THE URI SEA GRANT NEWS

WHAT IS SEA GRANT?

The National Sea Grant Program is a partnership between government, universities, and industry that has existed since 1966 to increase scientific understanding of the oceans and coastal waters, improve management of marine resources, and promote development of marine products.

It consists of research, education, and advisory services carried on primarily in 29 colleges and educational institutions across the country. It is administered by the National Oceanic and Atmospheric Administration (NOAA) in the Department of Commerce, which provides two-thirds of its annual budget, close to $40 million. The remainder is provided by matching funds from state and local governments and private industry.

The Sea Grant concept was born at a time when government leaders began to realize that in the race to be first in space our country had badly neglected ocean science. Meanwhile, the number of problems and questions concerning the ocean and its exploitation was growing daily. Pollution, coastal conflicts, a tottering fishing industry were only the most obvious. Who could solve these problems? Who would answer the questions? They seemed too large and complex for any one group to tackle alone.

In 1963, an educator named Athelstan Spilhaus suggested publicly that government, universities, and industry work on the problems together. In his keynote address at the annual meeting of the American Fisheries Society, he asked, "Why do we not do what wise men had done for the better cultivation of the land a century ago? Why not have Sea Grant colleges?"

It was a persuasive idea. Land Grant colleges, established by the Morrill Act of 1862, had not only revolutionized higher education in the United States by creating a unique university-based system that

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FISHERIES ENTER THE SPACE AGE WITH NEW TECHNOLOGY

URI oceanographer Dr. Peter Cornillon, working with the National Marine Fisheries Service's Atlantic Environmental Group, is making a major new technology useful to recreational and commercial fishermen.

Information received from a polar-orbiting satellite by the National Environmental Satellite Service in Washington, D.C., is relayed to URI and NMFS personnel in Narragansett, R.I. There, computer enhancement is used to convert the thermal infrared imagery into high-resolution regional sea-surface temperature charts. The charts show water masses of uniform temperature and their associated oceanic fronts, an important clue to the presence of some fish. Sea Grant is supporting a trial project to furnish fishermen with copies of the charts within 24 to 48 hours of a satellite pass.

For several years, NOAA has been using its remote-sensing capability to produce large-scale Oceanographic Analysis Charts of the Gulf Stream

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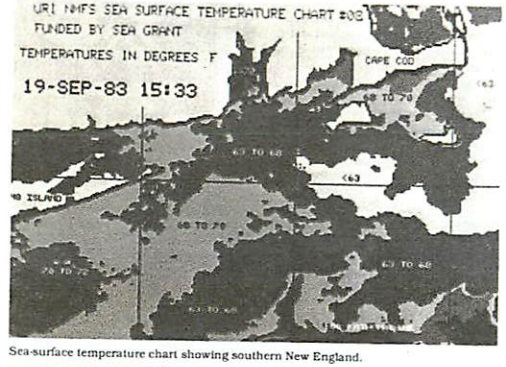

Sea-surface temperature chart showing southern New England.

15 YEARS OF SEA GRANT AT URI

The University of Rhode Island was named one of the first four Sea Grant colleges in 1970—a distinction based on "sustained excellence along a broad front of marine work." The three other original Sea Grant colleges are Texas A & M, Oregon State University, and the University of Washington.

However, URI's involvement with Sea Grant began much earlier. At the time the concept was beginning to take shape, the University was entering a new phase of its development. A growing number of the faculty and students had become interested in marine-related studies, and President Francis H. Horn strongly supported the growth of marine programs. In 1961, the Graduate School of Oceanography was established, building on the foundation of the earlier Marine Laboratory and Marine Resources Program. Its dean, John A. Knauss, recognized the potential of Sea Grant and found a strong legislative ally in Rhode Island Senator Claiborne Pell.

In 1965, seeing nationwide interest growing in the Sea Grant college idea, URI sponsored the first national Sea Grant conference. The following year, when the Pell-Rogers Sea Grant Program and College Act was introduced in Congress, the first day of Senate hearings was held on the URI campus.

Having provided much of the impetus for the creation of Sea Grant, URI set out to broaden its curriculum to meet the mandate set forth by Congress. Marine research projects developed in formerly "landlocked" disciplines like geography, engineering, and food and resource economics. The Department of Fisheries and Marine Technology was established in 1967, as well as the Department of Ocean Engineering and the Master of Marine Affairs program. During the 1970s, as demand for more specialized training grew, new elements, such as the Ph.D. program in marine resource economics, were added to the curriculum.

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DESIGNING FISH GEAR FOR HIGH YIELDS

Of the many factors that spell success or failure for a fishing fleet, one of the most significant is the type of gear used. The size of the catch, the species caught, and the ease of operation of the gear are all influenced by the type of nets and trawls. Since 1969, the URI Sea Grant Program has been working with southern New England fishermen, introducing new kinds of gear and new ways to use the more productive of the European fishing methods. The result has been a significant increase in earnings for the participating vessels—a return considerably greater than the Sea Grant money spent on the project.

"We started nearly 15 years ago by importing the wing trawl from Europe," Walter Gray, director of the Division of Marine Resources, said. "Our goal was to assist fishermen in harvesting the higher swimming fish in addition to the bottom-dwelling species, which were their usual catch. A net designed by Bert Hillier, of the Department of Fisheries and Marine Technology, was effective and was then adapted for local use as the URI 340, a high-opening bottom trawl. This 'high-fly' net was particularly successful with fluke, whiting, scup, and butterfish—all of them less-exploited species. The net was used in a test in which Russian and American vessels participated and it accounted for the Americans catching more fish than the Russians. Now the net—or copies of it—is being used from Maine to North Carolina. Unlike commercial enterprises, Sea Grant is happiest when its ideas are pirated."

Traditional vessels are now exploring new gear and methods.

The Scottish seine net for small, low-powered boats was imported and demonstrated by Advisory Service personnel and Scottish fishermen. This method is now being used by individual fishermen in Maine and Massachusetts.

A next step was to help New England fishermen compete with foreigners in catching adult herring in the offshore fishery. The goal was to extend herring fishing into the late winter and early spring, when the fish leave the inshore bottom areas and move out into midwater. For this purpose, midwater trawls from northern Europe were introduced. Along with the nets came a specialist from Ireland, Captain James McLeod. Working with two skippers in Galilee, R.I., he introduced to New England fishermen the new concept of two fishing vessels towing one net. Says Dr. Niels Rorholm, first coordinator of the URI Sea Grant Program, "Each skipper had his own way of doing things, and the only reason the trial succeeded was because on a day in the middle of the trials the weather was terrible, and this gave the two captains a chance to work out their very real differences in operation before they set out.

"Even before the foreign fishing limit was changed, the midwater pair trawls had proven their value in increased income. By 1980, 18 vessels from Maine to Rhode Island were using the gear, and two were using the even newer single-boat midwater trawling methods, which we are just beginning to refine," Rorholm reported.

Based on 35 days of winter fishing and average costs, the 18 boats increased their revenue on an average of $27,300 per vessel and the costs averaged $18,360 per vessel. These included $5,000 per boat for the trawl, for its installation and conversion, and for net repair costs.

RHODE ISLAND BOATING A $102,000,000 BUSINESS

Ocean State boating businesses are developing a substantial trade in products and services that cross the state line.

In fact, balance-of-trade problems are foreign to this state industry, which, in 1981, with a total of $102 million in sales, "exported" out of state over $73 million in boats and boating products and services. This contrasts with imports by the industry of $39 million in out-of-state products and services. The net amount of $34.5 million, or 34 percent of industry total sales, is thus new money entering the state's economy from outside—money available to be respent on labor, rents, and other expenses.

