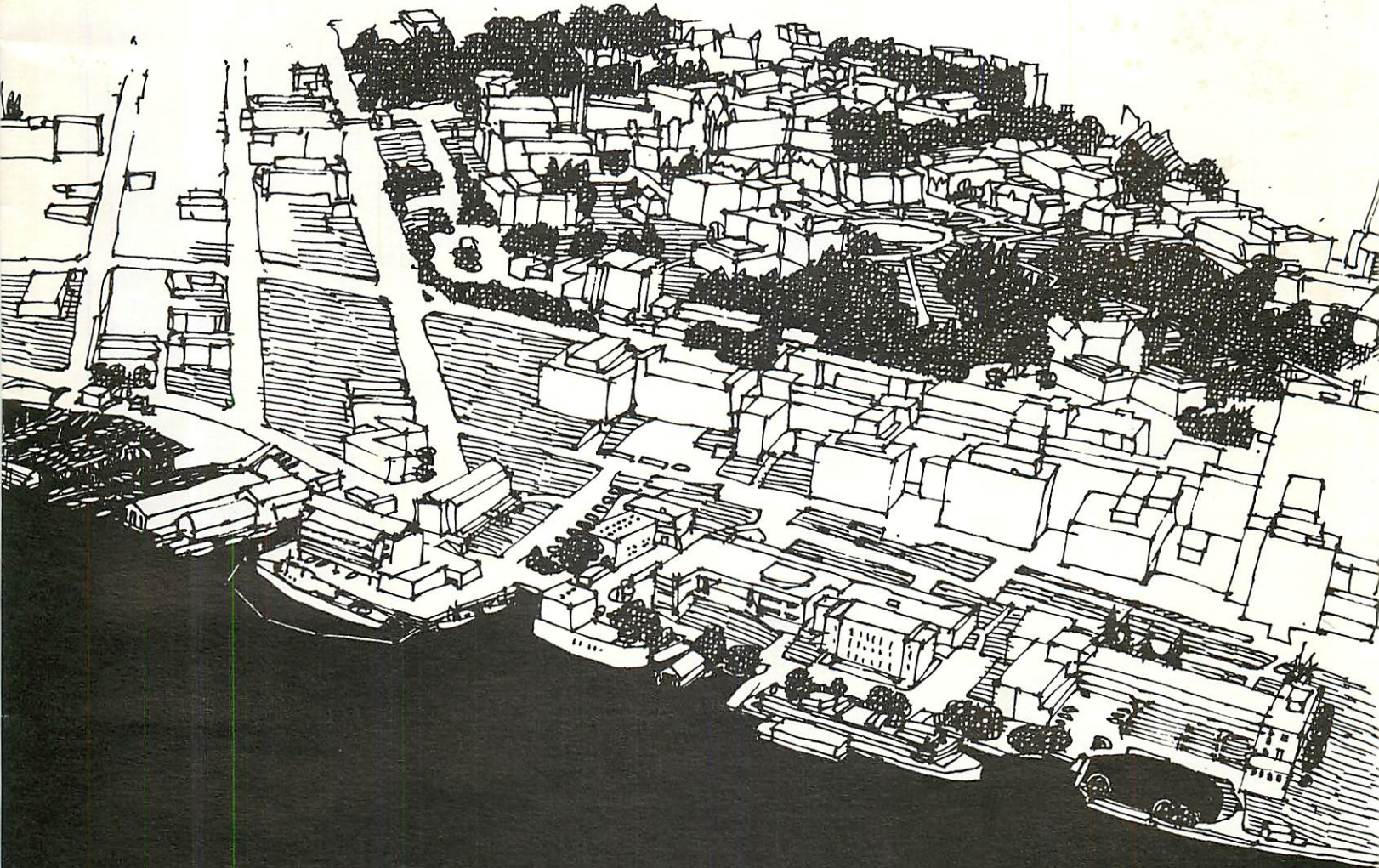


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A Report of Activities 1979-1980



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Sea Grant programs are underway in 27 states and two territories: Alabama, Alaska, California, North Carolina, South Carolina, Connecticut, Delaware, Florida, Georgia, Guam, Hawaii, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, New Hampshire, New Jersey, New York, Ohio, Oregon, Puerto Rico, Rhode Island, Texas, Virginia, Washington, Wisconsin

A Nationwide Partnership

The Sea Grant College Program is a partnership between the federal government and universities around the country whose purpose is to develop and transmit knowledge and skills necessary to make the most effective use of the nation's marine resources. The marine world, as seen by Sea Grant, includes the oceans and the Great Lakes, the physical and biological resources of these waters, and the air and land masses that interact with them. Among other factors, Sea Grant considers the economic, political, esthetic, and sociological aspects of man's interaction with the seas.

This broad view makes Sea Grant's goal of optimizing the use of marine resources exceedingly complex. The strands making up the fabric of the marine world are great in number and highly varied, and they are so tightly interwoven that a change intended to affect only one of them usually affects many others. One important role of Sea Grant is to determine the relationships among the various elements making up the marine world so that reasonable predictions can be made of the consequences of decisions concerning marine resources.

Because it is clearly impractical to investigate every possible impact resulting from every possible change to every element of the marine environment, Sea Grant has established guidelines for determining priorities so that available resources can be focused in those areas where positive results are most likely to be achieved.

... to serve regional needs

Although many a marine issue is applicable to every coastal area of the nation, the details of the issue may vary significantly from area to area. For example, almost every local Sea Grant program supports one or more projects in aquaculture; however, the animals or plants being cultured are determined primarily by the environmental conditions of the individual region. For example, salmon culture is of crucial interest to the Pacific Northwest but of little interest to the Gulf Coast compared with shrimp or crawfish. Similarly, survival in cold water carries a much greater priority in the northern states than in southern parts of the country.

An effective means to assure that realistic priorities are established for each region is the provision that at least a third of the funding must come from non-federal sources. Thus states, local governments, industry, or other sources of support participate in both the funding of the local programs and in determining the activities of those programs. This is the basis of the partnership concept.

... in a practical way

An essential characteristic of a Sea Grant activity is that it be practical. It addresses a specific and recognized problem or opportunity and works toward a solution or use that is realistic from scientific, economic, and social points of view. The time scale of the application varies tremendously from one project to another. In one case it may be as immediate as introducing an improved material, device, or technique to a fisherman. In another case it may be but one of many steps in a research program spanning a number of years. But the important test is that a clear link to a practical application is demonstrated, rather than the activity's being undertaken merely for the sake of increasing knowledge.

... cooperating with other programs

Sea Grant, of course, is not the only program addressing marine-related problems. Many agencies of the federal, state, and local governments have been assigned responsibilities in one or more aspects of the marine world. Many of these responsibilities are of a regulatory nature, and therefore quite different from Sea Grant's responsibilities. Sea Grant may develop the technology necessary for enforcement of a regulation, or may provide guidance on the likely outcome of a managerial decision, but it does not become involved directly in the regulatory process.

