



Connecticut Sea Grant College Program

Annual Report 1999



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Sea Grant
Connecticut



The Connecticut Sea Grant College Program is sponsored by the National Sea Grant College Program, administered through the National Oceanic and Atmospheric Administration (NOAA), United States Department of Commerce, and the University of Connecticut. This document reports the program's activities during 1999.

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

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Letter from the Sea Grant Director

This past year has, on balance, been a vintage one for the Connecticut Sea Grant College Program. This, the 18th year of Sea Grant at the University of Connecticut, and the 11th year since UConn received the federal designation as the Sea Grant College for the State of Connecticut, was the first year in which a revised organizational structure has the Sea Grant Office report directly to the Vice Provost for Research and Graduate Education of the university. The enhanced visibility for Connecticut Sea Grant, both within and beyond UConn, that this restructuring has engendered is already reaping dividends for those who participate in this state-wide program committed to fostering, by the support of relevant research, educational, and outreach, activities, the wise use and conservation of our marine resources.

More preliminary proposals were submitted to the Connecticut Sea Grant Office in response to our early 1999 call than were ever previously tendered. And more projects will be supported in the coming year via funds received as a consequence of our omnibus submission to NOAA, and of the success of our Connecticut investigators in the recent National Strategic Investments competitions, than in any year in the current director's memory. When all of the NOAA awards to the CTSG program for the present fiscal year are added up, we find that they total some \$1.16M, and while all of the various awards for the coming year are not yet in place, we are confident they will again total well above the million dollar mark. And while our staff numbers continue to suffer some attrition, in common with other educational and research support units within this and other universities, our program has recently received additional state funds which greatly add to the ability of this office to respond to opportunities on behalf of our investigators.

This annual report documents in a systematic fashion the accomplishments this past year of our Connecticut researchers, and of the Marine Extension and Communication elements of our Connecticut Sea Grant Office, but I cannot let pass this opportunity to mention just a few highlights.

But first, I must mention with great regret the recent passing of Professor Bill Niering of Connecticut College. Dr. Niering served his college in many capacities over his almost 50 years of service, and over the past decade he served our Sea Grant program in several capacities; as a member of our Senior Advisory Board, as a member of our state-wide Program Review Panel, and as a very productive Investigator contributing insights on a variety of salt marsh and wetlands issues.

We were pleased to note that in this past year a number of Sea Grant-supported scientists have received a wide variety of well-deserved honors. Space constraints don't permit me to even begin to list these distinctions, so I will just mention two of many. Professor Gaboury Benoit was awarded tenure as an Associate Professor of Environmental Chemistry at Yale, and UConn Professor Charles Yarish, and his research on nori, featured as the December subject on the recently issued *Connecticalendar*, a publication dedicated to heralding the global contributions of UConn faculty.

Nancy Balcom, in addition to keeping our Marine Extension efforts moving forward at full speed this past year, working with collaborators in the UConn Nutritional Sciences Department, completed a monumental study, funded by our Department of Environmental Protection, on the seafood consumption habits of Connecticut residents.

And the Non-Point Source Education for Municipal Officials project, conceived as a collaborative effort between the Cooperative Extension Service and Sea Grant, received this year the UConn Chancellor's Award for Information Technology, with Heather Crawford of our Sea Grant Marine Extension program acknowledged along with the rest of the NEMO team.

The public education project, "*Sound Facts*", which appeared as a weekly feature in *The Day* of New London, and then as a small paperback, received the "best educational publication" award at the biennial Sea Grant Week meetings held in Portland, OR, in June. It's always nice to be recognized by one's colleagues, as I am sure Peg Van Patten, who conceived this effort with Milton Moore of *The Day*, and the other Sea Grant contributors, would acknowledge—and there is every indication that *Sound Facts* has not run its course — there's now a move afoot to produce selected Facts as posters for public display.

As you read the following report, please rest assured that your Connecticut Sea Grant Program looks forward with confidence to serving our community in Y2K and beyond.

Sincerely,



Edward C. Monahan
Sea Grant Director



Dr. Edward C. Monahan

CT Sea Grant photo

THE SEA GRANT MISSION

The Connecticut Sea Grant College Program's mission is to foster wise use and conservation of marine and coastal resources. To accomplish this goal, the program funds research, outreach, and education activities that have special relevance to Connecticut and Long Island Sound, and tie into theme areas that the National Sea Grant College Program has identified in its Strategic Plan: Economic Leadership, Coastal Ecosystem Health and Public Safety, and Education.

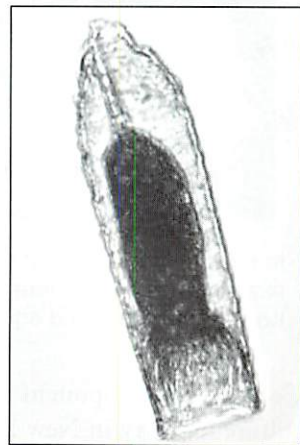
RESEARCH

Major research sponsored in 1999 fell into the broad topics of Harmful Algal Blooms, Aquaculture, Sea Level Rise, Biotechnology, Marsh Vegetation Dynamics, and Coastal Ecosystems Health.

HARMFUL ALGAL BLOOMS

Virtually every coastal state of the U.S. has been impacted ecologically and economically by harmful algal blooms. While most algae are beneficial, outbreaks of red or brown tides, and other blooms can kill or injure aquatic organisms, close beaches and shellfishing beds, impact human health, and severely impact economies dependent on coastal resources. The harmful effects depend on the particular organism, its concentration, and the exposure time. To better understand factors that can delay, prevent, trigger, or control harmful algal blooms, Sea Grant is conducting research on natural predator controls of potentially harmful algae. This knowledge will enable advance warnings and can also improve the site selection of aquaculture facilities.

George McManus and Hans Dam, Associate Professors of Marine Sciences at the University of Connecticut, and colleagues at the Marine Biological Laboratory (Woods Hole), Southampton College, and the NOAA National Marine Fisheries Milford Laboratory are examining the effects of several harmful algal bloom (HAB) species on consumer organisms, such as tintinnids, copepods, and scallops. The HAB species they are studying are found in Long Island Sound and other locations worldwide. These researchers are feeding consumers a diet of cultured algae and documenting effects on growth, digestive organs, and behavior. A better knowledge of the effects of these toxic organisms on their consumers is useful in predicting and controlling harmful blooms, and in choosing appropriate sites for aquaculture. Early results show that the planktonic grazers (copepods, tintinnids and other ciliates) are not adversely affected by *Prorocentrum minimum*, a harmful dinoflagellate. Bay scallops fed the same alga, on the other hand, experience digestive disruptions and higher mortality. The scallops, which are important grazers of dinoflagellates and other algae in shallow-water areas, probably cannot feed enough on *P. minimum* to keep it from reaching bloom population levels. This suggests that shallow-water blooms would be exported from bays and harbors into the open Sound, where their numbers would be reduced gradually by ciliates, copepods, and other planktonic grazers.



