CONNECTICUT SEA GRANT

College Program

ANNUAL REPORT 2002

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) and the University of Connecticut. This document reports the program's activities during the calendar year of 2002.

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

Written by Peg Van Patten, Connecticut Sea Grant Communications Office, with input from the principal investigators and Sea Grant staff.
Illustration and design by Peg Van Patten, Connecticut Sea Grant Communications Office.

Cover photo credits: Front cover photos, Peg Van Patten (see pages 4 and 14)
Back cover: Peter Morenus, UCONN (top); Mark Gordon (middle); Peggy Stewart (WCSU), bottom.

Additional copies of this report can be obtained at no charge, while supplies last, by making a written request to:

Connecticut Sea Grant Communications Office
The University of Connecticut
1080 Shennecossett Road
Groton, Connecticut 06340-6048

or download a PDF copy (1.6MB) at <http://www.seagrant.uconn.edu>

 Connecticut Sea Grant College Program CTSG-03-03

Sea Grant Connecticut

UCONN

NOAA National Oceanic and Atmospheric Administration U.S. Department of Commerce

CONTENTS

Letter from the Director's Desk

Edward C. Monahan , Connecticut Sea Grant Director

If 2001 was the year of new accommodations for our Connecticut Sea Grant program, then 2002 surely can be designated the year of new faces. In spite of the economic vicissitudes faced by our state and the nation in 2002, we have been very fortunate to have had three new staff join the hard-working cadre in our Sea Grant Office on the Avery Point campus of the University of Connecticut.

Dr. Robert (Rob) J. Johnson has "come aboard" as our Associate Director, bringing with him a familiarity with Sea Grant gained while on the faculty at the University of Rhode Island. Diana L. Payne is now our Sea Grant K – 12 Education Coordinator, having previously been involved in Sea Grant education while at the Maritime Aquarium at Norwalk. Dr. Robert (Bob) S. Pomeroy has joined us as a Sea Grant Fisheries Extension Specialist, bringing with him from the World Resources Institute a wealth of experience in international fisheries and aquaculture outreach. Both Rob and Bob also hold academic appointments in the Department of Agricultural and Resource Economics, and both teach in the Coastal Studies Program here at Avery Point.

As documented in the report that follows, our Sea Grant Extension staff continues to be front and center when it comes to dealing with pressing problems and potential opportunities for the marine community of Connecticut.

We are glad to see the progress that has been made to date by the investigators whose research on the possible factors involved in the 1999 Long Island Sound lobster die-off we are helping to support. If anyone had any doubts about the vital, and practical, significance of this effort, they only need review the subpoenas served on our Sea Grant staff by those representing the litigants in the civil actions over this resource disaster. We appreciate the efforts of our Assistant Attorney General in helping us, as non-parties to these legal actions, continue, undistracted, to focus our efforts on assisting the scientists to continue unfettered their necessarily complex and lengthy investigations. While freely acknowledging the obvious right of everyone in our society to seek legal redress, we hold firm to our conviction that objective scientific research, rather than adversarial process, is the optimal approach when it comes to discovering scientific truth, and we are more than ever anxious to discover the underlying cause of the 1999 lobster die-off, so that collectively we can do everything in our power to see that it does not manifest itself again.

And while dealing with these pressing issues, we are pleased that our Sea Grant office was able to serve this past year as the catalyst for the initial academic conference on "Explorations in Ocean and Marine Sciences" held on our campus of the University of Connecticut in conjunction with the Center for Talented Youth of Johns Hopkins University. The need to stimulate more young men and women to study marine science, and science in general, is apparent, and we are pleased to have facilitated, in collaboration with our Avery Point colleagues, this national goal with the resources at our disposal.

We're delighted that our new flagship magazine, *Wrack Lines,* has been so well received, and are pleased to announce that it will henceforth appear twice a year.

In addition to the critical research on lobster disease currently being done with Sea Grant support, our Connecticut program continues to sponsor research on a range of other relevant topics, as is documented in the following pages.

As a reading of this report will attest, our Connecticut Sea Grant program continues its tradition of being actively engaged in responding to the needs of our citizens.