These are among the findings of two URI economists who studied the impact of boating at the request of the Rhode Island Marine Trades Association. The study, by Dr. Niels Rorholm and David Burrage, was funded by Sea Grant; a report of their conclusions, *The Economic Impact of the Rhode Island Boating Industry*, is available for $2 by ordering P 942 from the URI Marine Advisory Service.

The economic activity or multiplier generated in Rhode Island by the boating industry, comprised of boatbuilders, marinas and boatyards, boating products and boat sales, is estimated at $2.20 per $1 of sales. Of that $2.20, 80¢ is personal income. This means that in 1981 over $225 million of economic activity of which $82 million was personal income was accounted for by boating.

On a value-added basis, the amount contributed to the state's $9 billion economy from the sum of wages, salaries, commissions, interest, rent and property taxes from boating was pegged at $35 million. This makes it about equal to contributions from the fish-harvesting sector in Rhode Island, another important marine business.

Rorholm hopes the economic information he has compiled will be used by Rhode Island economic developers in combination with other factors. Examination of the value-added figures for each type of boating firm can give them some clues as to which to help establish or expand. For example, marinas and boatyards, which have a 32.7% of sales value added, would appear to be businesses to encourage, although coastal locations are scarce.

BUREAU INVESTIGATES VESSEL STABILITY

The all-too-frequent and tragic loss of life and property in the New England fishing industry prompted the establishment in 1981 of the Vessel Safety and Engineering Advisory Bureau at URI. It is supported by Sea Grant.

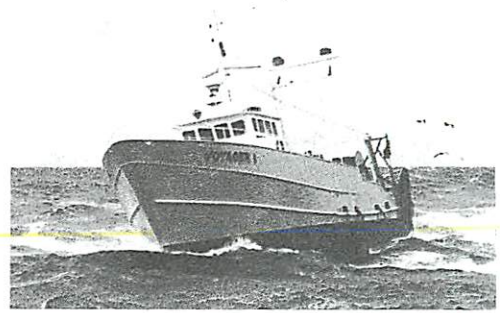
The bureau addresses four problem areas—vessel stability, vessel seakindliness, vessel efficiency, and education for fishermen in vessel safety—which were identified during a preliminary engineering analysis of the Point Judith fleet.

Calculations of stability take into account changes in the center of gravity caused by factors such as the shifting of fish in cargo holds, the lifting of heavy nets by booms and A-frames, and the icing of topsides.

Research on vessel seakindliness attempts to define the range of weather conditions that make fishing suitable, unprofitable, or impossible for a given vessel. The goal is to devise simple graphs or charts, based on expected sea conditions and vessel loading, which will help fishing captains decide whether or not to go to sea and when to cease fishing operations.

The bureau investigates, on a boat-by-boat basis, possible improvements in a vessel's propulsive efficiency and may recommend a propeller which will better match the engine type and boat shape. But even with a vessel that satisfies all stability requirements, safe operation depends to a large extent on proper training of the crew. Consequently, the bureau conducts an annual training seminar for New England fishermen.

The advice currently being offered by the bureau is based on theoretical calculations, but installation of a wave maker in the URI tow tank will make possible tests on specific models of fishing vessels.



Studies by URI ocean engineers could increase safety of vessels in heavy weather.

Fishing vessel safety activities at URI are being coordinated with those at the University of Washington in Seattle and at the Florida Institute of Technology.

ENZYMATIC PROCESS PRESERVES FRESH FISH

As fresh fish gains popularity with American consumers, Sea Grant researchers have been increasing their efforts to find ways of slowing down spoilage so that non-frozen fish can be marketed far from the coast.

URI researchers Dr. Arthur G. Rand and Dr. Stanley M. Barnett report that enzymatic treatment coupled with hypobaric storage can extend the shelf life of fresh fish by up to 90 percent.

The enzyme glucose oxidase proved effective as a dip for whole or filleted fish, as an ice mixture in which fish are held, and as an algin blanket surrounding fish. All three systems were found to extend shelf life of fish by 40 to 50 percent in ordinary refrigerated storage. The study found that the enzyme treatment changed the pattern of deterioration in fish, slowing down the intrusion of bacteria.

Another facet of the work by the URI team combined the enzymatic system with hypobaric storage, which places the fish in a flowing stream of air nearly saturated with water, at a reduced pressure and low, controlled temperature. Tests with a full-scale chamber loaned by Grumman Allied Industries, Inc., showed that the combination of the two was synergistic. The shelf life of fish was extended by a surprising 30 to 35 days, or about 90 percent longer than with ordinary refrigerated storage.

Graduate students arrange fish before placing them in hypobaric storage.

Several fish processors plan to try out the enzyme system, which will cost them a few cents a pound to use. However, because it offsets moisture loss, and hence weight loss in stored fish, they expect the cost will be balanced by having more pounds of fish to sell. A producer of smoked fish is also interested in determining whether the process will solve his marketing problems.

Use of this process should benefit fishermen and processors alike. Fishermen could add the enzyme to ice and achieve longer shelf time for their catch without having to change onboard handling procedures. A plant using the combined enzyme and hypobaric system would not be forced to freeze all surpluses of fresh fish but could store the fish until market conditions were favorable for selling it fresh.

Senator Pell welcomes Dale Brown, URI graduate student, who spent a year in Washington, D.C., as a Sea Grant intern. Annually, 10 to 15 interns are sponsored by Sea Grant, chosen from a field of graduate student candidates nominated by Sea Grant programs nationwide. They work directly with the congressional committees and federal agencies responsible for steering U.S. marine policy. Since the intern program began in 1979, URI students have been among those selected every year. At the end of her internship, Ms. Brown secured a permanent position in the Office of Technology Assessment.

NEW USES FOUND FOR SEAFOOD-PROCESSING WASTES

In separate studies, Sea Grant researchers have linked activities such as oil well drilling, the production of cheese, and the culturing of rainbow trout to an underutilized and increasingly abundant resource—seafood-processing wastes.

From chitin—the main component in the rigid outer "shell" of shrimp, crayfish, and lobster—URI food scientist Dr. Kenneth R. Stauffer has developed a way to produce xanthan gum, a commercially important gum used in oil well drilling and in some foods as a thickener. Stauffer uses a tiny microbe rather than a chemical process to transform the chitin. The bacterium *Xanthamonas* uses a form of chitin as a food source, then produces the gum as a waste product.

Working with URI chemical engineer and seafood scientist Dr. Stanley M. Barnett, Stauffer has harnessed this bacterium for gum production, and grows the organism in quantity in a laboratory. The University is applying for a patent on the process.

Xanthan is a synthetic replacement for tragacanth, a natural gum produced by a shrub that grows in Iran. The standard way of producing xanthan commercially employs the same microorganism that Stauffer is using, but cornstarch, not chitin, is used as the food or substrate for the bacterium. By replacing cornstarch with less expensive chitin, Stauffer is providing a way to lower the cost of xanthan production.

Dr. Barnett with foam made from clam-processing wastes.

Another URI seafood technologist, Dr. Arthur G. Rand, has had promising results in the use of digestive enzymes from fish stomachs for the manufacture of cheese.

Milk-coagulating enzymes have traditionally been obtained from the waste stomach tissue of calves, cows, and pigs. However, these sources are insufficient to meet the demand for an expanding cheese-manufacturing industry. Rand's work has examined the potential for obtaining these enzymes from the stomachs of tuna, mackerel, dogfish, whiting, and flounder.

Working under Rand, research assistant Vicki McCabe extracts enzymes from the stomachs of flounder and whiting. The extraction process is crucial, since any tissue left with the enzyme can cause the cheese to have a fishy taste. McCabe also intends to characterize the "fish rennet" in comparison with the calf product to establish its suitability for cheese manufacture.