George McManus, UCONN

Tintinnopsis tubulosoides, a microscopic zooplankton found in Long Island Sound (greatly magnified).

BIOTECHNOLOGY

CONTROL OF CRUSTACEAN PROCESSES BY JUVENILE HORMONES

Decades of research on crustacean endocrinology continued by Hans Laufer, UCONN Professor of Molecular and Cell Biology and co-investigators were instrumental in identifying the juvenile hormone methyl farnesoate, which regulates many aspects of crustacean molting, growth, and reproduction. The knowledge gained has been used by shrimp and crab growers, who ablate the animals' eyestalks to increase the MF production and therefore increase egg production. This latest project tested MF production in animals with one or both eyestalks ablated and found that with one eyestalk the animal is still capable of regulating some of its MF output, whereas with both eyestalks ablated the animal may experience excess elevated MF levels continuously, possibly resulting in eggs of lesser quality. This has implications for managers of aquaculture facilities, and suggests that regulating MF levels by the crustaceans' diet rather than

by the more permanent eyestalk ablation, may be a better method. The investigators examined the role that juvenile hormone plays in morphogenesis; specifically the effect of MF on larval production. When juvenile hormone is absent in critical stages, the animals undergo metamorphosis; conversely, when they have excess juvenile hormone, larvae may remain larval and fail to reach adult form.

In a related project, Bill Biggers and Laufer have identified polyunsaturated fatty acid compounds that control settlement and metamorphosis in annelids, primitive ancestors of crustaceans and an important part of shrimp diets. Metamorphosis is a rapid indicator for juvenile hormone activity in annelids. When juvenile hormone is put in the annelids' water, it serves as a signal to settle, which they do within a single hour. This paper identifies the molecular mechanism by which this signal transduction pathway process occurs and clearly demonstrates that Protein-kinase C functions in a marine organism's metamorphosis. The findings are important to those who raise bait organisms and for the development of controls for fouling organisms.

Peter Morenus, UCONN



In his UCONN Stamford laboratory, Prof. Charles Yarish examines nori specimens with Dr. H.G. Kim, a visiting Korean scientist, and aquaculture students from Bridgeport.

NORI AQUACULTURE

Charles Yarish, Professor of Ecology and Evolutionary Biology at UCONN's Stamford campus, led the

Connecticut component of a regional research collaboration aimed at expanding and enhancing the seaweed aquaculture industry in New England. The product is *Porphyra*, or nori, a red seaweed that is commercially valuable in both pharmaceutical and food applications. Nori is often consumed as the wrapper for sushi in the U.S., and is a \$2 billion industry in Asia. Yarish has established a large culture collection of native species of *Porphyra* not yet domesticated and is compiling information on the genetic characteristics of each and their physiological tolerances and optimal growing conditions. This year, Dr. Shan Lu, from the Chinese Academy of Sciences was brought to Yarish's laboratory to collaborate on seedstock research. In a related development effort, Yarish and colleagues including Peg Van Patten from the CTSG Communications Office edited 19 manuscripts on world seaweed aquaculture, generated from a special session at the World Aquaculture meeting in Las Vegas, which were published in three issues of the Society's magazine in 1998 and 1999. A compilation of these papers is in the planning stage.

MARSH VEGETATION DYNAMICS

For thousands of years, *Phragmites australis*, or common reed grass, was a minor component of the vegetation found in North American wetland ecosystems. But in recent years, *Phragmites* has expanded aggressively and rapidly, and now dominates many marshes along the northern and middle Atlantic coasts, and is expanding further south. *Phragmites* has a bad reputation as an unwelcome invader to tidal marshes because once established, it tends to proliferate in monocultures, decreasing native biodiversity, and is not as high in nutritional value as the salt marsh grass that it displaces. While *Phragmites* invasions often occur when marsh water decreases in salinity, other factors affecting its establishment are less well known. Randy Chambers, Asst. Professor of Biology at Fairfield University, and David Osgood, Asst. Professor of Biology and Environmental Science at the University of New Haven, have been examining other conditions that encourage or discourage *Phragmites*. Preliminary results indicate that *Phragmites* may tolerate prolonged periods of flooding at low salinities better than *Spartina* (salt marsh) grasses. Further studies will examine the roles of nutrients, porewater dynamics, and sediment chemistry in relation to *Phragmites* vigor.

M.E.R.P. PROJECTS

Connecticut Sea Grant joined the Sea Grant programs of New Jersey, Delaware, and Maryland in sponsoring three additional marsh projects through MERP, the Marsh Ecology Research Program. Administered by The Academy of Natural Sciences in Philadelphia, MERP is a partnership of government, academic, and corporate entities which funds research on the ecology of freshwater and tidal marshes.

In one MERP marsh study, Kristiina Vogt, Professor of Ecosystem Ecology at the Yale University School of Forestry and Environmental Studies, and doctoral candidate Laura Ahern-Meyerson are examining ways that *Phragmites* may succeed in dominating a site because of its ability to control the cycling of certain critical nutrients, such as phosphorus and ammonium. The team has hypothesized various mechanisms by which *Phragmites* may sequester or immobilize nutrients, making them unavailable to other wetland plants. Preliminary results on plant tissues show that *Phragmites* takes up very large amounts of phosphorus in comparison with *Typha* (cattails) and other wetland plants. While no significant differences were found in the uptake of nitrogen, the fact that dense, tall *Phragmites* stands have such a large volume of biomass means that a lot of nitrogen is tied up, too. Even after the reeds die, the stems decompose very slowly, and can remain standing for two to three years. Further research analysis will look at the possible roles of silica and aluminum in immobilizing phosphorus.

In another of these projects, Jeffrey R. Powell and Kristin Saltonstall, Dept. of Ecology and Evolutionary Biology at Yale University, are comparing the genetic traits of modern *Phragmites* with samples up to 500 years old, attempting to completely understand genetic variation and geographic structuring in this species. This research examines the question of whether or not a new, more aggressive, strain of *Phragmites* has been introduced to North America.



Photo: Theresa Sinicrope Tally

Phragmites australis, common reed grass, has invaded this cattail marsh in the lower CT River estuary, altering its ecology.

