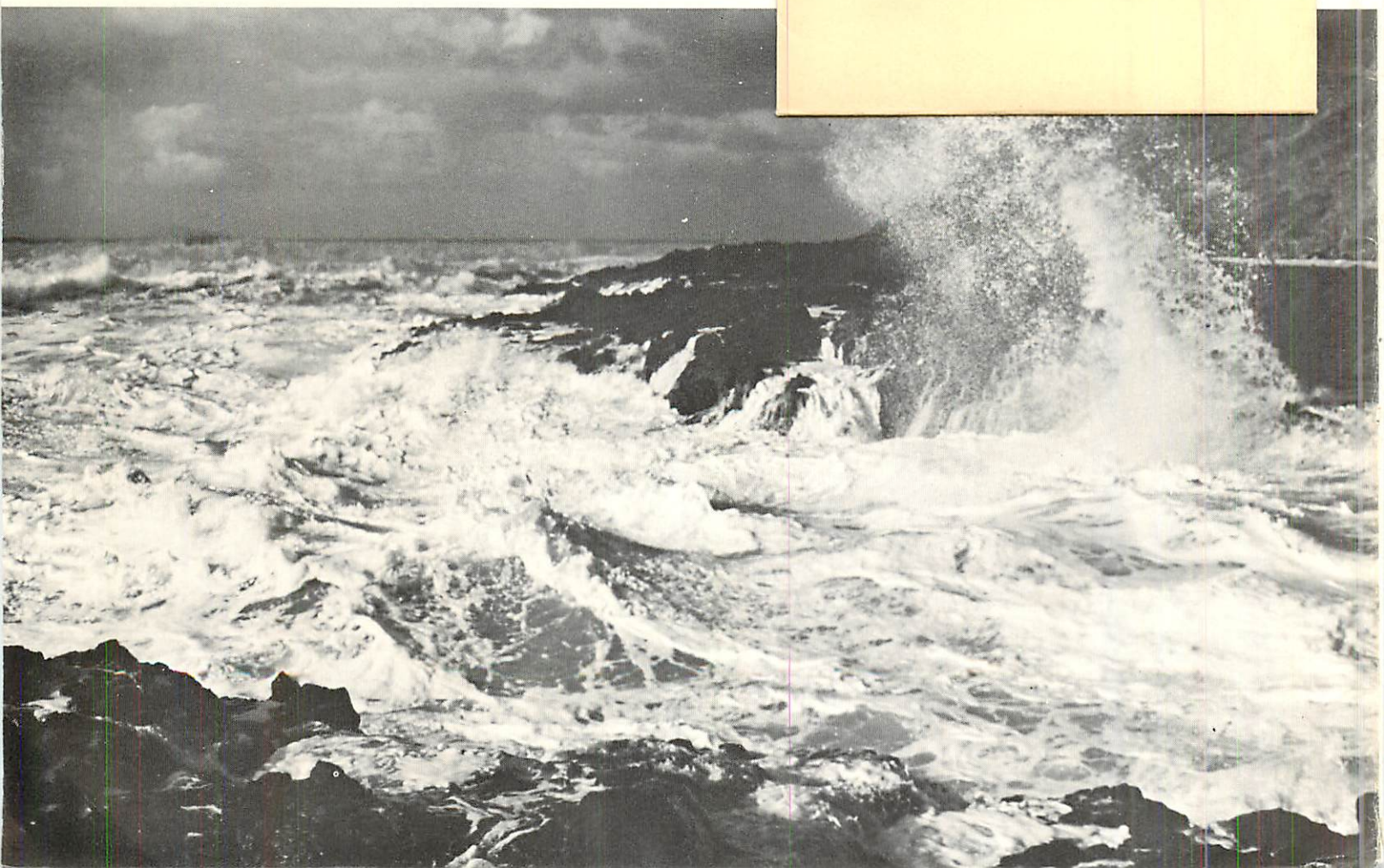
SEA GRANT

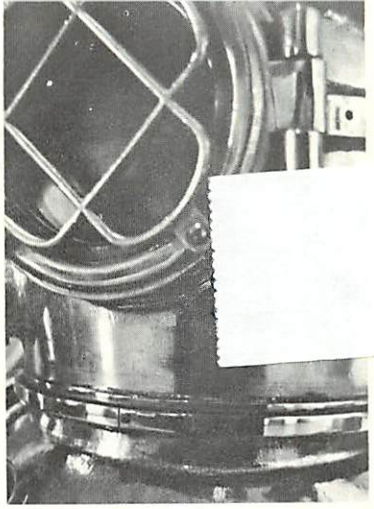
A Report on the Oregon State University
Sea Grant Program for 1971-72

Now small fowls flew screaming
over the yet yawning gulf;
a sullen white surf
beat against its steep sides;
then all collapsed,
and the great shroud
of the sea
rolled on as it rolled
five thousand years ago.

—MELVILLE



Introduction



Over 200 people—scientists, engineers, teachers, advisory agents, graduate and undergraduate students—are working together to help make Sea Grant a reality.

In principle the idea is simple: help develop Oregon's marine resources.

In practice Sea Grant takes an interdisciplinary, multi-school and multi-department approach, involving the Schools of Science, Engineering, Oceanography, Agriculture and Pharmacy at Oregon State University, the University of Oregon Law School, and Clatsop Community College. Support comes from the National Sea Grant Office, part of the National Oceanic and Atmospheric Administration (NOAA), within the U.S. Department of Commerce.

OSU Sea Grant is active in three general areas of particular interest to Oregon and the Northwest.

The food from the sea program concentrates on developing better ways of harvesting seafood and better ways of processing, storing, and using it.

The coastal zone environments program helps Oregon realize more orderly and productive management of its coastal zone, including the ocean, rivers, and associated land masses.

The human resources program provides information and leadership for the coastal community in developing coastal resources.

To realize these goals, OSU Sea Grant engages in research and educational programs to develop new knowledge and skills. Its advisory program provides on-the-scene help for problems in the coastal community. It sees that knowledge is carried directly to the people who can use it and that coastal area problems are in turn carried back to the laboratory.

As research and education programs go, Sea Grant is relatively new. The involvement of Oregon State University in Sea Grant work, however, goes back to the period before the original legislation was enacted in 1966.

Oregon State University is proud of its association with Sea Grant and of its designation as one of the four original Sea Grant Colleges. We are pleased to offer this report as an overview of our work for 1971-72, presented as case histories and capsule summaries. (Further technical information about individual accomplishments can be found in the publications listed on page 14.)

We find in our work a fulfillment, at least in part, of Sea Grant's mission: Many contributions have been made toward the responsible development of Oregon's marine resources.

Much remains to be done. New problems will arise in the future. But now, Sea Grant will be there to help.

Food From the Sea

So is the great and wide sea also:
wherein are things creeping innumerable,
both small and great beasts.
There go the ships,
and there is that Leviathan:
whom those hast made
to take his pastime therein.
These wait all upon thee:
that thou mayest give them
meat in due season.

