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# Connecticut Sea Grant

## COLLEGE PROGRAM

### *Progress Report*



The Connecticut Sea Grant College Program is sponsored by the National Sea Grant College Program, whose parent agency is the National Oceanic and Atmospheric Administration, United States Department of Commerce. This document reports the program's progress during the 1992-1996 funding periods, under grants NA90AA-D-SG433 and NA46RG0433. Additional funds were provided by the University of Connecticut.

The program is based at the University of Connecticut's Marine Sciences and Technology Center in Groton, Connecticut and has branch offices at the Yale School of Forestry and Environmental Studies in New Haven and The Maritime Aquarium in Norwalk. It is part of a national network of university-based programs in coastal and Great Lakes states, established by Congress in 1966 and modeled after the Land Grant Colleges.

The program's mission is to foster the wise use and conservation of the nation's coastal and marine resources through research, education, and outreach activities.

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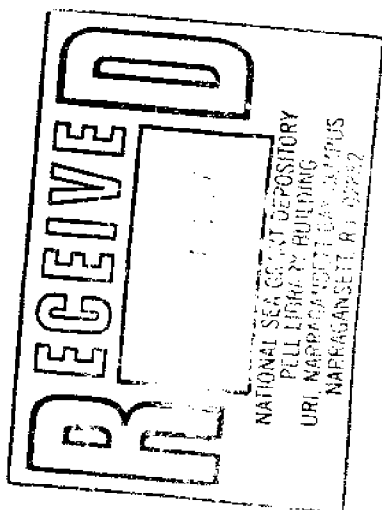
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# Letter from the Director

EDWARD C. MONAHAN

The four-year period covered by this Progress Report has been an interval marked by major changes for Sea Grant, both nationally and in Connecticut. As I write this letter in mid-1996, the budgetary conflicts in Washington, reflecting in part profound differences in opinion as to how university-based research in this country should be supported, are still unresolved. But all indications are that Sea Grant, and its cost-effective approach to assuring the wise use and preservation of our marine resources, has met every test, and can expect continued federal funding.

In the past four years, there have been several changes at the helm of the National Sea Grant Office, and we were pleased to welcome Ron Baird as the new National Director recently. In part in response to these changes in NOAA, the community of Sea Grant College Programs has undertaken several in-depth self evaluation exercises, to better prepare us collectively for the next millennium. Believing that ultimately the strength of the Connecticut program can only be increased by having a strong national program, I have been pleased to serve over the past several years on both of the major ad hoc committees established by the Sea Grant community to bring about change. The one committee, chaired by Mr. Dearborn of Alaska, has spearheaded the wholesale reorganization of the Sea Grant Association, and led to the absorption within that organization of the functions of the Council of Sea Grant Directors. The other committee, chaired by Dr. Malouf of Oregon, is working, in conjunction with the National Sea Grant Office, to completely

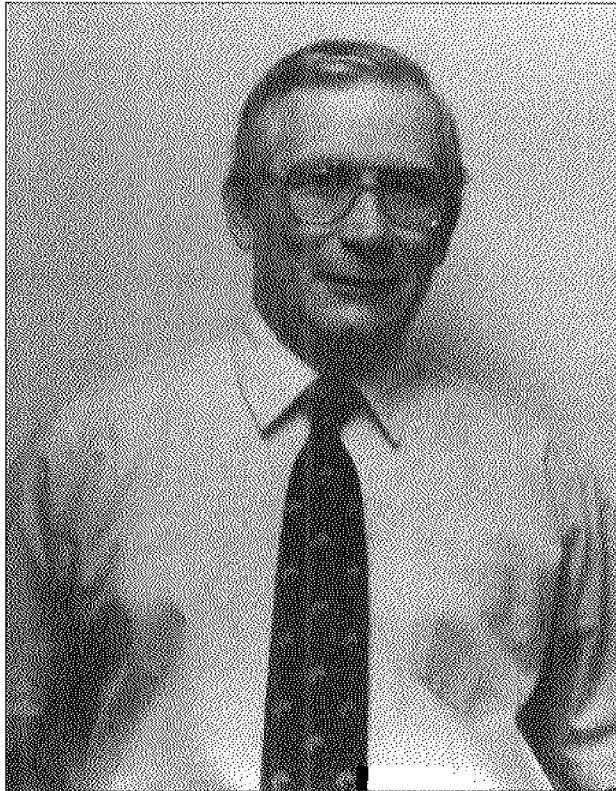
revamp the procedures of Program Evaluation, with the twin aims of streamlining the process while maintaining the meaningful competitive elements.

The Connecticut Sea Grant College

Program for our Connecticut program has remained quite stable over the past four years, increasing from \$1.068 M for the '92-'94 biennium to \$1.1 M for the '94-'96 period, and remaining stable through the

"modified moratorium", a number of new, supplementary Sea Grant funding programs have been introduced over the past four years. These supplementary funding competitions in the areas of "marine biotechnology" and "program enhancement", in which the Connecticut Program has more than held its own, when taken together with support via the Knauss fellowship, the zebra mussel programs and various "pass-through" awards, have resulted in the total federal support for our Connecticut program growing from \$1.548 M in '92-'94 to \$1.778 M in '94-'96.

We are pleased to report that the Connecticut Sea Grant Office is destined to be housed in the new Marine Sciences and Technology Center, a major facility now scheduled to be opened on the University of Connecticut's Avery Point campus in the year 2000, as part of the \$1 billion "UCONN 2000" initiative. But while we interface with the architects designing this new building, we have the more immediate concerns of moving forward with the restructuring of our Marine Advisory Service, a move necessitated by the withdrawal of the Connecticut Cooperative Extension System from our outreach effort, and of adjusting our Office operations to take into account the further loss of state-funded staff as a consequence of the University's immediate fiscal circumstances.



*Edward C. Monahan, Director of the Connecticut Sea Grant College Program. Photo Credit: Peg Van Patten/Connecticut Sea Grant.*

Program has experienced a number of changes over the past four years, which have necessarily influenced the way our office operates. While "core" federal fund-

We are fortunate to have our Sea Grant Marine Advisory Program presently well anchored by our two full-time UConn Sea Grant Extension Educators. Ms. Nancy Balcom, who serves as Interim Program Leader, is located in our Avery Point office, and Ms. Heather Crawford is housed in Yale University's School of Forestry and Environmental Studies. The Sea Grant Coastal Outreach Interns program, located in Yale's Center for Coastal and Watershed Systems and under the direction of Prof. Gaboury Benoit and Ms. Emly McDiarmid, is now in its third year and represents a major element in our outreach effort.

Likewise, our Sea Grant Education Program, at The Maritime Center (now Aquarium) in Norwalk, under the supervision of Ms. Valerie Cournoyer, Curator of Education at TMC and our designated Sea Grant Educator, is going from strength to strength and is scheduled to mount the NOAA/OAR Pathfinder program for the Northeast Region this coming summer.

Our program continues to foster international exchanges and the associated technology transfer. In April 1995, the Presidents of our two partner-universities in the ongoing Ir-Am-Aqua initiative, Sir Gordon Beveridge of the Queen's University of Belfast, Northern Ireland, and Dr. Colm ÓhEocha of University College, Galway, Republic of Ireland, were awarded honorary degrees by Connecticut College in New London, in a ceremony that recognized their institutions' cooperation in an applied aquaculture program "based largely on the American Sea Grant model", and acknowledged the role of our Connecticut program in this endeavor. Likewise, in a ceremony at the Bridgeport Aquaculture School in December, 1995, the role of the Connecticut

Sea Grant Program in facilitating a U.S. - Peoples' Republic of China exchange of long-line scallop culture technology was noted.

Our office also served as the North American "point-of-contact" for the Third International Symposium on Air-Water Gas Transfer, which was held at the University of Heidelberg in July, 1995. With welcome financial support from NOAA's Office of Global Programs and from ONR, and the invaluable assistance of our Communications Program and Ms. Peg Van Patten, our Communications Coordinator, we were able to assist this major meeting in "getting off on the right foot", and are pleased to note that the resulting 900-page proceedings volume, *Air-Sea Gas Transfer*, was duly published with due acknowledgment of NOAA and our Sea Grant Office, in December 1995, by AEON Verlag.

Our Sea Grant Program is currently benefiting from an infusion of funds from the Connecticut Department of Environmental Protection to support a project under the direction of Ms. Balcom on the "Quantification of Fish and Seafood Consumption Rates, Focusing on Long Island Sound Species, by Connecticut Citizens and Certain Subpopulations". All such awards are particularly welcomed in this time of State and Federal "belt-tightening", not only because the funding is vitally needed, but also because such awards are further evidence of our program's ability to successfully compete for research and outreach funds.

I cannot begin within the constraints of this letter to describe the panoply of successes recently met by our Sea Grant-sponsored research projects and the diligent participating investigators. Fortunately, the

results of the various research efforts supported by our office are detailed elsewhere in this Progress Report. I will just reiterate our long-standing goal of bringing the exceptional intellectual resources found in Connecticut's colleges, universities, and research institutes to bear on the pressing marine research and resource issues that face our State and Nation.

As we "come to grips" with the various recent state and federal changes that impact upon our program, we can look confidently toward the remainder of this century and beyond, assured of the support of Capt. Bud Nixon, our Fiscal Officer, of Ms. Karen Massaro, our Administrative Assistant, and of the other members of the Connecticut Sea Grant team mentioned above. Recently, a graduate student of mine from the Far East reminded me that in his culture the wish that "May you live in interesting times" is considered a curse, but we at Connecticut Sea Grant choose to see it as a challenge.

Edward C. Monahan, Ph.D., D.Sc.  
Director, Connecticut Sea Grant  
College Program

# Marine Biotechnology

## CRUSTACEAN GROWTH AND REPRODUCTION



Several research projects involving multi-investigators and building on earlier Sea Grant work are further enhancing our understanding of crustacean endocrinology. Dr. Hans Laufer, Professor of Molecular and Cell Biology, has devised a method for introducing a vital reproductive hormone into shrimp feed to help them grow to maturity, and dramatically increase egg production. He is now linking up with commercial hatcheries that can use the technology.

The results brighten the outlook for the global food supply—and shrimp cocktail lovers everywhere, and brought the University of Connecticut a U.S. Patent (no. 5,161,481). Laufer's Sea Grant research on the hormonal regulation of growth and reproduction in crustaceans began a decade ago. His investigation of vitellogenesis and metamorphosis in spider crabs has produced milestones in our understanding of crustacean reproductive

processes and their control. Building on his 1987 discovery of the identity and location of the juvenile hormone methyl farnesoate (MF), which stimulates reproduction and growth in

crustaceans, Laufer discovered that MF production increases in both vitellogenic (egg-producing) females and in reproductively active males. Laufer and his colleagues have also connected MF to the terminal molt process and to control of the reproductive diapause observed in male spider crabs. MF in the blood is synthesized by all crustaceans studied to date, including economically important species.

