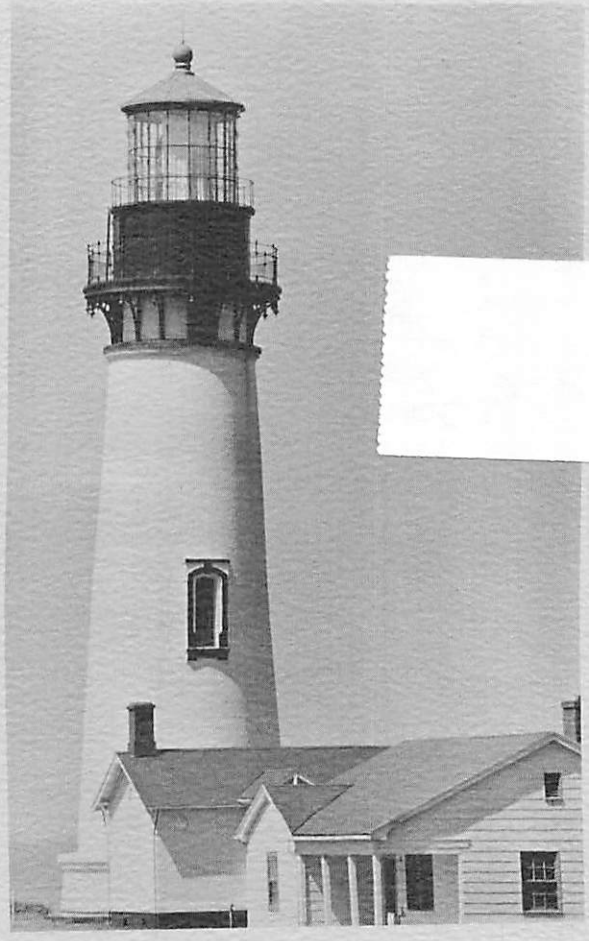
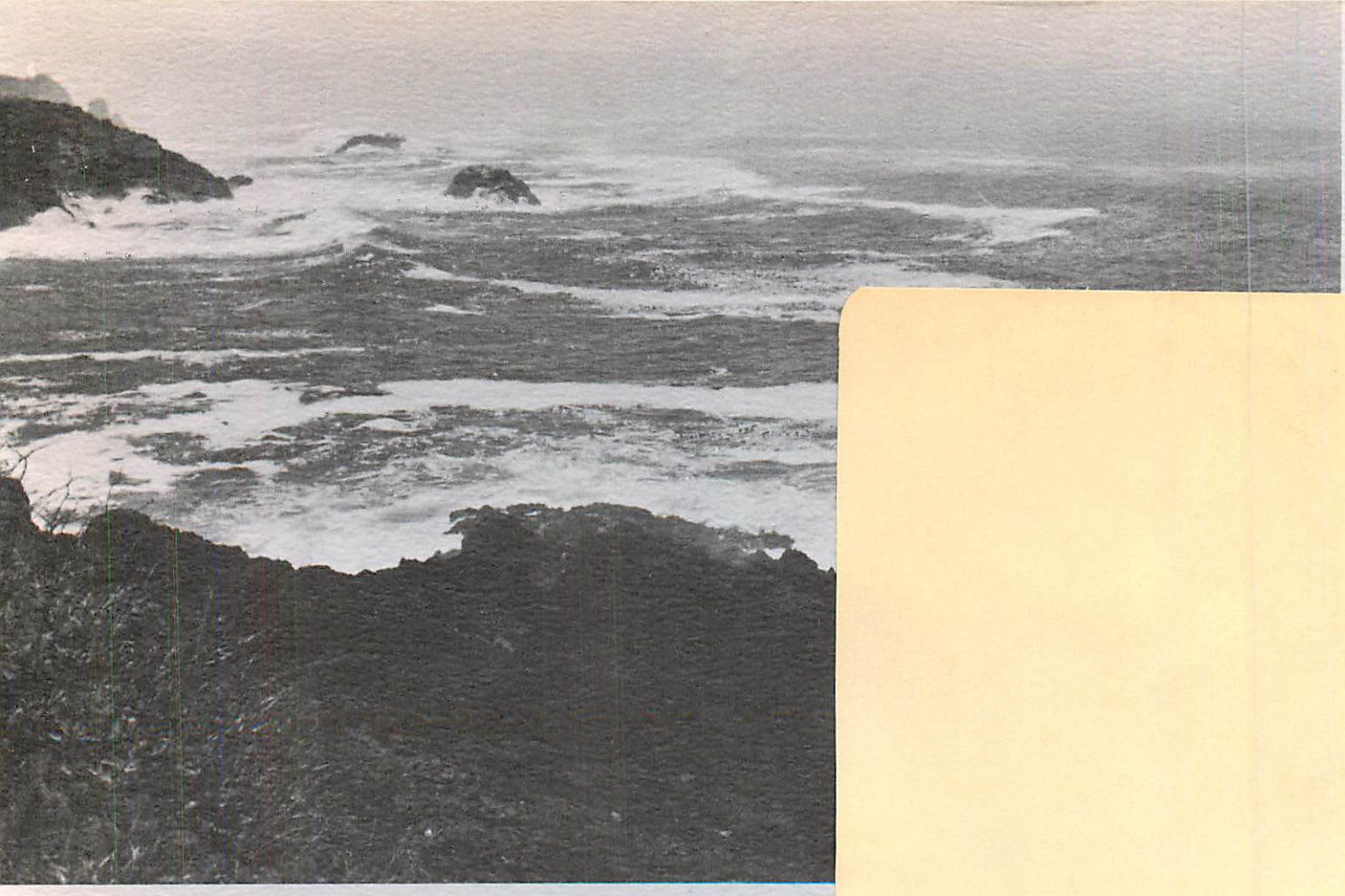
SEA GRANT



A Report on the Oregon State University
Sea Grant Program for 1972-1973



Break, break, break,
On thy cold gray stones, O Sea!
And I would that my tongue could utter
The thoughts that arise in me.
O well for the fisherman's boy,
That he shouts with his sister at play!
O well for the sailor lad,
That he sings in his boat on the bay!
And the stately ships go on
To their haven under the hill;

But O for the touch of a vanish'd hand,
And the sound of the voice that is still!
Break, break, break,
At the foot of thy crags, O Sea!
But the tender grace of a day that is dead
Will never come back to me.

ALFRED, LORD TENNYSON,
BREAK, BREAK, BREAK

Introduction

Mercury contamination, the consequences of dredging, limiting entry into certain fisheries.

At first glance, these three phrases seem abstract and unrelated. Standing alone, they are just that. But viewed together, they are representative of the three divisions of Sea Grant research at Oregon State University. As that, they signify the diverse work going on this past year that is covered in greater detail elsewhere in this report.

In the mercury study, for example, food scientists showed that fetal damage from mercury may be less than was previously reported. It is part of Sea Grant's Food from the Sea division, which concentrates on developing better ways to harvest, process, store, and use seafood.

The dredging work, carried out by ocean engineers, aims to find out what happens to material that results from the river dredging that must go on to keep Oregon's rivers navigable. It is one project in Sea Grant's Coastal Zone Environments division which helps Oregon realize more orderly and productive management of its coastal zone, including the ocean, rivers, and associated land masses.

Limited entry, which means that only a given number of fishermen are officially allowed to fish certain species, is a new concept. In two separate projects, an anthropologist and a marine economist are examining the impact of limited entry on the commercial fishing industry and Dungeness crab. Their studies are part of Sea Grant's Human Resources division which provides information and leadership for the coastal community in developing resources.