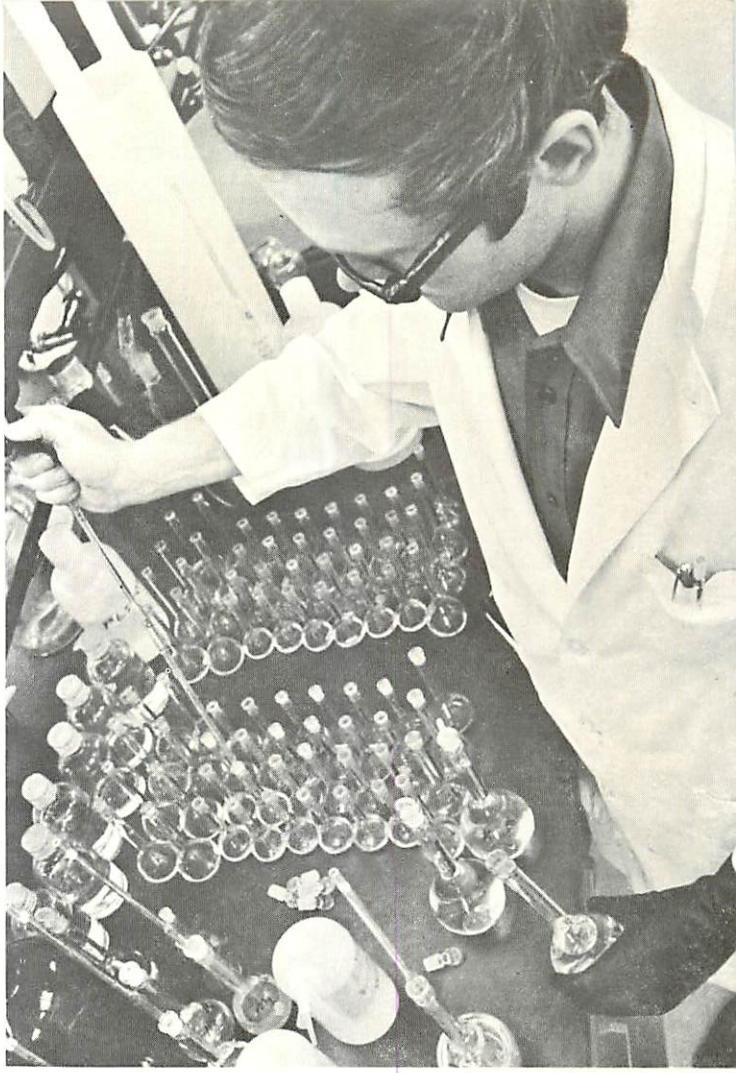
—THE BOOK OF COMMON PRAYER

Since large amounts of mercury were first discovered in fish caught in polluted areas, Oregon fishermen and seafood processors have worried about loss of consumer faith in the safety of their product, and the subsequent economic consequences. Toxicologists at the OSU Seafoods Laboratory in Astoria accepted the burden of proof for easing this concern. After refining the methods for measuring mercury, they showed with certainty that Oregon groundfish would have less mercury than Food and Drug Administration tolerances. After 1,700 samples, the only fish in the area with large amounts was dogfish shark, but it is never eaten. Since tuna canners are required to monitor all fish before processing, the toxicologists made available adequate industrial techniques for mercury analysis that could be performed in 30 minutes instead of the then six to 16 hours. This allowed plants to continue operation without holding fish a day or more for verification of their mercury content. It is no longer necessary to argue about the safety of Oregon seafood. Fears of confiscation have been eliminated. Thanks to Sea Grant toxicologists, fishermen and processors know their products are safe.

The salmon came back to Netarts Bay again this year. Mixed with the natural salmon run seemed to be many three year olds aquiculture investigators had raised from eggs and released into the ocean. The chum salmon hatchery produces about 10 times more young salmon than are naturally produced in the wild from the same number of eggs. The young salmon, however, still have to grow to maturity in the ocean before they return to their birthplace to spawn the next generation. The greatest return normally occurs in the fourth year, so investigators won't be sure of success until the fall of 1973. But the scientists were encouraged by this year's run of three year olds. And they were optimistic about future possibilities of breeding the salmon to improve characteristics like viability, amount and quality of meat and eggs, and growth rate. Private investors are optimistic, too. One firm has already begun a private hatchery using eggs from the Netarts Bay experimental hatchery to begin a "domestic" salmon run of its own. Eventually, such private hatcheries should be able to market the fish as food, to sell the eggs as caviar, and to raise pan-sized fish as "friers."

The Aquiculture Program is also trying to make other types of sea farming a reality. It is working on the controlled breeding and raising of oysters, crayfish, and English sole, a flatfish. It is looking at the possibility of using heated water, a by-product of nuclear power plants, to increase the growth rate of some aquicultured animals. It is investigating fish diseases and parasites that could be significant problems in an aquiculture operation. Thanks in part to the efforts of the Sea Grant Aquiculture Program, man may someday be successfully "ranging" tons of Pacific Northwest salmon in the ocean and operating "feedlots" for selectively bred oysters on rivers and bays.

If researchers at the OSU School of Pharmacy have their way, marine invertebrates and marine fungi may hold a key to a better understanding of the ocean's biochemistry and ecology and offer clues to the use of these organisms as possible future sources for drugs. In the case of the biomedicinals, the process is a slow one because of the time required to isolate and purify invertebrate and fungal extracts. These then are subjected to broad pharmacologic analyses and tested for antibiotic and anticancer activity. The compounds exhibiting interesting pharmacologic activity are submitted for critical chemical analyses and then forwarded to interested pharmaceutical firms and federal labs for other testing. In the broader area of ocean biochemistry and ecology, the pharmacognocists are making more fundamental discoveries. Because marine life is a source of food, knowledge of the biological chemistry of marine organisms will provide a better understanding of the ocean, particularly of the biochemical intracacies of predator-prey and parasite-host relationships. It will take time, but it could be worth the wait, thanks to Sea Grant.



Sea Grant made other contributions in this phase of its work:

• *the yield* of edible fish flesh has been increased by the Seafoods Laboratory which has also discovered a number of new uses for minced fish flesh: both to extend higher priced seafoods like shellfish and to mix with vegetable products.

• *research* is under way to lessen the deterioration of frozen seafoods by improving processing techniques, packaging techniques, and storage methods, and to improve their shelf-life and acceptability.

• *food scientists* are developing microbial standards and quality control procedures to help the seafood industry meet more stringent Federal regulations aimed at processing operations and sanitation procedures.

• *the laboratory* is developing processing procedures and methods to help 17 of Oregon's processing plants meet new FDA requirements for hot processed smoked fish.

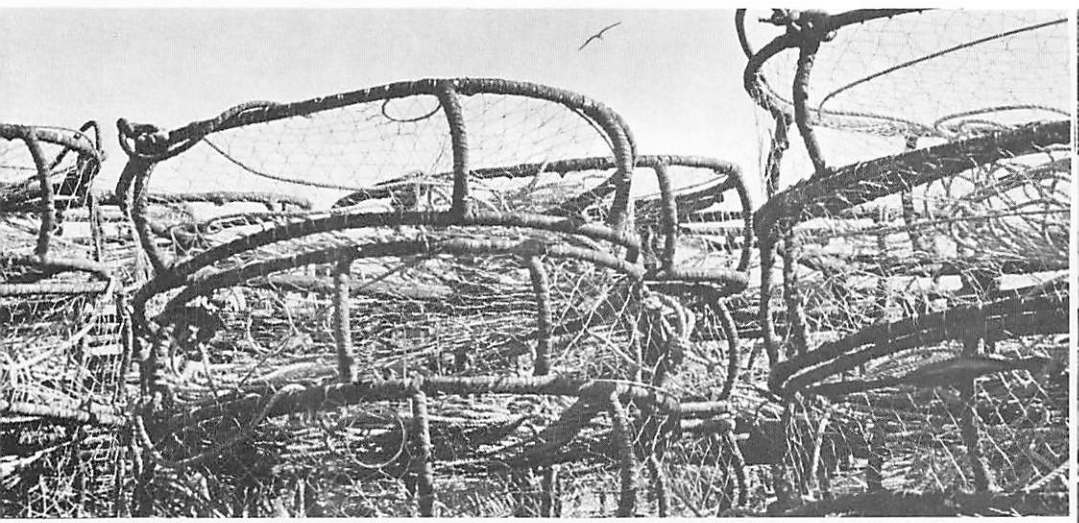
• *the quality* of flesh and the skin and muscular pigmentations of rainbow trout have been improved by feeding them high pigment shrimp waste supplements, resulting in a higher quality product as well as an economical use of waste material.