Crabs, lobsters and other crustaceans harvested from the sea don't reproduce well in

thwarted fish farmers' hopes for successful shrimp production. But Laufer's research into improved, controlled shrimp farming offers the best means to produce abundant marine food.

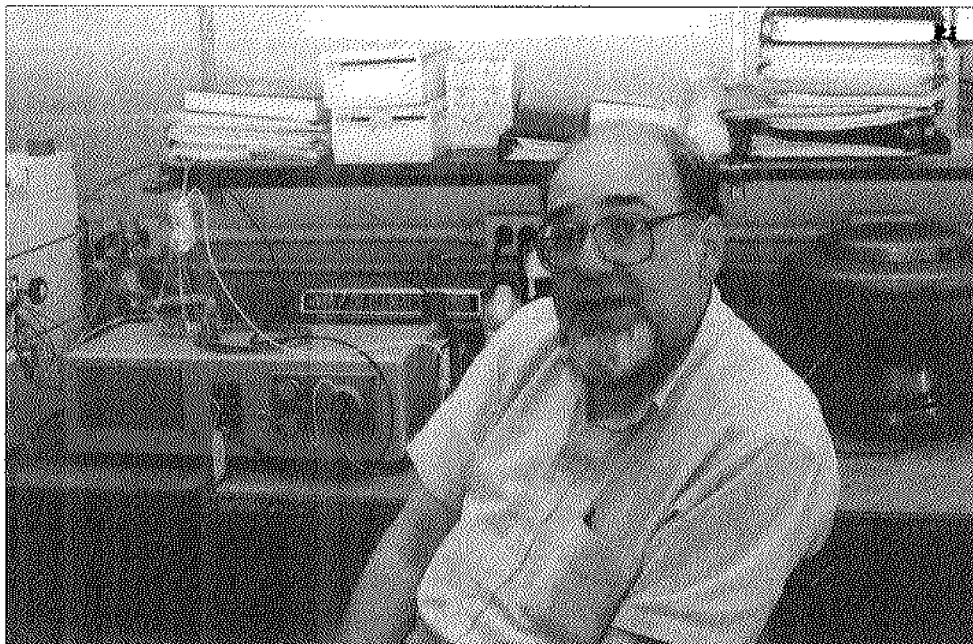
Additional Sea Grant funding led Laufer to apply modern methods of biotechnology to synthesize the growth hormone and incorporate it into a special shrimp "fertility food" made of bits of bloodworms, squid, and mussels. The result is enhanced egg production—nearly double in tests. The shrimp used in the

research was the Pacific white shrimp, *Penaeus vannamei*, a tasty and hardy, relatively disease-resistant species of shrimp that grows quickly to a large, plump size.

William Biggers (University of Connecticut) and Laufer have teamed up to continue the investigation into the various functions of MF in a project to define its role in the regulation of (1) ovarian egg maturation (2) embryonic development and (3) larval metamorphosis and

(4) postlarval metamorphosis of both spider crabs and lobster.

In commercial aquaculture of crustaceans, heavy losses occur during hatching, larval devel-



*Hans Laufer's research on juvenile hormones is essential to the aquaculture of crabs and shrimp and has brought UCONN a patent for a feeding method that increases shrimp egg production. Photo Credit: Peg Van Patten/Conn. Sea Grant.*

capitivity. Female shrimp hormones are adversely affected, and larvae do not readily mature. This results in a shortage of both viable eggs and larvae that has until now

opment and metamorphosis. This research furthers our understanding of the endocrine factors that regulate these processes in crab, shrimp, and lobster and will help in the production of more numerous and healthier animals in the future.

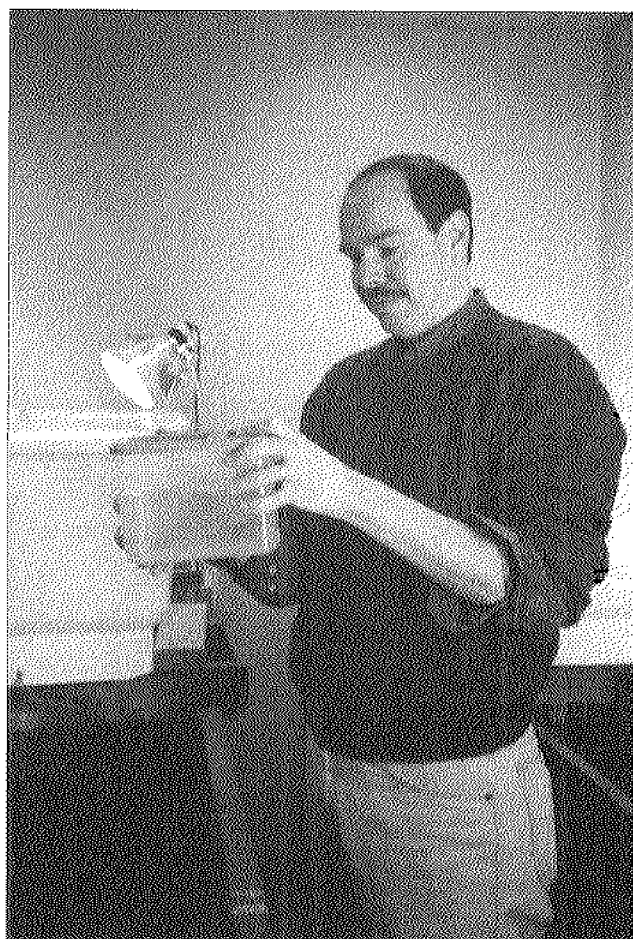
To this end, collaborations with other investigators in this area have been established. In a collaborative regional project, G. Prestwich (State University of New York at Stony Brook)

*Below left: Scott Price, one of Hans Laufer's students, devised an experiment to locate the production of pheromones in the female spider crab. Below right: Bill Biggers (shown here with a container of shrimp) and Laufer are discovering the role of methyl farnesoate in crustacean egg maturation, metamorphosis, and development.*

and James Hayward (Collaborative Labs Inc.), joined Laufer's efforts to design synthetic liposomes that can be used to deliver MF in an encapsulated form that can be mass-produced and used in industry to increase shrimp egg production and improve hatchability. This project is funded by a special Biotechnology Competition through the National Sea Grant Office and will continue through 1997.



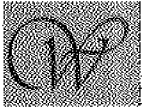
*Photo Credit: Peg Van Patten/Conn. Sea Grant*



*Photo Credit: Peg Van Patten/Conn. Sea Grant*

# Aquaculture

## NORI FARMING IN THE NORTHEAST



hat has more vitamin C than orange juice, more calcium than milk, and more protein than wheat germ? It's *Porphyra*, a health food best known to most people as nori, the seaweed used for sushi wrappers. Nori lowers cholesterol, and is high in vitamins A and C, calcium and protein. Nori is also being investigated as a treatment for stomach cancers and ulcers.

A regional Sea Grant Project links investigators from the Sea Grant programs in Connecticut, New Hampshire and Maine, as well as industry collaborators from Coastal Plantations International in Eastport, ME. The project has also benefitted from exchange visits with Dr. Xeingung Fei, an expert from the Chinese Academy of Sciences in Qingdao, Peoples' Republic of China.

As a first step to developing a commercially viable seaweed industry in New England, Charles Yarish and colleagues are evaluating the existing native populations of *Porphyra*—what species grow along the New England coast and how extensive their distribution is. They have collected *Porphyra* samples from Long Island Sound to the Canadian Maritimes. The species can't be told apart by merely looking, so they use various methods (documenting size and shape, differences in the cells, and genetic differences such as number of chromosomes) to distinguish the species they find. They also observe the seasonality of the species they find (i.e., times of year when they bloom, when they reproduce, when they are most abundant, when they are dormant or die out) and the accompanying natural ecological conditions. This gives them an idea what ecological conditions would be best for nori growing. While they sample, they also use spores from

*Researcher Charles Yarish examines juvenile nori growing in a flask in his laboratory at UCONN in Stamford. Photo Credit: UCONN*



the samples they collect for a culture collection in Dr. Yarish's lab. They isolate and grow the various species and varieties in the laboratory, and test the cultures to determine the best light and temperature conditions for growth and reproduction. The interaction of light and temperature may vary within New England; for instance, the best combination for Maine might be quite different from that in Long Island Sound. This will allow investigators to determine the best species to cultivate nori at a particular site, and provide a "gene bank" to maintain genetic diversity, from which commercial stocks could be started.

### POPULATION GENETICS

The species now farmed in Maine is a particular strain of a Japanese species, that can survive but not reproduce sexually in coastal Maine waters. Thus there is no danger at pre-

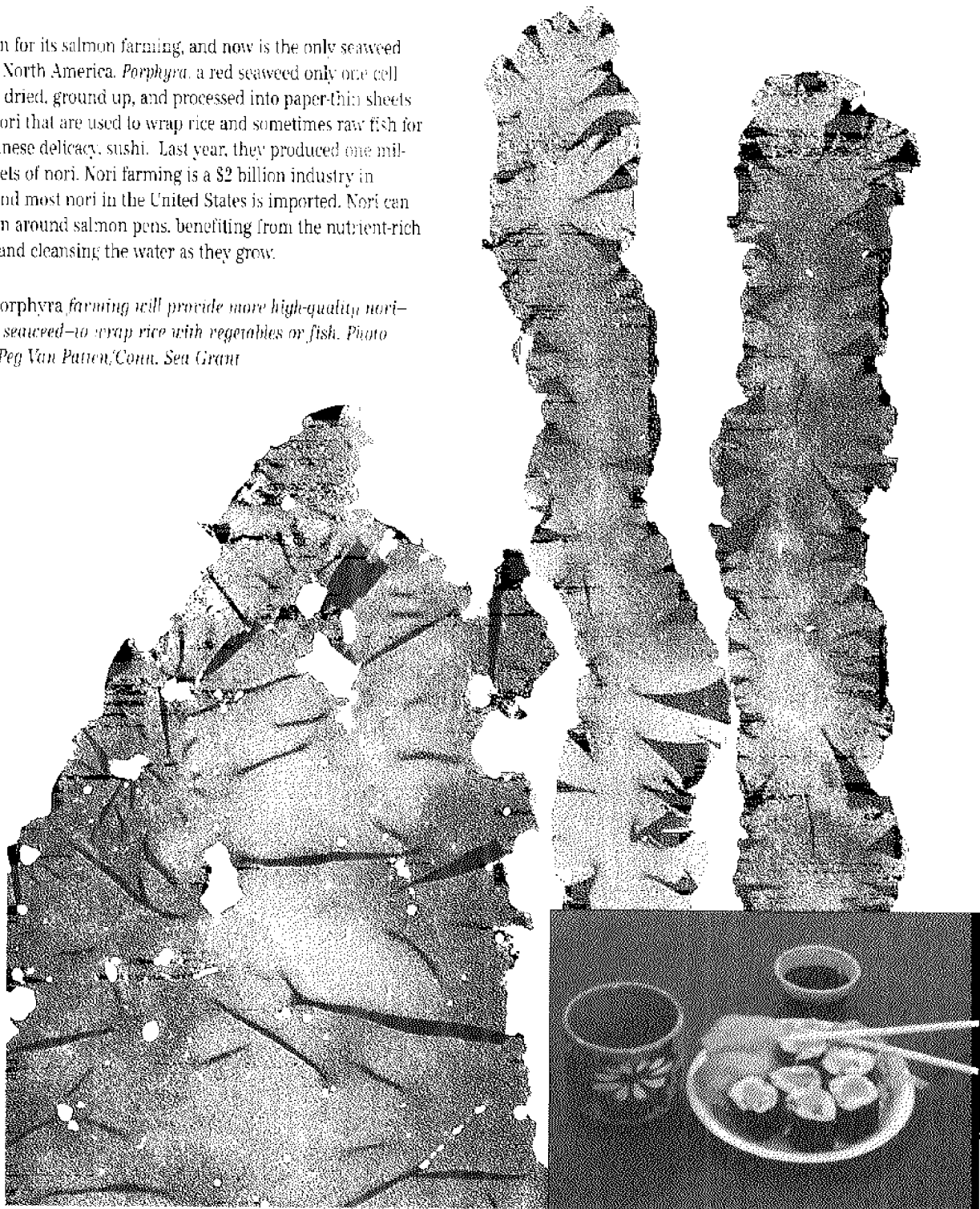
sent of the non-native species escaping and establishing itself in New England waters. Many native species of *Porphyra* already grow in the North Atlantic, but little is known about the genetic differences between them. Dr. Yarish and colleagues are using electrophoresis analysis and molecular DNA techniques to discover the differences and how they are inherited and passed on through a population. This is a preliminary step towards gene mapping and manipulation. The end product would be methods to use in the selection and engineering of cultivated species that carry desirable traits. Other collaborators in the project are developing the gene transfer methods and ways to efficiently transfer the technology to the industry users.