Other activities of the various agencies may be quite similar to those undertaken by Sea Grant. To make the best use of the limited funding available, Sea Grant seeks to augment rather than duplicate or compete with the activities of other organizations. Wasteful duplication or dilution of effort is avoided in part by asking appropriate agencies and industries to review proposals that have been submitted for Sea Grant support. These reviewers have an opportunity to comment not only on the quality of a proposed project but also on how the work would fit in with local programs. Frequently, reviewers suggest modifications to avoid duplication or to emphasize a particular aspect of concern to them. Conversely, descriptions of marine-related programs being carried out locally are often pro-

vided to Sea Grant so that projects that would support these programs can be developed. Since Sea Grant, through its university affiliation, has a broad interdisciplinary base, it is often possible for Sea Grant to provide additional considerations such as economic and legal constraints, or international policy impacts to strengthen another organization's program.

... through research, education, advisory services

Users of Sea Grant services comprise a vast array of people and organizations with a wide variety of interests, including fishermen, teachers, government agencies, boaters, legislators, divers, urban planners, consumers, industrial associations, waterfront residents, food processors, and concerned citizens.

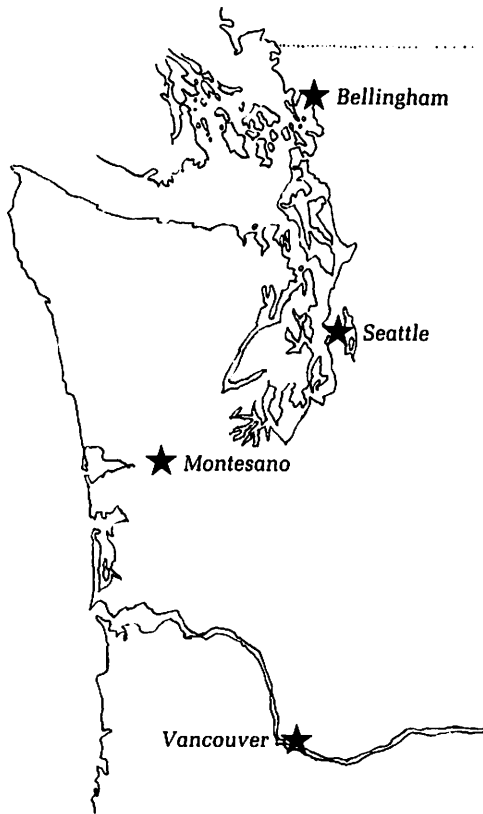
To address the needs of such diverse groups, Sea Grant activities are organized in three mutually supporting activities: research, education and advisory services. The boundaries between these categories are flexible, but in general the activities support one another in the following ways.

Through research Sea Grant not only develops practical solutions to real-world problems, but also provides experience for college students, an essential part of the education of future professionals.

Through its educational component Sea Grant helps develop new courses and stimulates the exchange of information through the participation of visiting faculty, frequently generating new opportunities for research in the process. This component also fosters vocational training for those moving into marine trades requiring special skills, a formal role closely linked with the less formal educational aspects of advisory services.

Through its advisory services Sea Grant provides the entire marine community with a problem-solving capability. Advisory services provide a two-way bridge between research and the users of Sea Grant services, bringing research results to the users and alerting the research community to problems identified by the users. Advisory services support education by publishing research results and informational material and by conducting training courses, workshops, and demonstrations in the skills needed by the marine community.

Washington Sea Grant



The National Sea Grant Program was established in 1966, its name being chosen to emphasize the parallelism with the Land Grant Program, which had been established a century before. The University of Washington joined the national program in 1968, and in 1971 became one of the first universities to be designated a Sea Grant College in recognition of the sustained quality and productivity of its program.

In Washington, the program reflects the geography of the state as well as the concerns and activities of its citizens. On the south, Washington shares with Oregon the nation's second largest river, the Columbia, and its estuary. On the west, the 160-mile seacoast has two distinct regions, the rocky, mountainous, relatively inaccessible northern half, and the sandy, low terrain and readily accessible southern half. Most of the western shorelands are publicly owned. The low-lying coast of the southern half is interrupted by two large estuaries, Willapa Bay and Grays Harbor, which provide homeports for fishing fleets, important wetlands for marine life, and cargo ports. The north-west corner of the state is bounded by the greater Puget Sound system, a large, island-studded, inland sea with several deepwater ports, rich clam and oyster beds, many salmon streams, and excellent recreational boating.

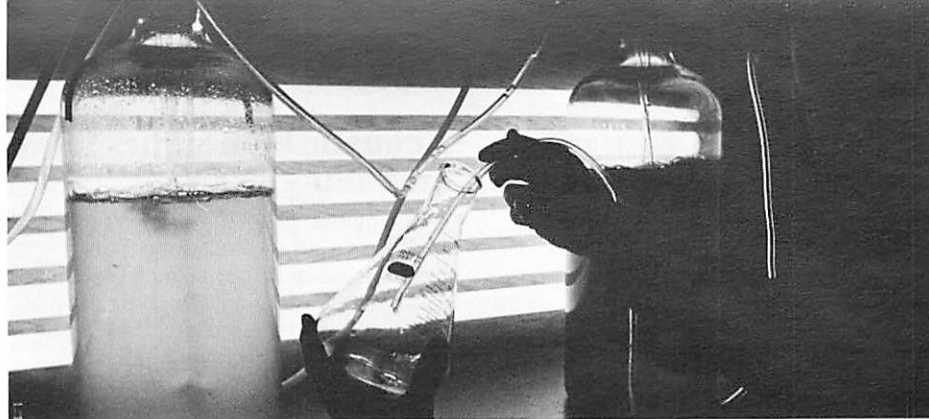
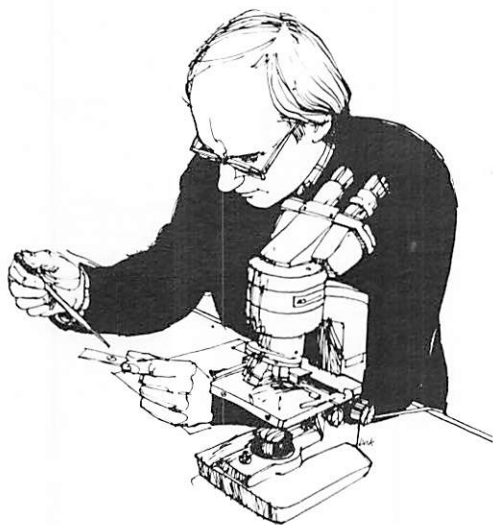
Commercial uses of these marine areas include traditional activities such as fishing, shipping, boat building, and waste disposal as well as the activities of emerging industries such as pen-rearing of salmon, geoduck harvesting, and the aquaculture of mussels and seaweed. Recreational activities combine historical uses such as fishing, clamming, swimming, beachcombing, and boating with more recent developments such as scuba diving and wind surfing.

The Washington Sea Grant program is administered by the University of Washington, but its focus is regional and a number of its projects support and are supported by other institutions and organizations throughout the state. Furthermore, since many of Washington's marine concerns are shared by its neighbors, Washington Sea Grant participates in joint projects with universities in British Columbia, Idaho, and Oregon. Through the Pacific Sea Grant Advisory Program (PASGAP), Washington Sea Grant participates in projects of mutual concern with the Sea Grant programs of the other West Coast states and with British Columbia. These projects include workshops on subjects of common interest, such as salmon aquaculture and the sharing of talent among the individual states.