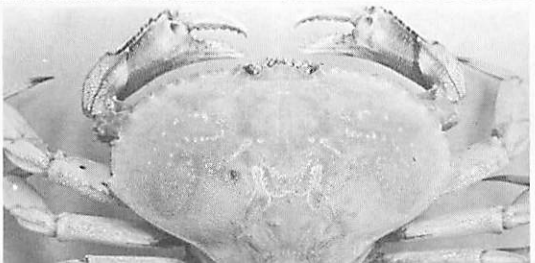
• *food scientists* have discovered that saxitoxin can link with the melanin pigment in clam tissue; if this linkage occurs in the live clam, detoxification of poisonous clams thus becomes potentially feasible and would remove a persistent hazard associated with shellfish consumption.

• *ocean engineers* at OSU have conducted a systems study of shrimp processing aimed at improving sanitation and processing standards which has also revealed opportunities for achieving greater volume of shrimp processed per hour and higher quality.

• *marine fisheries researchers* have used parasitological information to determine that juvenile English sole need time in estuaries to thrive, an added reason, they say, for eliminating pollution in estuaries. They have studied a protozoan that replaces virtually all intestinal tissue of juvenile English sole and is therefore, probably lethal. They have found it in Yaquina Bay where fish have been infected in the past. They are still assessing the discovery of protozoan blood parasites in several species of commercially important flatfish. In time, the specialists hope to identify and seek remedies for actual and potential diseases in all commercially important marine animals in the Aquiculture Program.

• *the same researchers* have developed an algae-snail simulation model that will form the theoretical basis for analyzing plant-animal





systems of relevance to Sea Grant, including knowledge needed to more efficiently use old data and determine the kind of experiments worth doing.

• *such scientists* are also gaining information about the early life of Northwest marine food fish and shellfish to help them predict fluctuations of abundance, assess the effects of coastal pollution, and manage commercial aquiculture stocks.

• *a vaccine* they developed previously, may help marine fisheries researchers assure success of the salmonid aquiculture program; by testing it with Sea Grant funds, the researchers hope to lessen the danger of salmon diseases.

• *a fisherman* can lose as much as $4,500 worth of crab pots in a single season; a system being developed by a Sea Grant ocean engineering and fisheries team uses a water jet to help get back crab pots buried beneath the ocean floor.

• *fishermen* using small boats powered by outboard engines used to have to winch their trolling lines in by hand; now they can bring back more fish using faster power winches and a hydraulic power take-off developed for outboard engines by a Sea Grant ocean engineering and fisheries team.

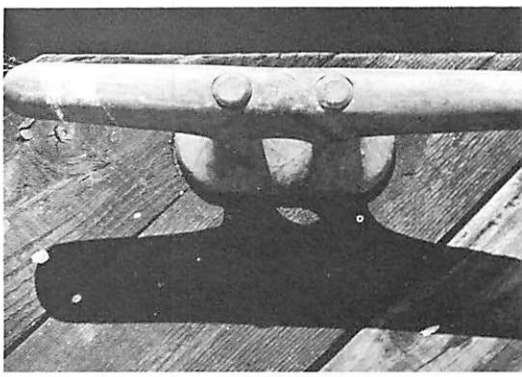
• *plastic fish holds* developed in the Commercial Fishing Methods and Gear Program of Sea Grant have been installed in 29 boats at both a savings and with improved sanitation.

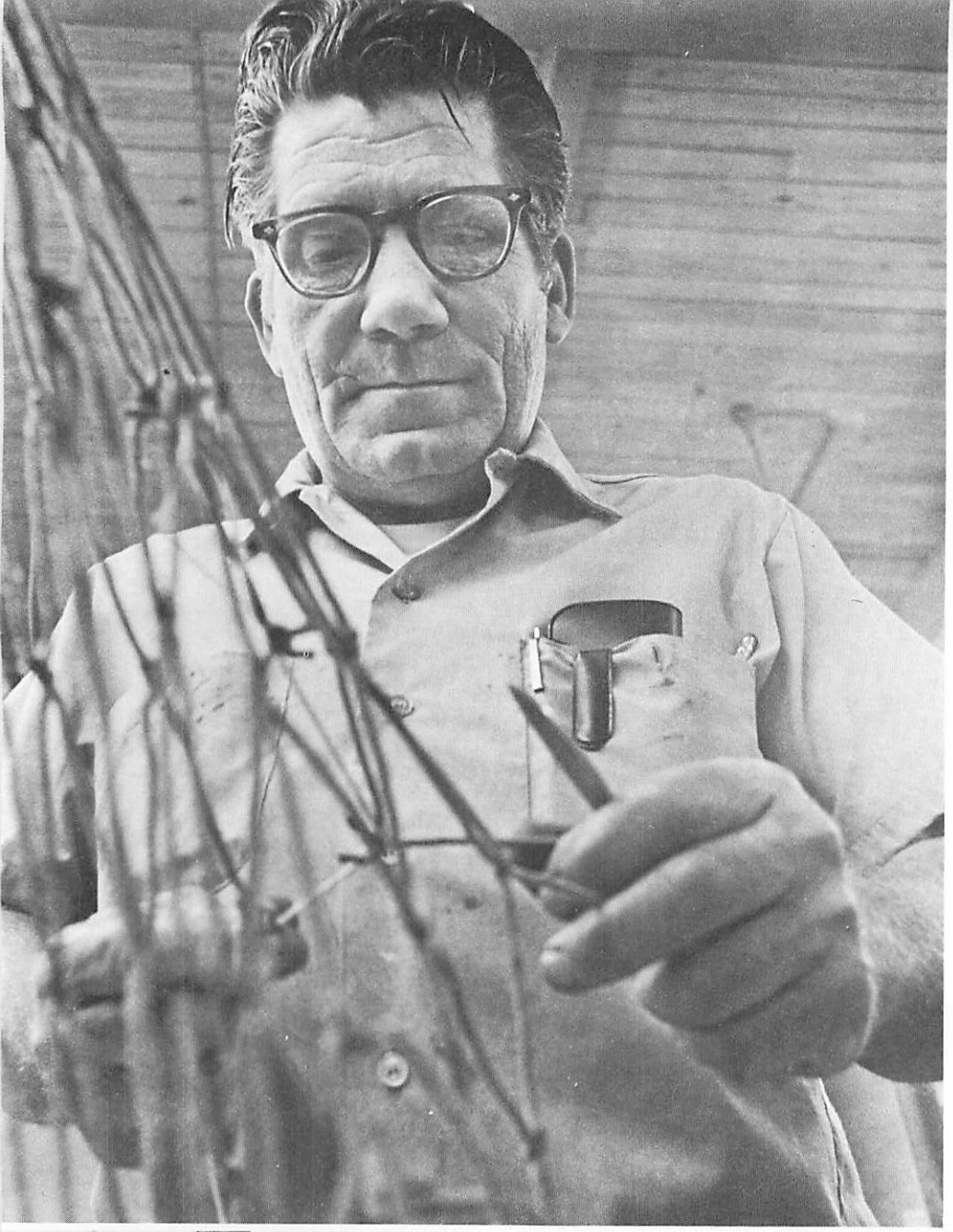
• *cost savings* in crab processing were achieved through time-motion studies in the manual picking of crab carried out by the engineering researchers, who also developed mechanized crab de-backers and evicerators, an inspection table, de-watering devices, and a crab-leg centrifuge.