Responding to the clam-processing industry's need for a productive way to utilize clam waste—a valuable protein resource—a URI graduate student has investigated its use as a replacement for fish meal in the diet of cultured rainbow trout. Because of the diminishing supply and increasing cost of fish meal there is a strong economic incentive to find alternative protein sources.

Working with scientists in the Department of Food Science and Technology, Nutrition and Dietetics and a representative of Blount Seafood Corporation, the student, Cynthia Goodrich, formulated a diet of clam waste which was fed to rainbow trout for eight weeks, along with two comparison diets, to determine effect on growth, food conversion, carcass composition, and whole body fatty-acid content. There were no mortalities, and the clam waste diet was found to support maximum growth and food conversion.

COMPUTER MODELING FORECASTS OCEAN PROCESSES

Once upon a time predicting the future was a feat performed by fortunetellers and soothsayers. Now computers are doing it.

Since 1969 URI ocean engineers funded by Sea Grant have been learning to use computer modeling to simulate and predict patterns of water circulation and pollutant transport in ponds, bays, and open-ocean areas. The models—combinations of equations to represent reality—can be used to compute tidal heights, currents, temperature, salinity, and water quality parameters. With their predictive ability, these simulations can solve important problems such as selection of oil-drilling sites that don't interfere with whale migrations.

URI's efforts in modeling have been guided over the years by Dr. Frank White, an ocean engineer whose first love has always been the physics of water motion. One of his early students, Dr. Malcolm Spaulding, now a professor in the same department, is, as White says, "our real expert." Professors White and Spaulding have teamed up to provide Rhode Island and New England with computer models to answer pressing questions on the marine environment.

White first began work on modeling in 1969, when he and student Paul Grimsrud provided a picture of circulation patterns in Point Judith Harbor using a model developed by the Rand Corporation. The model, verified through a series of experiments, plainly demonstrated the flow of tides into one breachway opening and out the other during slack conditions.

In 1972, in a project spearheaded by student Kurt Hess, a model of Narragansett Bay was designed—probably the best-known hydrodynamic simulation developed at URI. It provided information on tidal flows and flushing times. It too was verified through an experimental program, called Bay Watch. The model was used to compute hurricane surges and flooding in the Bay, flushing times, and paths of drifting particles.

In 1973 the ocean engineers developed for the first time a model that depicted the movement of an oil spill—a precursor of the state's contingency plan for spill cleanups. A later contract with the U.S. Department of Energy gave the engineers an opportunity to refine that model and its ability to determine oil-spill fates. It was designed in a modular fashion so that as new information—for example, a better understanding of evaporation—became available, it could be incorporated into the simulation.

In the late seventies and early eighties, efforts were focused on integrating models of different processes—the hydrodynamic one, for instance, with fish population models—into systems addressing important environmental issues.

Starting from this hydrodynamic model, Drs. James Kremer and Scott Nixon of the URI Graduate School of Oceanography developed an ecological system of the Bay which synthesized much of the data available about phytoplankton, zooplankton, and nutrients and could depict major variations in these components. The model has been used to predict the effects of increases or decreases in sewage, among other applications.

As an outgrowth of his work, Spaulding developed a complex three-dimensional technique, and formed a consulting firm, Applied Science Associates, in Wakefield, R.I., with a staff of engineers and programmers who tackle a variety of complicated marine problems.

More and more, the ocean engineers at URI are finding it necessary to assemble individual models into a system, particularly to address problems such as determining the impacts of oil spills on commercial fisheries. There, three independent models are combined—oil-spill fates, hydrodynamic patterns, and fishery impacts. Spaulding's experience in this project led to a contract with the State Department to provide information on the fate of oil spills within the disputed U.S.-Canadian territory. In another project, a series of models was assembled for the Environmental Agency for their use in designating ocean dumpsites.

A NEW SEAFOOD PRODUCT ON THE HORIZON

If it looks like crabmeat, tastes like crabmeat, and retails for as little as $5 a pound instead of up to $20, can it become a bestseller in U.S. supermarkets, even though "it" may contain little or none of that crustacean's flesh?

Seafood marketers believe it can, and as a result American imports of a Japanese product called surimi rose to a surprising 29 million pounds in 1983 from a mere 2 million pounds in 1979.

The Japanese developed surimi, or fish gel, over a century ago as the raw material for a variety of "restructured" fish products that are to them what hamburgers are to Americans. Today, thanks to freezing, the $60 million surimi industry accounts for half the seafood eaten in Japan.

Surimi begins as the mechanically deboned flesh of various species of fish. After a series of processing steps, including repeated washing, it emerges as an odorless frozen white block that can be stored for up to seven months without loss of quality before it is transformed, again through the magic of food chemistry, into a potentially limitless variety of food items. In Japan, the best-selling forms of surimi have traditionally been fish cakes called kamaboko, which are marketed in a variety of forms, textures, flavors, and even colors.

Kamaboko began to make its way in small quantities to our shores in the mid-seventies, mostly to supply Oriental markets. Its flavor and somewhat rubbery texture did not capture American tastes much more than domestic concoctions like "beef-fish," a mixture of minced fish and beef that U.S. food scientists tried unsuccessfully to promote around the same time.

A number of circumstances have conspired since then to make today's market appear far more promising. Americans have become more adventurous eaters over the last decade, the harvesting and processing capabilities of fishing fleets have grown, and seafood chemistry, primarily in Japan, has become increasingly sophisticated. The look-alike taste-alike protein double of crabmeat, called kanibo, is a recent example. (Shrimp and scallop products have also been developed in the past few years.) The fact that domestic landings of Alaska king crab fell from 185 million pounds in 1980 to 39 million pounds in 1982, with last year's landings expected to total only half that figure, was also significant. The stage appears to be set for a new food scenario.

Seeing the imported crabmeat substitute doing so well in supermarkets and restaurants, usually in the form of "crab sticks" or as the basis for seafood salads, domestic processors are becoming more than a little interested in trying to capture a share of the market.

There is also interest in the U.S. fishing industry. Most of the surimi manufactured in Japan today is made from Alaska pollock. This white-fleshed member of the cod family constitutes the largest single biomass of any exploited species of finfish in the world, with a maximum sustainable yield of up to 3 billion pounds a year. Two-thirds of the annual harvest goes to Japan. There is little market for it as a food fish in this country, at least in its natural state. Like red hake and Gulf croaker, other regionally abundant low-priced species, it does not appeal to American palates.

But if the market for the crab analog, kanibo, and other high-priced shellfish substitutes continues to grow, as industry observers believe it will, and if American processors can become as adept as the Japanese at fabricating seafood products, these currently undervalued species could become newly profitable for U.S. fishermen.

However, for this country to capitalize on its abundance of raw material and stem the tide of imported surimi products, it must establish dependable, consistent, and cost-effective production here, not only of the basic surimi gel but of the foods into which it can be transformed.

Several aspects of this challenge are being addressed at the University of Rhode Island, chiefly by food scientist Dr. Chong Lee, who says, "I am trying to bridge the gap between Japan and the United States by finding the best ways to adapt their technology for our use."

Lee has a solid background for the task. He has been working for the past eight years on the technology of protein gels and has believed for almost as long that surimi would someday find its niche here.