Sincerely,

Edward C. Monahan, Ph.D., D.Sc.

Director, Connecticut Sea Grant College Program
Professor of Marine Sciences, and of Resource Economics

The Connecticut Sea Grant College Program

Introduction and Mission

http://www.seagrant.uconn.edu

Fostering the wise use and conservation of coastal and marine resources is the mission of the Connecticut Sea Grant College Program (CTSG), based at the University of Connecticut's Avery Point campus. The program is the Connecticut component of a national network of 30 such Sea Grant programs based at research universities in coastal and Great Lakes states. The University of Connecticut was designated the State's Sea Grant College in 1988.

Connecticut Sea Grant carries out a statewide competition by soliciting, selecting, and funding proposals for research, outreach, and education activities that have special relevance to Connecticut and Long Island Sound. The program is implemented as a partnership between the University of Connecticut and the National Oceanic and Atmospheric Administration (NOAA), U.S. Department of Commerce. Core components of the program include Administration and Management, Extension, Communications, and Education.

Highlights FY 2002

• 2002 marked the University of Connecticut's 13th year as the State's Sea Grant College.

• The program gained an Associate Director, Robert (Rob) Johnston, who is also a member of the Agriculture and Resource Economics faculty. Dr. Johnston, who came to CTSG from the University of Rhode Island, also teaches in the Coastal Studies program.

• CTSG also gained a new Fisheries Extension Specialist, Robert (Bob) Pomeroy, who brings a wealth of experience from his work in international fisheries from the World Resources Institute. Dr. Pomeroy also holds an appointment in the Department of Agricultural and Resource Economics and teaches Coastal Studies classes.

• Seven major and many smaller regional and pilot research efforts were supported, involving seven academic institutions in the State and their partners. Key research themes included Aquaculture, Biotechnology, Economic Leadership, Coastal Ecosystems Health, Public Safety, and Education.

• CTSG continued leadership of the special national Lobster Mortality Research Initiative in which Congressional emergency funds were allocated to address Long Island Sound lobster mortalities. Preliminary results are being compiled and will be released at a symposium hosted by CTSG in March 2003, and in publications.

• CTSG began collaborations with Universidad Autonomous of Baja Califonia, Mexico, in conjunction with the UCONN Office of International Affairs. The program met separately with officials from the Mexican government and with university faculty to discuss common coastal issues and how the Sea Grant extension paradigm might be applied in Baja.

• The Sea Grant Education Coordinator received an award in 2002 from the Northeast Sea Grant Extension network for participation in developing curricula and field work in *Deep East 2001*, a national ocean exploration mission developed by NOAA's Office of Ocean Exploration.

Sea Grant Director Ed Monahan (left) and Associate Director Rob Johnston (standing) preside over the 2002 Sea Grant Advisory Board meeting at Avery Point.

RESEARCH

R/ER-21 A Ferry-Based Observing System for Long Island Sound: Application to Physical Influences on Hypoxia