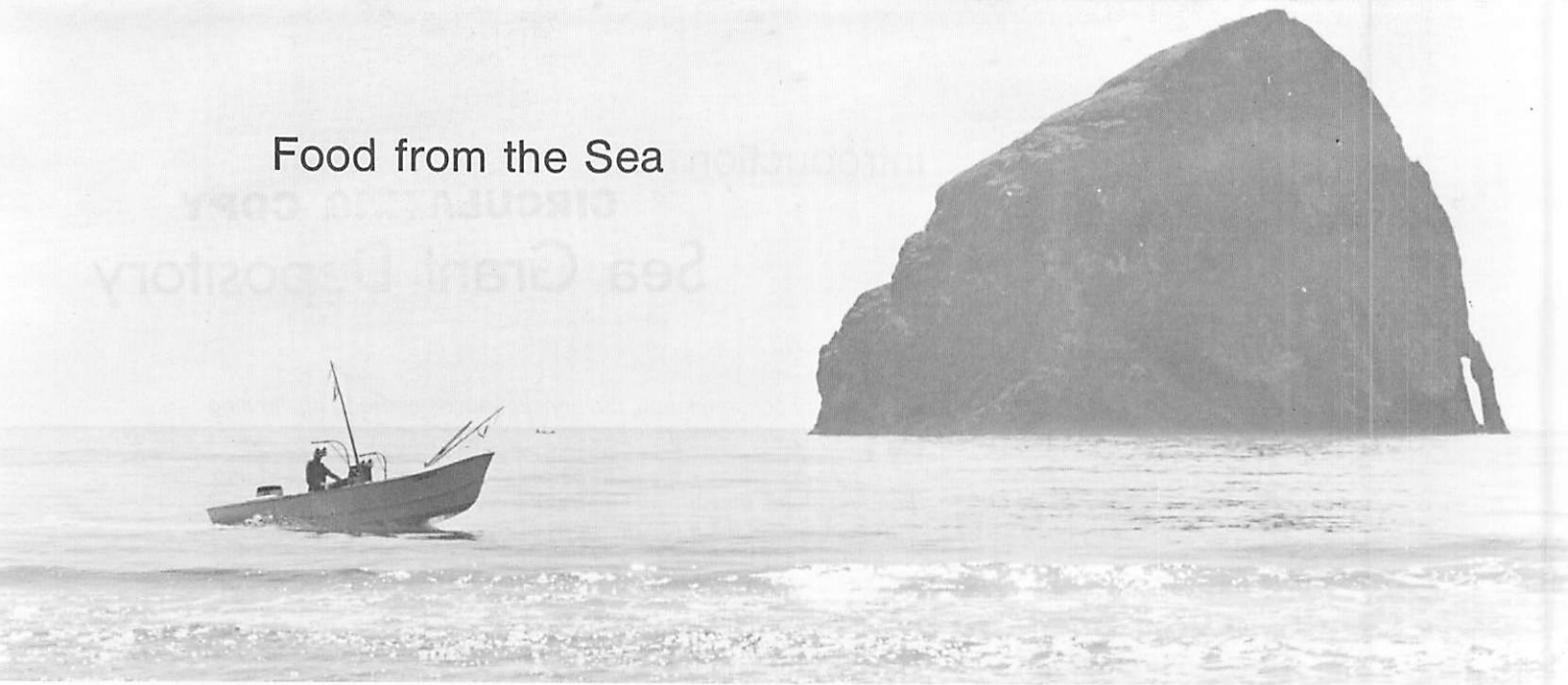
In addition to such research, OSU Sea Grant continued the other aspects of its work this year. The Marine Advisory Program helped solve problems on-the-scene for residents of the coast and carried the knowledge of the laboratory to them. Education and training aspects of Sea Grant went on as well. Graduate students continued their educations with help from the program and they, in turn, aided in the research laboratories.

In pursuing its main goal of helping to develop Oregon's marine resources, OSU Sea Grant continued to follow its previous framework: an interdisciplinary, multi-school and multi-department approach involving the College of Science, the College of Liberal Arts, and the Schools of Engineering, Oceanography, Agriculture, and Pharmacy at Oregon State, the University of Oregon Law School, and Clatsop Community College. Support comes from the Office of Sea Grant, part of the National Oceanic and Atmospheric Administration, within the U. S. Department of Commerce and the state and county governments of Oregon and interested marine industries.

In carrying out its work, Sea Grant provides the framework within which these varied parts can work. In some instances, the people involved in projects come from differing backgrounds, with their final goal the only common factor helping to develop the state's marine resources. More than anything, Sea Grant is a leverage project—influencing, encouraging, and helping conduct related programs.

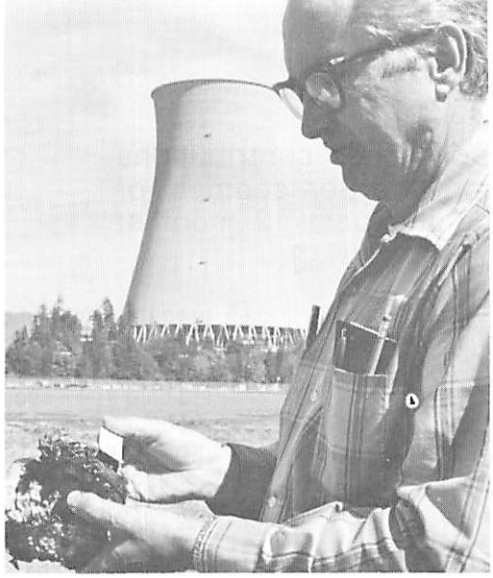
As its goals are achieved, the citizens of Oregon benefit. But so do the members of the Sea Grant program. They know that without their work, some of these valuable things might not be accomplished.

Food from the Sea



Do expectant mothers who eat fish containing mercury endanger their unborn babies by increasing the likelihood of deformities? Widespread fears about mercury contamination have appeared several times in the past few years, most recently in Iraq where thousands of people were poisoned by seeds treated with a mercury fungicide. Medical observers there suggested that babies whose mothers had eaten mercury during pregnancy were likely to show birth defects or retarded development because the mercury concentrated in the fetus. No definitive work had ever been performed to see if these worries should be extended to mothers eating fish, although many experts thought they probably could. Scientists at the OSU Seafoods Laboratory in Astoria discovered this year that these fears were not justified. Their investigations with mice showed that ingested mercury as it naturally occurs in fish is not selectively absorbed by the fetus. They found no fetal damage in mice that were fed tuna in amounts ranging on a weight basis from the equivalent of one can a day to 135 cans in a day in humans. After examining such factors as number of still births, size of the fetus, and frequency of deformities in 100 mothers and 900 fetuses, the scientists have concluded that the danger from mercury in tuna was not as great as once feared. Because of this work, expectant mothers can now eat fish without worrying.

Until the recent nationwide outbreak of scombroid poisoning from canned tuna, processors had relied on visual inspection to identify potentially poisonous lots of fish. That incident, which left almost 300 people sick and cost the processor almost $1 million, made obvious the need for chemical monitoring of the poison that had caused it, toxin histamine. Existing testing methods required 24 to 48 hours and were not very accurate. Toxicologists at the OSU Seafoods Laboratory developed a reliable seven minute test to overcome these problems. The process involves blending cooked tuna in water and adding a chemical which turns a deep orange if any histamine is present. Blends of normal tuna become a pale yellow-orange. With this simple and inexpensive test, tuna processors can know in advance that the product they ship is safe and guarantee that safety to the consumer.



Heated water from nuclear power plants, long viewed as a liability to the surrounding environment, may, under the proper conditions, actually improve the growth rate of oysters. At least that's what preliminary laboratory studies this past year by a group of researchers in Sea Grant's aquaculture program indicate. Three species of oyster (Pacific, native and European) have been successfully grown over a six month period in 100 percent heated ocean water with no harmful effects. In fact, the heated water has been found to significantly increase the growth rate of juvenile oysters as long as sufficient food is available in the water. This information will be used in future research to see if an actual oyster "factory" can be set up in sea water adjacent to a coastal power plant at ambient and increased temperatures. The researchers will evaluate methods of supplemental feeding to use during times of the year when the nutrient supply of natural sea water may be inadequate to sustain a high rate of growth. Shellfish are already being raised in warm water from a Pacific Gas and Electric power plant in Moss Landing, California. Alternate designs of factory systems will also be investigated in the OSU project. This information is of particular interest to power companies in the Pacific Northwest where future needs dictate the construction of several nuclear plants. Such plants require enormous quantities of cooling water which must be returned to the environment at elevated temperatures as waste. To lessen damage to the environment, many of the plants will have to be located on the coast. Although this heated water was long considered a threat to the environment there, Sea Grant has shown that it may be a benefit—at least to oysters and the people who enjoy them.

The scenario used to run something like this: the fisherman would enter a bank at a distinct disadvantage to get the financing for a new vessel or other equipment. He would try to fill the banker in on his business, but he often lacked enough statistical information to do the proper job. The risks seemed high to the banker so if he gave a loan at all, it was for a short term at a high rate of interest. Now, all that is changing because of the Marine Economics Data Sheets developed by an OSU marine economist in the Sea Grant program. The sheets, which have been prepared for different size fishing vessels, from selected ports, show variable costs of a year's operation (fuel, gear, bait), fixed costs (insurance, depreciation, fees, licenses), pounds of fish caught, and the resulting profit. Each sheet also has a technical description of the vessel and its market value. The 47 sheets on various vessels are updated periodically because of inflation, and changes in the fishery. Recently, such sheets have also been prepared on marinas, boat yards, and charter boat operations. They are useful any time these people need a quick rundown on their business. Now, all these companies and individual fishermen know things about themselves they never knew before. And, they can even bank on that knowledge helping them—thanks to Sea Grant.

Sea Grant made other contributions in the Food from the Sea segment of its work during the past 12 months:

• *scientists* in the aquaculture program had continued success in their primary goal of farming Pacific salmon and oysters.

• *about 1,300* chum salmon returned to the Whiskey Creek hatchery where many of them had been earlier spawned.