Coastal Plantations International, the project's industry collaborator, has a 120-acre nursery and grow-out site in Cobscook Bay and a processing facility in Eastport, ME. Eastport



is known for its salmon farming, and now is the only seaweed farm in North America. *Porphyra*, a red seaweed only one cell thick, is dried, ground up, and processed into paper-thin sheets called nori that are used to wrap rice and sometimes raw fish for the Japanese delicacy, sushi. Last year, they produced one million sheets of nori. Nori farming is a \$2 billion industry in Japan, and most nori in the United States is imported. Nori can be grown around salmon pens, benefiting from the nutrient-rich waters, and cleansing the water as they grow.

*Right: Porphyra farming will provide more high-quality, nori-pressed seaweed—to wrap rice with vegetables or fish. Photo Credit: Peg Van Patten/Conn. Sea Grant*



# Sea Level Rise

## AND GLOBAL CLIMATE CHANGE



An understanding of how coastal marshes grow or shrink in response to changes in sea level and climate fluctuations over various time scales is important for wetlands management. Detailed records of relative sea level rise exist only for the past 200 years or so in the United States. That's not long enough to put

response to changes in sea level rise over the past two thousand years, and how these changes relate to climate. Using radiocarbon dating to establish the time frame, Varekamp and Thomas examined sediment cores from marshes in Clinton and Guilford, Connecticut, analyzing the chemistry, vegetation, and fossilized animal assemblages.



current trends into perspective, because coastal marshes are ephemeral environments that undergo episodes of submergence or emergence lasting as long as a century. So, researchers must literally dig into the past to uncover more information.

Geologist Johan Varekamp and paleozoologist Ellen Thomas at Wesleyan University have teamed up to investigate marsh

They can tell when the marsh was flooded by the appearance of fine-grained deposits such as iron and zinc, and they know when metal pollution from human sources increased rapidly after the Industrial Revolution by the sudden appearance of copper. By the positions of certain species of fossilized animals in the sediment, they can figure out what the marsh's elevation was.

## The Shrinking Wetlands Mystery

*Johan Varekamp and Ellen Thomas are using a range of biological and geochemical means to document sea level changes over the past 2000 years, to help us understand marsh processes and help predict the future. Photo Credit: © Michael Vitri/Conn. Sea Grant*

What can we learn from this information? We know that sea level has been rising for the past 10,000 years, and rose about 2 meters in Connecticut over the past 1500 years, but the rise hasn't been steady. From about 7,000 to 5,000 years ago, sea level rose rapidly, then decreased to less than one millimeter. For most of the past thousand years, the rate of sea level rise remained fairly steady, between 1.5 and 1.8 millimeters per year, but about 500 years ago it increased and continues to

rise rapidly today at 2.9-5 millimeters per year.

The current rate of sea level rise is very high, and although they have grown in the recent past, these Connecticut marshes can no

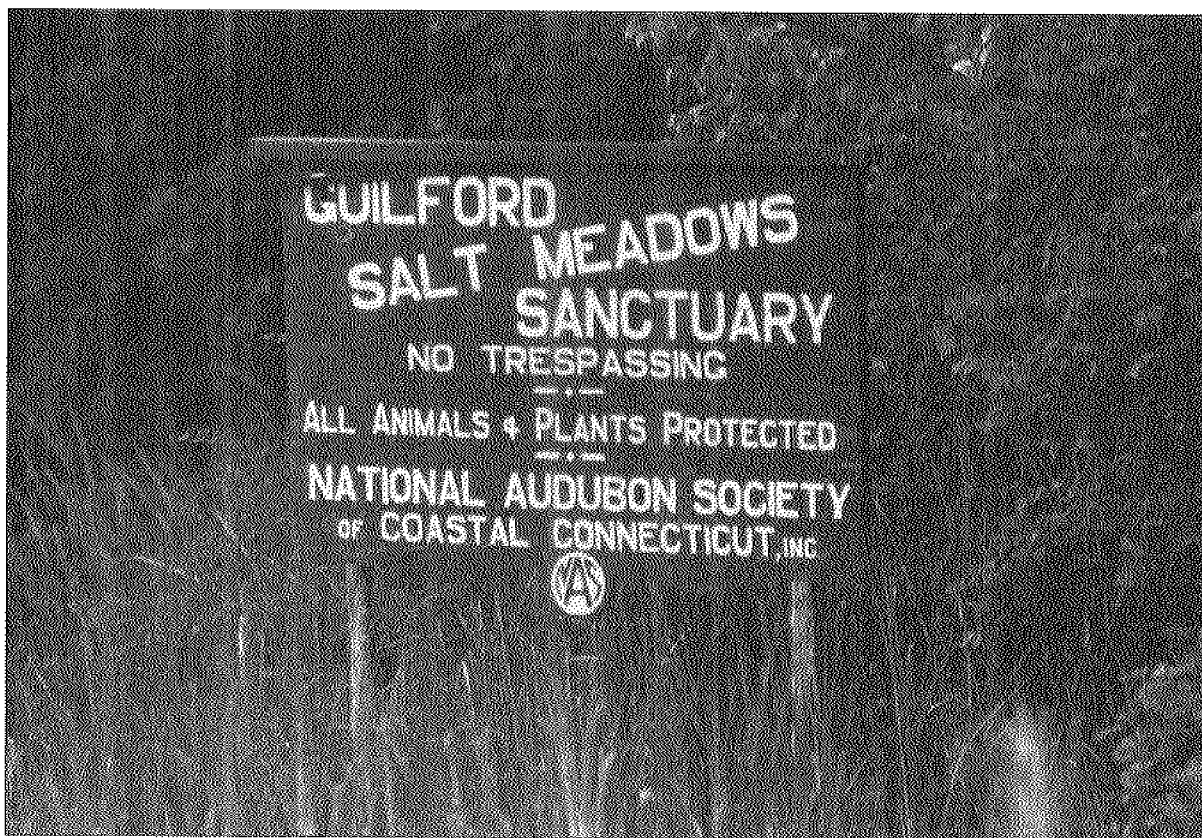
longer grow fast enough to keep up. If current trends continue, present middle to high marsh areas may become low marsh within a

few centuries, and today's low marsh may be submerged.

Can we blame this rapid sea level rise on global warming from greenhouse gases? Not likely. Surprisingly, this rapid, strong accelera-

tion of greenhouse gases from anthropogenic sources, which most researchers say began around 1900, Varekamp and Thomas believe that the

rapid sea level rise may be a result of the thermal expansion of ocean waters or the dynamics of the ocean surface.



Varekamp and Thomas have examined sediment cores from this salt marsh in Guilford, Connecticut to find clues

about past sea level rise and fall.

Photo credit: © Michael Vitti/Conn. Sea Grant

about past sea level rise and fall. Photo credit: © Michael Vitti/Conn. Sea Grant

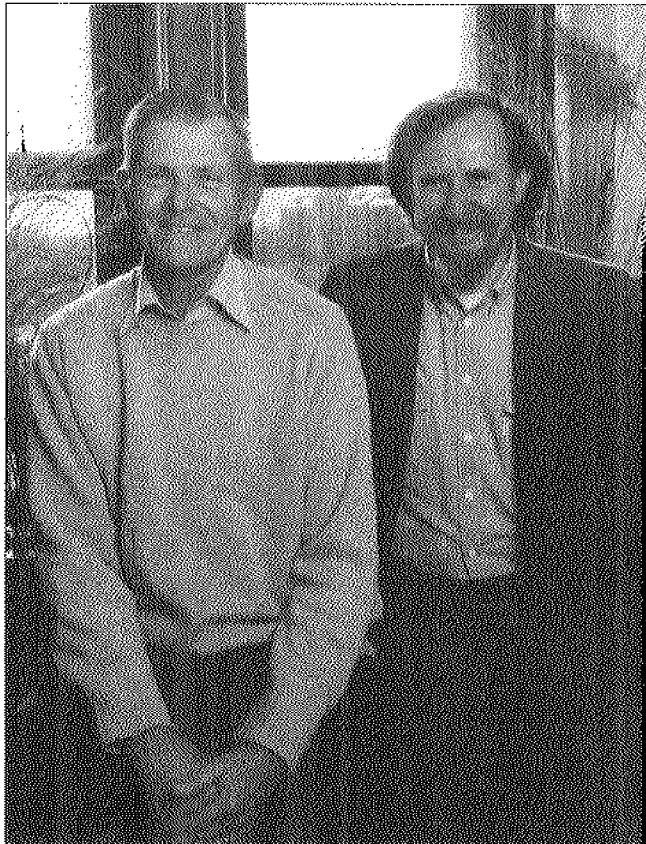
# Sea Level Rise

## AND COASTAL PROCESSES

No one expects a scientist's life to be glamorous, but Rich Orson's research twinkles with glitter. Gold, green, red, blue, and purple glitter, in fact—in circles, stars, and hexagons. Orson, a Research Associate with the Connecticut College Arboretum, and his colleagues, Scott Warren and Bill Niering, both professors of botany at Connecticut College, use layers of glitter to mark time horizons on a test plot at Barn Island, a Stonington salt marsh. The glitter layer process was begun in this marsh by Art Bloom in the 1960's and continued by Orson to provide markers that scientists can use to pinpoint specific periods over the past thirty-five years. A thin layer of glitter with a specific color and shape is placed on the marsh surface to represent each application. Then, whenever cores are taken to examine changes in sedimentation, sea levels and vegetation, the glitter incorporated in the samples clearly identifies the time frame. Because of its size, the glitter tends to stay in place in the soil unlike smaller particles of silt and clay that may migrate up or down.