In Washington Sea Grant's marine advisory program, the relationship with other institutions is particularly close. The marine advisory program is a partnership between the University of Washington and Bellingham Vocational-Technical Institute, Clover Park Vocational-Technical Institute, and Washington State University. In addition, Oregon State University and the University of Idaho are partners in the Columbia River services.

Research

During 1979–80, Washington Sea Grant supported 35 major research projects, and in the following pages results of selected projects are featured. Most projects were carried out at the University of Washington and involved 47 faculty members and almost 90 students. The remaining projects were conducted at institutions and research organizations across the state and, occasionally, in neighboring states. These projects involved an additional 7 principal investigators and 3 students. Research subjects included:



Marine Studies

- multidisciplinary study of selected industrial problems
- economic impact of joint ventures in Northeast Pacific fisheries
- forecast of cargo activity for West Coast ports
- role of women in commercial fishing
- legal analysis of limited entry fisheries

Coastal Resources

- economics of marine recreation
- urban waterfront enhancement through the reuse of obsolete port facilities
- analysis and description of legal issues involving Indian fishing rights, oil tanker traffic, and other coastal issues
- strategies for survival of shoreline towns in Puget Sound

Fisheries Management and Assessment

- mathematical models of economic and biological interactions affecting fisheries management
- acoustic techniques for estimating abundance in the herring and hake fisheries
- acoustic techniques for measuring abundance and identifying species of high-density pelagic fish schools
- acoustic estimation of salmon in terminal areas
- distribution, abundance, growth and residence time of juvenile salmon in the Skagit salt marsh
- northern Puget Sound non-salmon sport fishery
- lingcod population analysis

Aquaculture

- salmon stock enhancement
- coho salmon stock development for marine pen culture
- thyroid endocrine control of salmon smoltification
- improved strains of commercial seaweeds for greater yield
- technology for growing commercial seaweeds
- genetics program to develop oysters resistant to summer mortality
- culture techniques to increase yield of clams and mussels
- hybridization between the California red abalone and the local Pinto abalone
- genetic studies of a bacterium causing a serious fish disease
- treatment of bacterial diseases affecting fish with anti-bacterial agents

Marine Products

- economical and versatile method of making bromine compounds using marine organisms
- use of chitosan from shellfish waste in high-value, health-related applications
- chitosan as a commercial fungicide
- new products from algae

Ocean Engineering

- analysis and improvement of fishing vessel safety
- theoretical studies to improve the accuracy of determining acoustic target size of fish in their natural environment
- wave motions in harbors and marinas
- technological aspects of manufacturing a feed for fish larvae
- marine transportation management and risk reduction

Acoustic techniques for managing fisheries



During the early 1970s the Washington Sea Grant marine acoustics program concentrated on developing an "echo integration" technique by which fish abundance could be determined from the strength of acoustic signals reflected from fish. In recent years, emphasis has shifted to providing information for the management of specific fisheries, and the technique has been adapted, or "tailored," to the needs of different fishery management agencies. Notable success in this area is the incorporation of the echo integration technique as the primary tool for managing herring stocks in both Washington and Alaska by the respective state fishery departments.

Because of its relatively short life span and large natural fluctuations in abundance, herring is a fish species that is particularly difficult to manage with conventional techniques. With acoustic techniques, it is possible to determine accurately the size of a fish population before a harvest. Thus, surplus fish can be harvested efficiently in good years, and the stock can be protected from damaging overharvest in poor years.

The acoustic techniques for assessment of herring stocks were developed by the Washington Sea Grant marine acoustics program under the guidance of Professor Dick Thorne in cooperation with the Washington Department of Fisheries and the Alaska Department of Fish and Game. Both agencies now have their own systems for acoustic surveys, but Sea Grant still provides help and advice to these agencies as well as most of the data analysis for the Alaska surveys. The increased harvest that has been made possible by use of acoustic surveying is valued at several million dollars per year.

A spinoff from the resource assessment research is the use of acoustic techniques for assessing the effects of environmental alterations on the distribution, abundance, and behavior of fish. Washington Sea Grant efforts in this area have been valuable locally, and project techniques and personnel have been involved in assessments of nuclear power plant impacts on both U.S. coasts and the Great Lakes, as well as impacts of oil exploitation in the Arctic.

An example of these successful applications is a program sponsored by Southern California Edison (SCE). SCE is concerned with the impact of its coastal power-generating stations on marine fish populations. These stations use ocean water for cooling. Fish are sometimes caught in the cooling water intake systems and killed. Acoustic techniques were used to determine how the fish were caught and what procedures could

be used to decrease mortality rates. Studies revealed that some procedures which SCE had already put into operation were effectively reducing fish kills and suggested other procedures that could reduce fish kills even further.

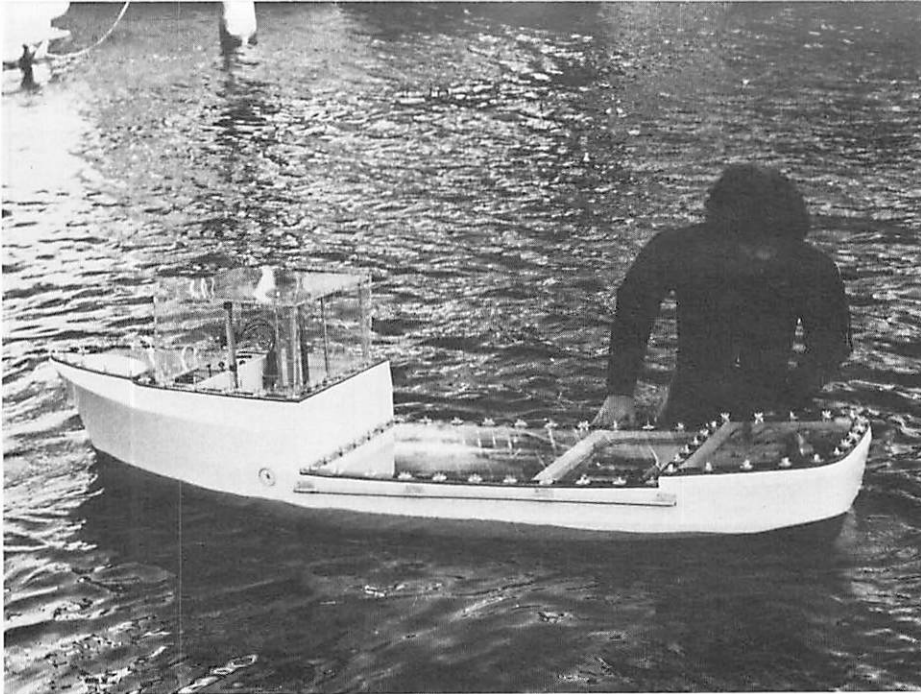
One measure of the success of the Washington Sea Grant marine acoustics program is the fact that nine federal agencies, seven state agencies, and seven public utilities, as well as numerous private companies involved in environmental impact work, have provided funds to this program for the solution of specific problems. Many other agencies and companies have utilized the program's developments. The funds attracted to the program are often several times greater than the Sea Grant funding itself.