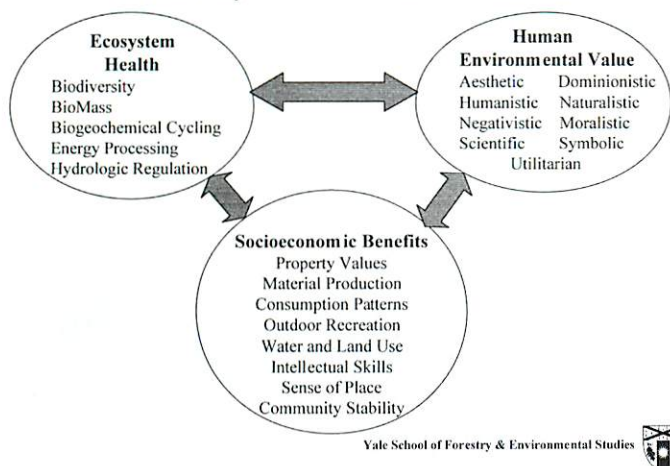
In the third MERP project, Lisa Levin, Professor of Marine Life Research at Scripps Institute of Oceanography in La Jolla, CA and co-investigators Professors Paul Fell, Zoology Department, and Scott Warren, Botany Department, both at Connecticut College, and their students are examining the ways in which invasions by aggressive vegetation modify the interaction of sediment-dwelling animals, and plant-animal interactions. The project will determine whether replacement of native upper marsh plants such as *Spartina patens* or *Typha angustifolia* by *Phragmites australis* in the lower Connecticut River leads to a shift in the structure and function of animal communities in the sediment, and will evaluate above- and below-ground plant-animal-sediment interactions. Preliminary results indicate that where *Phragmites* has invaded, there is more litter and more light reaching the sediment surface than with native plants. It did not appear that *Phragmites* affected porewater salinity or sediment chlorophyll a contents. Several gastropods and one crab exhibited higher densities in natural marsh habitat than *Phragmites*-invaded sites in at least one of the study areas, suggesting that vegetation and litter differences associated with *Phragmites* can alter the structure of animals living on the marsh (epifauna). The next phase of the study will determine whether that is also true for the infauna, the animals within the sediments.

CONNECTING ECOLOGICAL AND SOCIAL SYSTEMS: "THE MASTODON"

The ways in which humans and natural ecosystems interact are important but complicated and poorly understood. An interdisciplinary study led by Stephen Kellert, Professor of Social Biology at the Yale School of Forestry and Environmental Studies, is attempting to determine how the structure and function of natural ecosystems relates to human values and socioeconomic behavior.

The Greater New Haven Watershed Project (or "The Mastodon" as it is affectionately called, in an analogy to the blind men trying to take measure of the extinct elephant) represents the collaborative effort of six faculty and a number of graduate students in the chemical, hydrological, biological, economic, and social sciences. The study examines how ecological and social systems shape each other; how the structure and function of natural systems affects human values and socioeconomic behaviors, as well as the reverse. Kellert and colleagues believe that in urban as well as non-urban settings, ongoing positive and negative feedback loops persist between natural and

A Greater New Haven Watershed: The Quality of Nature and Human Life



human systems. How do these connections occur? The investigators hypothesize that the health and functioning of natural systems significantly influences human environmental values (the meanings people attach and the benefits they derive from natural systems) which eventually becomes manifest in a range of economic, social, and psychological relations among people, which then feed back and affect ecosystem structure and function, and the cycle continues.

The study area is the Greater New Haven Watershed, defined by the drainage of three river systems that converge at New Haven harbor. This area encompasses approximately 400 square kilometers, includes part or all of 22 towns and cities, and is home to roughly 400,000 people in a landscape that is 13%

urban, 24% suburban, 11% agricultural, and 41% forested. This study area has been divided into 18 subwatersheds, from which an extraordinary amount of chemical, hydrological, plant, animal, economic, and social data has been collected.

Preliminary results of this study suggest that the hypothesis is correct. They found, for example, that in some subwatersheds characterized by relative health and integrity (e.g., based on such criteria as species richness, fecal coliform, phosphate, etc.) there is a statistically greater occurrence in humans of more positive environmental values, greater environmental responsibility, enhanced environmental understanding, higher levels of neighborhood and household quality, and higher quality of life. Conversely, some subwatersheds of lower environmental quality have revealed in humans a lower quality of life, less interest in and contact with the natural environment, less concern and responsibility for conserving the natural environment, and a greater inclination to support the dominance and control of natural processes and diversity.

SEA LEVEL RISING RAPIDLY IN CONNECTICUT

Understanding how coastal marshes grow or shrink in response to sea level and climate fluctuations is important for wetlands management. To better understand this variation, Connecticut Sea Grant is supporting two separate research teams, one looking at long term sea level rise trends and climate change, and another looking at short term changes.

Long-Term Sea Level Rise

Two professors at Wesleyan University-Johan Varekamp, a geologist, and Ellen Thomas, a paleozoologist-have investigated marsh changes in response to sea level rise over the past two thousand years, and how these changes relate to climate.

The two examined sediment cores taken from coastal marshes in Connecticut, analyzing the chemistry, vegetation and fossilized animal assemblages. Radiocarbon dating was used to establish time frames for the various strata. By studying these data, they can determine when marshes were flooded, when they emerged and accumulated, and the onset of industrial pollution.



Ellen Thomas, paleozoologist at Wesleyan University, examines foraminifera from peat cores taken from coastal marshes.

©Michael J. Vitti / CT Sea Grant

From their investigations, Varekamp and Thomas have determined that sea level in Connecticut is rapidly rising, and many Connecticut marshes studied are not growing fast enough to keep up. But is it because of "the greenhouse effect" contributing to global warming? Varekamp and Thomas think not. They believe it is the result of longer-term thermal expansion of the oceans or dynamics at the ocean's surface. They discount the greenhouse effect because the acceleration in sea level rise began around 1650, which predates the rapid accumulation of greenhouse gases from anthropogenic sources, which started around 1900.

WHAT'S SHAKING IN CONNECTICUT:

An Upcoming Earthquake?