• *the Benthic* Environment Project has identified the seasonal changes of environmental conditions of the central Oregon continental shelf in order to help fishermen locate the fish living there.

• the economic condition of various types of fishing firms in the Pacific Northwest was the subject of another marine economics study, designed to improve the efficiency of existing firms and provide information to others interested in entering the fishing industry.

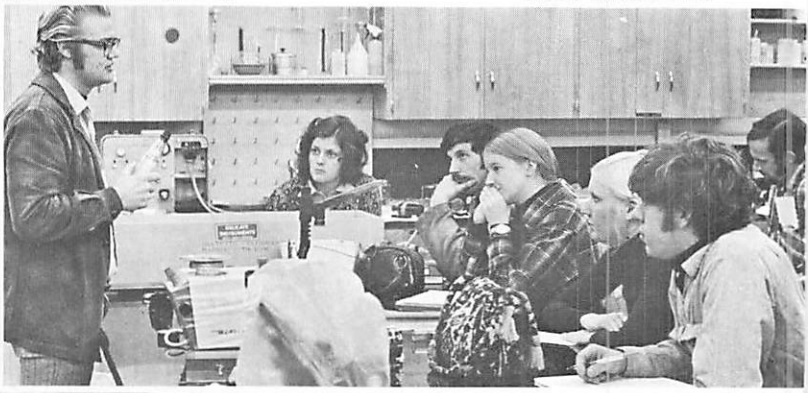
• marine economists have also developed econometric models of the demand and supply for several salmon species which will be useful in predicting the consequences of tariff policies, entry restrictions, and aquiculture development.





I must down to the sea again,
for the call of the running tide
Is a wild call and a clear call
that may not be denied.

—JOHN MASEFIELD



Human Resources

The fish were there for the taking, but the native fishermen of American Samoa weren't fishing much anymore. They had lost their incentive to catch the fish contained in abundance by the Pacific waters around them and were paying high prices for an inferior grade brought in from the outside. They never ran their primitive dugout canoes outside the reefs. Worse yet, in an area of the world where the giving of food and the catching of it have acquired a mystical quality over the years, they were losing status and prestige. Sea Grant and the Office of Economic Opportunity (OEO) changed this situation. A team of specialists from Oregon State University's Marine Science Center and Department of Fisheries and Wildlife went to the tiny islands at OEO's request and with its funding and taught native fishermen new fishing techniques and how to build 24 foot dorys similar to those used on the West Coast of the U.S. These craft stand bad weather and are easy to maintain. This is where Sea Grant came in. The gear handling machines aboard the dorys were driven by a hydraulic power take-off system first developed for use on the Pacific Coast by Sea Grant. Thanks to it, native fishermen have now built nine of the sturdy but inexpensive boats and they are in the water powered by 130 hp inboard-outboard motors. Fifty people are now making a living catching 30,000 to 40,000 lbs. a month of bottom fish. As more dorys are constructed, the number will increase as Samoans learn to fish using modern methods. And Sea Grant laid the groundwork for it all.

Existing laws relating to the sea have often been as murky and incomprehensible as the ocean depths they were written to manage. Worse, they have not always been applicable to areas of need—for nations and fishermen. Sea Grant's Ocean Resources Law Program at the University of Oregon is helping to change this situation in a number of ways. It published a layman's explanation of the ocean zones and boundaries established by international law which is already widely used by students, legislators, fishermen and industry people. It was instrumental in preparing two special ocean law issues of the Oregon Law Review. It has begun work on the Commercial Fishermen's Legal Guide and recently finished the newest segment of this longterm project, "The Fisherman as Borrower." It sponsored and organized a conference on "The Future Management of the Oregon Coast." Upper class law students are being trained in ocean resources law seminars and they, in turn, are conducting research in that area and helping inform others about the complexities of the law as it applies to ocean resource exploration and utilization. Of recent University of Oregon law school graduates, two have entered private practice to assist clients with ocean law problems, another is assistant attorney general for the Department of Natural Resources of the State of Washington, and one has joined NOAA's Legislative Liaison Office. None of this was possible before Sea Grant.

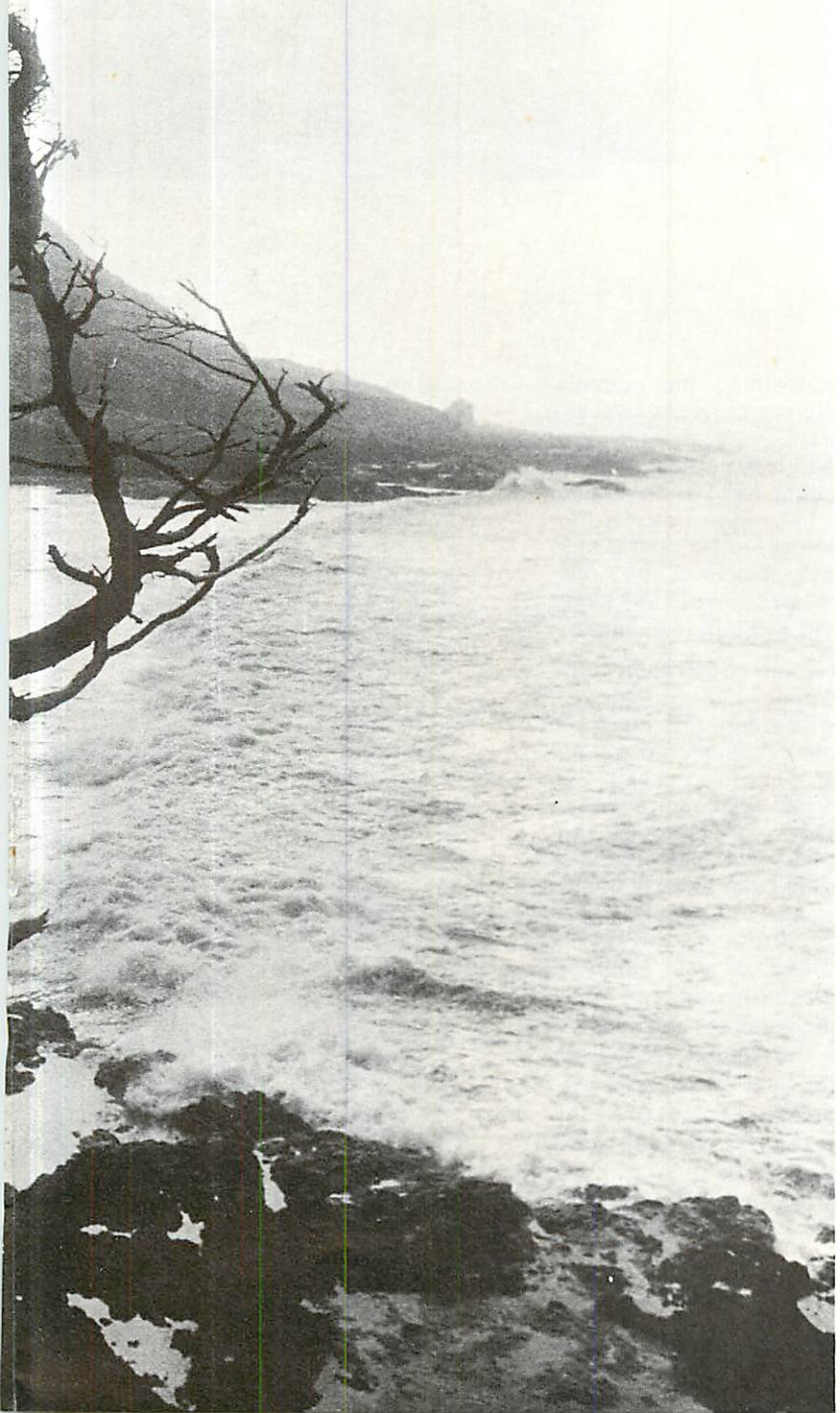
A commercial fishing technology program at Clatsop Community College in Astoria is preparing students to go down to the sea in ships—as trained fishermen, marine operating engineers, and boat operators. The two year course, which includes time on commercial fishing boats and college-operated craft for practical experience, covers everything the lone fisherman or crew member needs to know to survive today in the increasingly complicated world of commercial fishing: how to catch fish, crab and shrimp with nets, hooks, and lines; how to identify and sort fish; how to operate and maintain engines and gear; how to construct nets and mend them; how to weld, maintain and repair boats; how to keep books and run a fishing business; how to cook for a crew and store food at sea; and how to use modern fishing and navigational aids.