Despite its successes, not all problems have been solved, so the Sea Grant marine acoustics program must continue research in this area. Ongoing research by Professor John Ehrenberg includes studies of fish target strengths, ways to identify different species, and applications of advanced technology.

The accuracy of acoustic assessment techniques ultimately depends on understanding the acoustic energy reflected by fish targets. Since laboratory measurements are not completely satisfactory, project investigators study techniques whereby they can detect, isolate, and measure the strength of echoes from fish in their natural habitat. These are called *in situ* target strength measurements.

Species identification is another problem area. In order to measure the abundance of a fish species by means of acoustic surveys, investigators must be able to identify the fish from which they receive echoes. Therefore they are investigating various clues to identity, such as the dimensions of fish schools and distributional and behavioral characteristics.

Finally, several advanced techniques have resulted from military-related developments in underwater acoustics. Some of these, such as the sector-scanning sonar, have considerable potential for fisheries research. It will be important to evaluate these characteristics and their potential advantages versus the increased cost of such advanced technology.



Fishing vessel safety

In response to the tragic history of accidents in the Pacific Northwest fishing fleet, the Fishing Vessel Safety Center was established by the Ocean Engineering Program of the University of Washington under the guidance of Professor Bruce Adey in January 1978, with funding from Sea Grant, the National Marine Fisheries Service, and the University. While the Center's immediate goal was to collect fishing vessel accident data, it soon found itself taking a far more active role in safety education.

Almost immediately after the establishment of the Center, a group of marine underwriters asked that the Center develop and present a seminar on the safe shipboard use of polyurethane foam insulation. A number of serious losses had occurred because of fires involving this material. Because of the great interest shown in the seminar, a second presentation was quickly scheduled, and subsequently informational material has been widely distributed through marine advisory agents, articles, and exhibits.

Following these seminars, a working group was convened to consider the desirability and format of a simple but comprehensive vessel safety inspection checklist suitable for use by surveyors. Two meetings were held, attended by more than 50 people including fishermen, fishing vessel owners, marine surveyors, marine underwriters and brokers, naval architects and boat builders. Participants at these meetings concluded that such a checklist was needed by surveyors and would also be of value to all segments of the industry. After soliciting input from more than 90 industry representatives and reviewing initial accident data, the Center prepared and distributed checklists in July 1980. In addition to the initial broad distribution, more than 100 checklists have been distributed in response to specific requests.

Also soon after its establishment, the Center was asked by the National Council of Fishing Vessel Safety and Insurance to develop, edit, and publish its quarterly newsletter, which, with its current nationwide circulation of over 500, has become an important mechanism for distributing safety-related information to a broad audience.

In the meantime, the original purpose of the Center was being implemented, and by February 1979 the computer-based data system was fully operational. Data on accidents involving Pacific Northwest fishing vessels are received from the Coast Guard, the insurance industry, journal and newspaper articles, and personal contacts by Center staff. Initial analysis of accumulated data indicates that the information will be valuable in identifying the most productive areas for education and research in hazard reduction.

In addition to its data-gathering and educational roles, the Fishing Vessel Safety Center conducts safety-related engineering research. A major safety problem indigenous to the Pacific Northwest involves the stability of Alaskan king crab boats. Work on this class of vessels was begun prior to the establishment of the Center as the thesis research of Dr. Richard Storch, and it has continued under the auspices of the Center. The results of this research have been presented not only to the technical community through articles and seminars but also to the fishing community through an article in *Alaska Sea Grant's* publication *Alaska Sea and Coasts* and through a series of 10 seminars emphasizing practical safety measures. These 10 seminars were presented in fishing communities of Alaska, Washington, and Oregon.

A number of other research projects are underway. The Center has acquired an 8-foot model of an Alaska king crab boat from the Coast Guard and is instrumenting it in preparation for natural en-

vironment motion testing in Puget Sound. The goal of this research effort is to increase the understanding of capsizing modes of vessels of this design. Records of motions of the model in various stability conditions will be collected and analyzed, and films of the tests will be taken to be included in future vessel stability seminars for fishermen. A semi-submersible wave measuring platform has been designed and constructed and will be used at test sites to simultaneously record directional wave spectra so that the response of the model can be correlated with the sea conditions.

Growing salmon in saltwater pens

One of the earliest long-range programs undertaken by the University of Washington's College of Fisheries with Sea Grant support was the development of technology needed to economically raise salmon to maturity in enclosed pens. It has not been an easy task. Diseases spread rapidly through crowded pens, and improved vaccines and more efficient methods of inoculation had to be found. Available feeds were not well matched to the needs of fish in rearing pens, and new diets had to be developed.

These and many other problems were tackled in cooperation with state and federal agencies and with the support of the Weyerhaeuser Company and Dom-Sea Farms, Inc. Today a young but vigorous multi-million dollar industry is producing 2,000 pounds of pan-size salmon each day in Washington waters.

Another persistent problem was that of obtaining stable smoltification. Growing salmon in marine pens interferes with natural signals that trigger the salmon's transition from the freshwater parr state to the saltwater smolt. Typically, 50-80 percent of the fish failed to adapt successfully to the salt water of the pens after being transferred from the fresh water of the hatchery, either dying or simply not growing.

Three years ago, Professor Bill Hershberger started a genetics project to develop a strain of coho salmon that was better suited to marine pen culture. Although the project is still in its early stages, it has shown remarkable progress by doubling the rate of successful transfer of salmon from fresh to salt water. This will mean a saving of a quarter million dollars per year in the cost of raising salmon from eggs to market size.

Hershberger's breeding program is continuing, with the goals of improving growth rates in both the fresh- and salt-water phases and improving spawning and the viability of eggs and sperm from pen-raised salmon.



Seeding Manila clams

The Manila clam (*Venerupis japonica*) is a popular delicacy in the Pacific Northwest. This clam, known also as the Japanese littleneck or steamer clam, was introduced by accident to the West Coast of North America by imports of Japanese oyster seed. In Washington State, it is harvested commercially, primarily from southern Puget Sound and northern Hood Canal. It is also taken by recreational diggers from beaches scattered throughout these waters.

The current annual Washington State production of Manila clams is roughly a million pounds, but because the clam is in such demand, the market could support a significantly greater level of production. Recognizing this fact, Washington Sea Grant has supported the research of Professor Ken Chew of the College of Fisheries who, in collaboration with the state's Departments of Fisheries and Natural Resources, has been testing ways not only to maintain established clam populations but also to develop new ones.

Several techniques for enhancing clam populations have been tried in the past with limited success. These include collection of natural clam seed from the most productive areas and transplantation to selected grow-out sites, modification of the substrate of a beach to make it more suitable for natural clams, and use of such devices as current baffles or tree branches secured over a beach to create eddies that may in turn facilitate greater larval settlement.

These techniques have been successful in particular situations, but they depend on the occurrence and setting of natural larvae on a regular basis. In Washington State, large yearly fluctuations in larval setting are common for most of the important hard-shell clam species, and thus there is no guarantee of an adequate yearly settlement of natural larvae in potential clam beds.