Could slumbering Connecticut citizens awaken to the sounds of crashing china and crumbling chimneys in the near future? While studying ancient marsh sediments in order to determine past sea level trends, Connecticut Sea Grant-sponsored researchers recently inadvertently discovered evidence of an active fault line running along the Connecticut River Valley. Geochemist Johan Varekamp, paleozoologist Ellen Thomas, and geologist William Thompson were struck by discrepancies they found in the sediment histories of two nearby sites. Analysis of organic and fossil remains within the sediment samples taken from marshes along the Farm River in Branford and from Kelsey Island, about a mile away in Long Island Sound, indicated a much faster sea level rise in one area than in the other. The Wesleyan University scientists realized that the two sites were on opposite sides of the Eastern Border Fault. This fault, which forms the eastern edge of the Connecticut River Valley, was long considered to be dormant. Extensive research, including radiocarbon dating and sediment analysis, indicated that a pattern of slight upwelling in the Kelsey Island marsh has been followed by substantial earthquakes, which have occurred about once every 200 years over the past 1,200 years. The last significant earthquake to shake up the Connecticut River Valley was magnitude 4.4 and occurred in 1791—just about 200 years ago. Current research indicates that such an upwelling is now occurring in the area.

Connecticut residents need not worry too much, however. Even a "major" earthquake associated with the Eastern Border Fault would not be likely to exceed a magnitude of 5 on the Richter scale, the experts say. Unlike the recent tragedies in Turkey, Taiwan and Mexico, damage would be relatively minor—limited to jiggling furniture, crashing china, and cracks appearing in foundations and chimneys. While structural damage could be extensive in some spots in the greater New Haven area, and small boaters could get a rough ride, a magnitude 5 quake is not likely to collapse buildings or result in loss of life. Of particular interest to shoreline residents would be a repeat of a phenomenon observed during the 1791 earthquake: the captain of a ship moored off Clinton, CT reportedly observed fish "leap out of the waters in every direction as far as the eye could reach."

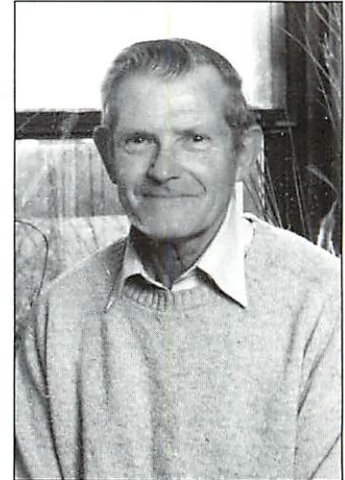
Short Term Sea Level Rise and Coastal Processes

As the researchers at Wesleyan University study long-term changes in marsh elevation and its climate implications, another research team identified sea-level fluctuations in the short term.

Scott Warren and Bill Niering, professors of botany at Connecticut

College, completed research funded the previous year. They examined how Connecticut marshes grow, shrink, and change shape in response to sea-level changes over periods of 25 to 50

years. The investigators found that, although sea level in southern New England rose at an average rate of 1 millimeter per year for thousands of years, increasing over the past 150 years to about 2mm, it has doubled over the past 25 years! Now at an average of 4.4 mm per year, this rapid rate of sea level rise is causing vegetation change and wetland loss. In some marshes where surface sediments accrete slowly, such as at Barn Island, Stonington, marshes simply can't build up quickly enough and are eroding away. At Barn Island, for example, marsh elevation increased 2.8 mm from 1989 to 1998, but sea level rise for the same period averaged



William A. Niering, Professor of Botany at Connecticut College, passed away suddenly, after completing his salt marsh research with Scott Warren. TIME Magazine's obituary identified him as "one of the first to figure out that marshes performed valuable functions...". His shoes will be hard to fill.

© Michael J. Vitti/CT Sea Grant

14.2 mm. If current trends continue, present middle to high marsh areas may become low marsh within a few centuries, and much of today's low marsh may be submerged. (This project was funded by the previous year's award, but came to fruition this year, just before Dr. Niering suddenly passed away in August. Three articles are in press.)

DEVELOPMENT PROJECTS

Many timely projects are implemented with development funds. Some are moderate-sized, multi-program, regional efforts while others are small-scale pilot efforts or requests for equipment or travel funds for investigators. These numerous efforts are listed in detail on the financial pages at the end of this report. A few will be described here, to give the flavor of the requests:

Impact of Dredging on Potential Red Tide

In a small-scale collaborative effort, CTSG supported a local study by Don Anderson, Woods Hole Oceanographic Institution, and representatives of the Groton Shellfish Commission and Sea Grant, in a study to examine the impact of dredging operations on toxic cyst distribution and subsequent red tide blooms. Sediment cores were taken and examined for *Alexandrium* cyst profiles before a dredging operation to transfer clams from Mumford Cove, Groton, CT to grow-out sites. Because the cysts were found in the cores, shellfish managers were aided in making a decision not to move the clams.

Habitat for Juvenile Cod

Peter Auster, biologist for the National Undersea Research Center based at UCONN, completed a study on factors that affect bottom habitat essential for juvenile codfish. Such factors include the effects of fishing gear on sea bottom, and the presence or absence of other benthic animals. More cod survived when sponges were also present, suggesting that the sponges helped to camouflage the larval cod from predators. Auster, who was named a Pew Fellow this year, believes this work will complement the new revisions to the Magnuson-Stevenson legislation relating to Essential Fish Habitat.

Conferences/Workshops

Conferences and workshops co-sponsored by CTSG as development efforts in 1999 included a conference on Arctic Seas research held at Mystic Aquarium, the first Housatonic River Symposium, a conference on the History, Status, and Future of the North Atlantic Fisheries at Connecticut College, a conference on Essential Fish Habitat with New Hampshire Sea Grant, and the first National Marine Bioinvasions Conference at MIT.

Seal Watcher and Turtle Watcher Guides

CTSG assisted the Mystic Aquarium in printing two colorful laminated pocket guides depicting endangered marine mammals and turtles that may be encountered by boaters in Long Island Sound. The cards give instructions for identifying and aiding injured or stranded animals.

Native American Programs

A series of environmental/humanities programs were presented at the New England Aquarium, in collaboration with the native American Tribes of New England and the northeast Sea Grant programs. The series opened in October 1998 and ended in the Fall of 1999. Programs encouraged aquarium visitors to interact with the Native American people, and demonstrated traditional tribal arts and crafts, including fishing practices, along with environmental concepts.



Edward Monahan, Sea Grant

Arctic sea environments present a chilly challenge to visitors. Some hardy researchers shared their experiences at the *Arctic Seas: Currents of Change* research conference held at the Mystic Aquarium.

OUTREACH

CONNECTICUT SEA GRANT EXTENSION

The Sea Grant Extension Program (SGEP) transfers technology to those who use or manage the State's coastal and marine resources. Workshops, forums, task forces, discussion groups and lectures are among the methods employed. Present staff consists of two educators.