• *192,000* chum salmon eggs were provided to the first commercial chum hatchery in Oregon; experimental quantities of eggs were made available to two other private hatcheries.

• *improved* design of oyster hatcheries is the aim of another aquaculture project where investigators are attempting to determine the most efficient method of operation, the best design and materials and the most desirable means of handling the young oysters; when finished, they will prepare a manual detailing oyster hatchery operation.

• *heritability* studies on oysters indicate that it should be possible to produce oyster lines with improved growth characteristics and higher commercial value.

• *scientists* at the Seafoods Laboratory have evaluated a way to measure factors like amine and protein breakdown and correlated results with time in storage to determine the quality of Pacific shrimp before shipment.

• *some Oregon* rockfish have a brown color, a fact signifying no harm, but to a purchaser's eye; researchers have discovered a way to whiten the fresh fish, thus eliminating a groundless worry over coloration.

• *research* on fish muscle quality during storage may result in a longer shelf life for frozen fish in general.

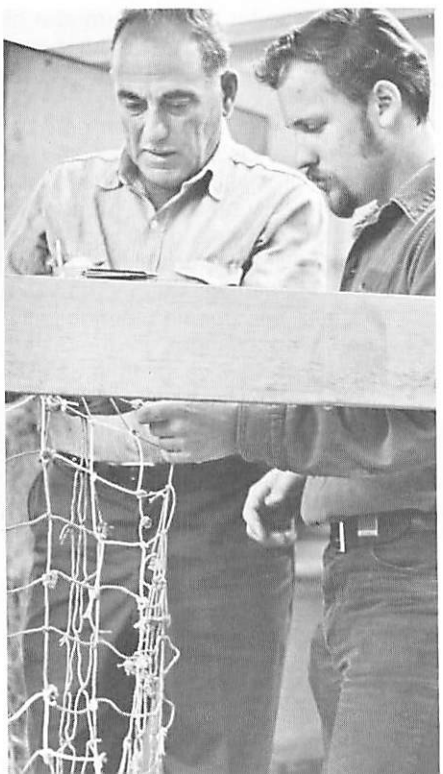
• *research* into the presence of heavy metals in Oregon bottom fish continued at the laboratory this year with results indicating that neither lead nor cadmium in bottom fish present any danger to the fish-eating public.

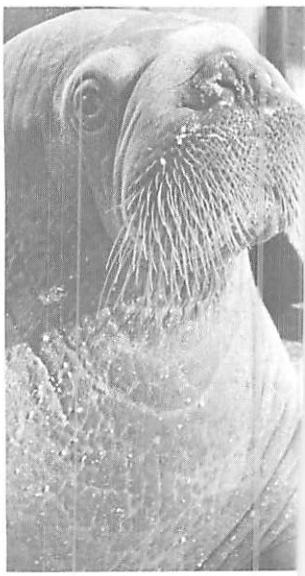
• *Chinook salmon,* adapted to sea water early in life, showed improved survival rates compared to the past but growth rates are inferior compared with growth rates in fresh water or with rates of pink and chum salmon in sea water.

• *results* from feeding experiments with rainbow trout showed that a diet containing certain highly unsaturated fatty acids markedly affect growth rates.

• *another* study hopes to extend the same information on fatty acids to silver salmon growth.

• *an experiment* investigating protein/energy relationships showed





rainbow trout can efficiently use high energy-low protein diets providing a saving in costly high quality protein.

• *scientists* have had some success in rearing English sole larvae at temperatures between 5° C and 15° C; their continued success could lead to the development of a successful commercial fish culture operation.

• *data* on the distribution, ecology and mortality of shrimp and crab larvae along the Oregon coast have been collected by OSU oceanographers; their continual analyses will help forecast the size of exploitable stocks of both species.

• *information* gathered on the reproduction, early life history and mortality of food fish along the coast will help the Oregon State Fish Commission and the National Marine Fisheries Service better evaluate and manage fish stocks located there.

• *other Sea Grant* scientists have found that a microsporidan protozoan disease infects juvenile English sole in Yaquina Bay, Oregon with mortality as high as 50 percent in some areas of the bay; further study may lead to information on where and why the disease occurs.

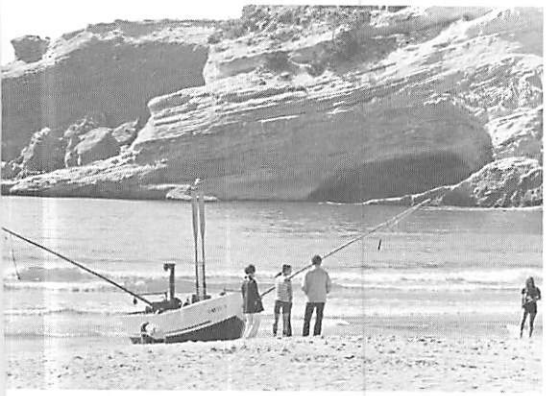
• *researchers* have found at least three species of new blood parasites in Oregon flatfishes.

• *a survey* to identify important Oregon fish viruses and their distribution, now nearly complete, will help the Oregon State Fish Commission and the Oregon State Game Commission prevent the spreading of these diseases to different water sheds when they are transporting fish or eggs and determine the viability of developing an oral immunization agent.

• *bioactive extracts* of marine invertebrates showing antimicrobial, tumor-inhibitory, neurotrophic, cardiovascular and insecticidal activity have been isolated by OSU pharmacognosists and are being analyzed and tested for possible therapeutic use in the future.

• *studies* on the chemical activities of fungi in marine environments indicate that these organisms produce metabolites which serve as nutrients, hormones, and vitamins for marine animals as well as being involved in the formation of detritus in estuarine food webs.

• *fisheries development specialists* in the Department of Fisheries and Wildlife are exploring the introduction of pair trawling in Pacific Northwest fleets to give fishermen with small boats a more versatile, efficient, and economical method of harvesting mid-water and demersal stocks of fish.



Human Resources

The Sea Grant lawyers were worried. Aquaculture was developing faster than expected and the people involved in it were not always able to keep up with new aspects. This newly emerging field of "ocean agriculture" was about at the stage its land counterpart had reached long ago at the time hunters changed to farmers. Instead of catching wild fish, the fishermen would soon be raising their own. And this is what presented the worry. This expansion of aquaculture would present new problems as it was developed commercially and extended to more and more species of fish. This growth could also have international implications if the fish raised in hatcheries wound up on the high seas. So, the legal specialists in Sea Grant's Ocean Resources Law Program at the University of Oregon Law School began to study these new problems, particularly the new state laws concerning aquaculture recently enacted in Oregon, Washington, and

California. The lawyer's scrutiny of how these factors would affect the commercial fishing industry is still going on. Results will be presented and the problems discussed in a special conference next year hosted by the Law School. This particular case exemplifies the importance of ocean law, because unless the legal problems connected with the use of estuaries and the handling of public species are solved, all the biological, economic, and engineering research will be wasted.

Work in the Ocean Resources Law Program has also involved the development of a classification and shelving system for materials in ocean law, the first ever undertaken. Results will be published in the future for use by other programs. Several more segments of the Commercial Fisherman's Legal Guide (on fishing treaties, insurance, limited entry, boat laws, and international law) are complete or nearly complete under the program. A second special issue of The Oregon Law Review was published this past year. Another special issue devoted to Oregon coast management is in the planning stage and will be published next summer.

Can the amount of gear and vessels involved in harvesting crab be limited without causing serious economic consequences to the fishermen involved? OSU marine economists are attempting to find out this year. The study results from federal and state concern about uncontrolled access to ocean fisheries and overcapitalization of any one fishery. It comes at a time when limited entry in salmon fishing is taking place in British Columbia and the political feasibility of similar plans in the U. S. is increasing. Would a reduction in crab fishing, by limiting the total amount of gear used, make the remaining vessels and equipment more productive and more valuable? Would it cause crabbers to leave the area, or switch to other fisheries, thus transferring the problem there rather than solving it? The marine economists don't know the answers yet because the basic interviews with 240 Oregon fishermen are still being conducted. Each fisherman is being asked about his occupational work history, non-fishing employment, and his profitability as a fisherman in order to find out how well Oregon fishermen do. The analysis of the data for those involved in crabbing should furnish answers to some questions about limited entry—before they are officially asked. OSU Sea Grant is neither for nor against limited entry. Rather, its specialists are trying to determine the implications of the concept so that fishermen, processors, and management agencies will have better data for their decision making.