One promising approach to obtaining reliable recruitment in clam beds is to carry out the early stages of the life cycle in a controlled environment. Several commercial hatcheries now grow juvenile clams to sizes that can be safely transferred to open beds. The optimum size of these seed clams for a specific location is determined by cost and the characteristics of the clam bed, and may range roughly from 1/16 to 3/8 inch.

Experiments conducted by Mark Miller, a graduate student on Professor Chew's Sea Grant project, showed that a beach chosen for clam seeding should be a gradually sloping one, with either natural or artificial protection. The ideal substrate is gravel, coarse sand, a certain amount of mud or clay, and some shell. The substrate should also be cohesive and not subject to excessive shifting.

Miller's research also indicated that planting should be done in the spring so that growth can start before the seed is exposed to cold temperatures and storms. If planting is done on an incoming tide, starting at the lowest beach level and proceeding upward ahead of the rising tide, exposure of the clams to the dry-

ing effects of the sun is minimized.

A key factor in improving the yield from seeded clam beds is the protection of the young clams from natural predators, which include a variety of birds, fish, crabs, and snails. Wire screen cages did not prove particularly successful, but a lightweight plastic netting (DuPont's Vexar) has been very effective. In pilot-scale experiments developed by Greg Anderson, another of Professor Chew's graduate students, recoveries of clams from protected beds were ten times as great as those from adjacent unprotected beds. An unexpected result was that the netting apparently increased not only the yield from the seed clams, but also that of naturally set clams. That the project has been worthwhile is attested to by the fact that two organizations—Webb Camp Sea Farms of Friday Harbor, Washington, and the Squaxin Indian Tribe of Shelton, Washington—are now using the technique to culture Manila clams in the Puget Sound area. Both of these groups have sponsored portions of the clam-seeding studies in the past.

Sea Grant publications have reported the progress of the experiments, and a final report providing details of the technique is in preparation. The procedure has also been described in a recent handbook on shellfish aquaculture published by the Department of Natural Resources.

Education

Washington is a state in which citizens play a very active role in the process of government. They frequently write initiatives, encourage referendums and participate willingly in a broad spectrum of hearings, workshops, teach-ins, petitions, and demonstrations. In this environment, the wise use of marine resources can be achieved only if a broad segment of the Washington public is well informed about what these resources are, about the alternatives for developing and preserving these resources, about methods for managing conflicting points of view, and about the losses to society that can result from poor resource management. Sea Grant provides educational programs not only for the general public, but for those in or aspiring to leadership positions, as well as those who will be involved in the development and management of marine resources.



... through University projects

During 1979 and 1980 new university courses were developed at both the graduate and undergraduate levels in ocean engineering, ocean law, and marine resource management. Special short courses and lectures by visiting scholars were offered in fisheries and marine policy. Selected graduate students were given advanced training through internships on the staffs of congressional committees and in the Seattle office of NOAA's General Counsel.

Other projects were directed toward the general public. TV programs combining documentary films with studio discussions were developed and presented on such topics as the 200-mile fishery management zone, the role of public ports, and developments in aquaculture in the Pacific Northwest. Plans were also developed for an educational exhibit concerning the historical changes on the Seattle waterfront and options for future changes.

... and at the Pacific Science Center

Projects aimed at the general public can, at best, reach only a small fraction of the population. To reach the largest number of people possible, a long-range program of training teachers and developing curricula is underway to bring marine resource awareness into the classrooms from kindergarten through the twelfth grade.

During the last two years, the marine education project (the ORCA project) at the Pacific Science Center continued to be a West Coast leader in the production of marine-related K-12 curriculum materials and teaching kits. This program, under the guidance of Bonnie DeTurck and Andrea Marrett, also conducted workshops (with University credit) to train teachers in the use of marine education materials. This program works closely with the office of the State of Washington Superintendent of Public Instruction, which helped print and distribute the curriculum materials. Seven marine activity packets for junior high schools were published and distributed widely under this cooperative effort in

1979. Four new elementary school packets were used experimentally by 60 teachers reaching 1,500 students. Before final printing and distribution the new packets will be revised to reflect the comments and suggestions resulting from this trial use. Experience has shown that trial use in classrooms and subsequent revision of the material are extremely valuable steps in the development of teaching material.

In cooperation with the Superintendent of Public Instruction, the needs of the state's schools for marine education material are being carefully monitored, and new materials are being prepared as needs are identified.

In addition to the new classroom material, the Pacific Science Center is developing a library of resource material available to teachers throughout the state. At present, more than 1,500 items are catalogued, including film strips, slides, cassette tapes, records, and books. This resource, as well as the availability of classroom materials, is being advertised by articles in literature sent to schools and school districts through the Office of the Superintendent of Public Instruction and through the newly activated Northwest Association of Marine Educators, which is actively supported by the Pacific Science Center.

The project leaders have been very active in coordinating their work with that of other educators developing marine educational material throughout the Pacific states. A highlight last year was Andrea Marrett's "showcasing" of the project at a national workshop of the National Marine Educator's Association held in Salem, Massachusetts. This year the quality of the effort has attracted the attention of the Northwest Regional Educational Laboratory in Portland, Oregon which is seeking to combine the materials produced by the Washington Sea Grant program into the International Pacific Circle Consortium.

Advisory Services

The Washington Sea Grant advisory services link the users of marine resources and the knowledge needed to use those resources wisely. The goal is to make wiser use of marine resources happen.

Business management for commercial fishermen

Pete Granger worked for a fish processing company before he became a Sea Grant agent, and there one of his main duties was keeping the financial accounts relating to the commercial fishermen who delivered to the company's southeast Alaska canneries. On the basis of that experience, he developed and taught, with the assistance of the Internal Revenue Service and two Bellingham accountants, a down-to-earth course in commercial fishing business management and recordkeeping techniques. This course has been repeated over the past three years at Bellingham Vocational-Technical Institute and, in shorter form, at Anacortes, Blaine, and Friday Harbor.

One of his students the first year was a Bristol Bay school teacher and part-time commercial fisherman who had just made Bellingham his residence for the winter months. Each winter since, that fisherman has come back to Pete Granger saying he has applied virtually everything Pete taught him and seeking more information. Using the planning and decision-making information techniques of the course, this student has become a full-time commercial fisherman. He now spends five months in Alaska each year, he indicates he has grossed close to a half million dollars each of the last two seasons, and he has hired an accountant to advise him on the use of his profits.

Nontraditional seafoods

Consumers are trying nontraditional seafood products because of high prices of traditional foods. With the assistance of seafood processors and retailers in coastal communities, extension marine agent Steve Harbell and home economist Pat Leslie of Cooperative Extension presented demonstrations at Westport, Ocean Shores, and Hoquiam; county-wide seminars at the Grays Harbor county fair, Tacoma, and Olympia; and a TV program on the handling, preparation and preservation of selected nontraditional seafoods. A total of 516 people attended. Of 350 attendees surveyed three months later, 49 reported increasing their total seafood consumption since the demonstrations, and 30 of the 49 were also preparing nontraditional and less expensive items.

Octopus— an alternative fishery

Octopus is a preferred halibut bait. This exotic seafood also enjoys a small but devoted ethnic market (Italian, Yugoslavian, Japanese, Chinese, Filipino). In early 1980, southeast Alaska fishermen who were interested in alternative fisheries expressed curiosity about octopus. At the request of Alaska Sea Grant, commercial fisherman agent Scott Harrington gave seminars on the octopus fishery to 250 fishermen in Ketchikan, Petersburg and Sitka.