Natural and anthropogenic events also appear in the cores over time. For example, a band of fine sand marks the infamous 1958 hurricane,

while 157 cesium molecules, detected by radioisotope analysis, document the beginning of atmospheric thermonuclear testing in the early 1950's and the nuclear test ban treaty of 1964. Orson also identifies and counts pollen grains in the cores and examines plant remains, to document vegetation and community changes over time. These



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*All That  
Glitters Is  
Not Gold...*

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techniques are all part of a Sea Grant project to study how salt marshes grow, shrink, or change shape in response to changes in sea levels. It appears that Connecticut marshes respond to sea level rise with a resolution of 25 to 50 years, Orson said.

*Bill Niering and Scott Warren, professors of botany at Connecticut College, document and analyze changes in marsh vegetation in response to events such as storms, floods, and climate changes. Photo credit: © Michael Vitti/Conn. Sea Grant*



*Above: Beneath the grass, sediments hold clues to the processes that allow tidal marshes to accumulate or erode away. Connecticut College scientists are using glitter to mark time horizons in the Barn Island marsh deposits. Photo credit: Edna Tiemann/Conn. Sea Grant Right: Richard Orson examines a sediment core marked by glitter from Barn Island, a salt marsh in Stonington, Connecticut. Photo credit: Peg Van Patten/Conn. Sea Grant*



# Environmental Issues

## AFFECTING LONG ISLAND SOUND

### **H**EAZY METALS IN NEW HAVEN HARBOR

Heavy metals, such as lead, silver, and cadmium, are extremely toxic substances in both fresh and estuarine waters, particularly when metals are released from sediments into the water column, then accumulate biologically as they progress from smaller to larger organisms through the food web. To compound the problem, the metals also tend to persist in the environment for a very long time. As a society, we need to better understand the sources of such metals, how they are transported in various forms, and where they ultimately end up. In urban, industrialized estuaries, the situation gets very confusing because there are numerous inputs from both point and nonpoint sources, including rivers, sewage treatment plants, industries, tidal exchange, urban runoff, combined sewer overflows, and the atmosphere.

Gaboury Benoit, Associate Professor of Environmental Chemistry at the Yale School of Forestry and Environmental Studies, is conducting a mass balance of these heavy metals in the Quinnipiac River, which feeds Long Island Sound at New Haven Harbor. He is examining the ratios of the metals, where and how they occur, and possible sources. First, he developed techniques in ultraclean sampling, handling and analysis to detect the trace metals in the river and quantify the levels found. Some concentrations were measured in parts per trillion, whereas previous measurements had been in parts per billion.

While the levels of lead, cadmium, and silver

were all below the detection limits of government agencies' routine monitoring measurements, Benoit found clear trends, with concentrations differing by orders of magnitude. This suggests that levels at which we currently define a river as "polluted" may need to be refined.

Benoit divided the river into zones according to metal concentration and presumed source. He found that some metals occurred at much higher levels in the industrialized portions of the river than in its headwaters and tributaries. All appeared to have different sources, causes of variation, and pathways of movement.

For example, lead showed the smallest variations, probably due to its diffuse sources. Even though leaded gas use has declined, lead is still dispersed throughout the environment from past use, and it becomes remobilized by streambed erosion and other processes. There was seasonal variation too, reflecting the differences in the flow volume and concentration of metals. While there was less silver than lead, the range of variation was larger. Detective work showed that gross contamination from silver deposits in flood plains at the river's mouth is a tangible reminder of a 1950's silver plating industry in Meriden, while a second, smaller pulse of silver detected in the ebbing tide comes from a sewage discharge source. Cadmium, on the other hand, showed patterns much different than either lead or silver, with a sudden, large peak appearing at the headwater stations, decreasing exponentially downstream. The source appears

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*"Hot Spots"  
can poison  
Seafood...*

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to be an old metal sludge lagoon from an industrial site in Southington. Benoit continues to quantify and refine the mass balance study, looking at seasonal and daily variations caused by factors such as tidal influence, storm events, and changes in effluent volume.

Insights from these metal "budgets" are important management tools. For example, this study showed that large storms and snow melt contribute about 50% of the metal flux to the river, and that about 25% is removed as it filters through marshes. Furthermore, efforts to reduce metal levels in treated sewage would have little effect on the water quality of the Quinnipiac River.

In a new project beginning in August 1996, Benoit and Yale co-investigator Xuhui Lee are developing a mobile micrometeorological system that can measure changes in mercury between the air and the surfaces

of salt marshes in Connecticut. They will also examine environmental parameters that may influence the flux in mercury, thus contributing to our knowledge of chemical cycling in and around the Long Island Sound estuary.

*Heavy metals are both toxic and persistent. "Hot spots," where large amounts accumulate, can severely contaminate water bodies, poisoning wildlife and seafood consumers. Photo credit: © Michael Vitti/Conn. Sea Grant*



# Nuisance Species

## INVASION BY SEA



"If modern ocean-going ships are biological islands acting as biotic conveyor belts," concludes a shipping study for the U.S. Coast Guard, conducted as a Sea Grant effort by James T. Carlton, Director of the Maritime Studies Program at Williams College - Mystic Seaport. Each day, vessels transport hundreds to thousands of non-indigenous species of plants, animals, bacteria, and viruses.

Every hour, more than 2.4 million gallons of ballast water arrive in U.S. waters, containing plankton and other living organisms that may survive the journey to inhabit a new environment when discharged. At least 57 species of marine invasions in the United States, and 16 in the Great Lakes, are thought to have begun this way. While ballast

water—water taken aboard ships to provide stability—is surely the primary means of transport, fouling organisms on ship hulls are a close second. Inland waterways, too, are increasingly invaded by new species that can become nuisances. Thousands of species from outside the U. S. have ecological

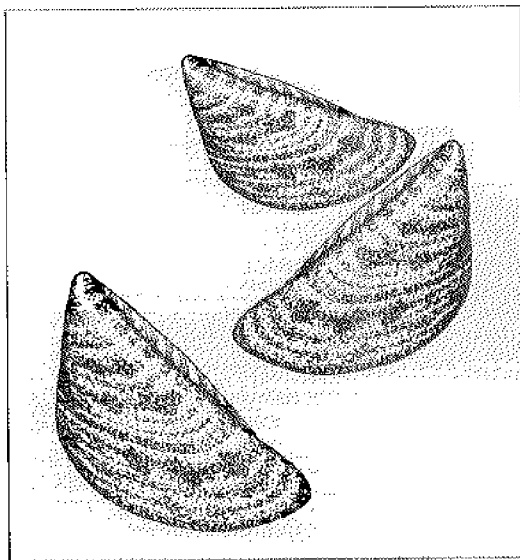
requirements matching those found in U.S. waters. These species can cause severe ecological, economic, and social crises if successfully introduced, a situation that Carlton calls "invasion roulette."

The study by Carlton and his colleagues, D. R. Reid and H. van Leeuwen, examines shipping as a major transport pathway for aquatic nuisance species in coastal waters,

possible ways to control introduction of species through shipping, and the feasibility of implementing regional, as opposed to national, control measures. Its recommendations include ballast exchange in deep waters, and a new concept called "Integrated Ballast Management,"

which would establish a formal international system to identify "global hot spots"—areas where

blooms of plants and animals occur. The study also calls for the establishment of a National Ballast Water Control Program. National and international solutions are preferred to regional measures, since ballast water comes from ports, harbors, and estuaries all over the world, and species invasions



*Zebra mussels, Dreissena polymorpha, wreak havoc with beaches, boating, utilities, and industries when they invade a lake or river. Illustration: Judy Ricketts-White*

*These species can cause severe ecological, economical and social crises, a situation Carlton calls "Invasion Roulette."*

occur globally as well.

The study, published by the U.S. Coast Guard and Connecticut Sea Grant, was distributed to Congress and is available from the National Technical Information Service and the National Sea Grant Depository.

Another project, concerning invasions of nonindigenous aquatic nuisance species into estuaries, was carried out in San Francisco Bay by Carlton and co-investigator Andrew N. Cohen (University of California at Berkeley). The project, completed in December 1995, showed that in some areas of the Bay, 100% of



the current common species are introduced. The results and a discussion of the economic and ecological impacts are available in a report for the U.S. Fish and Wildlife Service titled "Nonindigenous Aquatic Species in a United States Estuary: A Case Study of the Biological Invasions of the San Francisco Bay and Delta", by Cohen and Carlton. The report is available from the National Technical Information Service and the National Sea Grant Depository.

## INVASION BY LAND

In addition to the transport of zebra mussels and other nonindigenous nuisance species

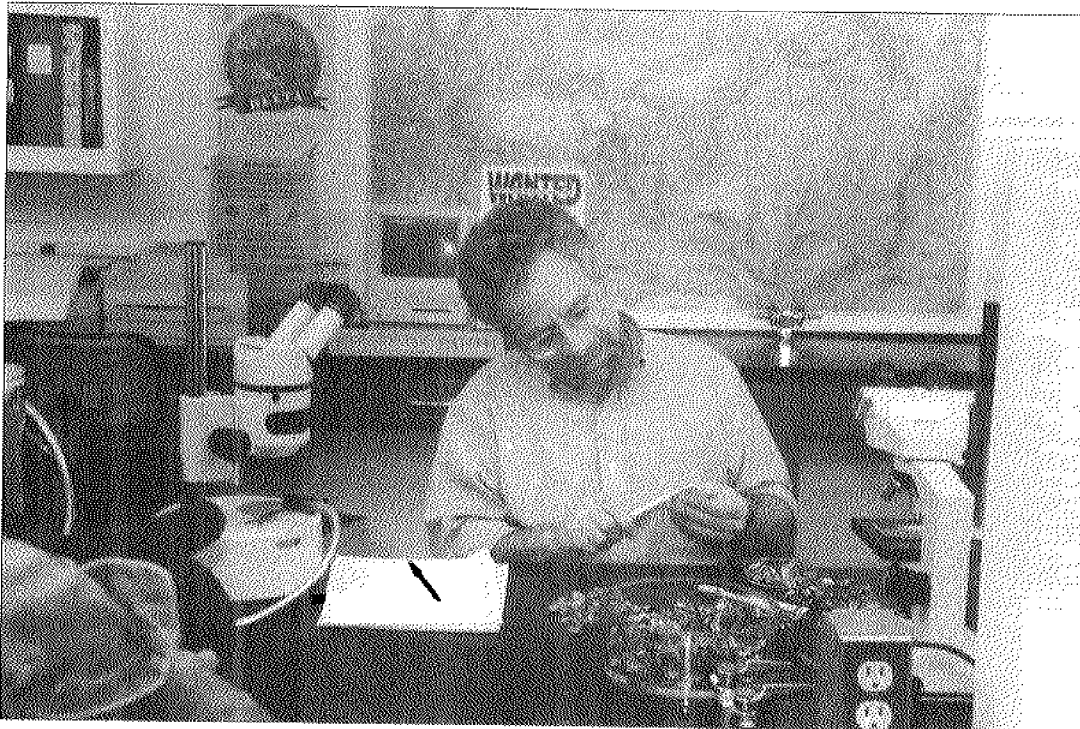
through the ocean via ballast water, overland dispersal also occurs. The exact mechanisms of overland dispersal were not well documented, so Johnson, Carlton, and colleagues carried out a study to examine them. They found that waterfowl are not an important mechanism for zebra mussel transport, since larvae rarely survive passage through the birds' digestive systems. Recreational boating is a significant means of dispersal, however, particularly in live wells and on aquatic plants. For more information, see the journal articles listed at the end of this report.