In 1866, William and G. W. Hume and Andrew Hapgood established a cannery on the north bank of the Columbia River across from Astoria. They packed 4,000 cases of salmon, starting what has become a dominant industry in Oregon and the Northwest. The activity grew as fishermen fanned out along the Columbia and other streams. The preferred stocks of spring Chinook diminished for reasons which may include overfishing, loss in irrigation systems, destruction of spawning habitat, construction of dams, stream pollution, and increasing competition from sportsmen. Professional fishermen increasingly exploited other stocks of salmon and reached further out to sea for the yearly salmon harvest, fewer salmon were canned, and more were sold on the fresh market. Because these changes have occurred gradually and, at times imperceptibly, over the last century, no one has ever tried to analyze the impact of such evolutionary and cultural changes on Oregon's commercial fishing industry. An OSU anthropologist is trying to find out, using Sea Grant funds. He has begun a detailed description of the human dimensions of the Oregon fish harvest system as it has responded to attitudinal, social, and technical innovations during the past 100 years. His study will eventually analyze the human resource effects of these innovations and provide an improved set of social facts upon which to base policy decisions regarding fishery resource management and specifically, limited entry. This year, he is evaluating fishermens' organizations and communication effectiveness because both of these factors affect the ability of people to participate in decision-making. His project will attempt to identify organizational strength and weakness and find out the individuals and groups not now getting proper information. Prior research on the impacts of limited entry showed great variability among fishermen and fishermens' organizations in their ability to participate in policy decisions affecting their industry. In some instances strong organizations are able to influence policy decisions. In others fishermen are not well organized and have relatively little impact. The same variations apply to information dissemination. When complete, this study should help fishermen, fish processors, scientists, advisory agents, and the general public have a better idea of the role played by the commercial fishing industry in Oregon.

Specialists in ocean law and marine economics used to be in short supply. At least before Sea Grant. In the past, few people with the knowledge to properly study the rapidly growing legal and economic needs of the sea were available because the fields were so new. Now, because of training programs in the law at the University of Oregon Law School and marine economics at Oregon State University, answers to those previously vexing questions are finally emerging. The same increase in trained specialists has resulted from the Sea Grant-sponsored training courses for commercial fishing technicians, marine technology technicians, and marine engineering technicians at Clatsop Community College. All these areas were short of people before Sea Grant. But training and education are also an integral part of Sea Grant's research effort. Graduate students act as research assistants on many projects. In the process, they are helping Sea Grant achieve its goals while furthering their own professional education and producing a satisfactory thesis at the same time.

Coastal Zone Environments

With its hotel, natatorium with salt water swimming pool (photo), and vacation cottages, Bayocean, Oregon had become a thriving resort by 1911. Its wonders were advertised nationally and when a railroad to nearby Bay City and an accompanying ferry system were completed that year, the community finally began to grow. That same year, construction of a north jetty to the Tillamook channel was approved to stabilize the bay entrance for the anticipated increase in shipping brought by the railroad. The jetty was completed in 1917. By the 1920's, Bayocean had begun to deteriorate for economic reasons. By 1933, it had begun to disappear for physical reasons—the sand spit was eroding and the natatorium was gone (photo). The residents blamed the north jetty which was lengthened in that year. They said it trapped large amounts of sand which caused the erosion of the northern shoreline where the village was located. Winter storms lashed the spit for the next 20 years. In 1952, the spit was breached, with high tides penetrating the gaps and finally destroying a 4,000 foot long segment of the spit's narrow sand ridge neck. And, Bayocean disappeared.

A Sea Grant oceanographer and geographer have recently been studying Bayocean's sad history as part of a larger coastal sand transport project. Its general objectives are to establish a sand budget for the Oregon coastal zone, determine areas of beach erosion and deposition produced by the new south jetty at Tillamook Bay, and ascertain the extent and cause of beach erosion at Siletz Spit, where an estimated $4.5 million in coastal homes and property is endangered. A team of Sea Grant oceanographers and OSU engineers was called in this year when high tides threatened the spit and its homes. At their recommendation, rip rapping (the placement of large boulders along the shore to lessen the impact of the waves) is being carried out.

The overall study is continuing and as they do it, the oceanographers and engineers will keep the lessons of Bayocean in mind.

The fair breeze blew, the white foam flew,

The furrows followed free;

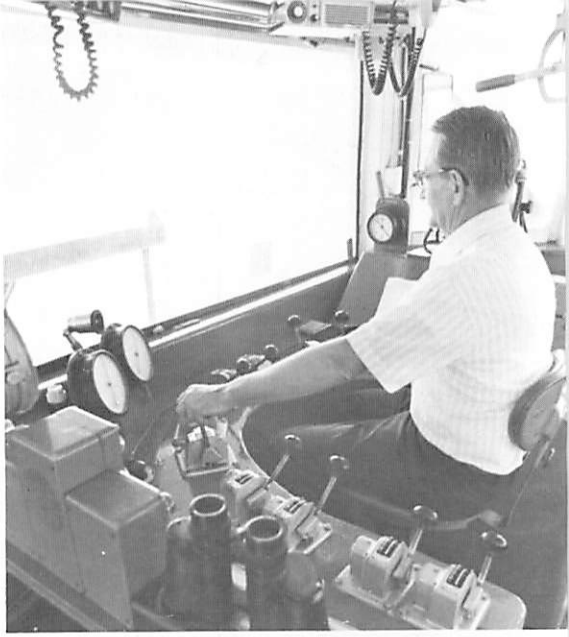
We were the first that ever burst

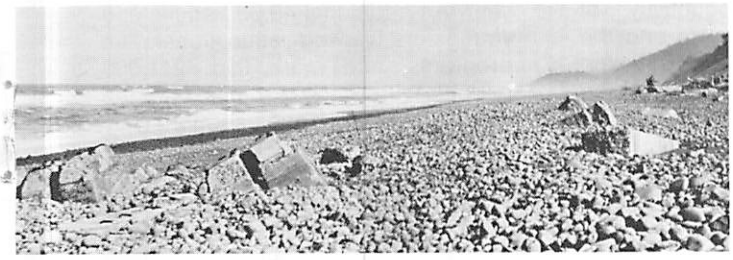
Into that silent sea.

SAMUEL TAYLOR COLERIDGE,
THE ANCIENT MARINER

The Columbia must be dredged continually along the 90 miles from its mouth to the Port of Portland and beyond to keep it clear of sand, broken tree trunks and other obstacles to free passage. The same task must be carried out in several of Oregon's smaller coastal rivers. Hydraulic dredging is nothing new; it is the most efficient way to excavate large quantities of submerged sediments. In the Columbia, however, the material must often be returned to the river bottom because of the cost of carrying it a great distance for disposal in the open sea. An increasing problem is how to control the large amount of this excavated material generated by channel maintenance dredging and determine where it goes. It is not uncommon for a single dredge to pump 50 million gallons per day of such materials and operators do not want it to go back where they've just removed it. Enter Sea Grant's ocean engineers with an analytical model they conceived and tested over the last year. This model predicts where the material goes initially. Existing sediment transport theories can predict the long term fate. The next step in testing the model's validity is to board the dredge *Oregon* and, with the help of the Army Corps of Engineers, try to put their laboratory results into actual practice.

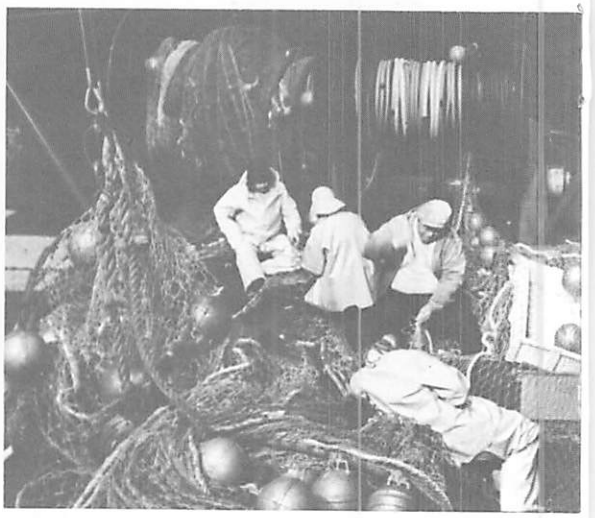
In the meantime, a group of OSU Sea Grant researchers and advisory specialists are looking at the alternatives of banking the spoils on upland areas adjacent to the Columbia with a big question on their minds: Can garbage and crab shells be incorporated with dredge spoils to make fertile soil for vegetable or other crop production?





The past 12 months have seen the completion of a number of other tasks in the Coastal Zone Environments phase of Sea Grant's work:

- better sea and surf forecasting techniques are the aim of another project by Sea Grant oceanographers; if they are successful, losses of life and property will be reduced and use of harbors and beaches will be improved.
- the design of offshore structures and undersea pipelines may be improved in the future because of a study of the ocean's effect on them carried out by OSU ocean engineers.
- marine economists continued their study of Clatsop County, Oregon, concentrating on the environmental impact of new industries on that area.
- OSU ocean engineers discovered problems in circulation and water quality on Alsea Bay, Oregon, and for this and other reasons, developers decided not to risk the construction of a $400,000 salmon-rearing enterprise there.
- engineers and oceanographers also worked with the Army Corps of Engineers to monitor the hydraulic, water quality, and biological changes occurring because of maintenance dredging in the Suislaw estuary of Oregon.
- on-going studies at the Alsea, Suislaw and Siletz estuaries on the Oregon coast are providing an increased understanding of circulation patterns and tidal fluctuations.



