000, FRAMD staff continued to provide leadership for coast-wide coordination of groundfish research and management advice. In addition to conducting critical stock assessments, program scientists provided review and oversight for assessments carried out at other West Coast laboratories. FRAMD scientists coordinated the establishment of stock assessment teams of scientists from among state, federal, tribal and academic entities and constituent groups. They also recruited expert reviewers to participate in review panels. Stock assessments provide scientifically based estimates of the safe harvest levels for exploited stocks and the status of these stocks relative to target levels of abundance. This information is necessary to prevent overfishing and to guide rebuilding efforts for already overfished stocks. FRAMD scientists conducted assessments for canary rockfish, bank rockfish, and darkblotched rockfish. The NWFSC also continued to support cooperative grants with OSU and UW to improve stock assessments and to foster training of students in this important field.

As part of their efforts to communicate groundfish issues and FRAMD research activities to the general public, they continued to collaborate with staff of the HMSC's Visitor Center to complete an exhibit featuring important groundfish species. The exhibit consists of a large seawater aquarium that presently holds several marine fish species, including two large sablefish. Next to the aquarium is a visitor-activated computer monitor that offers two repeating videos of about 3 min. duration each. The videos have information about the life history, commercial importance, and population status of sablefish; and each presents a short summary of different types of sablefish research being conducted at the HMSC.

FRAMD staff also planned and organized biological studies and habitat investigations of key West Coast fish species to be carried out in 2000. These studies will help to better understand life history characteristics and essential fish habitat requirements of a variety of commercially important fish species. The scientists served on domestic and international committees and teams that address general stock assessment and fishery management issues. For example, they served in advisory roles for the Pacific Fishery Management Council.

Among other FRAMD research projects at HMSC during the past year were:

- The continuation of annual resource surveys begun in 1998. These surveys were conducted with continental slope species from Cape Flattery, Wash. to Morro Bay, Calif. at depths of 100 to 700 fathoms using chartered commercial fishing vessels. Data obtained in this survey series are being used to develop indices of relative abundance, for example, measures of catch-per-unit-effort (CPUE), which are needed to produce accurate results for stock assessment analyses and to provide additional insight regarding the biology and life history strategies of the slope species.
- The depth-specific sampling project was carried out for another year with the assistance of the commercial trawling industry and the ODFW. It is designed to collect depth-specific biological information throughout the year. Its objective is to provide detailed information regarding the depth and seasonal migration habits of species in the

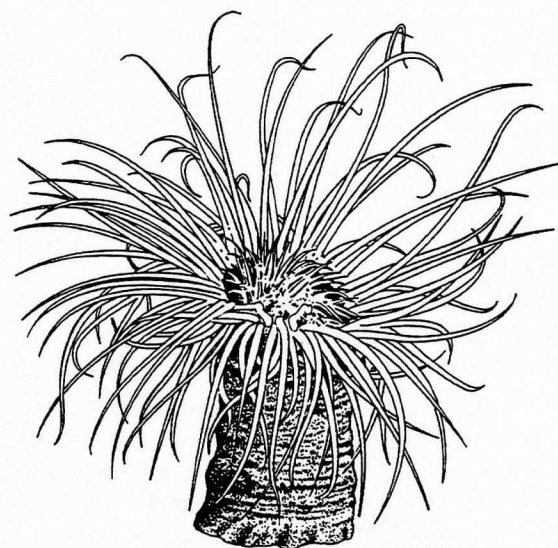
deep-water complex. During 2000, the sampling effort will be done with chartered vessels.

- Two collaborative projects with Oregon State University were continued. One project assembled information on worldwide, cooperative research programs between industry and scientists. This global perspective will help the NWFSC explore appropriate industry collaborations. The other project involves research on the biology of adult and juvenile sablefish. The age-specific spawning patterns and migratory behavior of adult sablefish are being investigated, as well as the recruitment of juvenile sablefish into commercially harvested stocks. This sablefish research has direct application to stock assessments of this species.
- The NWFSC provided funds for the Cooperative Ageing Project (CAP) located among FRAM staff at the HMSC. CAP consists of a team of specialists who determine age and other information about groundfish using the ear bone (otolith) of fish. Researchers use data on the ages of fish for stock assessments and for studies of growth and fish movement. CAP is a cooperative effort among the ODFW, NWFSC, and Pacific States Marine Fisheries Commission.
- Pot and longline gear experiments conducted as a collaborative effort between FRAM and ODFW were performed for another year. The efforts of this year completed a three-part project with pot and longline gear that may provide a new survey tool for sablefish off the Oregon coast. The experiments were conducted aboard two commercial vessels and looked at the effectiveness of pot and longline gear in catching sablefish. It appears fixed gear surveys could be used for depths where current NMFS trawl surveys do not sample.