Quality control in seafood processing

High personnel turnover and pressures for higher quality products force Northwest seafood processing plants to seek new and trained personnel at the beginning of each season. Because of this situation, Washington Sea Grant seafood processing specialist John Peters now coordinates a 30-hour short course, taught largely by industry quality control supervisors, at the University each spring. The course introduces entry-level employees to the Northwest seafood industry and provides industry representatives an opportunity to evaluate potential employees. During the past two years, more than 130 students received certificates of satisfactory completion.

There is little need for the students to hunt jobs at the end of the course; practically all are offered jobs in the industry by the time each course is completed.

Smallcraft moorage facilities

Moorage industry leaders had known for some time that there were serious shortages in moorage facilities in western Washington for recreational and commercial smallcraft, but the extent was unknown. Similarly, industry leaders, both public and private, knew that the economic impact of the shortages was significant, but its magnitude was conjectural. Furthermore, current information on the demands facing smallcraft facilities was unavailable to those planning, regulating, financing, and constructing such facilities. With funding and assistance from Washington Sea Grant, the Washington Public Ports Association (WPPA), and the Northwest Marine Trade Association (NMTA), coastal management specialist Bob Goodwin participated in the organization and execution of a series of research activities and supervised a survey of 2,500 boating households in Washington and northern Oregon as well as a study of the area of residence of the users of representative public and private marinas in western Washington. Over several years, these extensive efforts produced a series of badly needed publications providing

previously unavailable information. Recent publications include:

The Moorage Industry in Washington's Coastal Zone

Survey of Marine Boat Launching and Moorage Facilities in Washington

Recreational Boating in Washington's Coastal Zone (forthcoming)

In planning for the expansion of Shilshole Marina, the Port of Seattle's planning staff had the problem of preparing a policy position for the port commissioners to establish new moorage fees. The staff asked the University's Coastal Resources Program for information concerning (1) pertinent characteristics of the boaters themselves, particularly their income, and (2) economic consequences of raising public moorage rates to the general public, to the boater, to the Port of Seattle, and to the private moorage industry. The analysis of the data generated by Washington Sea Grant in response to this request was reflected in a position paper that is now under consideration by the port commissioners.

For the final environmental impact statement on its Sequim Bay marina project, the Port of Port Angeles needed information on the likely origin of tenants

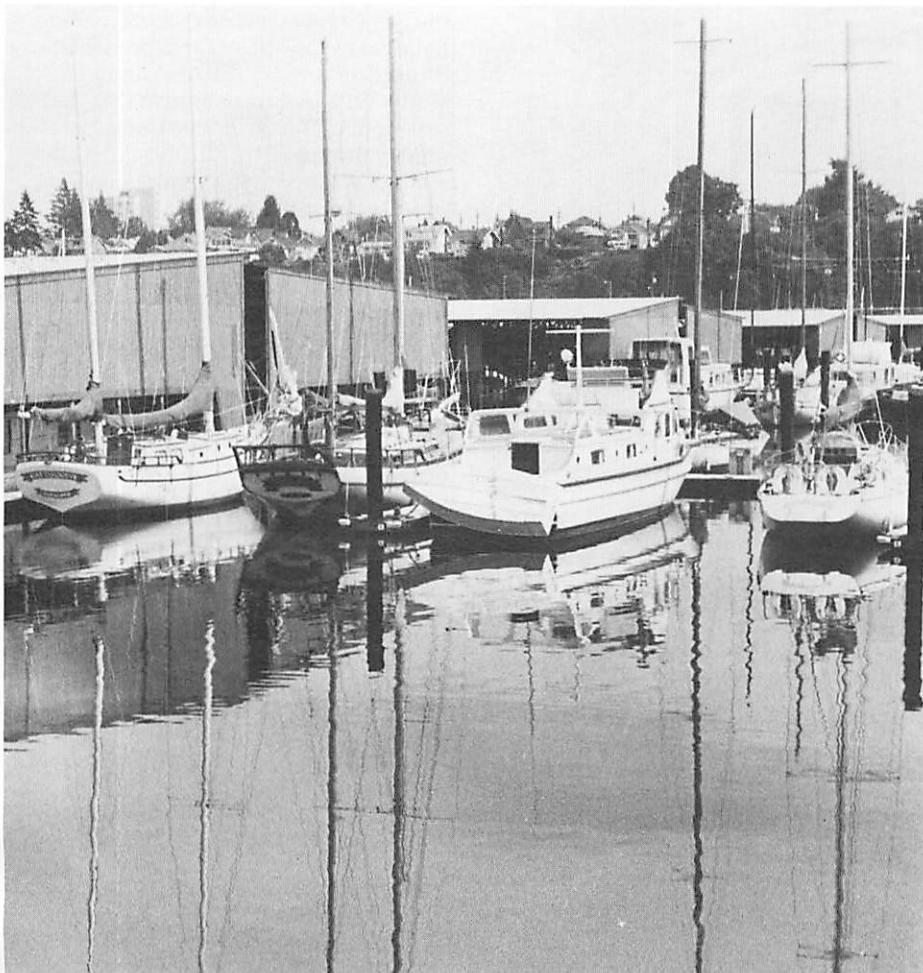
for the Sequim Bay facility. Bob Goodwin provided origin data for nearby public smallcraft harbor facilities, and the information has now been included in the final environmental impact statement.

Bob Goodwin also provided, at the request of the State Department of Revenue, an estimate of the total number of pleasure boats in the state of Washington. Washington does not have a boat registration law, and U.S. Coast Guard records are admittedly accurate to only plus or minus 40 percent. The information requested was available nowhere else. The Revenue Department needed the information to prepare a policy analysis of the fiscal implications of various boat registration and taxation measures now under consideration by the state legislature. The Revenue Department's findings were published in a report in October 1980.

Economic aspects of commercial fishing industry

Information on economic aspects of commercial fishing at the local or county level is not readily available, and therefore the industry does not always receive full consideration when local shoreline development decisions are being made. At the request of the commercial fishing industry in the Bellingham area, marine advisory agent Pete Granger conducted a locally oriented study with guidance from Sea Grant's marine economist, Jim Bray, and a great deal of cooperation from the commercial fishermen themselves. The resulting publication, *The Commercial Fishing Industry of Whatcom County: Some Economic Aspects*, was made available for the consideration of both commercial fishermen and local decision-makers.

The information has already proved useful. A major construction company has proposed building drilling rigs at Cherry Point, and a major consideration is the proposal's impact on the fisheries of that area. Information from the Sea Grant report was cited on both sides of the issue at the shoreline development hearing by the construction company in support of the permit and by the Lummi Indian Tribe and a local citizens' group in opposition.