Marine Advisory Program

Year in, year out, ships depart Oregon ports with regularity. Oregon leads the nation in timber exports and is a major grain exporter. Yet, maritime employment here has been diminishing for at least 25 years. An extension oceanographer singled out this situation for Sea Grant involvement this year, introducing the Marine Advisory Program (MAP) to this important economic sector when he began an ongoing program to consolidate polarized maritime factions. With support from private yards, steamship companies, labor, government, and education, he convened a regional conference on the future of Oregon maritime industry. Eighty-seven individuals, the majority from policy-making management levels, participated. Attendees met on neutral ground and spoke their minds—off the record. On the record, they agreed on six sets of objectives aimed at informing the government and the public of what needs and can be done to bolster American maritime commerce in Oregon and the Pacific Northwest.

You fish successfully, but your boat is small. You can at least quadruple your landings with a larger boat. Given your irregular and uncertain income, where do you get credit to buy it? A Marine Advisory Program agent and a marine economist took this common dilemma as a challenge. With help from the agents, the economist conducted business management workshops for professional fishermen across Oregon, teaching profit analysis, records keeping for tax purposes, and proper use of credit. Meanwhile he refined statistics on the productivity of classes of fishing boats. He and the agents counseled farm Production Credit Associations and banks on the economics of fishing. By year-end, loans to fishermen by the credit associations had gone from zero to more than $2 million. How do fishermen assess the efforts? Twenty-seven of those who sat in at management workshops afterward submitted amended tax returns for better than $30,000 in rebates. Muses one fisherman from Portland, "I saved $3,000 as a result of one hour's counsel."

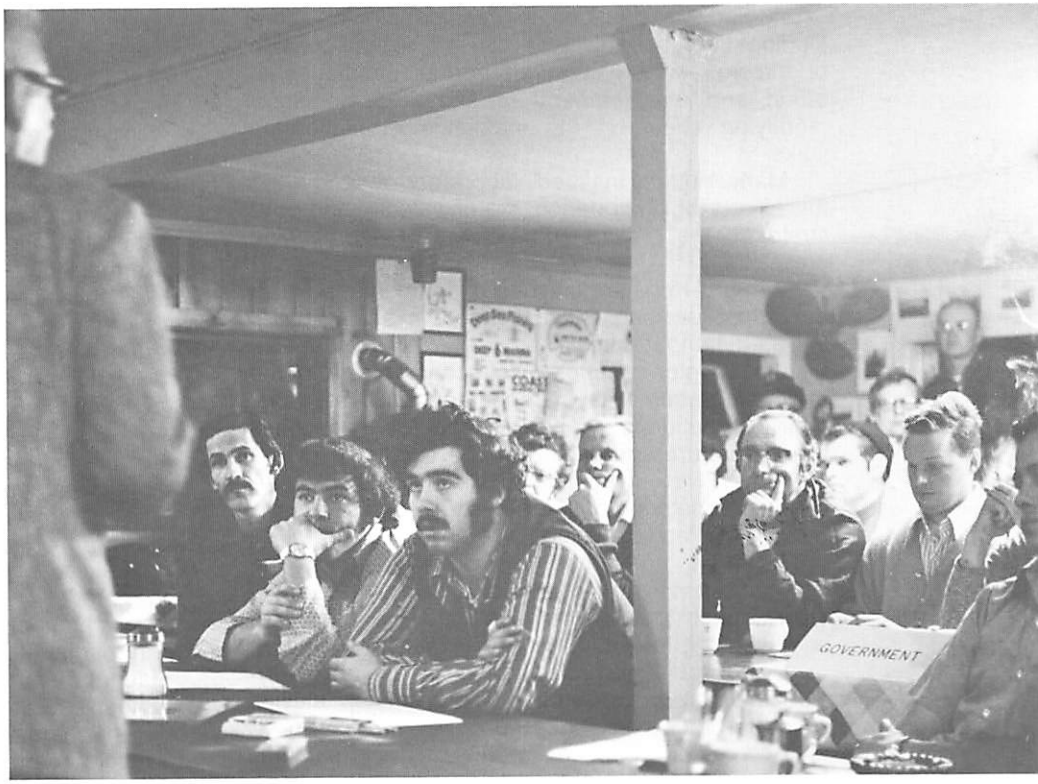
If saltwater is not new to Oregon school kids, what lives in it often is. Again this year MAP educational specialists organized and taught a year-long calendar of educational offerings at the OSU Marine Science Center. A four-weekend course in basic marine science drew 30 upper elementary school teachers, who instruct about 1,000 students annually. A MAP agent enlisted for a presentation to a class of blind children, returned smiling: "You haven't seen anything until you watch the expression on a blind child's face as he handles a live shore crab for the first time." In all, 15,198 students and teachers received instruction this year. An additional 40,000 adults and youngsters viewed educational film programs, and more than 211,000 people toured the exhibits and the aquarium—all offerings supported by Sea Grant. These activities ranged from lectures at the center to workshops on clam digging in coastal state parks, from creation of 4-H marine science projects to filming, from demonstrating aquaculture of oysters for students to teaching teachers.

Of the almost 7 billion pounds of fish and crustaceans consumed in United States last year, 65.8 per cent was imported. With such lopsided supply and demand, a MAP agent became intrigued with an unhar-

vested, large population of Tanner crabs off Oregon. Playing the catalyst's role, he talked to a county economic development committee, a bank, the Port of Coos Bay, and fishermen. These factions pieced together financing for an exploratory fishery; by the end of June, a fisherman was converting a Gulf Coast shrimper for the experiment. If successful, it could mean a new fishery worth a half million dollars annually to just one port.

Other accomplishments of the Marine Advisory Program this past year included:

- answering more than 350 inquiries about handling and use of sea food from consumers and food processors.
- escorting 378 school groups on tours of the Marine Science Center and nearby coastal and estuarine study sites.
- demonstrating an efficient new fish flesh separator to fish processors, resulting in at least one processor installing the machinery.
- co-sponsoring a vocational fisheries education conference to encourage communication directly between vocational educators and commercial fishermen in the Pacific Sea Grant Advisory Program region.
- counseling a seafood processor on foreign markets, leading to his establishing a strong Japanese market that is paying promptly.
- assisting a high school to start a hatchery operation raising crayfish, salmon, and steelhead trout.
- designing a slide-tape presentation on the nature and the scope of Sea Grant, for use nationally to generate wider application for the results of Sea Grant research and education.
- working to "renovate" dying estuaries through field activities such as clearing obstructed channels and by authoring popular and technical articles to build public cooperation.
- supporting a developmental project to create a hake fishery that would supply fish for domestic consumption in fish and chips.
- sponsoring a marine electronics workshop in the interests of extending reliable operation of marine electronics to durations of three or four seasons, under the PASGAP talent-sharing arrangements.



- helping a Coos Bay fisherman become the first person in the nation to receive a loan under the Farm Credit Act of 1971; now, 175 loans exceeding $7 million are in force in Oregon, Washington, and Alaska alone.
- loaning a marine economist to Alaska for a 4,500-mile circuit to present business management workshops to professional fishermen in Alaska, through the PASGAP talent-sharing agreement.
- assisting seafood researchers to prove that there is no mercury contamination in Oregon fish and to develop a whitening technique that renders rockfish more appealing to the consumer.
- teaching trainable mentally retarded youth about intertidal conservation and guiding them in experiences such as hooking and landing a fish.
- convening a meeting of crab pot fishermen and tugboat operators to establish clear shipping lanes and reduce losses of expensive crab traps from fouling with towboats.
- co-chairing a 26-day, 5-nation tour of Pacific Rim countries to promote exchange of fisheries and marine information and cooperation among fishing nations.

Education and Training

OREGON STATE UNIVERSITY

Fisheries and Wildlife

A number of students were supported under the marine fish and shellfish program:

Hossein Emadi completed his M.S. thesis on "Yolk Sac Malformation in Pacific Salmon," concluding that mortality was caused by coagulation of the yolk which impaired normal circulation of blood and that temperature and velocity had a modifying effect on the incidence of malformed yolks.

Mark Hutton initiated laboratory research on the effects of photoperiod, water velocity and substrate on the growth and survival of sub-yearling crayfish.

Bernard Kepshire finished experiments in which he reared yearling Chum salmon in sea water at elevated temperatures.