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

The FRAM Salmon Assessment Team consists of two scientists located at HMSC in Newport, and five scientists in Seattle at the NWFSC. The team works toward integrating the scientific basis for

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



National Oceanic and Atmospheric Administration

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

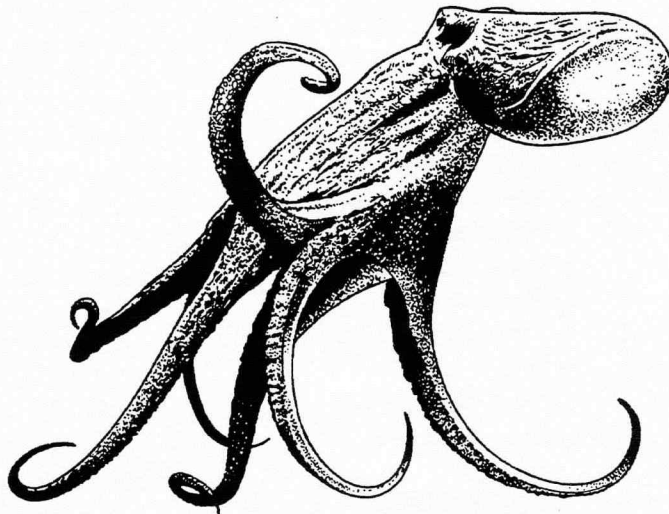
(Investigators: Dr. Robert Embley, Dr. Christopher Fox, Dr. John Lupton)

In 1999, NOAA scientists continued research and technical development focused on establishing the deep-ocean seafloor observatory, NeMO (New Millenium Observatory). NeMO is the nation's first deep-ocean observatory where a wide variety of sampling and monitoring instrument systems are linked for the purpose of studying and sampling a representative portion of the global subseafloor microbial biosphere. Many of the microorganisms which live in this deep, hot biosphere also have closer genetic affinities to humans than do bacteria in normal human environments and because they are so distinct from everyday bacteria, they have been assigned to a new phylogenetic kingdom, *Archaea*. NeMO has been established for the purpose of both gaining access to novel bacteria and for the purpose of beginning an interdisciplinary study of the bacterial biotope. NeMO is located in the summit caldera of an active submarine volcano where frequent eruptions are supporting an especially robust biosphere. Among current research objectives is an interdisciplinary effort to understand the chemical environment in which the bacteria live so that more of them can be artificially cultured. Other efforts are being directed at obtaining samples sufficient to begin assessing the species diversity of

the biosphere. At NeMO, there appears to be an especially high concentration of hyperthermophilic bacteria, bacteria that live at temperatures sometimes exceeding 100 degrees Centigrade.

Hyperthermophiles are of particular interest for their potential biotechnical and pharmaceutical applications. Within the ocean environment itself, thermophilic microbes appear to have a large-scale influence on the chemistry of global hydrothermal emissions, including mediation of ocean nutrient budgets and cycles. Specific accomplishments for the FY 99-00 year are:

- Continued monitoring and sampling to determine the chemical, physical, and biological responses to the volcanic eruption which occurred at NeMO in January and February, 1998.
- Deployment of a camera and three temperature probes which were linked in near-real-time to the Internet. This six-week-long experiment was a proof-of-concept which, for the first time, enabled scientists on land to access data from a deep ocean instrument system located within an active deep ocean hydrothermal system replete with a developing colony of chemosynthetic organisms.
- New species of thermophilic bacteria were sampled and are currently being characterized with regard to their roles in the subseafloor biosphere.