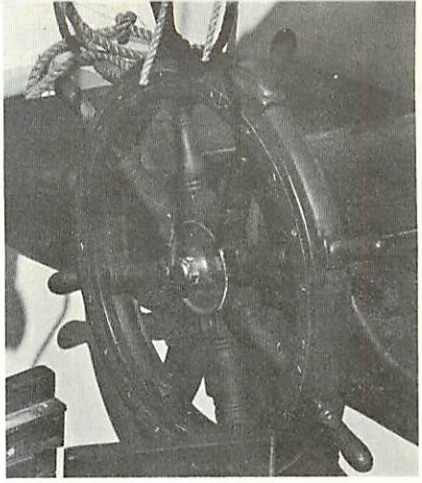
Coastal Zone Environments

Sport and commercial fishermen and people on vacation don't know it, but they owe a lot to Totem III. From a point 30 miles at sea, this buoy system provides offshore weather data about the continental shelf area off Oregon 24 hours a day. Sponsored by the State of Oregon, Office of Naval Research, National Science Foundation, industry, and Sea Grant, the 180 foot unmanned buoy is held in place by a semi-taut mooring system. The buoy is packed with a large number of sensing, recording, and telemetering instruments which gather the data and relay it to the OSU School of Oceanography data center. The data is then released to the National Weather Service in Portland and, subsequently, to broadcast stations in the Northwest for use in preparing weather forecasts. Above the water, Totem measures air pressure, temperature, wind direction and speed, and rainfall. It also gauges water current, water temperature, and conductivity at various depths under water. A side benefit is the useful information it provides about the environment of transient marine fish and how ocean conditions influence fish production and fluctuation. In the past, this kind of information came only from ship reports. Although useful, these reports usually only came in every six hours and from different locations, depending on ship tracks. Totem sends its data back at 10 minute intervals. With this data, fishermen, vacationers, and people planning picnics know in advance whether to proceed with their activities or stay home.

Waldport, Oregon has been discharging wastes from its sewage treatment plant into Lint Slough for years. The treated sewage flows from Lint Slough into the Alsea River and on out to sea. The low waste concentration never seemed to hamper the growth of young salmon raised in a connecting lagoon by the State Game Commission. But in late 1971, Waldport began planning for a needed increase in sewage capacity. Planners needed to know if Lint Slough could handle the increased effluent load. There was concern about what would happen to the salmon. Oregon State's Ocean Engineering Program, as part of a Sea Grant project, helped produce a comprehensive study of the water flow and flushing characteristics of the slough. The study indicated that the small stream wasn't up to it. Discharge would not be carried off fast enough. Cooperating biologists, using this data, concluded that backed-up waste might encourage an algal growth that would ruin the salmon-rearing lagoon. The town is now considering alternate discharge sites following the Oregon State engineers' recommendations. Further up the coast, the Ocean Engineering Program provided similar data concerning a common sewage outfall for two communities and a large campground near Netarts Bay. Planners there too are considering the engineers' proposed alternatives. Due partially to these Sea Grant project efforts, the fish in Netarts Bay, and in the lake adjoining Lint Slough, will enjoy a brighter future and clearer waters.

The balance of nature is not a status quo;
it is fluid, ever shifting, in a
constant state of adjustment.
—RACHEL CARSON





Sea Grant accomplished other things in the coastal zone environments segment of its work:

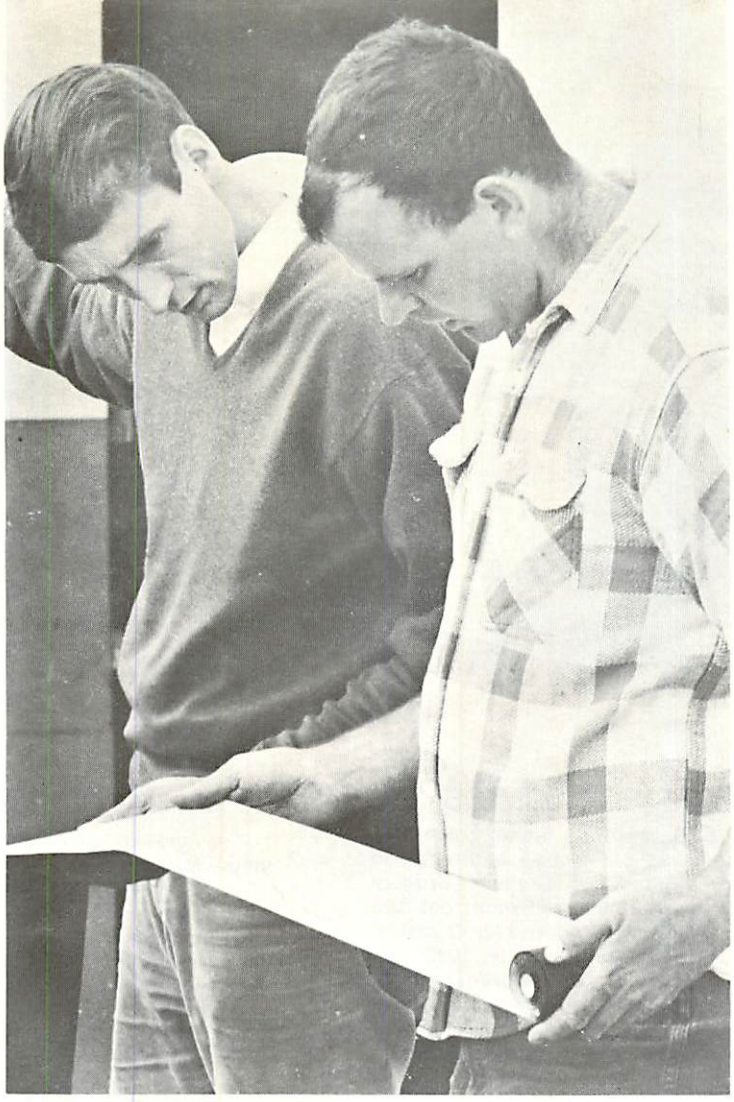
- private industry demonstrated support for the Ocean Engineering Program by providing almost $200,000 to begin construction of a wind-wave tank to be used for environmental model studies; Sea Grant funds will help instrument it.
- engineers working on Sea Grant dredging-impact projects hosted a World Dredging Association meeting which addressed itself largely to environmental impact problems of concern to government agencies and the dredging industry.
- Sea Grant ocean engineers, at the request of the Army Corps of Engineers, are helping assess dredging effects on environmental conditions in Coos Bay, Oregon.
- sea surface temperatures were measured from aircraft over the Oregon coast using infrared radiometry and the data was summarized daily and broadcast to the albacore fleet to help it scout for fish.
- practical techniques of forecasting hazardous sea and surf conditions along the Oregon coast have been developed by OSU oceanographers along with a means for the rapid dissemination of warnings, when necessary, to operational agencies like the National Weather Service, Coast Guard, and various Sea Grant ocean-going segments.
- the economics of coastal areas were studied by marine economists with several results: a multi-disciplinary case study of a complex water quality problem at Yaquina Bay was published and its future implications discussed with coastal planners; and an analysis of the economic structure of Clatsop County, Oregon was completed, and the implications of the anticipated construction and operation of a large aluminum plant discussed with local officials.