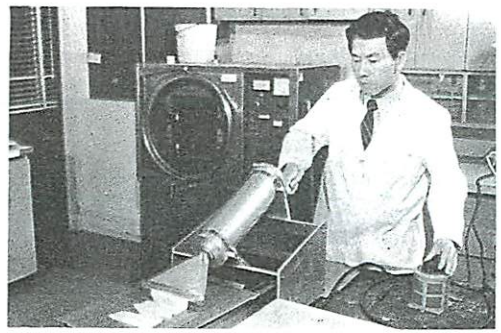
Last year, with support from Sea Grant, he developed ways to improve both the texture and the freezing qualities of surimi gel by the addition of certain starches combined with egg white in its formulation. Freeze-thaw stability, Lee explains, is essential to the profitable production of surimi, since only very fresh fish flesh makes a superior gel. Surimi did not begin its climb to becoming a multimillion-dollar industry in Japan until 1960, when freezing became a standard component of its processing. Today, about half the supply that feeds some 3,000 kamaboko factories comes from land-based plants; the other half is produced on specially equipped vessels fishing as far away as the Bering Sea.

Some of Lee's current Sea Grant research is concerned with producing a basic surimi gel that is particularly suitable for fabrication into shellfish products, those being the likeliest candidates for stardom in the American market. Working with two locally abundant species of fish, Lee and his assistants are changing the molecular structure and thus the texture of minced fish through a process called freeze contraction so that it will more closely resemble the texture of shellfish in the mouth. The amount of real shellfish in imported kanibo varies from none to up to 27 percent, depending on brand, and the amount of it in domestic products will be significant in pricing and profitability.

Last year, the National Marine Fisheries Service designated $1.5 million in Saltonstall-Kennedy funds to be spent on the U.S. surimi industry. With the share it received, the New England Fisheries Development Foundation has undertaken several projects. One that involves URI centers on determining whether red hake, a locally abundant, underutilized fish, is economically a good choice for making surimi. This summer, the University's Department of Food Science and Nutrition will start comparison tests on batches of the fish taken by local fishing boats to determine how various handling conditions on board affect the quality of the surimi.

"We are trying to determine whether red hake can be handled on board the vessel in a way to make it competitive with imported surimi and still result in a good product," John Sackton of the New England Fisheries Development Foundation explains.

Even if surimi never becomes the diet staple in the United States that it is in Japan, Lee points out that the technology being developed here will make possible better use of underutilized species and fish waste and produce new products that offer not only a high profit margin but excellent nutritional values.



Dr. Lee with apparatus extruding surimi gel.

BRINGING MARINE SCIENCE TO THE SCHOOLROOM

Sea Grant has given an enormous boost to the study of marine science in the nation's schools. Over the past 17 years, thousands of children and young people from kindergarten through twelfth grade have used curriculum materials prepared by Sea Grant educators for science teachers.

About 70 percent of the earth is covered with water, and the impact of the oceans on climate, economics, politics, and social situations is significant.

The curriculum material made available through the Sea Grant education program has dealt not only with the biology of the seas, but with arts, history, and literature in their relation to the marine world.

This teaching material has been catalogued in microfiche by the University of Delaware, and the Marine Education Materials System is now available in 21 Sea Grant centers across the country. At URI the Marine Awareness Center constantly updates its 125-page listing of current popular magazine articles on marine subjects. This compendium, known as the Sawyer Marine Resources Collection, is available to teachers to be used in conjunction with the curriculum materials. Together they provide URI with the world's largest source of marine literature for school-age students.

Under a University of Hawaii plan, curriculum material may soon be transmitted over telephone cables to other parts of the nation. Another plan is to make the seven master diskettes on which the curriculums are recorded available for duplication by schools that have their own computers.

Now marine education faces a new challenge. The National Commission on Excellence in Education recently published its report, *A Nation of Risk*, calling for a new dedication to effective teaching of mathematics and science in America's schools. Marine studies can and should contribute to this goal as a useful tool in developing science literacy.

This is an exciting time in the marine sciences, with the introduction of new concepts relating to the structure of earth, the circulation of the oceans, the resources of the deep seas, and the biology, physics, and chemistry of the mid-ocean ridges.

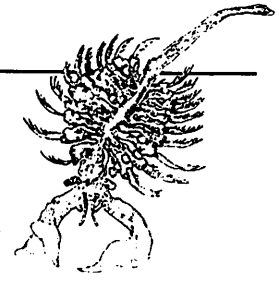
In teaching it is no longer sufficient to provide isolated facts. The far-reaching economic, political, and social implications of developments in marine science make it possible to give marine studies the interdisciplinary, thought-provoking scope that is essential in today's classrooms. Indeed, three major conferences this summer and fall developed recommendations on how to use marine education to help strengthen the nation's science programs.

The new type of marine studies curriculum that is emerging already takes this interdisciplinary factor into account. For instance, students learning about the oyster become involved in the economics of oyster harvesting and farming and the oyster industry as a whole. The Marine Awareness Center, in an effort to break away from the traditional separation of scientific disciplines, anticipates putting more emphasis on the legal aspects of ocean management, ocean transportation, plate tectonics, ocean dumping, and ocean climatology, and their implications for the world today and in the future.

The Center is also attempting to strengthen the field experience of classroom teachers of marine science. Teachers in Rhode Island and other New England states who have taken various classroom courses for certification had a chance this summer to spend a week on marine studies aboard the *Bill of Rights*, a Newport-based sailing vessel. This sort of field experience is happening in other states as well.

There is no question the raw material is available to make marine studies an exciting part of the new goal of a stronger background in science for all our young people. The modified curriculums should soon enable teachers, and through them their students, to better understand the oceans and how they affect our lives.

BRINE SHRIMP RESEARCH



For over 30 years, the durable brine shrimp, *Artemia*, has served as a primary food source for aquaculture stocks and lab-reared fish. To gain a better understanding of this tiny creature, scientists from URI, from the Environmental Protection Agency, and from Wales, Belgium, Spain, and the Philippines have collaborated on a multidisciplinary brine shrimp research project. The group has been investigating various aspects—the ecology, morphology, nutritional qualities, mass culture techniques, and genetic characteristics—of five brine shrimp strains.

According to Dr. Kenneth L. Simpson, of URI's Department of Food Science and Technology, Nutrition and Dietetics, various *Artemia* strains differ in chemical and biochemical composition and, thus, in nutritional quality. "We have found that different geographical locations and varying water quality can dramatically affect the quality of a particular shrimp strain," explains Simpson.

Working with Sea Grant funds and assisted by URI biochemist Dr. Charles E. Olney, Simpson fed each of the five strains to four species of fish and crabs over a two-year period. Two strains, which are sold commercially, proved to be foods that gave poor growth and survival. An analysis of the results suggests that the causes lie in the food's poor fatty acid profiles combined with high levels of dieldrin and chlordane pollution. The presence of DDT as a primary cause of poor nutritional quality was ruled out.

The URI researchers have developed the capability to identify brine shrimp populations of unknown or uncertain origin through isoelectric focusing—a protein "fingerprinting" technique.

Already the research has benefited one brine shrimp producer. Cysts from a San Francisco company that were provided to Simpson for his studies produced poor growth and survival in the fishes to which they were fed. Investigation showed that the cysts had come from nearby San Pablo Bay, an area subject to heavy commercial and agricultural runoff. "The company immediately took these shrimp off the market. If they had not known what the problem was and corrected it, they might have permanently lost their good reputation," Simpson said.

Simpson would like to see companies add these quality control measures to their one current criterion, hatchability of the cysts. A brine shrimp strain that has proved to produce good survival and growth is being maintained as a reference stock at the Artemia Reference Center at the State University of Belgium in Ghent. It is available to any researchers who want to know whether the brine shrimp they have been using are resulting in growth and survival problems in aquacultural or aquarium systems.