*Above: Purple Loosestrife, once imported for gardens, outcompetes native wetland plants, reducing food and shelter available to wildlife.*

*Illustration: Judy Richers-White*

*Left: James T. Carlton, Director of Maritime Studies at Williams College, Mystic Seaport, measures zebra mussels in his laboratory. Photo credit: Peg Van Patten /Conn. Sea Grant*



# Education

## THE MARITIME AQUARIUM & OPERATION PATHFINDER

**C**onnecticut Sea Grant routinely develops, produces, and disseminates educational resource materials for teachers and students, and handles many walk-in, phone or e-mail requests for information. Some of the publications are used in high-visibility locations such as the The Maritime Aquarium, Mystic Marinelife Aquarium, and the E.P.A. Long Island Sound Office.

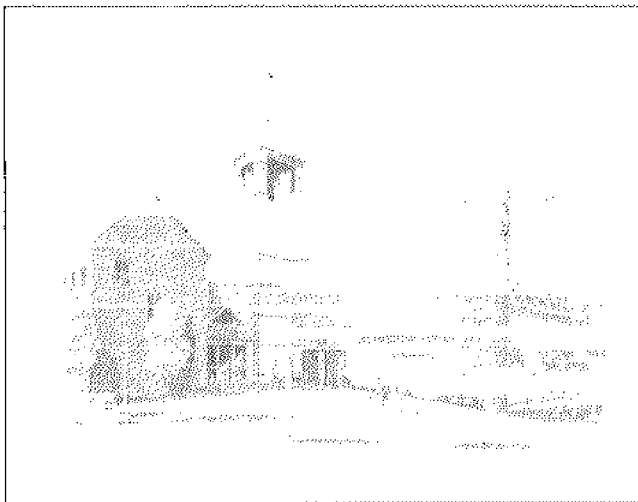
Connecticut Sea Grant research presently involves approximately 18 undergraduate and 6 graduate students at the University of Connecticut, some of whom are doing thesis work. Numerous students at other institutions within the State are also supported by the program's sponsored research through the principal investigators. The Sea Grant Marine Advisory Program recently employed two UCONN graduate students for short-term projects. In addition, the program has sponsored and/or hosted visiting professors and postdoctoral visiting scholars from many nations.

In May, 1996 the first-ever UCONN Marine Sciences Colloquium was held at the Avery Point campus, co-sponsored by Connecticut Sea Grant. During the day-long event, 22 graduate students affiliated with the UCONN Marine Sciences Department gave oral presentations and displayed posters about their research. Although it was extremely difficult to choose, selections were made for awards for the best presentations and posters. David Deilor received first prize for his presentation on "Organic Particle Generation and Subsequent Microbial Respiration", a Sea-Grant supported develop-

ment project under the guidance of Professor Hans Dam. The prize for best poster went to Michael Ford for "Quantifying Phytoplankton Aggregation Using an Image Analysis System", another Sea Grant-supported effort.

The Long Island Sound Research Conference is a joint effort between New York and Connecticut academia. Its location alternates

and specific encouragement for undergraduates. In the past the event has attracted about 200 participants, including many teachers and students. Connecticut Sea Grant Director Ed Monahan chaired the 1996 conference, held at the Avery Point campus, and Connecticut Sea Grant publishes the proceeding volumes for the Connecticut meetings.



*The Maritime Aquarium in Norwalk, CT is headquarters for Connecticut Sea Grant's K-12 marine education.*

between Connecticut and New York, and Connecticut Sea Grant is a lead organizing agency for the alternate years and a continuing sponsor. It is the only conference of its kind that provides a forum for multidisciplinary research about Long Island Sound, with ample opportunities for graduate students to submit papers for presentations and posters

### FORMAL EDUCATION

Connecticut Sea Grant's formal education program is carried out in collaboration with The Maritime Aquarium in Norwalk. Valerie Cournoyer coordinates K-12 teacher training in marine and coastal subjects. Activities include workshops for teachers, a Sea Grant Teacher Resource Room, an annual Long Island Sound educators' conference, curriculum development, and teleconferences. About 2,000 teachers benefit from these services annually. The 1996 Long Island Sound Educators' Conference took place in March, and attracted 120 teachers. Undergraduate and high school students displayed science projects and work in progress in the display hall.

### OPERATION PATHFINDER

Connecticut Sea Grant is coordinating this program, which will be implemented in July, 1997, as part of a national network to bring science education in basic oceanography principles to minority teachers and teachers of minor-

*Below: Children are our future. Sea Grant's formal education program helps teachers provide stimulating, high-quality marine education in our schools and on field trips to the shore.*

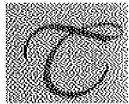
ity students in the primary and middle schools. Approximately twenty teachers will participate in a twelve-day course. Operation Pathfinder is a joint effort between Sea Grant, NOAA, the Naval Oceanography and Meteorology Command, and the U.S. Department of

Interior's Office of Territorial and International Affairs. The program, which is offered at six sites around the United States, seeks to improve teaching skills and increase information about marine issues, foster cultural diversity in marine careers, and provide access to data through emerging technologies.



# SGMAP: the Problem Solvers

## CONNECTICUT SEA GRANT MARINE ADVISORY PROGRAM



Taking the information generated by Sea Grant research to those who use or manage coastal and marine resources is the task of the Sea Grant Marine Advisory Program (SGMAP). SGMAP educators enable people to solve problems and to use coastal and marine resources wisely by providing accurate, objective, and current information on a variety of topics. The program links researchers with resource managers and users, by transferring emerging research and technology through workshops, informal discussion, and other outreach methods.

Coastal and marine priority issues are identified for program efforts using a variety of means: Sea Grant's national strategic initiatives; participation in professional association meetings, regional meetings and national conferences; discussions with local marine user groups and regulatory agencies; and by maintaining familiarity with emerging research results and regulations. These issues are then addressed on a local, state, regional and national level through workshops, forums, demonstration projects, publications, and individual assistance. A 12-member SGMAP Advisory Board, consisting of individuals from a variety of marine-related backgrounds, also helps to guide SGMAP's direction.

The current SGMAP staff consists of two full-time educators, Nancy Balcom and Heather Crawford. Balcom, based in Groton at the UCONN Avery Point campus, specializes in outreach involving nonindigenous species and also tackles seafood and fisheries issues. Crawford is based at Yale University in New Haven, and plays a key role in both water quality issues and Sea Grant Marine Advisory interns' activities.

SGMAP has 4 key areas of focus: fisheries, nonindigenous aquatic nuisance species, aquaculture, and coastal ecosystems.

### FISHERIES

It's not easy to be a commercial fisher in New England. Declines in traditional fishery stocks have led to closures of traditional grounds, limited days at sea, catch quotas, and gear restrictions, as managers seek ways to rebuild stocks. Fishermen are faced with an ever-shrinking number of options, which include finding alternative species. Recently, Balcom served as scientific advisor to two Stonington, Connecticut fishing families, recipients of federal Fishing Industry Grants to try and locate new species in deep waters off the Northeast coast. The Bomsters located, harvested, and marketed successfully a deep-sea species heretofore largely ignored, the royal red shrimp. The Allens located quantities of monkfish and redfish in deep waters as well. In both projects, rare deep-sea specimens were contributed to the Peabody Museum fish collection at Yale University.

Once the fish are caught, SGMAP aims to make sure that the public is offered the safest seafood possible. To enable local processors to meet new federal regulations, SGMAP is offering the FDA approved seafood HACCP training course throughout 1997, in conjunction with the CT Dept. of Agriculture and UCONN Cooperative Extension System. "HACCP" stands for Hazard Analysis and Critical Control Point, two of the underlying principles of this food safety assurance technique, commonly employed by the canned food industry among others. When the seafood reaches the dinner plate, SGMAP continues to gather and supply information. Balcom is working with colleagues from the Dept. of Nutritional Sciences and UCONN Cooperative Extension on a consumer survey to quantify seafood consumption in Connecticut. The project looks at overall consumption by the general population, and focuses on groups considered at higher risk of exposure to contaminants stored in some fish tis-

sues, based on fishing habits, age, gender, health status, or ethnic background. Funded by the state's Department of Environmental Protection, the project results will guide the reassessment of water quality standards currently in place and pinpoint which groups need additional information.

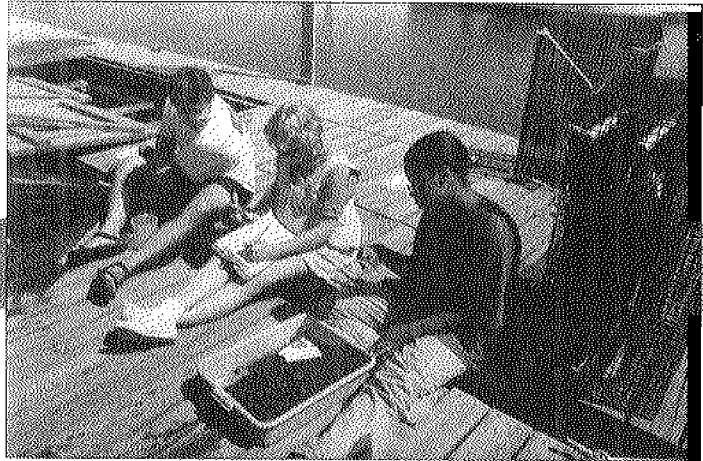
### AQUACULTURE

As the fishing community scrambles to find under-exploited species, others are turning to aquaculture as a way to increase seafood supply. Balcom has worked with the owners and researchers of the Cedar Island Marina in Clinton, Connecticut, and the National Marine Fisheries Service in a successful experiment using new aquaculture techniques to grow scallops in cages suspended under the marina's docks. Some of the scallops were then seeded in the nearby harbor in an effort to repopulate the area. Over-winter survival and growth rates were also examined. Balcom is a member of the advisory board for regional vocational aquaculture schools in Bridgeport and New Haven, and is working with local school officials in two other communities interested in establishing similar schools. Balcom was also invited to present at two aquaculture seminars held in Cambridge, MA and sponsored in part by MIT Sea Grant, providing an overview of Connecticut's regulations for the aquaculture industry, and a discussion of the restoration of Connecticut's oyster industry for the financial and investment communities.