Earl Krygier completed collections of Crangonid shrimp in Yaquina Bay, Oregon and discovered that their distribution is significantly affected by changes in temperature and salinity of the bay.

Robert Malouf completed the experimental design and methodology for a study of the energy budget of Pacific oysters.

Alvin Ott completed analysis of data on the cryogenic preservation of Coho salmon sperm at the Issaquah State Salmon Hatchery in Washington and is using the information as his Ph.D. thesis.

Derek Poon finished a study of the use of streamside incubators for rearing Chum salmon alevins which is part of his Ph.D. work.

R. A. Scott continued processing field samples and subsequent analysis of data on basket cockles.

William Staeger found that spermatozoa from the Pacific oyster were successfully cryopreserved in a solution of 20 percent dimethyl sulfoxide in seawater and has incorporated the information into his M.S. thesis.

Jerome Stefferud's sampling of Dungeness crab populations is intended to produce methods for predicting harvest yields one year in advance. Twelve experimental crab pots, fished for 33 pot soaks, caught 813 crabs which were examined for sex and size frequency distribution.

Steven Williams continued his study of developing food rations for the English sole. He achieved partial success in rearing larvae of sole in 5-15° C sea water, discovering that optimum growth can be achieved at 15° C with a ration of 8 percent of body weight.

Graduate research assistants were also employed in the aquaculture program. Harry Dovey initiated investigations into selective breeding of the Pacific oyster. The work of Malouf and Williams (see above) was also supported.

Seafood Science and Technology

In completion of work on her M.S. thesis, Alayne Boyko is investigating flavors associated with the spoilage of refrigerated Dungeness crab meat using a combination of gas-liquid chromatographic and mass spectrometry procedures.

Carl Decker is completing Ph.D. requirements and carrying out research dealing with proteolytic enzymes in Pacific shrimp, defining their importance in processing and developing means of utilizing and/or controlling their activity.

Sergio Flores completed all requirements for the M.S. degree and his research involved the determination of a wide range of biochemical changes taking place in iced Pacific shrimp during storage. He is now carrying out teaching and research duties at the School of Food Technology and Marine Sciences, Monterrey Institute of Technology, Guaymas, Sonora, Mexico.

Gary Geist's research involves an investigation of the catheptic proteolytic enzymes in the muscle of three commercially exploited species of flounder. He completed requirements for the M.S. degree and now works in product development at Land O'Lakes Co. in Minnesota.

Andrew Lieb is studying the effect of dietary polychlorinated biphenyls (PCB's) on rainbow trout in partial fulfillment of requirements for the M.S. degree. Fish showed no growth retardation or any other effects after 28 weeks on the diet.

Richard Whiting, who completed Ph.D. requirements, carried out research on the stability of lysosomes in fish muscle and the effect of decomposition on the rigor and quality of the muscle.

M. P. Gulan completed requirements for the M.S. degree and accepted a position with Carnation Foods, Van Nuys, California.

Marine Biology

Eugene Burreson completed his M.S. program through use of data gathered in a 12 month study of the parasitic fauna of the yellow fin sculpin in Yaquina Bay, Oregon. He presented an oral report of his work at the national meeting of the American Society of Parasitologists. He plans to work on his Ph.D. in the Department of Zoology.

James DeBoer has completed a part of collecting data on the feeding and nutrition of oysters.

John McMichael is making satisfactory progress on the epidemiology and distribution of infectious hemapoetic necrosis virus and infectious pancreatic necrosis virus in fish, a part of his Ph.D. work.

R. L. Miller has found that there is a possibility of determining populations of rock fishes that cannot be tagged by identifying the parasites on them.

Norman Morrison has completed his study of a new protozoan parasite of the tomcod and is writing his Ph.D. thesis.

J. Pribble finished a thesis project on the distribution of neoplasm in oysters in Yaquina Bay, Oregon and received his M.S. degree.

Peter Rothlisberg collected and counted populations of crab larvae to determine possible relations of larval population fluctuations to adult populations and the crab catch variability each year. The information will be part of his Ph.D. thesis.

David Ransom set up a fish disease diagnostic unit at the OSU Marine Science Center which should allow rapid detection, prevention and control of infectious diseases of fish and shellfish. This service is available to fish culturalists operating along the Oregon coast.

Marine Economics

Leon Abbas, a Ph.D. candidate, is completing his research on what determines the mobility of commercial fishermen. About 40 percent of Oregon's fishermen either entered or left the field over the past two years and this study will attempt to explain why, and identify the implications for public policy.

Christopher Carter is continuing his Ph.D. work which involves the refinement of the red salmon econometric model by subjecting it to current data as they become available.

Daniel McIntyre, an M.S. candidate, is finishing work on his thesis about income distribution in international fisheries policy.

D. Wang is completing his Ph.D. course work and has been working in the areas of demand and market structure analysis, specifically assembling and analyzing data on industrial concentration in the processed salmon market.

Ocean Engineering

B. Braham has created the first microfilm file of OSU Sea Grant proposals. His thesis study involves developing reliable methods to evaluate and manage integrated research programs.

Terrill Chang's M.S. thesis work, crab pot retrieval systems, has involved field testing an engine-pump-nozzle system. He also reviewed the pertinent literature in the field and contacted dealers, manufacturers, and commercial fishermen for guidance.

Kuei-Lin Chen helped to assemble and microfilm Sea Grant-related documents and publications and set up a resource planning and management network for Sea Grant activities over the past five years. He completed his M.S. thesis on the same subject.

Randall Conrads developed a video tape of a crab processing mechanization study which was shown at the Fish Expo in Seattle. He also completed a preliminary survey of machinery with potential usefulness in the seafoods industry as part of his M.S. thesis.

Patrick LeFebvre finished prototype testing of several water jet excavation systems for crab pot retrieval. Expensive oceanographic and fisheries gear often cannot be lifted or recovered from the ocean bottom because they are buried in sediment. This system will retrieve them easily.

Randy Peterson has completed and published "Filleting Sole," a manual for training filleters in the improved fillet method for flatfish.

Charles Rauw's research efforts have included the search of literature and collection of data for his M.S. thesis on seasonal variations in the physical and chemical parameters of Siletz Bay, Oregon.

The research of Robert Rupe, who completed his M.S. thesis in mechanical engineering, involved modeling an inextensible mooring cable, deriving the necessary equations to describe the system and creating a computer program which will ultimately be used for designing buoy mooring systems.

Michael Utt has been collecting data for his M.S. thesis on seasonal variations in the physical parameters of the Siuslaw estuary.

Ying-Chuen Tseng is finishing work on his M.S. thesis, "Hydraulic Dredge Spoil Fate" and assisting on dredge spoil distribution studies.

Oceanography

Two students are involved in an early life history project:

Robert Lough is working on the larval biology of crabs, many of which are commercially important.

Archie Vanderhart is studying the population dynamics of coastal zooplankton.

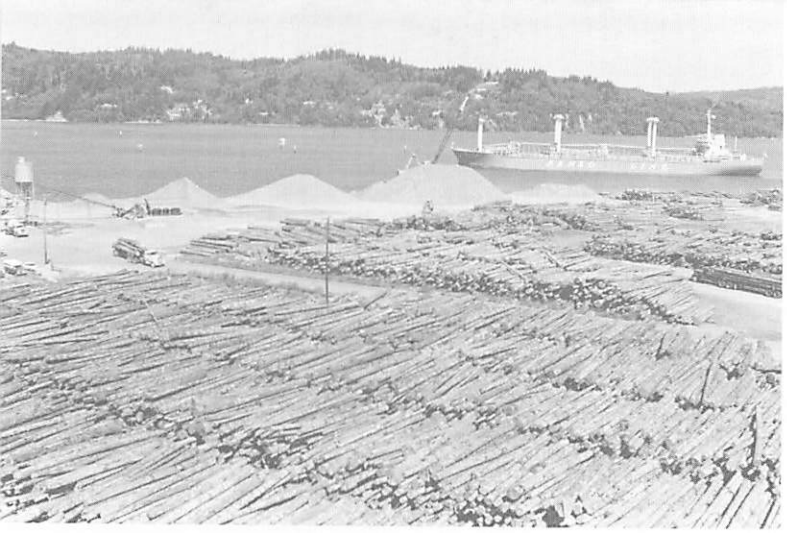
The pelagic environment has been the subject of other research projects:

Michael Schonzeit is determining chlorophyll dynamics in the immediate coastal environment off Oregon, specifically to see if there are recurrent areas of high primary productivity.

Ellen Deason is attempting to determine which phytoplankton species provide the food source for various zooplankton. This will provide detailed knowledge of seasonal patterns of production which will be of value to fisheries biologists and fishermen.

Gregory McMurray is determining production rates of phytoplankton, which will enable identification of those species which are primary food organisms and those which are "weed" species.