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

The Oregon Coastal Field Office of the U.S. Fish and Wildlife Service (The Service) houses employees from the National Wildlife Refuge Division and the Division of Ecological Services. Refuge personnel are responsible for the operations and management of six National Wildlife Refuges (NWR's) 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. Oregon Coastal Refuges currently has five employees, having added an administrative support assistant in March 2000. The staff focuses on four priorities: land acquisition, habitat management and restoration, biological surveys and monitoring, and environmental education and outreach. In late November 1999, the Oregon Coast National Wildlife Refuge Complex was formally separated from a larger refuge complex administered from Corvallis; this new autonomy will greatly improve the Service's abilities to manage the coastal refuges.

The Oregon Coast Refuge Complex has a very active land acquisition program. During fall 1999, the Service completed the environmental review process for expanding Bandon Marsh NWR and in January 2000 acquired a 407-acre farm along the Coquille River in the lower estuary. The majority of this property will be restored to tidal salt marsh, making this project one of the larger salt marsh restoration efforts in the Pacific Northwest. Five additional tracts are currently being appraised there for acquisition. Another key coastal acquisition was made by the Service in May 2000, when Crook Point in Curry County was purchased from The Nature Conservancy (TNC) for inclusion in Oregon Islands NWR. The Service acquired the 134-acre headland area to provide further protection for the Mack Reef Unit of Oregon Islands NWR. The offshore rocks, reefs and islands adjacent to Crook Point support the second largest concentration of nesting seabirds in Oregon, with over 200,000 birds present from March through October, including a breeding colony of 87,000

Leach's storm-petrels. This unique headland also supports rare plants, unusual geologic formations, and archaeological resources. The Service is just completing the environmental review process to expand Nestucca Bay NWR by acquiring up to 377 acres in and around Neskowin Marsh. This unique wetland contains a variety of freshwater wetland types such as bogs and fens, some of which are exceedingly rare both on the Oregon coast and throughout the Pacific northwest. In addition, the Service is currently appraising 5 tracts of land at Nestucca Bay for acquisition and is working with The Nature Conservancy in attempting to acquire up to 7 tracts at Siletz Bay.

Annual wildlife surveys included the monitoring of nesting seabirds (esp. common murre colonies), peregrine falcons, bald eagles, Aleutian and dusky Canada geese, black brant, and wintering waterfowl. Special studies were continued on the status of black brant in Oregon's estuaries and anadromous fisher 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.

Projects to improve public use or improve habitat or facilities that have been recently accomplished or will be initiated in 2000 include:

- the completion of the Coquille Point Interpretive Project in Bandon, this project included beach access and interpretive panels along a quarter mile trail overlooking several sea stacks, and is a site visited by hundreds of thousands of people annually,
- restoration of the Shell Island Interpretive Overlook on Cape Arago State Park, a project in partnership with Oregon State Parks, Oregon Department of Transportation, Federal Highway Administration, Friends of Shore Acres State Park, and the Shoreline Education for Awareness. A major portion of the funding (\$210,000) was received as a TEA-21 grant,
- construction of a new 3000-square-foot shop building at Nestucca Bay NWR following the removal and recycling of several dilapidated large dairy buildings,

- reforestation of a sizable tract of upland on Nestucca Bay NWR,
- pasture restoration to provide habitat for dusky and Aleutian Canada geese on Nestucca Bay NWR,
- deployment of regulatory buoys around Three Arch Rocks NWR to enforce the 500' seasonal closure zone for added protection of seabirds and marine mammals and,
- planning and preparation for wetland restoration projects at Nestucca Bay, Siletz Bay, and Bandon Marsh NWR's.

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, assist-

ing in the implementation of the Northwest Forest Plan, and providing technical assistance to Federal, State, and local conservation and restoration efforts. Much of our activity during 1999, and continuing into 2000, has been dominated by the New Carissa oil spill. Our spill response efforts focused on reducing impacts to western snowy plovers, marbled murrelets, and other sensitive shorebirds and seabirds. The ongoing Natural Resources Damage Assessment will evaluate the impacts of the spill on these and other species of concern. Other 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.