### NONINDIGENOUS AQUATIC NUISANCE SPECIES

Northeast regional outreach efforts to prevent and control zebra mussels and other invasive species are coordinated by Balcom. Waterproof signs were posted at boat launch

*Data on the growth of bay scallops in bags suspended under docks was collected during a feasibility study by SGMAP in conjunction with Cedar Island Marina. Photo credit: Heather Crawford SGMAP*



areas, and training sessions were held for lake managers and utility industry groups. A SGMAP survey showed that Connecticut anglers and boaters have become aware of the threat of zebra mussels and how to prevent their spread, and so far the state has continued to be zebra mussel-free. Through SGMAP's Aquatic Exotics News, readers learned that a prolific aquatic weed, Hydrilla, has now invaded a Connecticut pond. This species has been called "an environmental time bomb", and efforts to find and control it are crucial. Other recent invaders include the Japanese crab, now multiplying in Long Island Sound, and Asian clams, which have plagued the utility industry for some time. SGMAP is supporting a graduate student's research to track the spread of the crab, its feeding habits, and its impact on local species.

## COASTAL ECOSYSTEMS HEALTH

Coastal ecosystems are complex webs of environmental and organismic interactions which have been and continue to be both dramatically and subtly altered by human activities. Heather Crawford is involved in outreach efforts at a variety of levels to clarify the relationship between land use, coastal water quality and overall ecosystem health. Crawford has collaborated with Chester Arnold and the UConn Cooperative Extension System in the development and application of the NEMO (Nonpoint Education for Municipal Officials) Project, which provides local land use officials with concise, research-based information on how their local planning and zoning decisions and land use practices affect local and regional water quality. One key to the program is the use of Geographic Information Systems (GIS) technology to graphically demonstrate the potential long-term consequences of existing policies and regulations.

Crawford represented NEMO on the plenary panel of the Impervious Surface Reduction Research Symposium, held in Olympia, WA in March 1996.

Because so many of the activities which impact coastal ecosystems occur throughout the landscape, Crawford is also involved in outreach programs targeted at the general public and urban youth populations. Through grants from the Quinnipiac River Fund, Crawford collaborates with the UConn Cooperative Extension System and Schooner Inc., a local nonprofit marine educational program, in an ongoing educational effort which uses the Quinnipiac River watershed and New Haven Harbor as a laboratory to provide inner-city youths with hands on, marine-based scientific and career-oriented experiences. The program activities are designed to create an awareness of the linkages between the neighborhood participants live in, their everyday activities, and local water bodies.

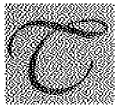
Other programs, such as "Sound Gardening," provide training to volunteers doing community outreach. Crawford implements this program with the Extension Master Gardeners, using slide shows, scripts and handouts to educate local groups about how individual activities contribute to water quality problems and how simple changes in lawn, garden and household management can protect the environment. In a two-year period, 50 trained volunteers reached over 5000 Connecticut residents with this important information. Cooperators with Sea Grant in the program include the UConn Cooperative Extension System, Connecticut Association of Extension Master Gardeners, and the EPA Office of Long Island Sound Programs.

Crawford's placement at the Yale School of Forestry and Environmental Studies as liaison with the Center for Coastal and Watershed

Studies and advisor to the Yale Sea Grant Coastal Interns also provides many opportunities to disseminate information on Connecticut's coastal ecosystems. She teaches an introductory one-day course for incoming graduate students on coastal issues and ecosystems and connects local communities or land trusts seeking management assistance or ecosystem inventories with students and faculty seeking class projects or research sites. In earlier outreach activities, "Sound Values", a fact sheet written by Joseph Blumberg (the program's Long Island Sound Study Public Outreach Coordinator until 1995) documented the economic and intrinsic value of the Sound. The fact sheet is used by state and federal agencies. Blumberg also set up a series of meetings for public comment on the Long Island Sound Comprehensive Conservation and Management Plan. Norman Bender, SGMAP's program leader until 1994, gave presentations that evolved from the production of Connecticut Sea Grant's documentary film, "Long Island Sound: Worth Fighting For!", at two international conferences in 1996. The film, produced by Connecticut Public Television, was nominated for two Emmys, one in community service and one for its musical mix. Additional video outreach efforts included Chester Arnold's "Luck Isn't Enough: the Fight for Clean Water", an award-winning educational film on nonpoint pollution for municipal officials, and Nancy Balcom's "Invasion of the Zebra Mussels: Just a Matter of Time?", for boaters and anglers.

# Coastal Outreach Interns

YALE CENTER FOR COASTAL AND WATERSHED SYSTEMS



The Coastal Outreach Interns are a special group of graduate students at the Yale School of Forestry and Environmental Studies, through the Center for Coastal and Watershed Systems. CTSG provides support for two interns each semester and one summer intern. These interns spend a semester, summer or year working on special projects to educate municipal officials and the public about watersheds and Long Island Sound.

Professor Gaboury Benoit and Program Director Emily McDiarmid oversee the program, assisted by Heather Crawford as the Sea Grant Marine Advisory Program liaison. Heather's role includes assistance with program development and evaluation as well as student supervision and counseling.

The goals of the program are threefold: (1) to increase the impact of physical and social science research on coastal communities, (2) to increase citizen participation in the stewardship of Connecticut's coast, and (3) to further enhance restoration efforts already underway and develop community ownership of restoration sites.

So far, nine students have participated in the Yale Sea Grant intern program, concentrating on the West River watershed in greater New Haven. The Department of Environmental Protection has recognized the West River as a priority urban watershed, and as such it is the focus of several pilot management and

restoration efforts by local, state and federal agencies. The interns have supported these efforts by developing educational programs, collecting critical data including a biological survey, and working with municipal officials.

The philosophy of the intern program and the Center is that watershed management studies should take an interdisciplinary, system wide view, incorporating socioeconomic components as well as biophysical data.

## SOME OF THE PROJECTS TO DATE:

Alison Ormsby developed a slide show, educational program and traveling display board on the West River watershed which describe physical and biological characteristics of the watershed, identify areas with significant human impacts and provide information on projects currently underway in the watershed.

Duncan Schmitt compiled a list of key community contacts in the watershed and collected information on the values of riparian corridors, policies for their protection and specific data on critical areas in the West River corridor. During this process, Duncan learned of the proposed redevelopment of a formerly industrial property on the river's edge and he put together extensive information for the developer and city commissions on considering stormwater impacts, nonpoint source pollution and a streamside vegetative buffer to be considered in the design of the development.

Lara Nachiem gave several presentations on the West River watershed to a variety of school and civic organizations, including training Special Olympics volunteers at Edgewood Park in New Haven. Lara also helped with data col-

## *Increasing Citizen Participation in the Stewardship of Connecticut's Coast.*

lection for the West River Biological Inventory. Working with a local elementary school environmental club, Nina Rooks designed and completed a series of signs for a nature trail in the watershed. The signs point out the importance of the watershed and ways individuals can help protect water and Long Island Sound, interspersed with descriptions of local plants and animals.

Chris Page has created Geographical Information System (GIS) database map layers for the watershed, combining social data from the U.S. Census Bureau with data on water quality and land use, to identify "issue hot spots".

David Casagrande is editing data collected for the watershed's biological inventory. In addition, he has carried out a sociological values and attitudes survey of neighboring residents and users of the river. His results have been published in the journal *Coastal Management* and will aid in the restoration of

marshes surrounding the river. In a related project, Matthew Udziela examined the non-market values involved in restoring the West River and compiled his survey results into a report as part of his master's thesis.

Bill Martin studied opportunities for coastal open space acquisition in the state, documenting the necessary legal processes and various financial mechanisms.

Environmental risk assessment concerns intern Brett Evans. He is examining the pathways of the pesticide triazine in aquifer

and estuarine sites, and he will provide the resulting information to the Connecticut Dept. of Environmental Protection.

Obviously, these interns are a dynamic and dedicated crew. Their recent reports and publications are documented at the end of this report. The Yale collaboration is very productive, and we look forward to keeping the coastal intern program going for a long time to come.

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*The Sea Grant Coastal Interns sampled benthic fauna to compile a biological inventory of the West River watershed in New Haven. Other projects by the interns include working with municipal planners in the West River on public policy issues, evaluating methods of open-space acquisition, and constructing interpretive signs for a nature trail. Photo credit: Heather Craeford/SGMAP*



# International Collaboration

CHINA/ECUADOR/ISRAEL/GERMANY/IRELAND

## CHINA

Connecticut Sea Grant has had a number of successful collaborations with the Peoples' Republic of China.

- The program worked with the NOAA Office of International Relations to assist the Bridgeport Aquaculture School, a multicultural magnet school in Bridgeport, Connecticut, with its efforts to learn aquaculture techniques for bay scallops. The program facilitated an extended visit by Dr. Luming Sun of the Chinese Academy of Sciences in Qingdao, who taught Chinese aquaculture techniques to the school's teachers and students. In 1996, the first successful Long Island Sound crop of cultured scallops was harvested.

- Connecticut Sea Grant also facilitated the visit of Dr. Xieqiong Fei, also from the Chinese Academy of Sciences, who assisted investigators in the regional nori farming project described elsewhere in this report.

- Sea Grant P.I. and UCONN professor Charles Yarish presented findings from his Sea Grant kelp research at the International Phycological Society meeting in Qingdao. This work was also presented at an international conference in Brest, France.

- A Chinese UCONN graduate student, Qin Wang, received travel funds to present a paper at the University of Heidelberg at an international conference on air-sea gas transfer, co-sponsored and co-chaired by Connecticut Sea Grant.

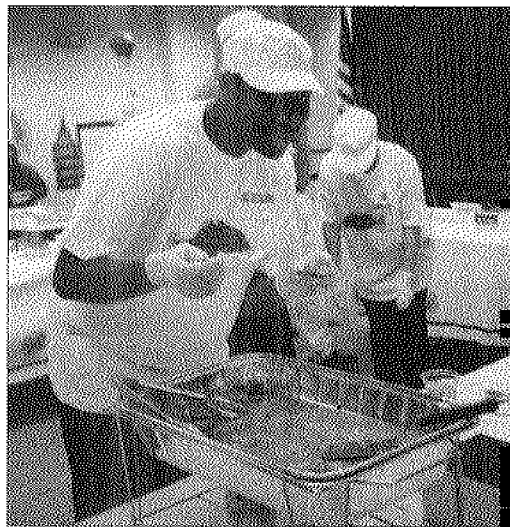
## ECUADOR/ISRAEL

Dr. Hans Laufer has collaborated with researchers and shrimp growing facilities in

Ecuador and Israel to develop and enhance laboratory culture and shrimp farming techniques. In addition, postdoctoral visiting scholars from Korea, India, Spain, and France, all funded by their respective governments, worked in Dr. Hans Laufer's laboratory on his Sea Grant research projects.