Daniel Lundy is working on the physiological changes in two species of marine diatoms as they undergo nutrient depletion. In the long range, such information will be useful in forecasting and controlling phytoplankton "blooms."



John DeManche is determining the significance of organic nitrogen (urea, ammonia and amino acids) as a nitrogen source for phytoplankton. His chemical data will indicate the form of nitrogen made available by regeneration processes which determine the quality and quantity of food available for higher trophic levels.

Jack Reid is building an analytical isoelectrofocusing device and designing purification schemes for characterizing the nitrate reductase enzymes from principal marine phytoplankton species. These enzymes may determine which species predominate at various seasons.

Students have also worked on various phases of work on the benthic environment study:

Robert Carney has identified sea cucumbers from the school's quantitative beam trawl collections. John Dickinson has identified crustacea organisms gained from seasonal bottom grabs and beam trawl samples over a two year period. Both are also organizing the school's research reference collection.

Margaret McFadien is a specialist in molluscs and has been working with this group from the school's 1968-69 collections.

John Frey is looking at the diel rhythm activity in the pink shrimp, results of which will reveal details about their behavior that will optimize shrimp catch.

D. Keene is studying the catch rates of albacore tuna off the Oregon-Washington coast and how they vary in time and space. Results may assist albacore fishermen in planning, fishing strategy and tactics.

In studies of the reproductive cycles of oysters, David Elvin is examining the food utilization and bioenergetics of seasonal gonad growth in the edible mussel to determine the role of food availability and temperature in the annual cycle of nutrient storage, gonad growth, and fecundity of mussels.

Coastal sand transport work includes: Martin Miller, who gathered data on the erosion of Siletz spit; Thomas Terich, who gathered past data on the erosion of Bayocean sand spit; and Michael Gaughen, who is reviewing and compiling literature and data on breaking water waves.

In the sea and surf forecasting project, Gudrun Bodvarsson has been analyzing wave records from pressure, visual and seismometer type sensors to determine the correlation among them, and especially to examine whether the land-based seismometer can serve as a useful tool for operational all-weather wave observations.

UNIVERSITY OF OREGON LAW SCHOOL

Ocean Resources Law

Scott Clark graduated and has just accepted a position in ocean law at the Department of Interior where he will specialize in leasing problems of the continental shelf.

Doug Harcleroad graduated and has accepted a position as legal officer for a Portland accounting firm. In the program, he specialized in coastal law.

David Mackie graduated and has joined a Portland law firm. In school, he specialized in law as it relates to living resources.

Of current students in the program, Josephine Pickford has been studying aquaculture law and is preparing a brochure on that subject. She has also been analyzing aspects of the marine mammals protection act, as has Hollis McMilan, who wrote an article for the student law review.

CLATSOP COMMUNITY COLLEGE

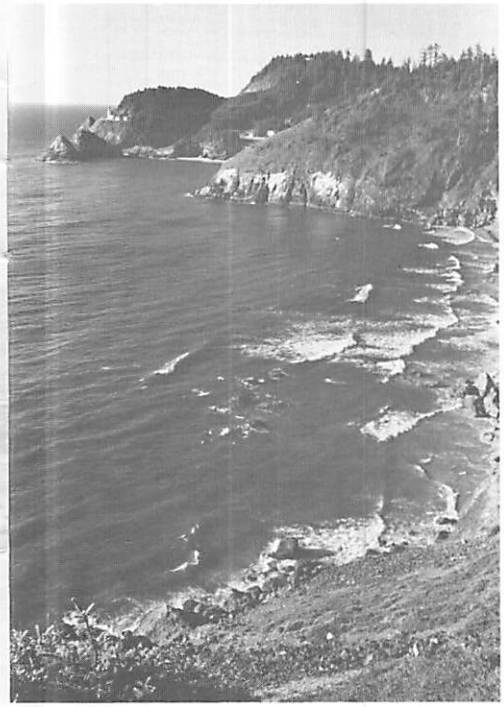
Technician Training

All students in the commercial fishing technician training program who graduated in June 1973 were placed in permanent jobs in the commercial fishing industry. All but one freshman student secured summer employment in the industry. This program aims to provide vocational training in all phases of Pacific Coast commercial fishing including how to operate and maintain equipment and gear and to navigate seagoing vessels.

In the marine technician training program, 38 parttime and fulltime students obtained ocean operator, inland operator, motor boat operator, or operator of uninspected towing vessel licenses. Eleven students from the commercial fishing technician program were trained in seamanship, piloting, and boat handling under this program. Thirty oceanographic technology students were also trained in seamanship and boat handling. This program gives saleable skills to students seeking jobs as boat operators, deckhands, and as other supportive personnel in the marine industry.

Twelve students were enrolled in the diesel engine class and 10 in the marine electricity class. Both classes are conducted within the marine engineering technician program which is designed to provide students with the knowledge and skills to operate, repair, and maintain machinery in boats.

All programs except oceanographic technician, are organized for both fulltime and parttime students. The aim here is to train both new people and to upgrade the job skills of those employed within the industries.



Publications

SEAFOOD SCIENCE AND TECHNOLOGY

Childs, E. A. 1973. Electrophoresis of fish myofibrillar proteins with sodium-dodecyl sulfate-polyacrylamide gel. *J. Fish. Res. Bd. Can.* 30:706-707.

Childs, E. A. 1973. Kinetics of transplacental movement of mercury fed in a tuna matrix to mice. *Arch. Environ. Health* 27:50-52.

Crawford, D. L., D. K. Law, and J. K. Babbitt. 1972. Nutritional characteristics of marine food fish carcass waste and machine-separated fish. *Agric. Food Chem.* 20:1048-1051.

Lee, J. S., and D. K. Pfeifer. 1973. Aerobic microbial flora of smoked salmon. *Milk and Food Tech.* 36:143-145.

Lee, J. S., and G. P. Putnam. 1973. The response of rainbow trout to varying protein/energy ratios in a test diet. *J. Nutrition* 103:916-922.

Miller, III, A., R. A. Scanlan, L. M. Libbey, H. Petropakis, and A. F. Anglemier. 1973. Quantitative determination of dimethyl- and trimethylamine in fish protein concentrate. *Agric. Food Chem.* 21:451-453.

Miller, III, A., R. A. Scanlan, J. S. Lee, L. M. Libbey, and M. E. Morgan. 1973. Volatile compounds produced in sterile fish muscle (*Sebastes melanops)* by *Pseudomonas perolens. Applied Microbiol.* 25:257-261.

Miller, III, A., R. A. Scanlan, J. S. Lee, and L. M. Libbey. 1972. Volatile compounds produced in ground muscle tissue of canary rockfish (*Sebastes pinniger)* stored on ice. *J. Fish. Res. Bd. Can.* 29:1125-1129.

Price, R. J., and J. S. Lee. 1972. Effect of cations on the interaction between paralytic shellfish poison and butter clam (*Saxidomus giganteus)* melanin. *J. Fish. Res. Bd. Can.* 28:1659-1661.

Sinnhuber, R. O., J. D. Castell, and D. J. Lee. 1972. Essential fatty acid requirement of the rainbow trout, *Salmo gairdneri. Federation Proceedings-American Institute of Nutrition Symposium on "Essential Fatty Acids,"* 31:1436-1441.

MARINE FISHERIES

Burreson, E. M., and Ivan Pratt. 1972. *Trypanosoma pacificia* sp. n. from the English Sole *Parophrys vetulus* Girard from Oregon. *Protozoology* 19:555-556.

Kittredge, J. S., and F. T. Takahashi. 1972. The evolution of sex pheromone communication in the Arthropoda. *J. Theor. Biol.* 35:467-471.

Olson, R. E., and Ivan Pratt. 1973. Parasites as indicators of English Sole *(Parophrys vetulus)* nursery grounds. *Trans. Amer. Fish. Soc.* 102:405-411.

OCEANOGRAPHY

Gonor, J. J. 1972. Gonad growth in the sea urchin, *Strongylocentrotus purpuratus (Stimpson)* (Echinodermata: Echinoidea) and the assumptions of gonad index methods. *J. Exper. Marine Biol. and Ecol.* 10:89-103.

Komar, P. D., and M. K. Gaughan. 1972. Airy wave theory and breaker height prediction. Proc. 13th Coastal Eng. Conf. Vancouver, B. C., Canada.

Komar, P. D., R. H. Neudeck, and L. D. Kulm. 1972. Observations and significance of deep-water oscillatory ripple marks on the Oregon continental shelf, p. 601-619. *In* Swift and Pilkey, [ed.], Shelf sediment transport. Dowden, Hutchinson & Ross, Inc., Stroudsburg, Pa.

Pearcy, W. G. 1973. Albacore oceanography off Oregon—1970. *Fish Bull.* 71:489-504.