List of Awards and Scholarships

Curtis & Isabella Holt Marine Education Fund for 2000

Steve Tolzman (\$7,500)

"Columbia River Estuary Study"

Walter G. Jones Memorial Scholarship for 2000

William Pinnix (\$1,000)

"Early Life History of Sablefish"

Mamie Markham Research Awards for 2000

- Jirawat Yongsawatigul (\$10,000)

"Biochemical & physical properties of myofibrillar proteins"

- Carl Demetropoulos (\$6,848)

"Commercialization of Pacific dulse"

- Ebru Onal (\$2,000)

"Evaluation of spray-dried algae as a food for Manila clams"

- Blaine Griffen (\$9,432)

"Interactions between burrowing shrimp and commercially-grown oysters"

- Christopher Krenz (\$2,200)

"Role of recruitment of barnacles & mussels in rocky intertidal communities"

- Bill Pinnix (\$10,000)

"Relationship between early larval and juvenile growth rate"

- Colin Chapman (\$9,700)

"Effects of maternal age on offspring survival in black rockfish"

- Scott Hecht (\$9,821)

"Uptake and accumulation of nonylphenol in food chains"

Lylian Brucefield Reynolds Scholarship for 2000

Not given this year

Anja Robinson Fellowship for 2000

Ebru Onal (\$1,000)

"Evaluation of spray-dried algae as a food for Manila clams"

Wiancko Awards for 1999-2000

- Tanis Carey - Undergraduate award

- Bernta Bechler - Graduate award

Bill Wick Marine Fisheries Awards for 2000

- Okan Esturk (\$5,000)

"Characterization of Pacific whiting surimi"

- Justine Hoffman (\$5,000)

"Effects of various freezing methods on shelf stability of surimi"

Guin Library

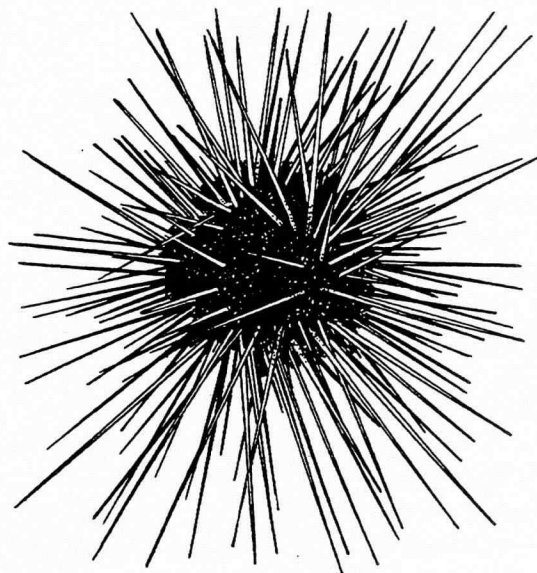
Janet Webster, Librarian

As part of Oregon State University's Information Services, the Guin Library houses a strong collection of marine-related information. The Guin Library staff provides excellent service to researchers, staff and students located at HMSC as well as those in Astoria at the Seafoods Lab and people on the main campus in Corvallis. Self-service circulation is proving popular with the library users; registered borrowers can type in their library number, scan the book's barcode, and be on their way. Library users are also beginning to use more journals online as the library sets up electronic access to those titles offering free access. We are also evaluating electronic subscriptions to see when we should replace a print subscription with electronic access. Times continue to change.

The Library staff is currently revising its strategic goals. Listed below, they give an excellent overview of the issues and challenges we face.

- Support the diverse faculty and students of OSU as they research and learn.
- Train people to use tools and resources.
- Teach people to evaluate and synthesize information.
- Inform people of services and resources.
- Keep information affordable and accessible.
 - * Build strong consortiums.
 - * Work with publishers.
 - * Ensure access
- Maintain a vital and unique collection.
 - * Collect multiple formats
 - * Address changing needs and research interests.
 - * Incorporate local and regional resources.
 - * Add material and records in a timely and responsive manner

Janet Webster, the Head Librarian, currently serves on the Vision 2010 Committee of the Oregon Library Association, and chairs the Strategic Planning Task Force for the International Association of Aquatic and Marine Science Libraries and Information Centers (IAMSLIC). Her current research focuses on the utility of single session library instruction for undergraduates (<http://osu.orst.edu/dept/library/classign/fw240.htm>), and delivering information services to the seafood technology industry (<http://osu.orst.edu/dept/library/guin/seafood.htm>). Ms. Webster presented a poster at the IAMSLIC annual conference that spurred better coverage of Sea Grant publications in the international abstracting database, Aquatic Sciences and Fisheries Abstracts. With the assistance of Heather Hiveley, a graduate student in Fisheries and Wildlife, she has completed a comprehensive bibliography of Yaquina Bay with funding from Oregon Sea Grant and the Environmental Protection Agency (<http://osu.orst.edu/dept/library/guin/yaqbib.htm>).