Marine short courses

The marine advisory program in the North Sound is supported by Washington Sea Grant and administered by the Bellingham Vocational-Technical Institute (BVTI) in Bellingham. The Institute has a day-time enrollment of 1,000 full-time students and night school enrollment of 4,000. In 1976 marine agent Pete Granger and education coordinator Bob Suggs initiated a marine education program. In 1978, BVTI's marine education program offered 26 courses for a total of 635 hours of instruction; 513 students signed up, and 85 percent completed their courses. *Marine Short Courses—a Notebook*, by Pete Granger and Bob Suggs, was published in 1979 as a guide to planning and developing marine short courses so that marine extension agents in programs elsewhere, and other interested educators, might benefit from BVTI's experience.

The Southeast Alaska Region Resource Center oversees grants and curriculum development for that region. Since 1979, the Resource Center has worked toward developing vocational fisheries programs in the Southeast Alaska school district. The Center staff recently received a grant to develop full-day or short courses to that end, and the short course notebook came to their attention. In November 1980 they visited the authors in Bellingham where they were introduced to Paul Avery, the superintendent of schools in LaConner. A full-time day program in LaConner emphasizes keeping high school students in school until graduation by teaching academic fundamentals from a commercial fishing point-of-view. Approximately 35 percent of the students in the LaConner school system are Swinomish Indians.

In December the Southeast Alaska Resource Center invited instructors from LaConner schools and the Sea Grant authors to visit Juneau to meet with administrators from the school districts and towns of southeast Alaska. The Alaska people are now applying the Washington experience to their schools.

Smallboat trawling

Washington's commercial salmon fishermen are catching fewer and fewer fish, so Scott Harrington, the commercial fisherman agent, began seeking ways in which salmon fishermen might trawl for bottomfish with their small salmon-fishing boats. He has demonstrated that trawling can be done successfully with small boats, and he has tested the types of trawl gear that make this possible. The manuscript making this information generally available is now nearing completion.

Steve Drage, a salmon troller with no previous experience in trawling, helped Scott test these conversions and used his own 38-foot boat in the tests. On the basis of that experience and his success in small boat trawling, Drage was hired as the skipper of a new 66-foot trawler that is now operating off the Washington coast.



Applied marine economics

In January 1980, the Office of Applied Marine Economics was established as part of Washington Sea Grant. The office, an expansion of the responsibilities of the marine systems economist, is under the direction of the chief economist, Dr. James Bray. Projects typically are study team efforts that are advisory in nature and undertaken in conjunction with parallel efforts by trade associations and/or government agencies.

As a member of the "salmon team" for the Pacific Fishery Management Council, Bray provided economic analysis of the troll and recreational fisheries that assisted the Council in its efforts to maintain an equitable regulatory impact on these ocean fisheries. In turn, this helped to reduce the potential for confrontation between participants in these fisheries. In other efforts for the Council Bray defined the operational problems of providing economic input to the planning process and assisted in the development and utilization of a coast-wide economic data system.

In conjunction with efforts of the National Marine Fisheries Service (NMFS), the National Food Processors Association, the National Fisheries Institute, and various regional industry associations, the Sea Grant economist coordinated a national review of an Environmental Protection Agency (EPA) economic study. This review demonstrated that assessment of the economic impact of technology proposed by EPA for the treatment of waste water in the seafood processing industry could be significantly improved in both accuracy and completeness. This information has been transmitted to the EPA for consideration and is being utilized as the basis for a review of EPA's methodology by legislators in some of the impacted states. It also is being utilized by NMFS in their preparations for discussions with the EPA on the economic impact of wastewater regulations. If successful, these efforts will help to preserve employment, to mitigate increases in consumer prices, and to fully utilize the harvestable resources of the commercial seafood industry without compromising the nation's recreational opportunities or seafood production.

Publishing the Results

The research, education, and advisory activities supported by Washington Sea Grant do not achieve their maximum potential unless the results are communicated to audiences needing that information. These audiences include specialized segments of marine industries and businesses, financial institutions, government agencies, marine scientists and engineers, recreational interests, marine editors, as well as the general public. Through its communications program, Washington Sea Grant relays research results and information about program activities to these audiences through books, technical reports, advisory leaflets, lectures, and news releases and fact sheets for the media. These publications are distributed widely to targeted audiences usually by Sea Grant itself but at times through the University of Washington Press.

Of special note during the past year was publication of the book *Conservation and Management of Whales*, by K. Radway Allen, former chairman and currently a member of the scientific committee which advises the International Whaling Commission. The book resulted from a series of lectures that Dr. Allen gave at the University of Washington's College of Fisheries, as part of a Washington Sea Grant education project.

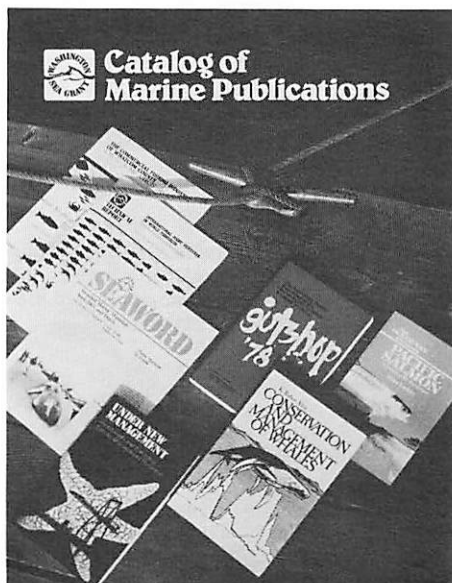
Because of widespread public interest in marine mammals, the communications staff approached the University Press about active marketing for this book and also about the possibility of selling foreign rights to it. As a result of queries sent to presses throughout the world, rights to a European edition were sold by Sea Grant to Butterworth's of London. In addition, approximately 750 pre-publication orders for the book were received from commercial booksellers throughout North America.

In 1979-80, the program assisted researchers and advisory personnel in the development, publication, and distribution of manuscripts dealing with the following topics:

- international joint ventures in world fisheries
- early life history of marine fish
- recent advances in the estimation of animal abundance

- coastal planning and conflict resolution in Grays Harbor, Washington
- the moorage industry in Washington's coastal zone
- hydroacoustic techniques for studying fish behavior around coastal power generating stations
- limited entry as a fishery management tool
- computation of barotropic tides in deep estuaries
- far-field matching for tidal calculations in near-shore regions
- the future of Pacific salmon
- commercial fish landings in Washington State ports, 1971-79
- economic aspects of the commercial fishing industry in Whatcom County
- a notebook of marine short courses
- some do's and don'ts for dealing with stranded marine mammals
- a logbook for commercial trollers
- maturation of salmonid broodstock

A catalog of Washington Sea Grant publications, produced in the fall of 1980 by the communications program, can be obtained by writing: Washington Sea Grant Communications, University of Washington, 3716 Brooklyn Avenue N.E., Seattle, WA 98105. Updates to the catalog are published bi-monthly and are also available from the communications office.



Journal articles

Research supported by Sea Grant usually is reported through articles in scientific and technical journals. During the 1979-80 biennium, the following articles by Washington Sea Grant investigators were published by various journals which are available in many university libraries and through interlibrary loan.

Ahern, Tim J., G. Graham Allan, Darrell G. Medcalf. 1980. New bromoperoxidases of marine origin partial purification characterization. *Biochimica et Biophysica Acta*, 616:329-339. WSG-TA 80-10.