NEMO – A Water Quality Initiative

Nonpoint Education for Municipal Officials (NEMO) is a joint University of Connecticut Cooperative Extension System / Sea Grant project using innovative techniques such as geographic information system (GIS) technology to

teach local officials about the sources and impacts of nonpoint source pollution, how land use affects water quality, and what towns can do to protect water quality. The education approach is to simplify and explain the complex relationship between land use and water quality. The NEMO concept is now being adopted in 17 other states. The NEMO team received the UCONN Chancellor's Award for Innovative Technology this year.

As part of the NEMO program, Sea Grant Extension Educator Heather Crawford has developed *Clean Waters*, a program for homeowners. The hands-on program focuses on the care of septic systems, household hazardous chemical and waste management, yard and garden care, and naturalist landscaping. A fact sheet series on these topics is in production. Since 1998, more than 300 members of garden clubs and local

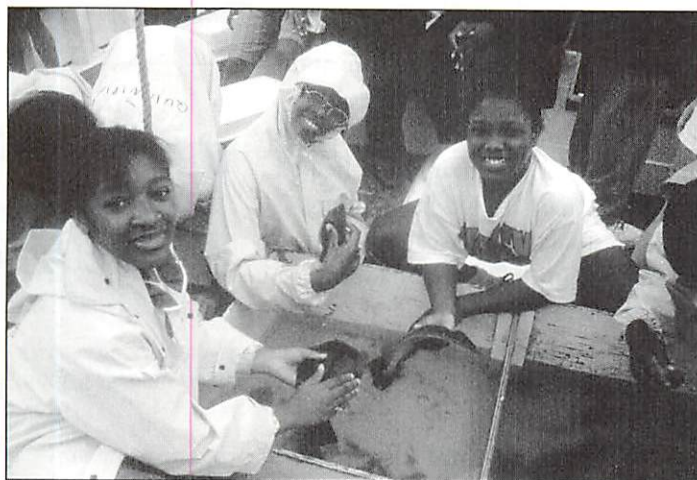


Photo: Heather Crawford, CTSG

A real live fish! As part of CT Sea Grant Extension's urban youth education program, city kids discover their links to New Haven Harbor and Long Island Sound.

land trusts have participated in the program. A joint program with Cooperative Extension for the Branford River watershed has trained volunteers to visit urban dwellers and new suburban homeowners as an "Environmental Welcome Wagon". This program may be adopted by Norwalk River watershed communities during the next year.

Seafood Safety

Sea Grant Extension wants to help the seafood industry produce the safest fish and seafood possible. A 1997 federal (FDA) regulation requires domestic and foreign seafood processors, wholesalers and importers to anticipate and control potential seafood safety hazards utilizing processing principles known as HACCP (Hazard Analysis and Critical Control Points), which were pioneered in the 1960's by the Pillsbury Company for the space program, and later required for low-acid canned food producers. To enable the seafood industry to accomplish this, Sea Grant educators nationwide are training industry members in HACCP, the basis of which is to identify and control for potential food safety hazards relating to species and process. Since becoming certified to teach HACCP techniques in 1996, Sea Grant Extension Educator Nancy Balcom has taught 11 HACCP courses, in Connecticut, Massachusetts and Rhode Island, and trained over 250 industry members, enabling them to accommodate the regulation. Balcom also collaborates with Rhode Island Sea Grant to produce a semi-annual newsletter, *Seafood Safety Savvy*, to update HACCP trainees on new information regarding hazards, the interpretation of the regulation, and new courses. Brochures describing HACCP with instructions for consumers on how to safely handle, store and cook seafood were distributed.

Connecticut Seafood Council Debut

Connecticut seafood is establishing a collective identity, thanks to the new Connecticut Seafood Council (CSC), and Sea Grant Extension Educator Nancy Balcom is helping the council to get off to a good start. Established by the Connecticut General Assembly in 1997, the Council includes appointees representing seafood harvesters, processors, wholesalers and retailers, and ex officio members. *Ex officio* members include Balcom and representatives from the State's Departments of Agriculture (Bureau of Aquaculture), Environmental Protection and Economic and Community Development. The CSC attracted more than 40 members in its initial call for members, following a 1999 kick-off marketing promotion featuring American shad. Balcom produces the quarterly newsletter, *Seafood News*, for the CSC.

Aquaculture Techniques

SGEP is working with the NOAA National Marine Fisheries Service laboratory in Milford, CT on the development of a training manual in bay scallop hatchery techniques. A draft of the manual is currently in the review stage and CTSG expects to publish it by Spring 2000.

Eelgrass Recovery Aids Atlantic Bay Scallops

SGEP was approached by a local shellfish commission to assist in a program to restore and protect eelgrass beds, which provide a habitat refuge for juvenile bay scallops, in an estuary known as "The Scallop Estuary" as the first step towards restoring a natural population of bay scallops. Warning flags posted around eelgrass beds in the Niantic River estuary have helped boaters stay clear of the beds, aiding the restoration effort. More than 24,000 bay scallops were held in suspended cages during the summer 1999 in the estuary. These scallops were placed on the bottom after they had spawned in July and August, in the hopes of adding new juveniles to the small nascent population.



Bernie Faber

Flags warn boaters away from sensitive eelgrass beds.



Photo: Vermont DEC

Recent Invasion: water chestnuts have invaded Connecticut rivers.

Aquatic Nuisance Species

SGEP has been involved in aquatic nuisance species (ANS) programming since 1991, focusing primarily on the freshwater zebra mussels and aquatic plants such as Eurasian watermilfoil and *Hydrilla hydrilla*. Since the discovery of *Hydrilla* in 1996, zebra mussels in 1998, and water chestnut in 1999 in Connecticut water bodies, the issue of invasive species continues to demand attention. SGEP has played a pivotal role in alerting user groups, lakeshore residents and the public to these threats, both in Connecticut and throughout the Northeast. Task forces, workshops, publications, signs, videos, and a regional newsletter are all components of this comprehensive program. Extension Educator Nancy Balcom served on the steering committee of the first National Conference on Marine Bioinvasions, held in Cambridge, MA in 1999, which drew an extensive national and international audience. SGEP also provided modest support, including travel funds, for a Ph.D. student at UCONN studying the Japanese shore crab, *Hemigrapsus sanguineus*, which appeared in Long Island Sound in 1993. Balcom was recently elected to serve on the Board of Directors for the Connecticut Federation of Lakes.