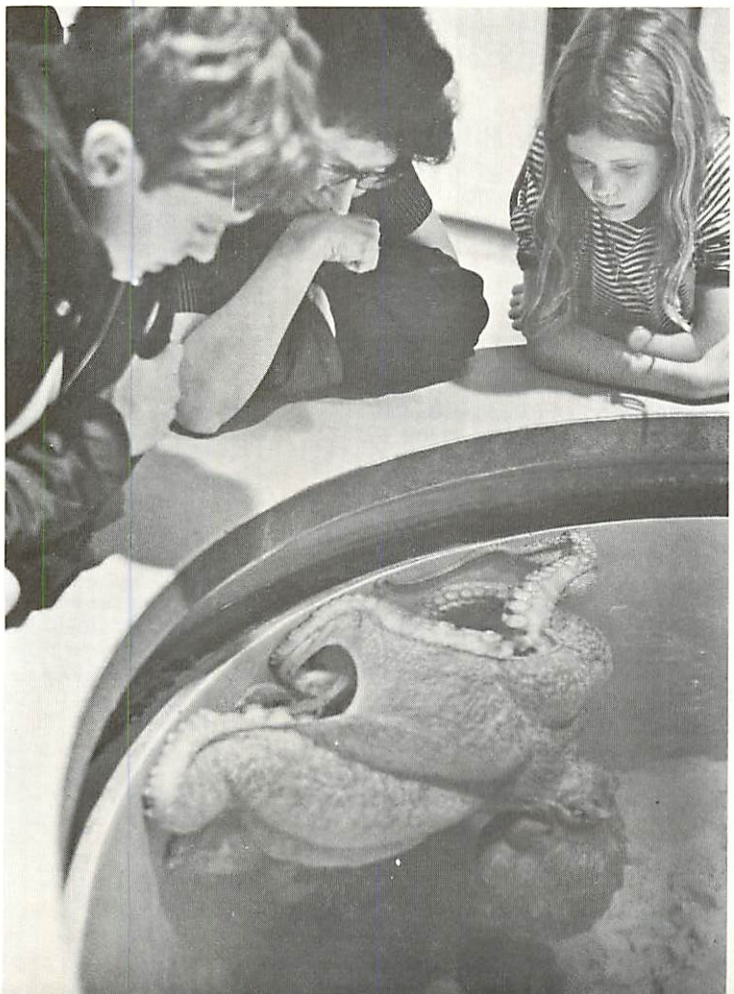
Marine Advisory Program

The Pacific Ocean is the chief textbook for the 75 fourth grade girls and boys at the Sam Case School in Newport, Oregon. During part of their school year, nearly all their study is based on the ocean, a fact that is soon apparent to any visitor to their classroom: watercolor seascapes cover the walls and marine specimens like starfish, limpets, snails, oysters, and fish dot the tables. And this approach doesn't stop with decor. Sam Case fourth graders have vocabulary and spelling lists that are loaded with words of the sea and marine science. Their notebooks are called logbooks and they even write their poetry about ocean subjects. The unique curriculum was developed by Sea Grant education specialists at the nearby OSU Marine Science Center in cooperation with the school's principal and fourth grade teachers. The center's public museum-aquarium was host to 15,000 children from 225 schools last year. But, for the Sam Case youngsters, the education specialists took their program out of the center. Not only did they help develop and provide unique learning packages concerning the ocean's physical features, currents, waves, tides, explorers, vessels, and economic values, they also provided some fascinating visitors: an Alaska King Crab fisherman, an oyster farmer, a deep sea diver, and a marine biologist. Summed up one fourth grade girl: "We can learn more than we thought we could."

Take any joint conference with nine government and educational agencies represented, and chances are the private citizens there will be overwhelmed. But this wasn't the case last spring when the smoked fish processors of Oregon and Washington met with assorted experts in Seattle and Astoria under the sponsorship of Pacific Sea Grant Advisory Program (PASGAP), a group organized to foster cooperation between the marine community and the universities and federal agencies in the Pacific. PASGAP sponsored the two identical workshops to demonstrate modern methods of processing smoked fish, how to comply with federal pure food standards, and ways to improve the product by using scientific testing instruments. When all the give-and-take was over, the experts found they had almost as much to learn as the men from the smoked fish industry they had set out to help.

Help from marine extension agents in Sea Grant may have made a success of Gene Nordgren's retirement. When health reasons caused Nordgren to turn to commercial fishing in the Pacific six years ago after a long, exacting business career, he needed help in learning how to make the change-over work. Although skilled in business, Nordgren soon discovered that he needed advice on the general management of his new business as well as details about fishing gear, fishing economics and bookkeeping, and new developments like methods of sanitizing holds. He got what he needed from a Sea Grant marine extension agent—personal advice and selected publications for more concentrated study. Now, with his new business off to a good start, he has Sea Grant to thank—along with his own ability.





• The Marine Advisory Program made a number of other contributions:

• served as technical and educational consultant to legislative committee, task forces and coastal zone planning groups concerned with management and estuarine development.

• developed and maintained rapport with marine clientele groups by providing technical information, developing leadership among clientele audiences, fostering communication among federal, state, and local agencies, and by developing local advisory groups.

• contributed general leadership and management to the regional Pacific Sea Grant Advisory Program.

• provided professional economics counseling to seafood processors and fishermen and extended modern methods of business management to fishermen on an individual and group basis.

• conducted educational programs intended to aid the seafood industry in dealing with matters of waste management.

• conducted in-plant demonstrations, lab analyses, and an interstate workshop on hot-processed smoked fish processing.

• conducted public demonstrations of sport harvest and use of Oregon seafoods.

• sponsored, with other state and federal agencies, more than half a dozen "town hall" meetings dealing with fishing, fishing gear, charts, weather, communications, navigation, and marine safety.

• used radio, television, and other mass media to educate about the need for conserving intertidal resources in Oregon.

• conducted the nation's first marine extension workshop for approximately 25 students.

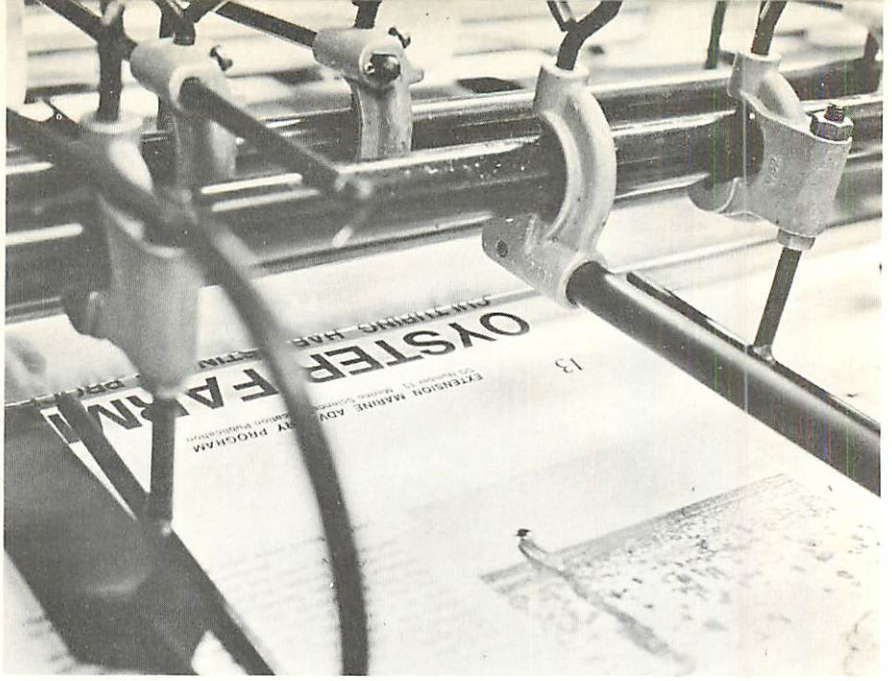
• produced "They Share the Sea," an 18-1/2-minute film about Sea Grant in Oregon.