The National Sea Grant Depository

The National Sea Grant Depository is a unique collection housing all publications generated by the National Sea Grant Program. The Depository, located at URI's Pell Marine Science Library, provides access to journal reprints, technical reports, newsletters, marine advisory reports, directories, and conference proceedings to anyone in need of such information. The publications cover a wide variety of subjects. Current holdings amount to 10,256 individual titles. The Depository can also identify any current Sea Grant research project. For further information, contact:

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A PLAN TO PRESERVE RHODE ISLAND'S SALT PONDS

A chain of shallow salt ponds stretches for miles along the southern coast of Rhode Island, narrowly separated from the sea by inlet-pierced barrier beaches. This salt pond, or coastal lagoon, region is not only one of the most beautiful in the state but historically one of the most productive. From colonial times through much of the last century, the bounty of fish and oysters in the brackish ponds and the variety of game and vegetation that surrounded them were as important to the lives of local families as they had been to successions of Indian civilizations.

As travel became easier, during the nineteenth century, Rhode Islanders and others began to see the ponds and beaches in a new light—as lovely places to play in summer and, soon, as lovely places to live. Summer cottages and boarding houses sprang up alongside farms.

But the truly dramatic shifts in land use did not begin until after World War II, when money suddenly became available for highways and cars and homes. Where there had been 775 structures around six of the coastal lagoons in 1950, there were 5,570 in 1980, a sevenfold increase in 30 years.

Under current zoning regulations of the three towns with jurisdiction over the area, another 11,000 homes and seven times more people could conceivably locate on this ribbon of land before "saturation development" is reached. This is a disturbing prospect to people who care about the ponds.

Over the years, residents in the area became increasingly worried by the changes they saw taking place in the ponds, though unlikely to agree as to the causes. Each interest group among the citizenry and management authorities involved had its own perspective. What everyone failed to realize was that all the problems were related and stemmed from people pressure.

However, no one would dispute that many fewer varieties of fish now lived in the ponds, that fishing, particularly for shellfish, was nowhere near as good as oldtimers recalled, and that the oyster population, once wildly abundant, was almost gone.

Sand flats were building up in those ponds that were not economically important enough to dredge regularly, making it difficult, even dangerous at times, for boaters to reach the permanent breachways that had been constructed in the 1950s.

Polluted wells, rank summer blooms of algae in the ponds, and closures of some parts of them to fishing, although not seen as being related, all pointed to the declining quality of both pond water and the groundwater that supplies the thousands of wells in the region.

Coastal lagoons are particularly vulnerable to the stresses human activities impose, thanks to their small size and limited exchange with offshore waters. Caught between the land and the sea and dependent on both, they are very sensitive to what happens on the acreage surrounding them and the sea beyond them. And in the past 30 years much has been happening.

In 1977, concerned local officials and residents asked the state's Coastal Resources Management Council for help in understanding and, if possible, remedying the conditions that threatened the ponds. By then, town governments recognized that piecemeal solutions could not dispose of problems arising in part from piecemeal decisions over the years. Through its research arm, the Coastal Resources Center at the University of Rhode Island, the Council has access to a broad range of expertise.

Because so many of the things that were happening were interdependent, it was necessary to understand the area's history, marine biology, botany, geology, and hydrodynamics in order to arrive at a plan for future management that didn't create new problems in the effort to solve old ones.

When Sea Grant and the state's Coastal Zone Management Program agreed to supply the bulk of the funding, such an ambitious interdisciplinary project became possible. In 1978, scientists in seven fields, their graduate students, and a dedicated group of volunteer citizen monitors set to work to find the reasons for the processes taking place in the ponds and to provide information that could be the basis for managing the area as an ecosystem.

By 1983, it was possible to say for the first time what had been happening to the ponds and why.

All the studies showed that the building of permanent breachways and the periodic dredging these necessitate had done more to disrupt the ecology of the ponds than any single other human action—although the intent had been just the opposite. Permanent access to the sea, while a convenience for boaters, has had a profound effect on the fish and shellfish stocks it was supposed to enhance. Changes in water circulation and salinity have discouraged spawning of many important species, and encouraged the invasion of oyster predators. The decline in the fish and shellfish populations was shown to be just as serious as oldtimers claimed and attributable to a combination of altered habitat and overfishing.

The breachways are also responsible for another unforeseen and unfortunate change in the ponds. They allow sand to be drained off the beaches on the ocean side and deposited in the ponds, causing the sandbars that impede boaters.

The bacterially contaminated fresh water going into the ponds and into some residential wells, principally through surface runoff, is believed to come from homes with failing septic systems, from discharges of improperly treated sewage, and from the excrement of domestic animals.

Nutrient enrichment of the ponds, choking some of them with algae in summer, was also traced to residential development. Nitrogen-laden domestic wastes and the fertilizers used to beautify lawns leach into the groundwater and thence into drinking water and the ponds.

Obviously, the region has serious problems, basically the same ones that have beset other heavily settled communities on coastal lagoons along the Atlantic coast. But, with the information now available, there is still time to correct many of them, provided residents, town governments, and the numerous regulatory agencies that have a say in their management can agree on what should be done.

After studying all the research, the Coastal Resources Center has put together a special area management plan for the Coastal Resources Council, the agency with a specific mandate to manage ecosystems.

According to the SAM Plan, it is possible to: maintain the area's scenic quality; prevent further bacterial water pollution; keep drinking water potable; preserve and enhance the remaining fish and shellfish; and restore, at least partially, the beaches, dunes, and wildlife habitats. The report also strongly advises that thought be given to hurricane preparedness.

The URI study has left a clear message: If the residents of one of the state's loveliest areas want to keep what they have, they will need to show a rare degree of responsibility as dwellers on the land and a rare amount of support for the efforts of town governments to ease the pressures on it. By the same token, town government and state agencies must agree on management objectives and cooperate with one another in their role as guardians of the ecosystem.

A special area management plan gives hope that the unique quality of the salt ponds can be saved.

15 YEARS *continued from page 1*

In addition to these academic departments and programs, a growing number of research projects began to develop in traditionally non-marine departments throughout the University.

As URI's marine expertise sharpened, the public in increasing numbers began to ask for answers to questions and solutions to problems. There was an obvious need for a formal extension division that could furnish information, technology, and research findings to the community. The Division of Marine Resources was established to meet this need in 1975. Each of its two units—the Marine Advisory Service and the Coastal Resources Center—acts as a link between the academic community and the public and private sectors.

Marine Advisory personnel specialize in the pragmatic: commercial fishing, coastal use and recreation, marine education, and marine resource economics. Specialists work directly with the public, translating basic research into useful information and tools. Because of their wide contacts, they are also able to keep University scientists informed of current needs in applied marine research.

The Coastal Resources Center was established to provide technical assistance to the state's Coastal Resources Management Council. Its initial task was to help that body prepare a coastal management program for Rhode Island. With partial Sea Grant support, the Center has since become engaged in such major university research projects as a multidisciplinary study of coastal ponds and another of upper Narragansett Bay.

Sea Grant also partially supports the URI Center for Ocean Management Studies, a forum for the exchange of ideas related to ocean policy on a regional, national, and international level.

The University has strong ties with the laboratories of two federal agencies based on the Narragansett Bay campus—the Northeast Fisheries Center Laboratory of the National Marine Fisheries Service and the EPA's Environmental Research Laboratory—and has cooperated with them in several projects sponsored by Sea Grant.

SEA GRANT *continued from page 1*

combined education, research, and extension activities, but made us the world's leading agricultural nation.

Three years later, Spilhaus' suggestion was shaped into a program that the U.S. Congress passed as the National Sea Grant College and Program Act. President Lyndon B. Johnson signed it into law on October 15, 1966.

The program's congressional mandate was to "accelerate the development of marine resources, their conservation, management and maximum social and economic use."