YALE SEA GRANT INTERNS ASSIST COMMUNITIES

Connecticut communities have been getting help in making critical environmental and economic decisions, thanks to student projects conducted through the Sea Grant Internship Program at Yale University. The projects implemented most recently include GIS-based studies on the spread of *Phragmites* (invasive reed grass), a potential marsh restoration site, and the analysis of land use patterns in a water supply watershed for the greater New Haven area. One intern compared nonpoint source nitrogen loading in various subwatersheds, while another used the NEMO format to turn research data into information more easily understood by local officials. Another intern studied newly-identified insects that cause

significant damage to *Phragmites* and have potential use in biocontrol. The interns are graduate students in Yale's School of Forestry and Environmental Studies, Center for Coastal and Watershed Systems in New Haven. The program has supported 22 interns since its beginning in 1994, and plans to support 12 new graduate student projects over the next two years.

EDUCATION

Marine Sciences for the Deaf

A project led by Peter Scheifele, Education Coordinator for the National Undersea Research Center at the University of Connecticut, seeks to improve science education for the deaf using a marine science curriculum reinforced by hands-on laboratory and field experiences. Students learn concepts of physics, chemistry and biology in the classroom at the American School for the Deaf in West Hartford, then apply them to marine science on Long Island Sound. Using hydrophones and SONAR, students distinguish background noise in the water from the sounds of animals and human activities by vibrations and the shape of the sounds' waveforms on a computer monitor. They also measure physical characteristics of the water and examine marine animals and sediments. As part of the project, in collaboration with Gallaudet University, new signs for scientific terms will be developed, approved, and compiled into a book. CTSG provided ship time for these students.

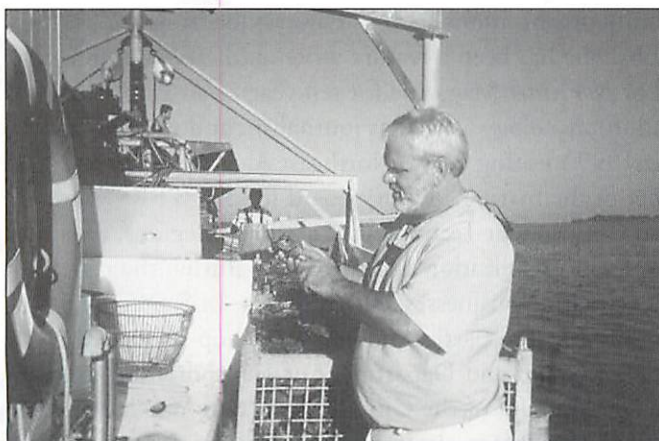


Jennifer Olmquist/CT Sea Grant

Crystal Jenkins, a high school student at the American School for the Deaf in West Hartford, CT signs to Jennifer Courville during class aboard the *R/V Connecticut*, UCONN's research vessel.

Investigating the Marine Environment

An earlier marine education project, funded in the 1980's, bore new fruit this year when Project Oceanology put its *Model Oceanographic Field Study: Investigating the Marine Environment* resource guide for teachers on CD-Rom, with video and selected chapters from the original Sea Grant-supported print publication. The CD is available from Project Oceanology in Groton, CT.



Sea Grant Teacher Intern Pat Allercon examines marine life in Norwalk Harbor during an on-the-water field trip organized by The Maritime Aquarium.

SEA GRANT EDUCATION AT THE MARITIME AQUARIUM

Bringing Marine Science to the Classroom

Connecticut Sea Grant's formal K-12 education efforts are based at The Maritime Aquarium in Norwalk. Sea Grant educators Diana Payne and Kim Raccio develop and implement activities and resources for teachers to learn about and access Sea Grant information designed to educate school children about Long Island Sound, watersheds, and the global ocean. Over 400 teachers attended Sea Grant professional development workshops for teachers this year, and thousands received mailings. The program serves as a curriculum development resource to a variety of schools in both CT and NY.

Activities this year included a Long Island Sound Educators Conference, the ongoing Sea Grant Teacher Resources Room, workshops on focused topics, and a four-week summer teacher internship program based on Sea Grant's successful Pathfinder model.

One major staff change took place in late summer when CTSG Education Coordinator Amy Haddow left to take a position with the Alaska Sea Life Center and was replaced by Diana L. Payne. Payne will coordinate the CTSG education programming activities at The Maritime Aquarium, while educator Kim Raccio will oversee teacher resources. Raccio produces *Making Waves*, a professional development newsletter for marine educators.

A special workshop on Marine Archaeology is planned for February, 2000, and plans are underway for the annual Long Island Sound Educators Conference to be held in March, 2000.

A number of four-week, paid summer Sea Grant Teacher internships are offered to teachers, who are enabled to investigate topics such as salt marsh reclamation, water quality analysis, commercial fishing, water treatment, aquarium animal feeding and tank maintenance, and curriculum development, assisted by state and city agencies, industry, and the Aquarium staff.



TMA photo

Teacher Lisa Zint talks to the animals: Sea Grant Teacher Interns learn to prepare meals for aquarium seals as part of their summer ocean experience at The Maritime Aquarium.

New Publication:

Long Island Sound in a Jar
Heather M. Crawford, CTSG
Extension

This 90-page publication is chock-full of fun learning experiences for youth (grades 4-8) relating to water, watersheds, pollution, and estuaries. Old favorites and activities with a new twist are combined in this lavishly illustrated activity guide. Originally intended for 4-H leaders and summer camp counselors, the activities are equally useful for formal classroom educators and families. By playing games such as "molecular tag" or "habitat circles", or creating a watershed puzzle, young people undertake hands-on discovery of basic scientific and ecological concepts and have fun, too. They discover the impact of humans on aquatic ecosystems, using Long Island Sound as the example. Creating "Long Island Sound in a Jar," polluting it, and then cleaning it up is only one of the challenges.

LONG ISLAND
S·O·U·N·D
I·N·A·J·A·R



ACTIVITIES FOR YOUTH - DEMONSTRATING
HUMAN IMPACT ON AQUATIC SYSTEMS

COMMUNICATIONS

The Connecticut Sea Grant Communications Office disseminates information from Sea Grant research to the scientific community and the public, oversees production of publications and media relations, and creates the program's image through its website, annual reports, and other products. Staff consists of one full-time Communications Director, Peg Van Patten, and occasional student help.