• through visits to the OSU Marine Science Center, provided marine science education experience to more than a quarter-million persons last year.

• developed a course in marine conservation, taught in five communities to 250 teachers.

• presented more than 50 talks before civic and educational organizations and service groups.

Publications



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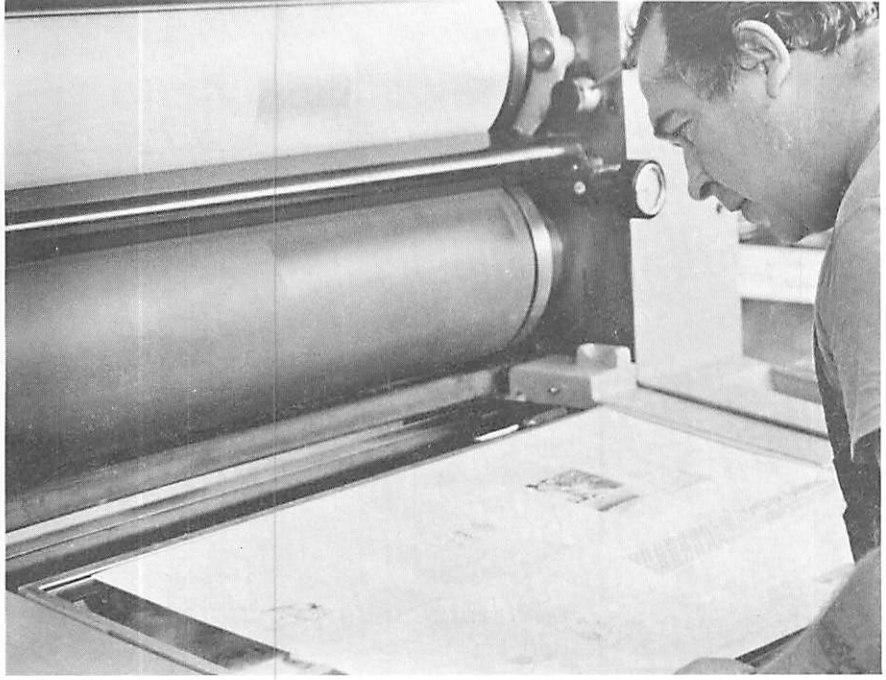

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SG 8—Byrne, John and Panshin, Dan, *Continental Shelf Sediments Off Oregon,* (revise), October 1972.

SG 10—Jacobson, Jon L., *Ocean Zones and Boundaries,* (reprint), June, 1972.

SG 11—Smith, Fred, *Incorporating a Fishing Business,* (revise), November, 1972.

SG 13—Wick, Bill and Breese, Wilbur, *Oyster Farming,* October, 1972.

SG 14—Heikkila, Paul, *Bottomfishing Provides a Pleasant Change for Oregon Anglers,* August, 1972.

SG 15—Roberts, Ken, *Diversity—Characteristic of Oregon's Year 'Round Fishery,* November, 1972.

SG 17—Roberts, Ken, *Economics of Hatchery Salmon Disposal in Oregon,* June, 1972.

SG 19—Smith, Fred, *Organizing and Operating a Fishery Cooperative,* Part 1, November, 1972.

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Education and Training

Oregon State University

Aquiculture

Roy A. Stein, Jr. established in his M.S. thesis that coho and fall chinook salmon are antagonistic in small streams. This gives management an additional tool in producing maximum populations of salmon. Alvin G. Ott, established in his M.S. thesis that it is possible to cryo-preserve the sperm of steelhead trout and chinook and coho salmon which will give hatchery managers a tool to increase efficiency in the versatility of culture methods. Robert Malouf's M.S. thesis established food densities and feeding rates for raising Pacific oyster larvae. In his M.S. thesis, Bernard Kepshire developed techniques for acclimating premigratory chinook salmon to ocean water and determined their growth rate in ocean waters.

Marine Biology

Eugene Burreson completed a twelve month study of the parasitic fauna of the yellow fin sculpin in Yaquina Bay. Jim Nelson completed the preparation of a vaccine against a microorganism that kills salmon fry in hatcheries. Francis Takahashi made crude isolations of a substance that induces copulation in the Dungeness crab. Michael Hartman has found that clams in Yaquina Bay containing certain algae, previously discarded by sports fishermen, were actually nontoxic and usable. He has joined the staff at the University of Delaware.

Richard Miller has found that there is the possibility of determining populations of rock fishes that cannot be tagged, by identifying the parasites found on fishes from various areas along the Oregon Coast. Peter Rothlisberg collected and counted populations of crab larvae to discuss possible relations of larval population fluctuations to adult populations and the crab catch variability from year to year. A. W. Hanson is teaching marine biology at Whittier College. Barry Wulff is teaching marine biology at Connecticut State College. G. S. Alspach is teaching marine biology at Western Maryland State.

Ocean Engineering Program

Bert Lee Barnes, M.S. in Ocean Engineering, 1972, has achieved results on cable strumming that indicate that drag predictions using steady state analysis underestimate physical hydrodynamic drag on taut cables by 500%. C. F. Glanzman, M.S. in Ocean Engineering, 1971, has had findings on the tidal hydraulics and flushing characteristics of Netarts Bay which significantly influenced the proposed siting of a sewage treatment facility based on the predicted impact of the treatment plants' effect on water quality of the bay.

C. A. Marshall, M.S. in Ocean Engineering, 1971, developed a successful outboard engine hydraulic power take-off system for economically operating winches, retrieving fishing lines and crab pots for small boat commercial fishermen. R. S. Thompson, M.S. in Mechanical Engineering, 1971, completed studies on vibration modes of inextensible two point cable suspensions which has led to solving a previously intractable problem in mooring dynamics. Burton W. Adams, M.S. 1971, found plastic linings for fish holds can result in construction cost savings of $1,500 per vessel and better meet cleanliness and sanitation standards.

J. W. Haefner, M.S. in Oceanography, 1972, completed his M.S. thesis entitled "Simulating Phytoplankton Population Dynamics in a Miniature Sea." His work entailed the construction of a small scale laboratory model of the oceanic water column in order to investigate the spatio-temporal distribution of both single species and multi-species phytoplankton populations. J. Plasher, M.S. in Civil Engineering, 1972, has worked with evaluating dynamic (ship) positioning systems. The study involved determining the effect of ship speed on the accuracy of a distance recording instrument (cubic autotape).

Terence Dibble has been investigating information regarding acoustic sensitivity of marine animals. Groundwork has been laid to investigate fish herding or acoustic fencing of marine life. Harry E. Weise has received nominal industrial support to develop methods for obtaining useful energy from waves. William J. Boyd is pursuing a M.S. in Ocean Engineering and plans to finish by June, 1973. A teaching assistant, he has designed a wave ripple tank for use in demonstrating wave reflection problems associated with harbors.

Scott Boley, M.S. in Ocean Engineering, 1972, has increased the store of knowledge regarding bay-ocean water exchanges. His research area involved the determination of channel mouth choking characteristics. Toku Yamamoto, Ph.D. 1972, has been an assistant to Dr. John Nath of the School of Oceanography, working on the correlations of the wave force on submerged cylinders.