In the years since, university-based research supported by Sea Grant has greatly increased understanding of the basic ecology of the marine environment and has made possible wiser management and more successful exploitation of a vast resource. Aquaculture, seafood processing, and fishing are just three commercial fields that have advanced spectacularly.

Sea Grant education supports marine-related courses, curriculums, and degree programs that did not exist 15 years ago, trains personnel needed by marine-related industries, and develops in the citizenry an understanding and appreciation of the marine environment.

Advisory services specialists work with and educate the growing number of users of the nation's marine resources.

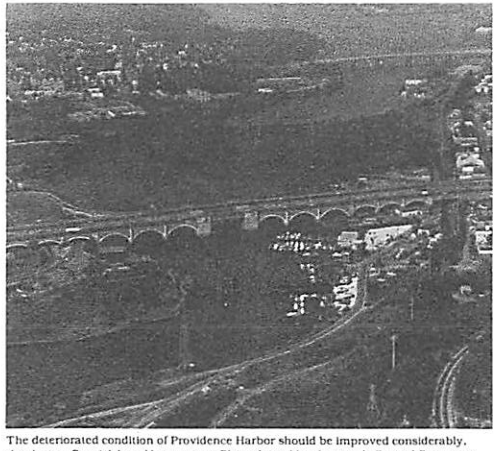
The program's usefulness is expected to grow as exploitation of a still largely untapped resource, the sea, continues.

Graduates of the URI Sea Grant Program

At universities across the nation, the Sea Grant Program helps foster ability in a variety of marine-related fields by supporting graduate students who work as research assistants on Sea Grant projects.

Between 1970 and 1983, 295 graduates at URI received Sea Grant support. The breakdown, by discipline, is:

Biology	64
Engineering	52
Economics, Business	49
Aquaculture	35
Seafood Processing	26
Chemistry	22
Pharmacy	18
Law, Sociology, Political Science, Geography	17
Fisheries Technology	7
Geology	5



The deteriorated condition of Providence Harbor should be improved considerably, thanks to a Special Area Management Plan adopted by the state's Coastal Resources Management Council. The 96-page plan, which covers the waters and shorelines of upper Narragansett Bay and the lower Providence and Seekonk Rivers, is based on a detailed study of the region by the Coastal Resources Center at the University of Rhode Island with partial funding from Sea Grant.

FISHERIES TECHNOLOGY
Continued from page 1

and related eddies on a weekly basis. They have proved useful to fishermen in pursuit of swordfish, tuna, marlin, and shark, species that tend to cluster in oceanic fronts. Knowing the location of these strong thermal gradients before setting out can save fishermen time and fuel and ensure a safer, more successful voyage.

A case in point is the adoption of temperature charts by swordfishermen. These longliners or harpooners generally try to set their gear in the vicinity of a 68–70°F isotherm. The American Swordfish Association, whose membership includes fishermen from the Gulf of Maine to the Gulf of Mexico, recently reported a savings of $2.25 million in fuel costs in one year because of the charts.

While the potential benefits are clear, limitations still exist. The biggest one is the inability of the satellite to "see" through thick cloud cover. The success rate, gauged by the number of clear images obtained per week, ranges from about 75 percent during the summer to about 25 percent during the winter.

The charts also reflect considerable seasonal variability. Inferences concerning bottom conditions cannot be made during the summer and fall, when a thermocline separates the variably warm surface waters from the much colder bottom waters. In late October or early November of each year, vertical mixing takes place, causing the surface temperatures to closely match that of the bottom. Moreover, surface temperature contrasts become more prominent, and consequently more discernible, on the charts during the winter months.

These limitations notwithstanding, the charts provide information that can minimize the uncertainty involved in plotting a course from the dock to promising fishing areas.

URI LENDS A HELPING HAND ON THE OTHER SIDE OF THE WORLD

Southeast Asia might seem a strangely remote target for the expertise of marine scientists from New England, but faculty and researchers from the University of Rhode Island who took part in a long-term cooperative program in marine resource management and development with three Malaysian universities would not say so.

"We can learn a great deal from helping other nations solve their marine resource problems," says Dr. Nelson Marshall, professor emeritus in the Graduate School of Oceanography, one of the leaders of the international Sea Grant project. "And, judging by the remarkable progress we saw, I believe the effects of our work in Malaysia will be lasting."

Sea Grant is known for supporting marine research, education, and advisory services in this country, but in 1977 Congress authorized the program to extend its activities overseas, following a government study to determine how the United States might help developing countries improve their marine technology and, at the same time, promote an international exchange of data on marine resources.

An underlying aim was to create a better climate for research in the oceans worldwide at a time when Law of the Sea agreements were increasingly restricting it.

When URI considered extending its marine efforts abroad in 1978, the relatively new country of Malaysia in the China Sea seemed a logical place to begin, even though it was on the other side of the globe.

During 1978, the two URI faculty members who became co-directors of the project visited Malaysia to discuss a possible cooperative undertaking with three Malaysian universities. Oceanographer Marshall had long experience in setting up marine programs; Dr. Harlan C. Lampe, a professor of resource economics, had spent much of the decade before working with the fisheries of a number of countries, including some in Southeast Asia. The following spring their Malaysian counterparts visited URI.

The three Malaysian universities involved proved to be quite different from one another in their interests, capabilities, and needs.

The agricultural university, Universiti Pertanian Malaysia, established in 1971 just outside the capital of Kuala Lumpur, was beginning to develop a faculty of fisheries and marine science and to establish outlying field stations. Its economics faculty was also interested in gaining expertise in fisheries economics, a field in which URI has been a pioneer. The university especially needed advice on curriculum building and operational questions.

Several economists at the Universiti Malaya in the capital had also become interested in studying fisheries resources, while other faculties, notably zoology, had recently begun work in mangrove ecology. The science university, Universiti Sains Malaysia in Penang, had a three-person mangrove ecology team as well.

In peninsular Malaysia, over 20 percent of the mangrove swamps that rim the coastlines have been lost to land reclamation in the last two decades. The country's lack of flat land provided part of the impetus to fill in the swamps; in recent years they were also being cut for timber to export to Japan. However, virtually no scientific information exists on what their loss might mean to the ecology of the estuaries. It is imperative to find out how important they are to the health of the coastal fisheries and what the most useful management policies might be.

Thus, it was clear that research assistance by URI scientists who had studied salt marshes intensively could be immediately useful to the country. Findings would also be applicable to mangrove swamps in Florida and the Gulf of Mexico and therefore useful to the United States as well.

Research on salt marsh ecology done in the United States in the 1950s had led to the belief that wetlands produce masses of organic matter that are vital in the food chain of juvenile fish and shellfish in these "nursery" areas. It was also believed that these organics and nutrients are flushed into coastal waters to help support the fisheries there. Much of our coastal management policy since then has been based on this assumption. Now scientists are not so sure.

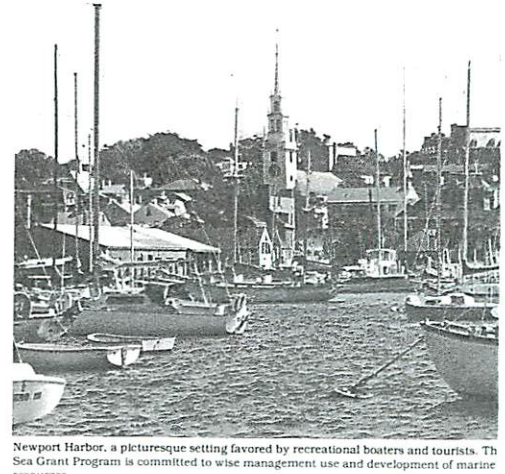
Dr. Scott Nixon, URI professor of oceanography with long experience in coastal wetland research, headed the URI team investigating the mangroves. Dr. Ong Jin Eong and Dr. A. Sasekumar headed the teams from the Universiti Sains Malaysia and the Universiti Malaya, respectively. During a visit to the area in 1980, Nixon and URI colleagues set up the protocol for food chain and nutrient input studies.