Principal Investigator: Daniel Codiga, Ph.D University of Connecticut

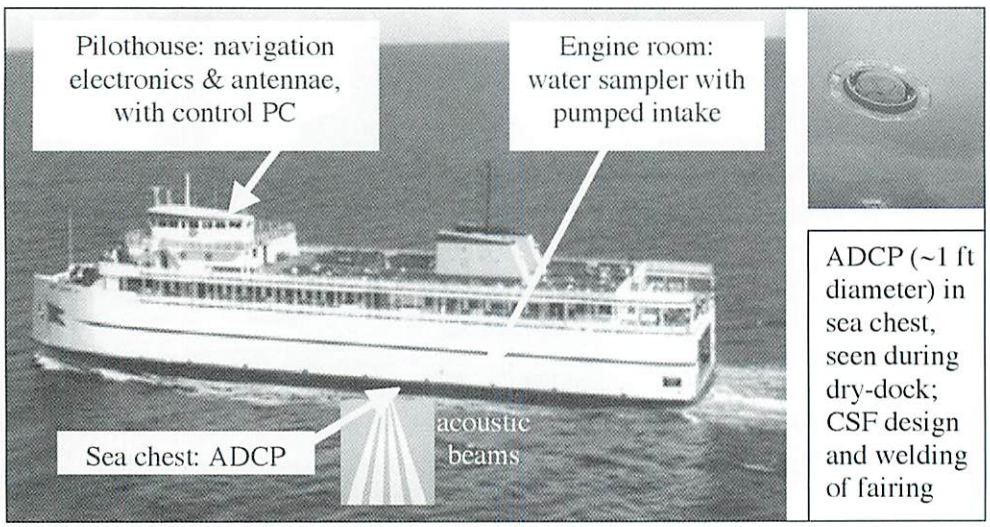
Dan Codiga, Assistant Professor of Marine Sciences at UCONN, has completed the first year of a project that makes innovative use of a public ferry to collect scientific data, in cooperation with Cross Sound Ferry Services, Inc. The goal is to improve understanding of how water properties and circulation in Long Island Sound evolve, and gain new insights into the formation and breakdown of hypoxic conditions. Because the ferry crosses the Sound continuously during a day, the instruments can collect a wealth of data over a broader time span, at minimal expense. The data helps Codiga, research assistant Dirk Aurin, and technician Dennis Arbige figure out where something will end up if it goes into the Sound at a particular depth and time, how fast it will move, and in what direction. It also shows what portion of the water movement is dependent on tides and what is due to the physical characteristics of the Sound alone.

Photo: P. Van Patten

UCONN marine scientist Dan Codiga utilizes the continuous crossings of the commercial ferry *MV John H.* to scientific advantage, recording oceanographic observations about the waters of Long island Sound.

Oceanographic sensors were installed on the *MV John H*, as shown in the diagram below, and deployed. The first is an acoustic Doppler current profiler (ADCP), which uses sound pulses to measure the speed and direction of water motion at multiple depths beneath the vessel. These measurements are combined with accurate navigation data to enable determination of vertical profiles of the current. The second instrument is a water sampler which measures the temperature, salinity, dissolved oxygen, and chlorophyll concentration of surface water. In addition, a computer system with GPS (Global Positioning System) and an air-link modem is installed in the pilot house, for navigation and data transmission. Complementing the instruments on the ferry is a moored CTD profiler (an instrument that measures salinity, temperature, and depth), deployed near Stratford Shoal in Spring 2002. The profiler collected hourly CTD and dissolved oxygen (DO) profiles for six weeks.

Insights have been gained into salt water intrusion and directions of flow at various depths. Curiously, it appears that the currents seem to be reversing - going one way at the surface and the opposite way at the bottom. It also appears that temperature and density-driven stratification may play a larger role in breaking down the summer thermocline than wind.



ADCP (~1 ft diameter) in sea chest, seen during dry-dock; CSF design and welding of fairing

The project's second year will add public outreach efforts to display the data via video on the passenger deck, with posters to explain the project to the ferry passengers. This phase will include collaboration with the CTSG Communications Office.

R/ER-23 Responses of Eelgrass Habitats to Land-use and Nitrogen Loading

Principal Investigator: James Kremer, Ph.D
University of Connecticut

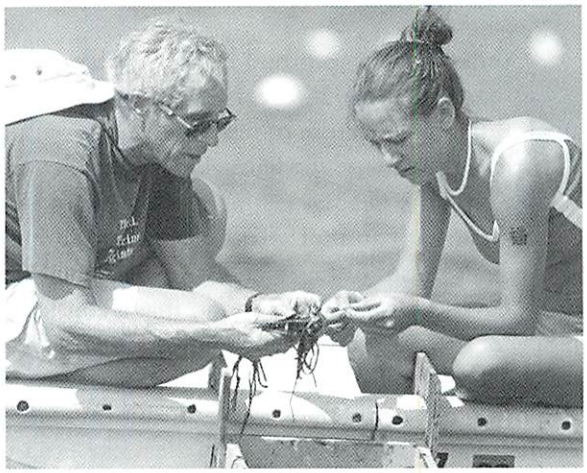


Photo: Peter Morenus, UCONN

Jim Kremer, left, Professor of Marine Sciences, and UCONN sophomore Callie Megargle look over eelgrass samples taken from the bottom of the Pawcatuck River.