## GERMANY

In July 1995, Connecticut Sea Grant co-sponsored an international symposium in



*At the Bridgeport Aquaculture School, multi-talented high school students used lantern net aquaculture techniques to culture scallops in Long Island Sound, then cooked up a tasty celebration of their efforts. Photo credit: Peg Van Patten/Conn. Sea Grant*

Heidelberg, Germany on Air-Sea Gas Transfer that attracted several hundred scientists from all over the world. Sea Grant Director Edward C.

Monahan co-chaired the conference with Professor Jähne of the University of Heidelberg. A 900-page proceedings volume was published in December, 1995 and a CD-ROM edition subsequently issued. Connecticut Sea Grant's Communications program assisted in planning, sending out announcements and other conference mailings, collecting manuscripts, book editing and design, and working with authors. Three UCONN faculty members and one graduate student presented papers.

## REPUBLIC OF IRELAND AND NORTHERN IRELAND

The Irish/American Aquaculture (Ir-Am-Aqua) initiative is an exchange of research and technology between the Republic of Ireland, Northern Ireland and the Northeast Sea Grant programs, begun in 1988. Three co-chairs—Ed Monahan at the University of Connecticut, John P. Mercer at University College Galway, and Dai Roberts of Queens University, Belfast—have coordinated the joint effort, holding three workshops since its beginning. While the program's original intent was to link Ireland and the Northeastern United States, interest has spread to include collaboration with others in distant ports, for example, California, Hawaii, Canada, India, and the European community. The initiative continues despite a lack of formal funding, in the form of continued collaboration between researchers and industry. Sea Grant Director Ed Monahan was asked to attend a recent meeting in Portaferry, Northern Ireland for consultation on the feasibility of designating Lough Foyle a marine sanctuary. In 1995, he



was asked to christen a research vessel for the Center for Marine Resources, also in Portaferry. In addition to its contributions to aquaculture, the program promotes peaceful interaction between Ireland and Northern Ireland. While the program is no longer formally funded, the informal interaction between researchers and aquaculture industries continues, and future workshops are planned.

The Ir-Am-Aqua initiative received high praise in a speech given by Connecticut College President Claire Gaudiani in April, 1995, at the dedication of the new F.W. Olin Sciences Center:

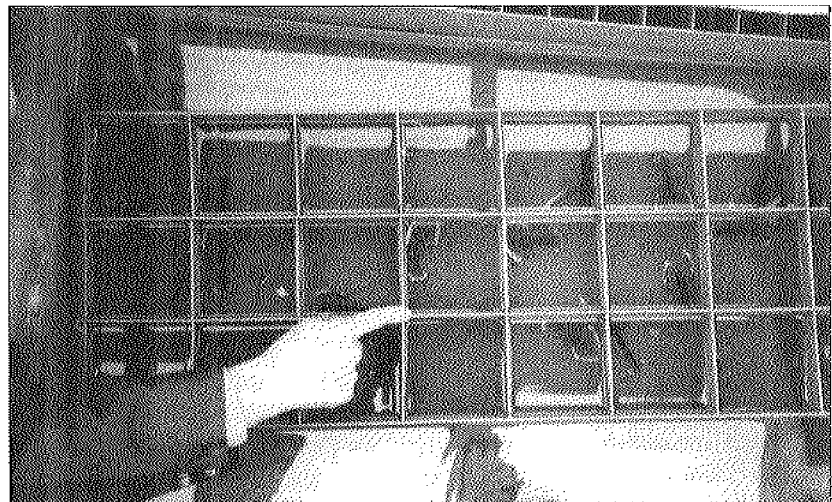
"The aquaculture initiative gives your universities, steeped in excellent academic traditions, an opportunity to heal the past and forge mutually beneficial relationships in the future...you have now established an effective means of transferring knowledge to the people who need it most, through educational outreach agencies. The Ireland/America Aquaculture Initiative now serves as an international model of linking research and education with universities, government agencies, and industry..." "Your leadership has brought together both sides of the Atlantic, as well as the Republic of Ireland and Northern Ireland, for the common good of all people. You have truly joined hands, hearts, and minds across boundaries and seas."

• The Presidents of University College, Galway and Queen's University Belfast were both awarded honorary degrees by Connecticut College for the Ir-Am-Aqua effort. At the ceremony on the New London campus, the Sea Grant program and the University of Connecticut at Avery Point were commended for their leadership.

• Doctoral candidate Bridgeen Magorrian, from Queens University, Belfast visited the Northeast Sea Grant Colleges in 1994. Magorrian was examining the effects of dragging equipment on benthic habitats and working on a project to create a marine sanctuary in Ireland similar to Stellwagen Bank.

• The program underwrote the travel expenses of several Irish aquaculturists to participate in both the First and Second International Lobster Congress in Portland, Maine.

*Right: Chinese scallop-growing techniques using lantern nets have been introduced to laboratories and aquaculture students in Connecticut. Below: Blue lobsters were raised at University College Galway's Shellfish Research Laboratory in Carna, Ireland, then released as part of a lobster stock enhancement program featured at an Ir-Am-Aqua workshop. Photo credits: Peg Van Patten, Conn. Sea Grant*



# Communication

## SENDING THE SEA GRANT MESSAGE



As the information explosion continues, the Connecticut Sea Grant communications program evolves to meet the challenge of packaging emerging knowledge in new ways.

It was a thrilling moment in January 1996 when the Connecticut Sea Grant Home Page appeared on the World Wide Web. Web presence has since expanded with an electronic edition of the *Aquatic Exotic News*, the Sea Grant Marine Advisory Program's regional newsletter on nonindigenous species, and additional publications will soon go online. Disseminating and publicizing Sea Grant research, education, and outreach is the key mission of the Communications office. The Communications office interfaces with the various components within Sea Grant—management, research, marine advisory, and education—linking them and connecting them to colleagues, industry users, schools, and information providers. Getting adequate information out in a timely fashion is a challenge, given the limitations of a one-person communications staff. Nevertheless, research has been transmitted to the National Sea Grant Depository in the form of journal reprints and technical reports, and publicized through a variety of media.

The public benefits from explanations of general concepts of coastal and marine ecosystems in simple language and graphics, using specific examples. General information in the form of printed matter is presented through feature articles for *Connecticut Currents*, our newsletter; *Nor'easter*, our regional magazine; web pages, and the media. The Communicator acts as liaison between Sea Grant researchers, the universi-

ty, and the media by supplying information for press releases and features to the University Relations office.

To see that the research reaches other investigators, the communicator facilitates the principal investigator in obtaining reprints and disseminating them, and preparing material for presentations and displays at conferences. The communicator also makes the researcher visible in expert guides and passes on information requests and contacts made via Internet.

In 1996 Peg Van Patten, the full-time Communications Manager, presented a talk to the UCONN Marine Sciences Department on why and how scientists can successfully work with the media. The talk will be expanded into a workshop for scientists given by Sea Grant communicators and reporters at the Estuarine Research Federation in the fall of 1997.

A 900-page volume from an international conference in Heidelberg, Germany was one of three proceedings volumes generated from scientific symposia. The Communications Office handled publicity for the Heidelberg meeting, and worked with the manuscript authors, conference chairs, and the book publisher. Related efforts by the communications office include assisting the Sea Grant Office in decisions involving the program's image and assisting in international collaborations by helping to arrange symposia and workshops both at home and abroad. The Third Biennial Long Island Sound Research conference was held at Avery Point in the fall of 1996, and a proceedings volume is in production.

*The Connecticut Sea Grant communications program evolves to meet the challenge of packaging emerging knowledge in new ways.*

Research is just one of the Sea Grant components supported by the Communications Office. The office also supports the Sea Grant Marine Advisory Program's outreach efforts and the formal education activities by providing editing and publications production, publicity for events, information distribution, and World Wide Web visibility.

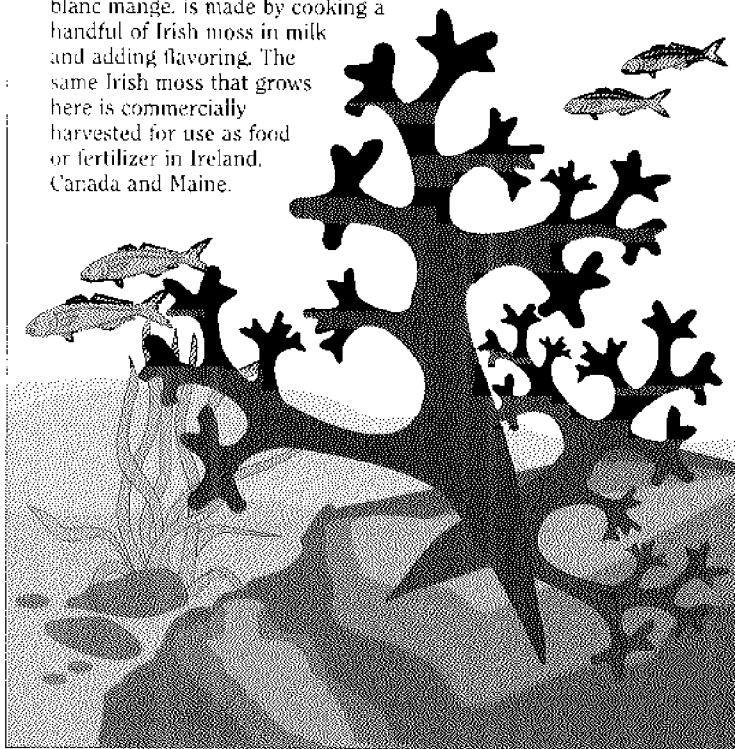
Van Patten was part of the work team that produced Connecticut Sea Grant's 30-minute documentary film, "Long Island Sound: Worth Fighting For!", a joint effort between the Marine Advisory Program and Connecticut Public Television. The film was nominated for two regional Emmys, one for its music and another for community service. The documentary, which first aired in 1995, has been distributed to high school educators, environmental groups, and libraries within Connecticut. The program also co-sponsored a television video featuring high school investigators, "The Living Sound", which was broadcast by Fox 61.

The program's first theater effort involved

## Sound facts

### My wild Irish moss

Irish moss, or *Chondrus crispus*, is a bushy red seaweed that commonly grows in colonies on subtidal rocks and often washes up onto the beaches of Long Island Sound. It may sometimes be more dark purple than red, and it may fade to white in the sunlight on a beach. This seaweed is a source of carragheenan, a thickener used in ice cream, pudding, toothpaste, pastry fillings and many other food products and cosmetics. A tasty pudding, blanc mange, is made by cooking a handful of Irish moss in milk and adding flavoring. The same Irish moss that grows here is commercially harvested for use as food or fertilizer in Ireland, Canada and Maine.