Sampling was done along an estuary bordering the Matang forest, a well-managed mangrove preserve, and also along a river where extensive land reclamation had taken place. Samples were flown to the United States and analyzed by URI scientists.

When the results were in, they cast considerable doubt that mangrove nutrients enrich these waters as directly as had been believed. The Malaysian teams have continued this research, and at a Sea Grant seminar held at the Universiti Pertanian Malaysia in 1982, co-sponsored by URI, several recommendations for further investigation were made.

The mangrove work was only one of several research projects, and research was only one aspect of the international Sea Grant program in Malaysia. Between 1980 and 1983, ten junior researchers, mostly faculty members from the Malaysian universities, spent at least a semester apiece at URI, studying in the fields of oceanography and resource economics. Several are continuing as Ph.D. candidates. Lampe, co-director of the program, spent over six months with the faculty of economics and agribusiness at the Universiti Pertanian Malaysia while it was establishing a master's program in fisheries economics. The URI faculty have also taught courses in their specialties there. At least four joint publications have resulted from the association.

"The input from the Malaysian institutions was impressive," says Marshall. "In fact, we are hoping to work with them in the future on other projects."



Newport Harbor, a picturesque setting favored by recreational boaters and tourists. The Sea Grant Program is committed to wise management use and development of marine resources.

GUIDE TO MARINE INSURANCE PUBLISHED

Insuring his vessel represents a major operating cost for today's commercial fisherman, but the chances of his being able to understand exactly what he is paying for are remote. The contract of marine insurance has been called "unquestionably the most complex legal document" the average person is likely to encounter. Some of its "labyrinth of verbiage," as a federal judge termed it, dates back to 1613.

To guide purchasers of insurance through this labyrinth, Dennis W. Nixon, director of the Marine Affairs Program at the University of Rhode Island, has put together a 44-page explanation of the law he hopes will help fishermen "repair the legal holes in their nets and avoid financial hangups." It is being made available, with Sea Grant support, by URI's Marine Advisory Service. Anyone who is unfamiliar with the concept of "negligent salvage," who does not know why a marine insurance underwriter can make money while apparently losing it, or who is not aware of the priorities of claims in cases of liens against a vessel should find it useful reading.

Because maritime law and marine insurance are so intertwined, Nixon devotes his first chapter to a quick review of the provisions in admiralty law with most significance for commercial fishermen: jurisdiction, maritime liens, collision, and salvage.

Admiralty law, which governs all maritime activities, including commercial fishing, is quite different from the law of the land. Of importance to fishermen is the fact that, unlike most businesses, theirs comes under the jurisdiction of federal courts and it is in these courts that insurance disputes are heard.

Skippers who pay their insurance bill without reading the policy and hope they are covered may find some surprises in this publication. Two relatively recent legal findings are the concepts of comparative fault in collisions at sea and of negligent salvage.

A landmark court decision in 1975 established the rule of comparative fault in allocating damages—a great improvement, the author says, over the rule of divided damages, which had prevailed until then. He cautions that the concept of negligent salvage is also gaining increasing acceptance in the courts. It means that anyone who undertakes a rescue operation can be sued if he does not adhere to reasonable standards of seamanship during the effort.

According to Nixon, the essence of salvage law is widely misunderstood. A salvor does not own a vessel he has pulled off a rock; he merely has an ownership interest or lien on it, and to exercise that he must file suit in federal court. He may not sell the vessel and pocket the proceeds.

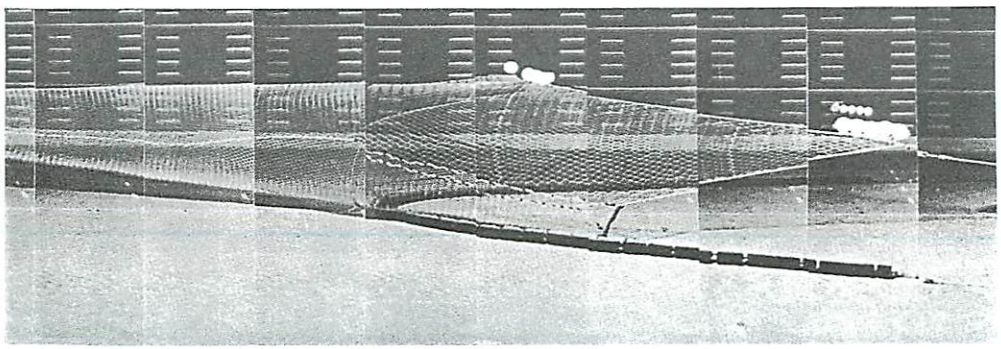
Unlike other forms of insurance, the marine insurance industry, which dates to the seventeenth century, is virtually unregulated. This explains why premiums charged can vary so widely from one underwriter to another. Although the losses they must pay can be enormous, so is the volume of premiums collected. In recent years of high interest rates, these funds, quickly invested, have brought in enough income to keep underwriters from raising premiums any higher than they have, despite an alarming increase in underwriting losses. When interest rates fall and insurers cannot count on investment income to offset underwriting losses, vessel owners can expect their premiums to rise even higher than they are now.

One way some fishermen have tried to prevent that is by participating in group insurance through a cooperative fishermen's association. This can lower premiums when every member adheres to high safety standards. Self-insurance, which other groups of fishermen have used, can be a money saver as long as only routine claims are filed. A catastrophic loss can bankrupt the fishermen-owned insurance firm.

Contrary to what some unfortunate vessel owners have believed, hull insurance is not an "all risk" contract. Instead, it protects the insured against certain named perils under strictly specified conditions. Nixon cites a number of instructive court decisions in which the owner has not been able to satisfy those conditions.

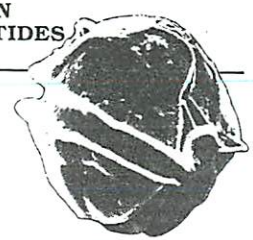
A standard P & I policy covers five categories of liability, the most important of which to a vessel owner is crew compensation, and the author discusses legal ramifications of this at some length. He also notes categories that are not covered by the basic policy.

With marine insurance as costly as it is today, every vessel owner needs to become a well-informed insurance consumer, Nixon concludes. Reading his book, *A Commercial Fisherman's Guide to Marine Insurance and Law*, can be the first step.



The tow tank at URI (100' long, 12' wide, and 6' deep) has proved a useful tool for testing fishing net design. Net models, built to exact scale and attached to a trolley, are towed the tank's length at speeds of up to 3.5 knots. Photographic records made of each run can be arranged in a montage like that shown above to document the behavior of a given trawl in water—something a fisherman is unlikely to see with his own eyes. Thus, they allow him or a net designer to measure vital parameters of a trawl's design and rig. URI's inventory of models includes a 60/80 Yankee with full wings, a 3/4 Yankee with full wings and rubber roller gear, a URI 340 high-rise rigged with cookie gear, and a new design large mesh, small lower wing developmental trawl. The tank is regularly used by both URI researchers and fishermen from around New England.

RESEARCHERS GAIN INSIGHT INTO RED TIDES



While red tides have been recorded throughout most of history, possibly as far back in time as Moses' curse of the Nile and the naming of the Red Sea, scientists have only recently acquired the capability to assess their toxicity and map their distribution.

The term "red tide" refers to the discoloration of coastal waters which often accompanies population explosions of certain microscopic plants. Blooms occur annually in response to favorable conditions of sunlight, temperature, and salinity.