Statistics

Student Enrollment

<u>Winter/Fall</u>	<u>Class</u>	Fall <u>1998</u>	Fall <u>1999</u>
FW 407/507	Seminar	11	11
FW 431/531	Dynamics of Marine Biological Resources	18	NA
FW 465/565	Marine Fisheries	NA	13
FW 494/594	Diseases & Parasites of Marine Fish & Invertebrates	8	7
FW 497/597	Aquaculture	11	10
FW 498/598	Aquaculture Lab	6	6

Spring

		<u>1999</u>	<u>2000</u>
Bi 450/451	Marine Biology	16	19

Summer

		<u>1999</u>	<u>2000</u>
BOT 499/599	Marine Phycology	NA	8
FW 408	Northwest Wetlands	15	NA
FW 408/508	Project GLOBE	15	18
FW 499/599	Intertidal Ecology	15	NA
FW 508	Water Quality of NW Streams	NA	20
FW 508	Salmonid Disease Workshop	NA	18
FW 508	Pathfinder/COAST Workshop	30	NA
FW 599	Aquaculture	15	NA
FW 599	Marine Mammals	NA	8
FW 599	Coastal Processes/Coastal Biology	15	19
HSTS 515	Evolution and Modern Biology	NA	10

Public Wing Visitors

Since opening, June 1965 = 9,596,767

June 1, 1999 through May 31, 2000 = 153,663

Number of students in scheduled school group visits = 10,841

HMSC Visitor Center Volunteers

1999-2000 Volunteers

Frank Aicher
Laura Anderson
Bob AutumnCook
Julie AutumnCook
Bonnie Bahn
Marlene Bellman
Bob Bickford
Peggy Bickford
James Bones
Gerald Boyd
Joyce Browning
Nathan Brunner
Loie Bunse
Philip Carbone
Gert Carey
Jane Carr
Prudy Caswell-Reno
Ray Clark
Matteo Costamagna
Dann Cutter
Beryl Czuleger
Tom Czuleger
Pat D'Eliseo
Don DeLisle
Mary DeLisle
Stuart Didtel
Charlotte Dinolt
Kathleen Dobson
Amy Eckstein
Carl Ehrman
Mildred Ehrman
Gregory Emmanuel
James Fackler
Theresa Farrell
Katherine Fernald
Kay Floyd
Helen Frank
Fonte Gassner
Shirley George
Mark Grefenson
Ferol (Dee) Hadden
Bill Hanshumaker
Teresa Hartsell

Sara Hodges
Melinda Hoffman
Wayne Hoffman
Kathleen Holt
Justin Huguley
Joel Hungerford
Ralph Irvin
Sonia Irvin
Paula Jones
Clyde Kellay
Donald Kennedy
Margaret Kennedy
Derian Kilgore
Nancy Kromer-Miller
Patricia Lewis
Jon Luke
Frank Lush
Susan Lynds
Leslie Lythgoe
Barbara Mate
Bruce McCallum
Curt McCann
Patricia McCann
Patricia McChesney
Donna McCoy
Ed McCoy
Serena McCoy
Walt McNeal
Tim Miller-Morgan
Patricia Modde
Maxine Moodie
Terry Morse
Polly Muller
Kenneth Nevar
Sue Nevar
Terri Nogler
Hamdi Ogut
Ed Osterman
Irene Osterman-Sussman
Jack Owens
Kennith Parks
Mary Emma Parks