Eelgrass is one of very few vascular plants that can grow underwater. It provides habitat for shellfish such as scallops, but eelgrass beds have greatly declined in recent years. This project examines the effects of nitrogen on this important plant.

Coastal development associated with changing land uses and population growth means greater inputs of terrestrial nutrients such as nitrogen to estuaries, particularly in densely populated and heavily altered watersheds of Connecticut and Rhode Island. Nitrogen impacts sensitive submerged vegetation such as eelgrass, and although management efforts to control nitrogen loads have been instituted, the impacts on specific habitats are not adequately known.

James Kremer, a Professor at the University of Connecticut Department of Marine Sciences, continued an ecosystems modeling project examining the effects of nitrogen loads on eelgrass health, involving both graduate and undergraduate students. The team is collaborating with the Dominion Nuclear Power utility and Professor Scott Nixon at the University of Rhode Island. Study sites include Mumford Cove, the Niantic River, Pawcatuck River, Ninigret Pond, and the Hammonassett River.

A new video survey method to document eelgrass distribution and abundance was introduced to help assess eelgrass health. The system uses an underwater camera coupled to a GPS receiver which overlays the location and depth on the video record, allowing the user to visualize benthic habitat conditions. After experimentation, Kremer's team feels that a similar system would allow them to visualize, record and analyze both coverage and density estimates of eelgrass and macroalgae assemblages. A GIS analysis of land use characteristics within the watersheds of the study sites was completed.

The team sampled both eelgrass and large algae for a particular isotope of nitrogen (∂N15) that indicates anthropogenic, terrestrial origins. As part of the project, graduate student Alison Biddle examined optical characteristics of the water column at the coastal sites, including levels of chlorophyll, colored dissolved organic matter, particle scattering, and light attenuation. In a complementary effort, graduate student Jamie Vaudrey deployed YSI sondes at the same study sites to collect continuous records of salinity, temperature, oxygen, chlorophyll, turbidity, and water level. The records will be used to estimate total system metabolism, another indicator of response to nutrients.

Photo: P. Van Patten

Alison Biddle (L.) and Jamie Vaudrey (R.), graduate students in UCONN's Department of Marine Sciences, perform laboratory titrations on water samples to determine ambient oxygen levels.

The team has completed nitrogen loading estimates for the study sites, based on GIS-derived land use data, using an existing computer model. These loading estimates can help town planners and environmental managers understand the process of non-point source pollution. The model inputs can be adjusted to reflect proposed development scenarios and resulting potential changes in nitrogen loading. This promises to be a useful predictive tool for local planners and regulatory agencies involved in conservation and coastal management.

R/ER-22 The Connecticut 'Hatting' Industry as a Mercury Source for Long Island Sound

Principal Investigator: Johan Varekamp, Ph.D Wesleyan University

Connecticut has a proud heritage of hatmaking that goes back more than 200 years. Mercury nitrate was used in the manufacture of felt hats from fur at many factories in Danbury, the hatmaking capital, from the 1780's until the U.S. government outlawed its use in hat making early in the1940's. Johan Varekamp, George I. Seney Professor of Earth and Environmental Sciences at Wesleyan University, has found that a considerable legacy of mercury still remains in certain locations, notably the Still River. Furthermore, the mercury is carried to Long Island Sound when storms cause flooding events. Varekamp's samples from areas close to the former hat factories showed extremely high levels of mercury ranging from 20,000 to 100,000 ppb (parts per billion). Because the existing equipment was designed to detect trace amounts, Varekamp's lab had to order a better analyzing machine to quantify such high levels (seen in photo). The Still River, which contains levels between 10,000 and 20,000 ppb, is only 15 to 20 miles from the Housatonic River, which drains into Long Island Sound 50 miles away. This project showed that storms and flooding events carry the mercury-laden sediments into Long Island Sound. Across from the former Mallory hat factory, which closed in the 1980's, is a park with a children's playground. There, mercury levels of 25,000 ppb were found in its surface mud. The state standard requiring cleanup is 20,000 ppb. Natural concentrations in soil would be around 100 ppb, and typical concentrations in soil caused by mercury from air pollution would be ~400 to 600 ppb. The levels in Danbury were extremely high, even for an industrial site, and many residents did not know about the problem.