Most of the organisms responsible for red tides are harmless, but a few—namely, species of *Gonyaulax*—are poisonous. Marine animals directly affected by these phytoplankton are mollusks, especially bivalves, which filter their food from the water. During a *Gonyaulax* bloom, clams, scallops, mussels, and oysters can accumulate enormous quantities of these toxic plants within their systems. People who unwittingly eat such contaminated shellfish can contract Paralytic Shellfish Poisoning (PSP), an unpleasant and potentially dangerous illness, though rarely fatal in the United States.

In New England, recognition of this health hazard and the concomitant threat to the region's important shellfish industry prompted URI Sea Grant researchers to initiate a series of red tide investigations. Led by Dr. Yuzuru Shimizu, of the Department of Pharmacognosy, and Dr. Ted Smayda, of the Graduate School of Oceanography, the URI team has established an internationally known center for red tide research.

Smayda has been examining the physical ecology of the red tide organisms. The results of his work indicate that *Gonyaulax* blooms are probably not triggered by a single factor. While blooms are often associated with periods of heavy rainfall followed by intense sunlight, Smayda does not consider these to be requisite for the occurrence of red tides.

Reflecting on his global studies, Smayda notes, "We have learned that sudden blooms occur off deserts where there is no rainfall to speak of." He adds, "We also thought that blooms occur in especially clean waters, those not changed much by human activities. However, now there is evidence to show that red tide blooms occur even in very dirty waters."

Indeed, with outbreaks arising in many new areas, the world's oceans appear to be experiencing a red tide epidemic. For many years, New England's problem with PSP was limited to the Gulf of Maine. Recently, however, the *Gonyaulax* strains have been gradually extending their range south. While the populations fortunately become less poisonous as they move south, Smayda points out that the inability to predict when and how long red tide outbreaks will occur remains a problem, particularly for shellfish aquaculturists.

Research aimed at developing such predictive capabilities is being conducted at URI by pharmacognosist Shimizu, who has long been involved in red tide toxin identification. More recently, his work has involved mapping the locations and typing the strains of *Gonyaulax* found in waters from the Bay of Fundy to Long Island Sound. Ultimately, Shimizu hopes to establish the regional distribution of toxic red tides.

Shimizu's lab has identified 12 different toxins produced by *Gonyaulax*. Analysis of samples from a number of locations revealed marked variations in toxicity among populations.

"The key seems to be in the chemistry of the toxins," Shimizu states. "Two compounds can be physically identical, differing only in the placement of a small group of atoms. Yet one is toxic and one is harmless."

Because of the unpredictable nature of toxic shellfish occurrences, both the public and the shellfish industry have long suffered from overprecautionary measures. Now Shimizu expects to ease this situation by providing the means to predict the potentiality and severity of PSP that one might expect for certain locations.

VARIETY OF EDUCATION OFFERED

Three unique academic programs, now entrenched in URI's marine education network, were begun with the help of Sea Grant.

The Department of Fisheries and Marine Technology was established in 1967 in the University's College of Resource Development to train men and women for various jobs connected with commercial fishing. The two-year associate degree program not only teaches practical skills (such as motor maintenance, net mending, and navigation) that make graduates instantly employable, but also includes courses in mathematics, communication, and economics, which give a wider perspective to vocational training and open up other job areas in the fishing industry. It is the only program of its kind in the United States offered on a university level.

In 1983, the Department of Fisheries and Marine Technology was combined with the Department of Aquaculture Science and Pathology to form the Department of Fisheries, Aquaculture, and Pathology.

The graduate program in marine affairs, an interdisciplinary study of coastal and ocean management and policy, was established in 1969 in the Department of Geography and Marine Affairs, part of the College of Arts and Sciences. Two master's degree programs are offered: a one-year Master of Marine Affairs, M.M.A., and a two-year Master of Arts in Marine Affairs, M.A.M.A.

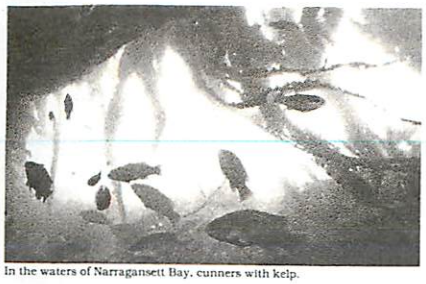
The first program is open to students who already have a graduate degree related to some aspect of the marine environment or have at least five years' experience in some ocean-related activity. The program focuses on problems related to marine policy. In addition to enrolling students from many government agencies, the program has attracted wide international interest.

The M.A.M.A. program was established in 1977 for students who lacked the advanced degree or marine experience required to take the M.M.A. program. Students undertake thesis work in one of four areas: fisheries law and management, coastal management and use of resources, ports and maritime transportation, and national and international marine policy and law.

In 1978, Sea Grant support helped revitalize a Ph.D. program in marine resource economics within the Department of Resource Economics of the College of Resource Development. This interdisciplinary program offers training in various ocean management strategies as well as in general economics, capitalizing on the University's breadth of expertise in marine subjects.

Demand for graduates in industry, government, and research here and abroad is so great that there are more jobs in the field than there are men and women to fill them.

A class in net mending at the Department of Fisheries.



In the waters of Narragansett Bay, cunners with kelp.

CONTENTS

Editors: Elisabeth Keiffer, Robert Ballou

To learn more about the Sea Grant Program and its research activities, contact the **URI Sea Grant Office, Marine Resources Building, Bay Campus, Narragansett, RI 02882-1197. Tel. (401) 792-6800.**

Scott Nixon, *Coordinator*
Joseph Farrell, *Assistant Coordinator*

For questions on services to the public, government agencies, and industry, or for information on Sea Grant publications, contact the **URI Marine Advisory Service, Bay Campus, Narragansett, RI 02882-1197. Tel. (401) 792-6211.**

Duncan Amos, *Acting Director (commercial fisheries)*
Sara Hickox *(marine business management, remote sensing)*
Neil Ross *(marine recreation)*
Prentice Stout *(marine education)*

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11/84/5M URI Publications Office

THE URI SEA GRANT NEWS

URI Sea Grant News Fall-Winter 1984

From the Sea Grant Coordinator

This is the first issue of a "newspaper" intended to give an overview of some of the major projects that have been part of the Sea Grant Program at the University of Rhode Island during recent years. While there have been and are now in progress a number of projects that have not been included, I think the topics covered give a good feel for the remarkable range and diversity of the program. I hope the excitement and quality of these studies are also evident, though these qualities are more difficult to show in the quick "snapshots" given here.

While much of the diversity and strength of the URI program has come from the competence and high caliber of the individual researchers and advisory specialists who have been involved with Sea Grant, they also reflect the sound leadership of Professor Niels Rorholm, Coordinator of the Sea Grant Program at URI from July 1971 to March 1984. The work described here is really his program, and I can only hope to do as well in coming years. Future issues will doubtless show some changes and shifts in emphasis, but the commitment to diversity and excellence will remain.

The Sea Grant Program is open to suggestions and proposals from anyone concerned with improving our understanding, management, or use of the marine environment and its resources. While most of our efforts will certainly continue to involve the University of Rhode Island, we are willing to work with others outside the University. The Sea Grant Program generally defines its mission broadly, and we have funded projects in the humanities and social sciences as well as in engineering and the natural sciences. We are particularly eager to encourage marine-related businesses and industries to use the University as a research laboratory to help them with a diverse array of problems, including short-term, very practical questions as well as longer-term explorations.

Anyone wishing to learn more about our program or to discuss future research or advisory projects will be welcome in the Sea Grant Office in the new Marine Resources Building on the Narragansett Bay Campus of URI.

Scott Nixon, Professor of Oceanography