Networking

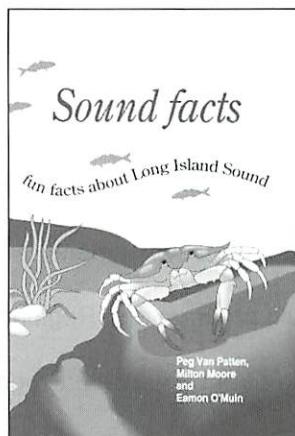
Van Patten gives occasional talks for school groups and community organizations such as Power Squadrons and Rotary Clubs. She has been a feature writer and served on the editorial board of *Nor'easter* Magazine for ten years. Van Patten has a background in phycology as well as journalism and was Co-convenor for the 1999 meeting of the Northeast Algal Society. She is a member of the marine advisory board for SECTER (South Eastern Connecticut Technology Enterprise Region), an industry development organization dedicated to featuring the region as a cluster of marine businesses and academia. In September, Van Patten was asked to participate in a workshop sponsored by the U.S. Coast Guard and Department of Transportation to chart the future development of the City of New London, a historic maritime port. Van Patten also served on the Save the Sound Habitat Restoration Taskforce, and is an invited member of the E.P.A. Long Island Sound Study Communications committee.

"Best Educational Publication" Award

Communications highlights this year included receiving the award for Best Educational Publication from the Sea Grant Association, in a national competition held during the biennial Sea Grant meeting in Portland, Oregon. The winning entry was a popular paperback booklet, *Sound Facts: Fun Facts about Long Island Sound*, by Van Patten, Milton Moore (*The Day* newspaper), and Eamon O'Muin. *Sound Facts* also won the People's Choice award in the same category.

Sound facts Spinoff Projects

Sales of *Sound Facts* to schools, environmental groups and aquaria continued briskly and consumers groups expanded. To increase the exposure of *Sound Facts*, two new ventures were begun: (1) a full-color PDF-format web version was created and offered on the World Wide Web; and (2) individual *Sound Facts* are being blown up into poster size for display in public places. The City of Norwalk recently began work on a baked porcelain outdoor display featuring one of the *Sound Facts*, to be erected on an outdoor walkway to the city's park. The Communications Office assisted several sister Sea Grant programs as well as the NOAA Atmosphere and Oceans Meteorological Laboratory in Miami, FL with developing their own versions based on the *Sound Facts* concept.



Heather Crawford

Sea Grant Director Ed Monahan and Communications Director Peg Van Patten accept the first prize plaque for Best Educational Publication, for *Sound Facts*.

Sea Grant Community

Nationally, Connecticut Sea Grant Communications helped to compile information on Sea Grant's Harmful Algal Blooms and Aquatic Nuisance Species projects and assisted in the creation and display of several national exhibits and a statement of Sea Grant's Environmental and Scientific Literacy objectives.

Student Contributions

The Communications Office makes effective use of undergraduate student help. In 1999, General Studies student Liz Kading wrote articles for the program's website, which was redesigned by Engineering student Robert Dowden.

CTSG Home Page on the World Wide Web
Northeast Sea Grant regional website:

<http://www.seagrants.uconn.edu>
<http://web.mit.edu/seagrants/northeast/>

The program's new online image was developed, introducing a dynamic new look for its pages with user-friendly fast-loading graphics and interactive components. Work commenced on digitizing earlier publications for online use. To fill the void after our regional Sea Grant magazine, *Nor'easter*, ceased publication after a decade, a brand-new Northeast regional website was instituted, coordinated at the Massachusetts Institute of Technology. Connecticut Sea Grant's contributions to the site included articles and graphics on aquaculture, coastal processes, nonindigenous species, marine education, and other timely topics. The site will be marketed to teachers and others in 2000. CTSG-sponsored biotechnology research was also featured on the Environmental Network News website.

Special Events

Special events coordinated by the Communications Office included the annual participation in International Coastal Cleanup, involving more than 500 volunteers, and Coastweeks Row on the Mystic River, with 150 participants.

FINANCIAL REPORT

MAJOR PROJECTS FUNDED 1998

Project No.	Title	Investigator
<i>Core Program Elements</i>		
M/PA-1	Program Management/ Admin. & Planning	E. Monahan
M/PD-1	Program Development	E. Monahan
M/PD-4	Multi-program and Regional Initiatives	E. Monahan
A/E-1	Sea Grant Extension Program	N. Balcom
M/CP-1	Communications Program	M. Van Patten
<i>Research Projects</i>		
R/A-20	Trophic Effects of Two Dinoflagellates Upon Representative Pelagic and Benthic Consumers	G. McManus, H. Dam <i>et al.</i> R. Smolowitz S. Shumway
R/A-21	Endocrinology of Shrimp Reproduction, Maturation and Spawning	H. Laufer
R/ER-2	Environmental Changes In and Around Long Island Sound: Natural and Anthropogenic Factors	J. Varekamp, E. Thomas
R/ER-12	Hydrologic and Chemical Control of Phragmites Growth in Tidal Marshes	R. Chambers D. Osgood
R/SL-8	Connecting Ecological and Social Systems: Watershed Research Relating Ecosystem Structure and Function to Human Values and Socioeconomic Behaviors	S. Kellert
<i>Education and Outreach Initiatives</i>		
A/E-3	Yale/ Sea Grant Coastal Internship Program: Development and Coordination of Public Policy ...	G. Benoit
E/T-7	Bringing Maritime Science into Classrooms: Outreach Programs and Teacher Support	J. Schneider A. Haddow
E/T-9	Advancing Science Learning for the Deaf Through Marine Science	P. Scheifele

GRAND TOTAL

* Development projects are listed separately on page 19.

Institution	NOAA funds	State funds	Totals
UConn	\$143,300	\$190,800	\$334,100
UConn	\$ 35,000	0	\$ 35,000
UConn	\$100,000	0	\$100,000
UConn	\$139,000	\$ 74,900	\$213,900
UConn	\$125,300	0	\$125,300
UConn LAAMP, UPENN; MBL Bigelow Laboratory	\$ 73,300 subaward subaward	\$ 23,500	\$ 96,800
UConn	\$ 11,200	0	\$ 11,200
Wesleyan U.	\$ 23,500	\$ 18,300	\$ 41,800
Fairfield U. Univ. of New Haven	\$ 50,200 subaward	\$ 34,000	\$ 84,200
Yale U.	\$ 45,300	\$ 84,500	\$129,800
Yale U.	\$ 27,400	\$ 29,000	\$ 56,400
The Maritime Aquarium	\$ 61,600	\$ 36,000	\$ 97,600
NURP, UConn	\$ 3,400	\$ 3,100	\$ 6,500
			<hr/> \$1,207,300

FINANCIAL REPORT**MAJOR PROJECTS FUNDED 1999**

Project No.	Title	Investigator
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Core Program Elements