Allan, G. Graham, J. R. Fox, G. D. Crosby, K. V. Sarkanen. 1977. Chitosan, a mediator for fibre-water interactions in paper. In: *Fibre-Water Interactions in Paper-Making*; Transactions of the Symposium held at Oxford, September 1977, pp. 765-794. WSG-TA 77-10.

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- Ebbesmeyer, Curtis C., Clifford A. Barnes. 1980. Control of a fjord basin's dynamics by tidal mixing in embracing sill zones. Estuarine & Coastal Marine Science, 11:311-30. WSG-TA 80-8.
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- Thorne, Richard E. 1980. Application of stationary hydroacoustic systems for studies of fish abundance and behavior. Oceans '80, pp. 381-385. WSG-TA 80-9.
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- Waterstrat, P., Kenneth Chew, K. Johnson, J. H. Beattie. 1980. Mussel culture: A West Coast perspective. In: Mussel Culture and Harvest: A North American Perspective, pp. 141-165. WSG-TA 80-3.

Theses

An important aspect of Sea Grant's educational effort is support for graduate research. During the 1979-80 biennium, the following theses and dissertations were completed, and they are available for interlibrary loan through university and public libraries.

Barker, Morris Wayne. 1979. Population and fishery dynamics of recreationally exploited marine bottomfish of northern Puget Sound. U of W, Fisheries. WSG-TH 79-3.

Blomberg, George V. 1979. An analysis of the concept of mitigation as used in decision making and estuarine management. U of W, Institute of Marine Affairs. WSG-TH 79-5.

Carlson, Thomas J. 1979. Near dorsal aspect hydroacoustic target properties of rainbow trout and an echo classifier based abundance estimation method. U of W, Fisheries. WSG-TH 79-4.

Gabaudan, Jacques. 1979. The effect of processing on protein ingredients for larval diets: biological evaluation. U of W, Food Science. WSG-TH 79-6.

Gaudet, David Michael. 1980. Hydroacoustic sampling of salmon escapements in trunk streams of Bristol Bay, Alaska. U of W, Fisheries. WSG-TH 80-5.

Humes, Douglas Houston. 1980. Socioeconomic aspects of an offshore Pacific herring fishery. U of W, Institute for Marine Studies. WSG-TH 80-1.

Johnson, Kurt W. 1979. The relationship between *Mytilus edulis* larvae in the plankton and settlement for Holmes Harbor, Washington. U of W, Fisheries. WSG-TH 79-1.

Knutson, Deborah Kay. 1980. Definition of the central urban waterfront reuse district. U of W, Urban Planning. WSG-TH 80-2.

McGuinness, Michael Matthew. 1980. Aquatic land management: central waterfront areas in Washington. U of W, Institute for Marine Studies. WSG-TH 80-3.

Nunnallee, Edmund Pierce. 1980. Application of an empirically scaled digital echo integrator for assessment of juvenile sockeye salmon (*Oncorhynchus nerka*, Walbaum) populations. U of W, Fisheries. WSG-TH 80-4.

Rawson, Christopher Bennett. 1980. Scales of the spatial patterns of the clams *Protothaca staminea* (Veneridae) and *Macoma nasuta* (Tellinidae) in Garrison Bay. U of W, Biomathematics. WSG-TH 80-6.

Waterstrat, Paul Richard. 1979. Prospects for the development of a mussel culture industry in Puget Sound. U of W, Fisheries. WSG-TH 79-2.

Accounting for the Dollars

	1979		1980	
	Sea Grant	Matching	Sea Grant	Matching
Research and Development				
Marine Studies Program	69,700	51,800	93,100	51,600
Coastal Resources Program	68,000	35,900	73,400	29,400
Research in Fisheries Mgmt.	115,000	64,400	120,500	65,800
Fisheries Assessment	110,300	72,100	88,300	61,000
Aquaculture	391,400	282,100	508,800	355,300
Marine Products Development	67,400	28,600	114,800	58,800
Ocean Engineering	145,800	76,800	164,200	69,700
Education and Training				
Education/University	83,200	86,000	33,000	52,700
Education/Other Institutions	93,400	73,300	64,000	54,500
Advisory Services				
Field Advisory Services	495,500	183,300	539,100	204,000
Program Communications	139,600		152,300	
Program Management				
Total	\$1,925,400	\$1,129,100	\$2,160,000	\$1,216,700

This summary is only approximate. The official financial report will be submitted to the Office of Sea Grant Programs, National Oceanic and Atmospheric Administration, in accordance with the federal grant requirements.

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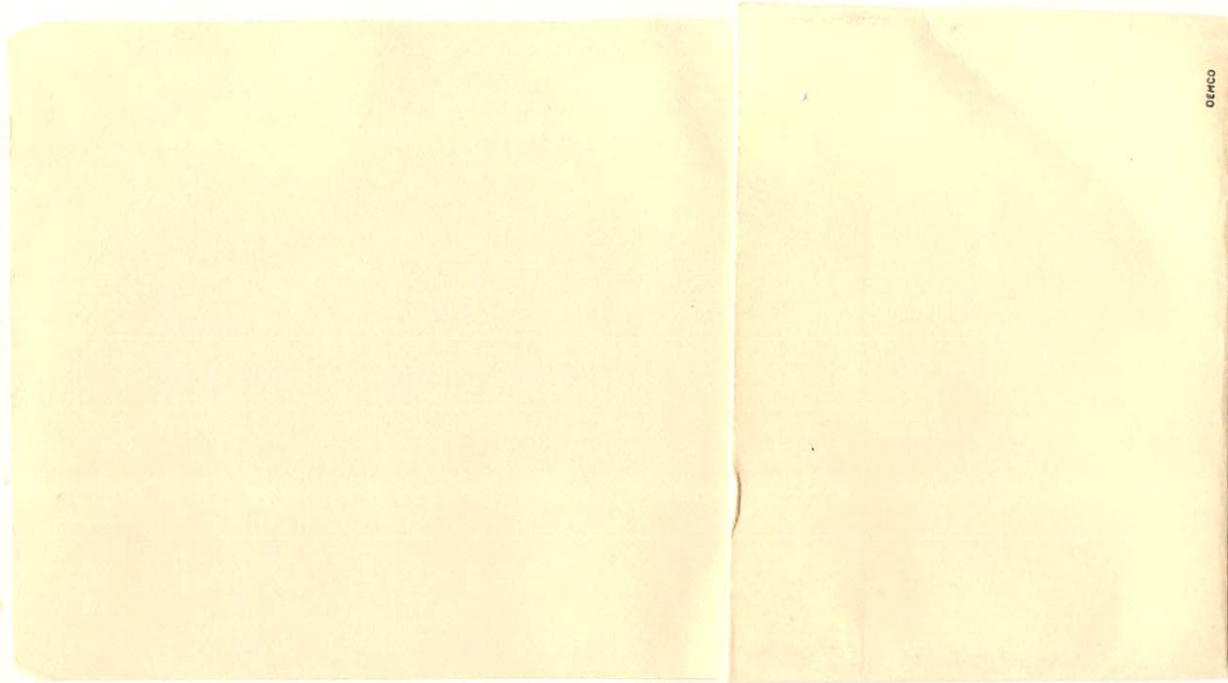
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