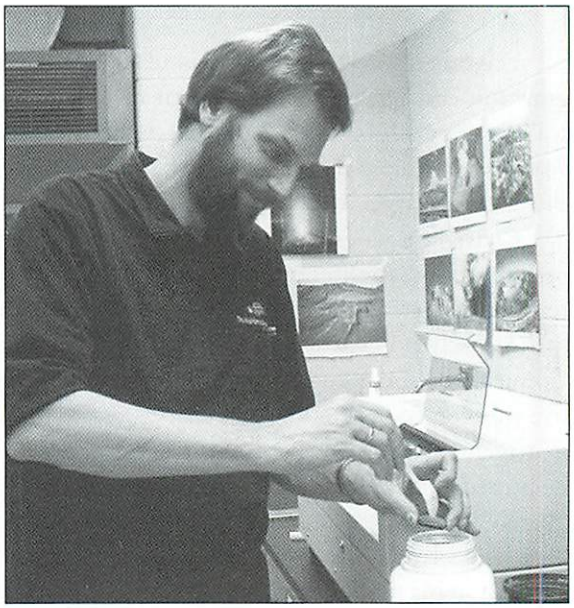
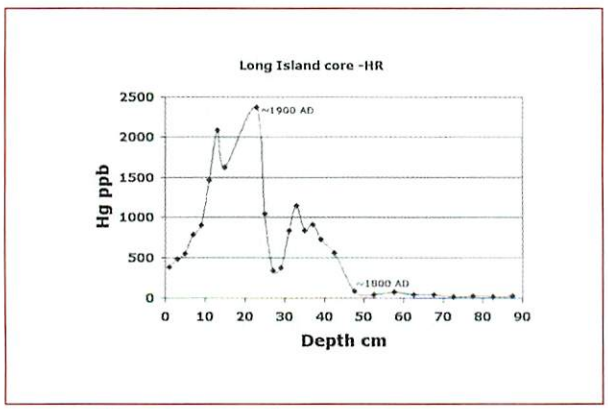


Photo: P. Van Patten

Johan Varekamp prepares a sample from Danbury sediments to test with a state-of-the-art mercury analyzer in his laboratory.



Plot showing mercury (Hg) in sediment cores from Long Island Sound. *J. Varekamp*

Mercury poisoning can have dire consequences for pregnant women and young children, and can come from eating large predatory fish that have concentrated mercury in their tissues as they consume large amounts of smaller prey.

Varekamp is working with town officialsin Danbury to further assess the risk to humans based on the project data. The data has also been supplied to the Department of Environmental Protection, an earlier sponsor of the project. Working with Varekamp, town officials expect to post warnings in the park to keep children from playing in the mud, and people are being warned to pay attention to fish consumption advisories. The project was featured in a broadcast by *Earth & Sky* radio, arranged by the Sea Grant Communications office. A flyer to inform the citizens of Danbury and surroundings about the potential exposure dangers of high mercury levels in soils and sediments is in preparation. Public science lectures have been given in impacted communities.

R/ER-19 Sediment Dynamics in Connecticut Estuaries: ^{7}Be, ^{210}Pb, ^{137}Cs, Trace Metals, and Modeling to Investigate Delivery, Erosion, and Accumulation

Principal Investigator: Gaboury Benoit, Ph.D Yale University

Learning more about the abundance, behavior, and distribution of heavy metals in muddy riverine and estuarine sediments will help coastal managers better understand what ecotoxicological risks exist and how best to manage them. To keep estuaries healthy, scientists need to know how and why such metals accumulate and how they might eventually become resuspended and enter the food web. Doctoral candidate Matthew Hirschbeck (also a Sea Grant Intern) and master's candidate Rosemarie Mannik joined Gaboury Benoit, Professor of Environmental Chemistry at Yale University School of Forestry and Environmental Watershed Studies, in sampling ten coastal rivers for these heavy metal complexes, as described in the Annual Report 2001. Work on the project accelerated in Fall 2002, when the team conducted a reconnaissance of sampling estuaries. The Hammonasset, Norwalk, Jordan, Branford, and Saugatuck River estuaries, as well as tidal ponds, were visited and evaluated as potential study sites.