MARINE BIOMEDICINALS

Block, J. H., P. Catalfomo, and G. H. Constantine, Jr. 1973. Triglyceride fatty acids of selected higher marine fungi. *Mycologia* 65:488-491.

Catalfomo, P., J. H. Block, G. H. Constantine, Jr., and P. W. Kirk, Jr. 1973. Choline Sulfate (ester) in marine higher fungi. *Marine Chem.* 1:157-162.

MARINE ECONOMICS

Collin, Theodore, Russell Youmans, Herbert Stoevener. 1973. *Impact of a major economic change on a rural coastal economy: A large aluminimum plant in Clatsop County, Oregon.* Agricultural Experiment Station Bulletin 614. Oregon State University, Corvallis, Oregon. 30 p.

OCEAN ENGINEERING

Smith, C. E., and R. F. Dominquez. 1972. Oscillations of buoy-cable mooring systems. Symposium on Flow-Induced Structural Vibrations, Technical Paper F3. Karlsruhe, Germany.

Yamamoto, Tokuo, John Nath, Larry Slotta. 1973. *Yet another report on cylinder drag or wave forces on horizontal submerged cylinders.* Engineering Experiment Station Bulletin No. 47. Oregon State University, Corvallis, Oregon. 139 p.

MARINE ADVISORY PROGRAM

Bird, Michael. 1972. The fisherman as borrower. Extension Service Marine Advisory Program SG 20. Oregon State University, Corvallis, Oregon. 4 p.

Breese, Wilbur. 1972. Oyster farming culturing, harvesting and processing a product of the Pacific coast area. Extension Service Marine Advisory Program SG 13. Oregon State University, Corvallis, Oregon. 8 p.

Byrne, John and Dan Panshin. 1972. Continental shelf sediments off Oregon. Extension Service Marine Advisory Program SG 8. Oregon State University, Corvallis, Oregon. 4 p.

Evans, Gwil and Vickie Gaffke, [eds.]. 1972. Inventory of marine resources and films. Extension Service Marine Advisory Program PASGAP 5. Oregon State University, Corvallis, Oregon. 43 p.

Heikkila, Paul. 1972. Bottomfishing, a pleasant change for Oregon anglers. Extension Service Marine Advisory Program SG 14. Oregon State University, Corvallis, Oregon. 4 p.

Hilderbrand, Kenneth. 1973. Preparation of salt brines for the fishing industry. Extension Service Marine Advisory Program SG 22. Oregon State University, Corvallis, Oregon. 4 p.

Lee, Jong. 1973. Cleaning and sanitizing agents for seafood processing plants. Extension Service Marine Advisory Program SG 21. Oregon State University, Corvallis, Oregon. 6 p.

Roberts, Ken. 1972. Diversity—characteristic of Oregon's year 'round fishery. Extension Service Marine Advisory Program SG 15. Oregon State University, Corvallis, Oregon. 2 p.

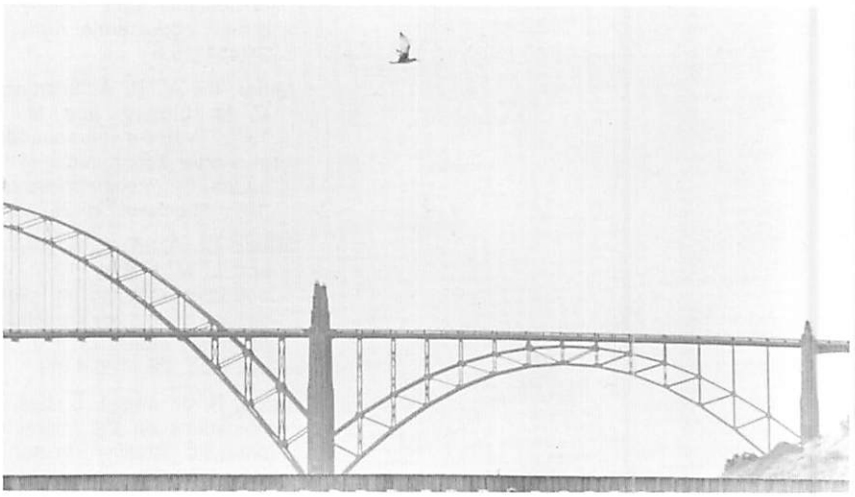
Roberts, Ken. 1972. Economics of hatchery salmon disposal in Oregon. Extension Service Marine Advisory Programs SG 17. Oregon State University, Corvallis, Oregon. 20 p.

Roberts, Ken. 1972. Understanding the use and management of Oregon estuaries. Extension Service Marine Advisory Program SG 18. Oregon State University, Corvallis, Oregon. 10 p.

Smith, Fred. 1972. Organizing and operating a fishery cooperative, Part 1. Extension Service Marine Advisory Program SG 19. Oregon State University, Corvallis, Oregon. 4 p.

Smith, Fred. 1972. Organizing and operating a fishery cooperative, Part 2. Extension Service Marine Advisory Program SG 19a. Oregon State University, Corvallis, Oregon. 43 p.

Wick, W. Q. 1973. Estuaries—ugly ducklings and graceful swans. *Outdoor America.* 38:6-7.



BUDGET SUMMARY*

By Type of Activity
July 1, 1972-June 30, 1973

	National Oceanic & Atmospheric Administration Budget	National Oceanic & Atmospheric Administration Expenditures	University Matching (State, County, & Private Sources) Budget	University Matching (State, County, & Private Sources) Expenditures
Research				
Aquaculture	184,227	183,527	92,751	83,949
Living Resources, other than Aquaculture	381,126	388,065	120,147	147,208
Marine Biomedicinals & Extracts	21,000	21,754	12,986	12,000
Marine Law (University of Oregon) & Socio-Economics	164,081	159,081	72,912	73,541
Ocean Engineering	150,432	144,364	121,861	124,124
Resources Recovery & Utilization	269,741	296,760	120,137	113,952
Applied Oceanography	133,288	134,333	10,584	10,500
Education				
College Level	39,846	40,249	46,535	40,497
Vocational Marine Technician Training (Clatsop Community College)	89,195	69,195	53,744	52,084
Advisory Services				
Extension Programs	190,669	190,891	55,156	68,595
Other Advisory Services	54,607	29,385	84,974	99,964
Program Management				
Program Administration	89,588	112,726	34,364	57,899
Program Development	25,900	23,370	79,128	23,187
TOTALS	$1,793,700	$1,793,700	$905,279	$907,500

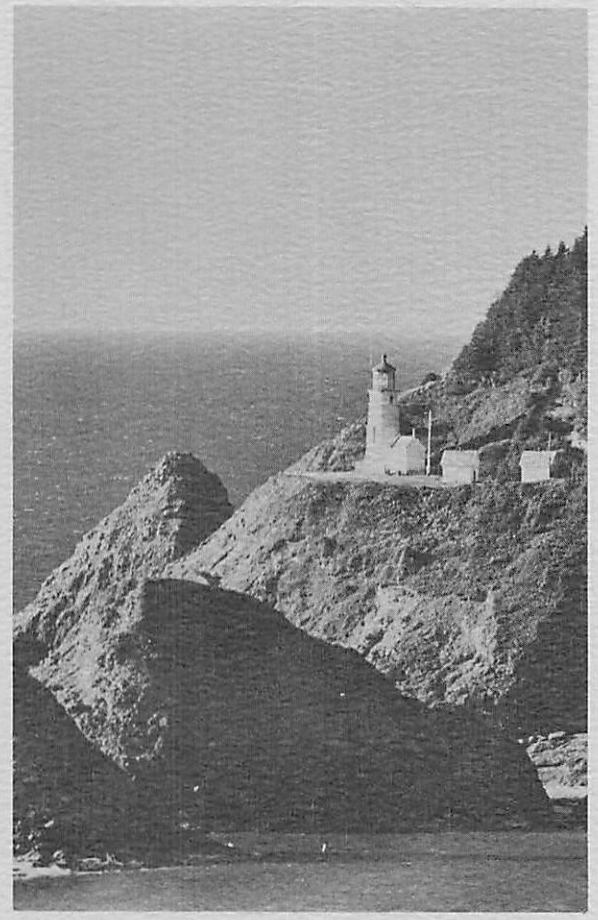
** This budget summary is not a final fiscal report. A grant extension in time was given allowing expenditures of funds beyond the date of publication of this annual report. Expenditure figures are only approximate.*

Oregon State University

This Annual Report is published once a year by OSU Sea Grant, Corvallis, Oregon.

RON LOVELL *writer/editor*
JIM FOLTS *photographer*
MARILYN HOLSINGER *designer*
WILLIAM WICK *director, OSU Sea Grant*

SEA GRANT



The sea! the sea! the open sea!
The blue, the fresh, the ever free
Without a mark, without a bound,
It runneth the earth's wide, regions round.

BARRY CORNWALL, THE SEA