Robert Patee
Sylvia Pauly
Bonnie Pazdalski
Walt Pazdalski
Isabella Potter
Lisa Rasmusan
Dolores Reed
Donna Reynolds
John Roberts
Suzanne Roberts
Howard Rubin
Christy Sallee
Talia Sanfilippo
Dyann Schierholtz
Mell Schierholtz
Gerti Schramm
Denise Schrock
Elfrieda Sinclair
Maggie Sommer
Julia Stalcup
Chet Stark
Rex Stephenson
Edwin Swartz
Craig Toll
Christine Tomsik
Larry Tyler
Wendi Van Tine
Van Vanderbeck
Linda VanderBurgh
Eric Vaughn
Marit Vike
Joe Voelkel
Mary Voelkel
Mike Walters
Helen Wellman
Jack Whipple
Jane Whipple
Glen Williamson
Marie Williamson
Sue Wilson
Jack Woods
Rosalyn Woods
Judith Wright

Donor Honor Roll

1999-2000 Annual Gifts

Penny Applegate*
Richard & Kathleen Balaban*
Andrew & Barbara Balerud*
David & Patricia Bauer*
Wilbur & Vivian Bauer*
Donald Beyer
Peter Brix*
William & Bonnie Brod*
A.C. Burlingham
Jane Burroughs*
Maybel Butler*
John & Shirley Byrne*
Louise Castles*
Dorothy Christensen*
Companion Pet Clinic*
Community Foundation of
Jackson Hole
Cecil & Sally Drinkward*
Claude & Melissa Elmore*
William Emery*
Letrice Freed*
R. Barry & Carol Fisher
Stephen & Virginia Glaser*
Crawford & Jean Graham
Arline Greenblatt*
James Greenblatt*
Glenn Harvey*
Mark & Antoinette Hatfield*
George & Suzanne Keller*
Tai-Kwan Lau
Carmen Jones
Ernest & Zelma Josi*
Anne Kapuscinski
William & Gretchen Kimball*
Evmorfilli Kyridis*
MKL Foundation*
Arthur & Tammy Mills*
Ellison Morgan*
Richard & Valerie Nichols
Allison Northcutt*

Margaret Norton*
Robert & JerryAnn Olson
Jay Owens*
Donna Payne*
Jack & Jody Pfeifer*
James & Terry Quinn*
Roland & Patricia Rehm*
Nita Rose*
Sally Rose*
Jean Roth*
Eldon & Shirley Schamp*
David & Nancy Scharff*
Carl and Sonia Schmitt*
Sea Lion Caves, Inc.*
Bonnie Serkin*
Jack & Carol Shininger*
Randolph Sleet
Lynn & Susan Spruill*
Loran Stewart*
Ann Swanson*
John & Frances Von Schlegell*
Tim Turner*
Marie Vandewater*
James & Judith Wallin*
Lavern Weber
Stephen & Janet Webster
Norbert & Ann Wellman*
Thomas Wildish*
Harriet Winton
Ritchie & Lesghinka Wilson*
Mary Youmans*
James Young*

* = Marine Mammal Endowment

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OSU Programs at Hatfield Marine Science Center

<u>Research Administration</u>	<u>\$ Amount</u>	<u>Unit Sub-Total</u>	<u>Total</u>
Administration	371,122		
Visitor Center Support	156,360		
Non-Sponsored Research	4,049		
Non-Sponsored Education	36,202		
Sponsored Education	42,700		
Sponsored Research-Chadwick	27,195		
Sponsored Research-Chapman	38,497		
Sponsored Research-Hansen	110,151		
Sponsored Research-Other	<u>87,803</u>		
Total Research Administration		\$874,079	
<u>Physical Plant</u>			
State Support	384,032		
Federal Support	<u>274,294</u>		
Total Physical Plant		\$658,326	
<u>Cooperative Institute for Marine Resources Studies (CIMRS)</u>			
Administration	48,420		
Sponsored Research	1,192,383	\$1,240,803	
<u>College of Oceanic & Atmospheric Sciences</u>			
Ship Support/Operations	2,036,764		
Ship Support/Training	16,157		
Ship Scientific Equipment	<u>93,816</u>		
Total Ship Operations		\$2,146,737	
<u>Education Programs</u>			
Extension	189,490		
Sea Grant	350,961		
Visitor Center (self-funded)	116,530		
Sponsored Programs	98,990		
Self-Funded Programs	54,299		
OR Dept of Education	<u>7,450</u>		
Total Education Programs		\$817,721	
<u>Housing</u>			
Self-Funded Operations	<u>125,510</u>	\$125,510	
<u>Bookshop</u>			
Self-Funded Operations	<u>190,427</u>	\$190,427	
<u>Other</u>			
Guin Library	267,500		
OSU Foundation	73,115		
Network Service	28,550		
Federal Agencies (through OSU)	<u>19,210</u>		
Total Other		\$388,375	