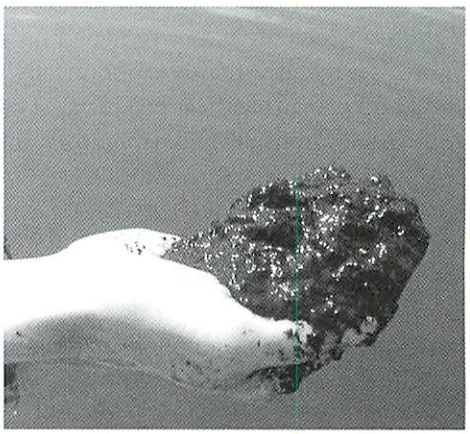


Photo: Wesleyan University

Lowly mud can hold a lot of secrets, in the form of heavy metal complexes that may change over time, and contaminate estuaries.

When cosmic rays collide with nitrogen in the earth's atmosphere and cause it to break apart, they leave behind the metal Beryllium. Changes in Beryllium levels in turn can be used to evaluate several biogeochemical processes. Benoit and Hirschbeck refined methods for measuring short-lived radionuclides such as ^{7}Beryllium (Be) using detectors that measure radioactivity. Test cores were collected near Branford, Connecticut, to confirm sampling and counting methods. Results show that short-lived ^{7}Be and ^{234}Th are readily detected in surface sediments, penetrating up to a depth of 5 cm in some cases. Traces of these naturally-occurring radionuclides are also measurable in the water column. A wet-dry atmospheric deposition collector was established, and samples are being collected. Sample treatment and analysis protocols have been finalized to evaluate the atmospheric flux of ^{7}Be, and average levels in the Branford River area have been established, to serve as a baseline. The data collected will help not only in modeling sediment dynamics in coastal ecosystems, but also in finding out how marine organisms transfer sulfides through the food web and how the environment may change once contaminated.

R/A-35 Characterization of the Biological Function of Somatolactin - Identification of the Somatolactin Receptor and Determination of the Somatolactin Target Tissues

Principal Investigators: Thomas T. Chen, Ph.D
Bih-Ying Yang, Ph.D University of Connecticut

Somatolactin, "body milk" in Latin, is a hormone found in some finfish. Exactly what it does and where it is found in various fish is something of a mystery. This study was deferred until 2003, at which time these UCONN investigators will attempt to identify and quantify somalactin in finfish, and determine its physiological functions.

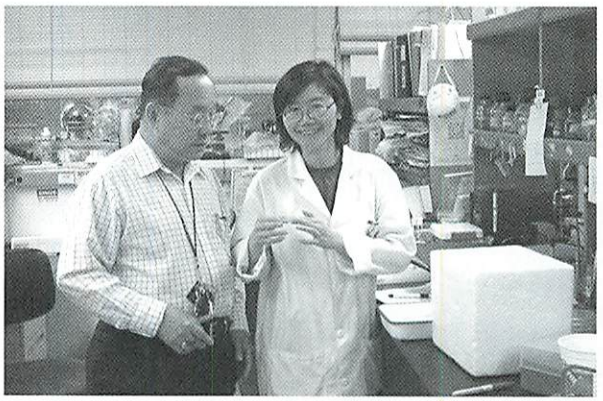


Photo: P. Van Patten

Professor Thomas T. Chen and Bih-Ying Yang have already begun preliminary work for their project to identify somatolactin in finfish, although the project officially begins in 2003.