M/PA-1	Program Management/ Admin. & Planning	E. Monahan
M/PD-1	Program Development	E. Monahan
M/PD-4	Multi-program and Regional Initiatives	E. Monahan
A/E-1	Sea Grant Extension Program	N. Balcom
M/CP-1	Core Communications Program	M. Van Patten

Research Projects

R/A-20	Trophic Effects of Two Dinoflagellates Upon Representative Pelagic and Benthic Consumers	G. McManus, H. Dam R. Smolowitz
R/ER-2	Environmental Changes In and Around Long Island Sound: Natural and Anthropogenic Factors	J. Varekamp, E. Thomas
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R/SL-8	Connecting Ecological and Social Systems: Watershed Research Relating Ecosystem Structure and Function to Human Values and Socioeconomic Behaviors	S. Kellert

Education and Outreach Initiatives

A/E-3	Yale/ Sea Grant Coastal Internship Program: Development and Coordination of Public Policy ...	G. Benoit M. Tyrell
E/T-7	Bringing Maritime Science into Classrooms: Outreach Programs and Teacher Support	J. Schneider
E/T-9	Advancing Science Learning for the Deaf Through Marine Science	P. Scheifele

GRAND TOTAL

* Development projects are listed separately on page 19.

Institution	NOAA Funds	State Funds	Totals
UCONN	\$149,200	\$200,000	\$349,200
UCONN	\$ 57,000	0	\$ 57,000
UCONN	\$100,000	0	\$100,000
UCONN	\$139,000	\$ 78,500	\$217,500
UCONN	\$128,200	0	\$128,200
UCONN LAAMP, UPenn	\$ 64,600 subaward	\$ 24,600	\$ 89,200
Wesleyan U.	\$ 24,000	\$ 16,300	\$ 40,300
Fairfield U.	\$ 43,300	\$ 29,000	\$ 72,300
Yale U.	\$ 52,200	\$ 87,900	\$140,100
Yale U.	\$ 28,400	\$ 30,100	\$ 58,500
The Maritime Aquarium	\$ 59,800	\$ 37,800	\$ 97,600
NURP, UCONN	\$ 3,400	\$ 3,100	\$ 6,500
			<hr/> \$1,356,400

FINANCIAL REPORT**M/DP-1 DEVELOPMENT PROJECTS****Project/Request Title****Investigator**

Symposium, "Arctic Seas: Currents of Change"	David St. Aubin
Color Plate to accompany journal article in <i>The Biological Bulletin</i>	Hans Laufer
Research re <i>Perkinsus</i> infection in the Eastern Oyster	Thomas Chen
A comparative plan for an aquatic animal health teaching program	Salvatore Frasca
Housatonic River Symposium	Barbara Milton
Testing the validity of a simple particle aggregation (Mike Ford)	Hans Dam
Taste, Touch and Smell of Science (summer youth camp)	Kam Tang
Coastal Perspectives Lecture Series	Jim Kremer
Video-Based Demonstrations of Rotating Fluid Dynamics...	Dan Codiga
UConn/Sea Grant 10th Anniversary	VECR
Sponsorship of Visiting Scientist	Tom Chen
Printing laminated Seal Watcher guides	Deb Adamson
Travel to conference of European Comparative Endocrinologists	Hans Laufer
National Ocean Sciences Bowl	Peter M. Scheifele
Endangered Coastal Resources lecture Series	M. Tyrelle/E. McDiarmid
Travel to scientific meeting in Crete	Tom Chen
Brochures for Coastal America habitat travelling displays	Jim Stone

FINANCIAL REPORT**M/DP-4 DEVELOPMENT PROJECTS - REGIONAL AND MULTI-PROGRAM FUNDS****Project/Request Title****Investigator**

Influence of <i>Phragmites</i> Invasion on the Fauna of Conn. Wetlands	Lisa Levin
Genetic Change in <i>Phragmites australis</i> in North America	P. Fell, S. Warren
Impact of <i>Phragmites australis</i> on Nutrient Pools and Fluxes ...	Jeffrey Powell
National Conference on Marine Bioinvasions (at MIT)	Kristiina Vogt
Baseline Information regarding Distribution ... of <i>Porphyra</i> ...	Chrys Chrysostomidis
Liposome Delivery of Hormones for Crustacean Aquaculture	Charles Yarish
Native American Programming at the New England Aquarium	Hans Laufer
Long Island Sound Research Conference	Susan Dowds
Circulation and Exchange at the Entrance to Narragansett Bay	Susan McNamara
Characterization of <i>Argopectan irradians</i> stock structure	Linda Huzzey
Royal Red Shrimp Study	Joseph Crivello
Effects of Nori Aquaculture on the Marine Flora of Cobscook ...	Nancy Balcom
The Impact of Dredging Operations on Toxic Cyst Distributions ...	Charles Yarish
Essential Fish Habitat workshop (Portsmouth, NH)	Donald M. Anderson
Long Island Sound Study Public Information (with NYSGI)	Brian Doyle
<i>Nor'easter</i> magazine	Mark Tedesco
Logistics for Northeast Sea Grant Meeting (Mystic, CT)	Peg Van Patten
	Heather Crawford

Institution	Funds
Mystic Aquarium	\$4,000
UConn	\$ 500
UConn	\$5,600
UConn	\$3,000
CT Audubon	\$1,500
UConn	\$1,560
UConn	\$ 250
UConn	\$ 240
UConn	\$1,300
UConn	\$4,458
UConn	\$1,500
Mystic Aquarium	\$3,000
UConn	\$ 800
NURC, UConn	\$2,500
Yale U.	\$1,000
UConn	\$3,000
Mystic Aquarium	\$2,500

Institution	Funds
Scripps Inst. of Oceanography	\$34,363
Connecticut College	subaward
Yale University (MERP)	\$25,000
Yale University (MERP)	\$12,435
M.I.T. Sea Grant	\$ 5,100
UConn	\$13,860
UConn	\$14,980
New England Aquarium	\$ 3,000
Southern CT State Univ.	\$ 3,500
U.S. Coast Guard Academy	\$ 3,500
UConn	\$ 9,000
UConn, SG Extension	\$ 5,000
UConn	\$ 9,900
Woods Hole Oceanographic Institution	\$ 3,500
New Hampshire Sea Grant	\$ 500
E.P.A. Long Island Sound Study	\$25,000
UConn, CTSG	\$ 7,013
UConn	\$ 1,000

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Heather M. Crawford, Extension Educator
Capt. Charles H. Nixon, Executive Officer
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