George Paul Willis has accomplished test-run evaluations of the sound color motion picture concerned with crab meat extraction and training. Bobby Jack Walls has developed a simplified model of a fish processing plant's manpower and raw materials resource in his Ph.D. work. Randy Peterson is working on establishing processing-size relationships for fillet of sole (Petrale, Dover, English and Sand) standards. Peterson has completed time and motion studies on fish filleting practices and is developing a fillet manual for training of employees of processors. F. D. Lane is pursuing a M.S. in Industrial Engineering. His thesis topic concerns using the DELPHI method of analysis of the Sea Grant Program at OSU. This study may identify areas of needed research and should provide a "map" to aid in the future coordination of O.S.U.'s Sea Grant Program.

Scott Fitzwater is working on the "Quality Assurance in the Dungeness Crab Industry" which will provide Oregon seafood processors with guidelines for meeting quality standards. Joseph Dumon is completing course work toward his Ph.D. He has initiated an analysis and design of "Improved Cost Administration Systems" by studying the information logistics related to two fish processing companies in the Coos Bay region.

William P. Muellenhoff has gained continuing support for his Ph.D. studies from the Environmental Protection Agency Laboratory in Corvallis, Oregon. Until recently his work was concerned with determining tidal exchange processes in Alsea Bay, Oregon. Resulting data has influenced the siting of a developing aquiculture project on the Alsea.

Marine Economics

Kenneth Roberts completed his Ph.D. dissertation, "Economic and Environmental Tradeoffs in an Estuarine Based Economy: A Modified Input-Output Model of Clatsop County, Oregon," and is now an extension marine economist at Clemson University.

Daniel McIntyre is completing requirements for a M.S. degree and will be writing a thesis on the role of multiple objectives in international fisheries treaty negotiation.

John B. Nordling, Perry Hobson, and Heau Ma have completed, or are now completing, M.B.A. degrees. Each has done research on measurement techniques and computer algorithms for experimental analysis of consumer perception of seafood products.

Leon Abbas has completed course requirements for a Ph.D. and is now doing dissertation research on determinants of mobility of Oregon's commercial fishermen.

Oceanography

The Ph.D. thesis completed by Steven Zimmerman describes the seasonal cycles of the zooplankton population in Netarts Bay, Oregon. This work is critical for the timing of the future releases of young chum salmon from the Netarts Bay hatchery, which will be manipulated to coincide with the seasonal abundance of the cope-

pods, a major component of the zoo plankton and the important food item for newly released chum salmon. He now works for the State of Alaska. F. Gunther's research demonstrated the seasonal variability of foraminiferal communities and characteristics of the continental shelf benthic environment. Casey Bowman completed a Ph.D. in geological oceanography working on the heavy mineral sands of southern Oregon and is employed at San Jose State.

Deborah Kirk received an M.S. degree with a thesis dealing with hydrography and nutrient nitrogen budget of Auke Bay, Alaska, and plans to continue for a Ph.D. degree.

Seafood Science and Technology

A number of people were trained at the undergraduate and graduate levels who are capable of fulfilling the needs of marine-oriented industry and governmental programs. One graduate now holds a product development and production position with a diversified Oregon food company. Another, who was supported by Sea Grant through both a M.S. and Ph.D. program, now holds a position with FDA in its fish inspection program.

University of Oregon Law School

Ocean Resources Law

Thomas Hanlon, research assistant in the program, graduated and is working for a Eugene, Oregon law firm. Michael Bird, another research assistant, graduated and is now practicing law in Grants Pass, Oregon. Ron Wolf, an ocean resources law student, graduated and is now Assistant Attorney General for the State of Washington Department of Natural Resources. Geoffrey Haynes graduated and has joined NOAA's Legislative Liaison Office.

Clatsop Community College

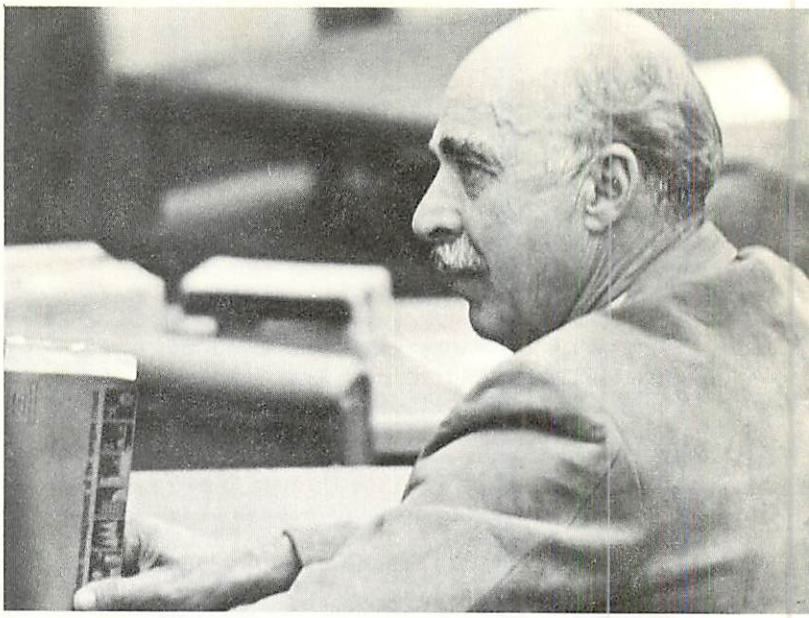
Technician Training

Eleven students graduated in June, 1972 in Oceanographic Technician Training and are employed as follows: two have technical positions in fish processing plants; one is a crew member on an oceanographic research vessel; three work for National Marine Fisheries Service in Oregon, Washington, D.C., State of Washington, respectively; one works at the Marine Science Center in Newport; and one is employed by Oregon Ocean Supply.

Four students graduated in June, 1972, in the Fisheries Technician Training Program and are employed as commercial fishermen. One has gone as far north as Alaska and another is a captain of his own vessel. A number of students gained enough skill in one year to be employed on a full-time basis.

In Marine Technician Training, 42 students have been trained in seamanship including practical experience on the three college owned vessels.

In Marine Engineering Technician Training, 24 students were enrolled and took courses in marine operating engineering and gained skills in pneumatics, electronics, diesels, refrigeration, hydraulics, and electrical systems.



Budget Summary*
By Type of Activity

July 1, 1971—June 30, 1972

	NOAA Budget	NOAA Expenditures	Univ. Match Budget	Univ. Match Expenditures
OSU Training	336,850	330,342	114,498	141,959
Clatsop Community College	65,900	65,900	48,925	49,521
Marine Fisheries	250,807	256,607	145,724	129,323
Aquiculture	126,411	129,203	49,315	64,274
Seafood Science & Technology	139,226	138,400	85,613	68,912
Marine Economics	105,766	106,490	47,488	48,542
Ocean Engineering	88,137	99,283	85,538	96,374
Ocean Law (University of Oregon)	32,104	32,230	16,829	22,959
Coastal Ocanography	94,550	100,356	–0–	–0–
Commercial Fishing Methods	62,600	67,080	16,230	20,377
Marine Biomedicinals	20,000	22,755	16,234	16,234
Marine Weather Station	5,000	3,000	–0–	–0–
Ship Operations	69,000	69,073	52,000	52,013
Advisory Services	199,533	177,660	138,315	133,014
Program Development & Management	104,116	101,621	67,091	45,100
TOTALS	**$1,700,000**	**$1,700,000**	**$883,800**	**$888,602**

**This budget summary is not a final fiscal report. The final report will not be available until all outstanding bills are finalized.*

SEA GRANT