R/A-34 Development of an Integrated Recirculating Aquaculture System for Nutrient Bioremediation in Urban Aquaculture

Principal Investigator: Charles Yarish, Ph.D University of Connecticut

Charles Yarish, Professor of Evolutionary Ecology and Biology at the University of Connecticut, has teamed up with colleagues at the University of New Hampshire and University of New Brunswick in a project to examine and document the effects of light, temperature, and nutrients on four species of *Porphyra* which are native to New England coasts. *Porphyra* (nori) is a red alga that is economically important for use in food and pharmaceutical products. The investigators grew the four species in small-tank laboratory cultures with varying light, nutrient, and temperature conditions. They found that all species grew best and exhibited highest nutrient uptake under medium to high light conditions with high levels of nutrients similar to those expected in fish tank culture effluent. The native species grew better in comparison to the Asian cultivars currently utilized, and incredibly, **all four were able to tolerate ammonium levels up to 600% of those expected from fish farm effluent.** This finding is important for use of these species in polyculture applications and in bioremediation (using the seaweed to remove nutrients from fish wastewater).

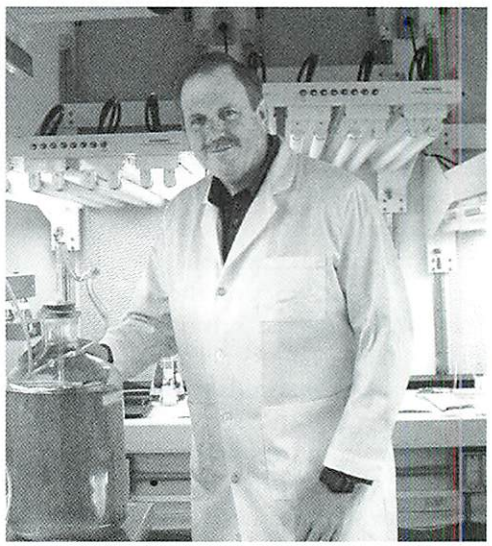


Photo: P. Van Patten

"Dr. Seaweed": Charles Yarish, Professor of Ecology and Evolutionary Biology at UCONN, is part of an international team developing revolutionary ways to use algae to clean wastewater from fish farming efforts.

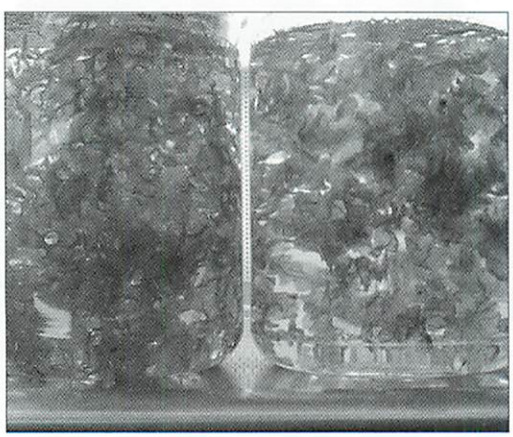
It's Incredible and Edible!

Four native nori species were able to tolerate ammonium levels up to 600% of those expected from fish farm effluent, promising efficient means to "scrub" nitrogenous nutrients from fish farming wastewater. The nori can be used for sushi and other food products.

Procedures have been developed for assessing levels of commercially valuable compounds in *Porphyra* including taurine (controls blood pressure), phycocyanin, and phycoerythrin (florescent tag in immunological research).The species produced more phycobilin (red) pigments under low to medium light conditions and high ammonium conditions. The best temperature for growth, pigment production, and nutrient uptake, however, varied for each species.

In addition the team made progress in shortening the amount of time needed to produce "conchospores" (a "seed", or juvenile, life stage of *Porphyra)* in order to produce mass cultures of small blades for tank aquaculture.

This work will directly benefit the marine aquaculture industry in the Northeastern United States and the Canadian Maritimes. High nutrient loading in finfish aquaculture operations has been identified as an area of critical concern. This past year, several aquaculture operations in the Northeast were cited for violation of the Clean Water Act. The technology developed in this project will assist aquaculture operations in complying with stringent effluent guidelines and regulations and at the same time produce a valuable second crop–truly a win-win situation.