Total Hatfield Marine Science Center

\$6,441,979

Coastal Oregon Marine Experiment Station

Astoria

Research Type	<u>Amount</u>	<u>Unit Sub-Total</u>	<u>Total</u>
Seafood Laboratory Administration	109,022		
Experiment Station Non-Sponsored Research	278,193		
Cost Shared to Sponsored Research	130,695		
Self-Funded Research/Education	44,240		
Sponsored Research	<u>172,178</u>		
Total Astoria			\$734,328

Newport

Marine Branch Station - Admin	410,951		
Cost Share to Match Federal Funds	95,852	\$506,803	
Marine Mammal Research - <i>Mate</i>			
Marine Mammal Endowment	523,950		
Sponsored Research	77,258		
Non-Sponsored Research	24,166		
Extension	<u>47,471</u>		
Total Marine Mammal Research		\$672,845	

Marketing - <i>Sylvia</i>			
Sponsored Research	97,152		
Non-Sponsored Research	<u>98,737</u>		
Total Marketing		\$195,889	

Fish Disease - <i>Reno</i>			
Sponsored Research	58,531		
Non-Sponsored Research	<u>66,483</u>		
Total Fish Disease		\$125,014	

Fishing Analysis			
<i>P.I. - Sampson</i>			
Sponsored Research	91,388		
Non-Sponsored Research	20,107	\$111,495	
<i>P.I. - Berkeley</i>			
Sponsored Research	212,640		
Non-Sponsored Research	<u>14,396</u>	<u>\$227,036</u>	
Total Fishing Analysis		\$338,531	

Aquaculture			
<i>P.I. - Langdon</i>			
Sponsored Research	252,616		
Non-Sponsored Research	66,928	319,544	
<i>P.I. - Robinson</i>			
Sponsored Research	0		
Non-Sponsored Research	<u>2,350</u>	<u>2,350</u>	
Total Aquaculture		\$321,894	

Total Newport			\$2,160,976
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Total Coastal Oregon Marine Experiment Station			\$2,895,304
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BUDGET CONTINUED ON NEXT PAGE

Cooperating Agencies at Hatfield Marine Science Center

	\$ Amount	Total	% of Total
Environmental Protection Agency	2,463,760		16%
Oregon Department of Fish & Wildlife	3,215,680		21%
Vents Program - Federal	2,100,000		13%
Nat'l Marine Fisheries Service - NWFSC	3,000,000		19%
Nat'l Marine Fisheries Service - AFSC	702,000		4%
US Fish & Wildlife Service	<u>4,133,000</u>		<u>26%</u>
Total Cooperating Agencies		\$15,614,440	100%
<u>Funding Sources</u>			
<u>Direct State Funding</u>			
HMSC	1,095,772		
COMES	<u>1,317,881</u>		
Total Direct State Funding		2,413,652	10%
<u>Other State Funding</u>			
Matching Funds (Endowments)	212,075		
Guin Library	267,500		
Total Other State Funding		479,575	2%
<u>Sponsored Research</u>			
Nat'l Oceanic & Atmospheric Admin (NOAA)	2,815,775		
Nat'l Science Foundation (NSF)	1,258,557		
US Dept of Agriculture (USDA)	308,579		
Dept of Defense (DoD)	59,914		
Oregon Dept of Fish & Wildlife (ODFW)	111,323		
Oregon Dept of Education (ODE)	7,450		
Extension Service/Extension Sea Grant	587,922		
Donations & Private Business	767,361		
Sub-Contracts from Other Universities	<u>87,156</u>		
Total Sponsored Research		6,004,037	24%
<u>Other Funding</u>			
Self-Funding Units	440,019		
Cooperating Agencies	<u>15,614,440</u>		
Total Other Funding		<u>16,054,459</u>	64%
Total Funding		\$24,951,723	100%



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