Source: P. Van Patten & E. O'Muin, Connecticut Sea Grant

Milton Moore, *The Day*

collaboration between the Communications Office, the Eugene O'Neill Theater, middle schools in Groton, and Groton Youth and Family Services. The result was a play written and performed by middle school students for younger children, using life size papier maché puppets. The play, *Save Our Sound*, was taped by Groton Public Library and broadcast on Storers cable television.

From 1987 to 1995, Connecticut Sea Grant carried out the public information and participation function of the federal Long Island Sound Study, with staff funded by the Environmental Protection Agency. Although the Study's research has been completed, the Communications office continues to work with the EPA LISS office by serving on the Public Information and Outreach committee.

The watershed of this major estuary extends from Long Island, NY through five states and into Canada, encompassing an area of 15 million people. These people continue their interest and demand for information on Long Island Sound, and will continue looking to Sea Grant to provide it. A small grant of \$4,000 was awarded to the Communications office by the EPA in 1996 to compile an educational, graphic-oriented booklet on Long Island Sound, "Sound Facts". This project is currently in production. Originally, "Sound Facts" was a very popular existing computer-generated graphic series about the various aspects of the Long Island Sound estuarine ecosystem that was developed in 1992 by the Connecticut Sea Grant Communications Office and *The Day* newspaper as a weekly news feature. The concept has been mimicked and adapted, with permission, by other institutions such as the Woods Hole Oceanographic Institution, South Carolina Sea Grant, and the University of

Kansas.

During the years 1994-1996, the Communications manager also served as regional representative for the Northeast Sea Grant communications network. As such, she represented the six Sea Grant programs and colleges in that region. Highlights included hosting regional meetings and planning hands-on workshops to help communicators hone their

skills in electronic media and photography.

As we approach the 21st century, the Connecticut Sea Grant communications office will continue to reach out to the diverse audiences concerned with coastal issues, evolving as the issues, methods, and audiences change.

# Financial Report



<b>PROJECT</b>	<b>SECTION AND PROJECT TITLE</b>	<b>INVESTIGATORS</b>
	<b>MARINE BIOTECHNOLOGY</b>	
R/A 8	Endocrine Control of Crustacean Reproduction with Some Emphasis on Shrimp	H. Laufer
R/A 9	Hormonal Regulation of Reproduction in Male Morphotypes Of Spider Crab	H. Laufer
	<b>SEA LEVEL RISE</b>	
R/OE-2	Sea Level Rise Over the Last 2000 Years: Investigations of Marsh Sequences in Connecticut	J. Varekamp E. Thomas
R/OE-5	The Influence of Accelerated Sea Level Rise on Tidal Marsh Development at Barn Island, Stonington, CT	R. Orson W. Niering S. Warren
	<b>EDUCATION</b>	
E/T-7	Coordination an Expansion of Marine Education and Activities	C. Arnold
A/E-1	Sea Grant Marine Advisory Program	N. Bender G. Whaples
A/E-2	Long Island Sound: a Public Discussion of Critical Issues	N. Bender L. Lange
	<b>PROGRAM MANAGEMENT</b>	
M/PA-1	Program Management: Administration and Planning	E. Monahan
M/PD-1	Program Development	E. Monahan
M/PD-2	Program Development II: International Projects	E. Monahan
M/CP-1	Core Communications	M. Van Patten
	<b>OTHER FUNDING</b>	
	Introduced Species	
	Knauss Fellowship	
	<b>TOTALS</b>	



<u>NOAA</u> <u>'92-'93</u>	<u>STATE/OTHER</u>	<u>NOAA</u> <u>'93-'94</u>	<u>STATE/OTHER</u>	<u>TOTALS</u> <u>'92-'94</u>
62,400	40,959	62,400	44,545	210,504
32,675	47,959	53,184	44,545	178,366
19,120	24,016	19,120	24,016	86,272
24,605	17,197	24,597	17,197	85,394
57,700	-	57,700	-	75,400
155,574	159,467	155,574	160,552	591,167
52,500	49,155	-	-	81,455
75,600	110,065	77,600	111,804	375,067
22,250	-	22,250	-	44,500
14,000	-	12,000	-	26,000
79,775	-	89,775	-	169,550
56,488	28,797	42,197	302,777	450,259
15,000	-	15,000	-	50,000
<u>605,488</u>	<u>477,615</u>	<u>591,197</u>	<u>705,456</u>	<u>2,579,754</u>

# Financial Report



<u>PROJECT</u>	<u>SECTION AND PROJECT TITLE</u>	<u>INVESTIGATORS</u>
	<b>MARINE BIOTECHNOLOGY</b>	
R/A-9	Hormonal Regulation of Reproduction in Male Morphotypes of Spider Crabs	H. Laufer
R/A-10	Endocrine Regulation of Development in Decapod Crustacean Resources	W. Biggers H. Laufer
R/A-12	Liposomal Delivery of Hormones for Crustacean Aquaculture	H. Laufer
R/A-14	Developing a Commercially Viable Seaweed Aquaculture Industry in New England	C. Yarish
	<b>NONINDIGENOUS SPECIES</b>	
R/ES-8	An Assessment of Overland Dispersal of Zebra Mussel into Inland North American Lakes	L. Johnson C. Kraft J. Carlton
	<b>SEA LEVEL RISE</b>	
R/ER-2	Sea Level Rise Over the Last 2000 Years	J. Varekamp E. Thomas
	<b>ENVIRONMENTAL ISSUES RELATING TO LONG ISLAND SOUND</b>	
R/ER-7	Mass Balance of Point and Nonpoint Sources of Heavy Metals to New Haven Harbour	G. Benoit
	<b>EDUCATION</b>	
E/T-7	Coordination and Expansion of Marine Education and Activities	V. Cournoyer J. Schneider
	<b>ADVISORY SERVICES/OUTREACH</b>	
A/E-1	Sea Grant Marine Advisory Program	N. Bender, et al.
A/E-5	Coastal Marine Outreach Interns: Public Policy and Environmental Education	G. Benoit
A/E-5	Zebra Mussel Outreach and Education	N. Balcom N. Bender
M/PA-1	Sea Grant/USDA Ext. Service National Zebra Mussel Training Initiative	N. Balcom N. Bender
	<b>PROGRAM MANAGEMENT</b>	
M/PA-1	Program Administration and Planning	E. Monahan
M/PD 1	Program Development I	E. Monahan
M/CP-1	Core Communications	M. Van Patten
M/CP-4	Reaching the Public With a Greater Wealth of Information	M. Van Patten
	<b>OTHER FUNDING</b>	
	Knauss Fellowship	
	<b>TOTALS</b>	



<u>NOAA</u> <u>'94-'95</u>	<u>STATE/OTHER</u>	<u>NOAA</u> <u>'95-'96</u>	<u>STATE/OTHER</u>	<u>TOTALS</u> <u>'94-'96</u>
92,052	48,266	86,041	59,027	265,386
15,000	17,294	15,000	18,716	66,010
75,000	25,925	75,000	28,027	203,952
-	-	70,582	33,862	104,444
51,152	18,068	50,767	18,068	98,055
54,000	28,880	22,000	22,740	107,620
62,546	34,450	66,549	31,338	194,883
52,870	26,325	55,280	26,629	159,604
85,798	60,600	90,023	64,559	300,980
15,662	10,829	17,040	11,514	55,045
24,999	18,800	46,569	20,000	110,568
25,452	15,400	12,856	4,875	56,583
77,600	140,916	79,100	143,312	440,928
27,000	-	28,000	-	55,000
87,472	-	92,967	-	180,439
-	-	12,365	-	12,865
56,000	-	56,000	-	72,000
<u>742,605</u>	<u>446,255</u>	<u>878,685</u>	<u>482,667</u>	<u>2,550,206</u>

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Liu, Lei and H. Laufer. H. 1996. Isolation and Characterization of Sinus Gland Neuropeptides with both Mandibular Organ Inhibiting and Hyperglycemic Effects From the Spider Crab *Libinia emarginata*. *Archives of Insect Biochemistry and Physiology* 52:575-585. Wiley-Liss Inc.

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Laufer, H., E. Homola, and M. Landau. 1995. Hormonal Regulation of Reproduction in Female Crustacea. NOAA Technical Report NMFS 106. pp. 89-98.

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#### TECHNICAL REPORTS AND PROCEEDINGS

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Jähne, B. and E.C. Monahan. 1995. *Air-Water Gas Transfer*. Selected papers from the Third International Symposium on Air-Water Gas Transfer. AEON Verlag, Hanau, Germany. 900 pp.

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SGMAP assisted a local fisherman in implementing a Fishing Industry Assistance Grant to assess deep-sea species, such as this royal red shrimp, as alternative commercial catches. Photo credit: John Leamon/UCONN

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# Current Projects

1996 - 1997

R/ER-2	How Coastal Salt Marshes Grow: Investigations into Long Island Sound and Delaware Bay Marshes	J. Varekamp E. Thomas
R/ER-9	Development of a Mobile Micrometeorological System for Measuring Volatile Mercury Flux In Connecticut Salt Marshes	G. Benoit X. Lee
R/ER-10	The Response of Connecticut Tidal Wetlands to Sea-Level Rise: Micro-relief, Vegetation, and Patterns of Accretion	R. Warren W. Niering
R/A-12	Liposomal Delivery of Hormones for Crustacean Aquaculture: Formulation, Biochemical Mode of Action and Physiology	H. Laufer
R/A-14	Developing a Commercially Viable Seaweed Aquaculture Industry in New England: Field and Culture Evaluations	C. Yarish
R/A-17	Hormonal Regulation of Morphogenesis and Reproduction in Male Morphotypes of Spider Crabs	H. Laufer
R/A-18	Production of Fast-Growing Transgenic Shrimp and Crayfish by Pantropic Defective Viral Vectors	T. Chen
E/T-7	Project LISTEN: Long Island Sound Teacher Enhancement Network	A. Haddow
A/E-1	Sea Grant Marine Advisory Program	N. Balcom H. Crawford
A/E-5	Coastal Marine Extension Agent Interns: Development and Coordination of Public Policy and Environmental Education	G. Benoit E. McDiarmid
A/E-6	Connecticut Sea Grant/USDA-Extension Service Training Initiative Sub-Proposal	N. Balcom
M/PA-1	Administration and Planning	E. Monahan
M/PD-1	Program Development	E. Monahan
M/PD-4	Multi-Program and Regional Initiatives	E. Monahan
M/CP-1	Communications	P. Van Patten
M/CP-4	Reaching the Public with a Greater Wealth of Information: Expansion of Nor'Easter to an On-line, Disk and Print Project	P. Van Patten

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