Nori in vats in Professor Yarish's UCONN Stamford campus laboratory.

Sea Grant Technology

T-11-02 CT Development of an *In-Situ* Heat Flux Measurement Instrument and Measurement Program in Long Island Sound

Principal Investigator: James P. Boyle, Ph.D Western Connecticut State University

The oceans and the atmosphere interact together in complex ways, including the exchange of heat, which takes place through three different processes: conduction, convection, and radiation. Accurate, real-time measurement of heat transport is important for weather forecasting as well as in understanding climate variation. Dr. Boyle, an Assisstant Professor of Physics and Meteorology at Western Connecticut State University, is leading this new 2-year project, funded via the Sea Grant Technology Program, that seeks to develop and test a promising *in-situ* ocean heat flux instrument to directly measure heat exchange between the atmosphere and oceans. Advantages of the new device over existing instruments would be its simplicity, accuracy, and ability to measure heat exchange real-time in remote ocean locations.

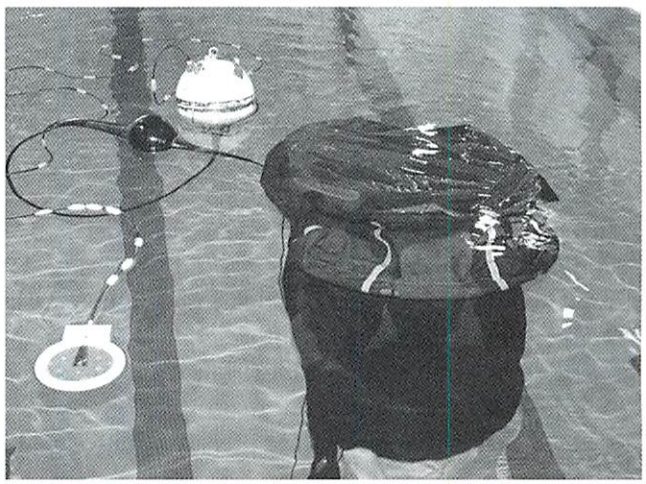


Photo: P. Stewart, WCSU

This new *in-situ* heat flux measuring instrument will measure the exchange of heat between the atmosphere and ocean, collecting data from the ocean surface for use in weather forecasting and climate change prediction.

The instrument includes two flux-sensing plates, which are placed directly within the thermal conductive layer at the ocean surface. These plates are held in place by a "donut-shaped", wave-riding float. The instrument evolved from technology developed a decade ago at the Space Science and Engineering Center at the University of Wisconsin-Madison and tested on Lake Mendota. The specific tasks of the project are to remedy several known deficiencies in the original design and to test new designs on Long Island Sound and Martha's Vineyard. Seed monies from CTSG supported the purchase of a data collection system and meteorological instruments. The ultimate goal of the project is to deploy dozens of these instruments as part of an existing NOAA oceanic drifting buoy program, to provide ground truth for satellite-based measurements.

Photo: P. Stewart, WCSU

Dr. Jim Boyle (left) and assistant Manvir Bhangu prepare to test the new instrument in the swimming pool at Western Connecticut State University.

R/ES-15 Species and Community Attributes Affecting Invasion Success by Exotic Species

Primary Investigator: Robert B. Whitlatch, Ph.D — University of Connecticut

Biological invasions can threaten marine biodiversity, and have important ecological and economic impacts in coastal habitats. Fortunately, only about a tenth of the species that invade these coastal habitats as larvae, seeds, or transplanted adults become successfully established. Whitlatch, Professor of Marine Sciences at the University of Connecticut, and his co-investigators, John J. Stachowicz (University of California-Davis), and Richard W. Osman, (Academy of Natural Sciences), asked two questions: "What makes some species particularly successful at invading?" and "Why are some communities more easily invaded than others?". To answer the first question, the study examined the attributes of four species of marine ascidians that have invaded New England waters within the past 25 years. To answer the second question, the investigators employed both field experiments and and observational approaches to assess the effects of species diversity on the invasion of subtidal marine invertebrate communities. Results indicated that decreasing native species diversity increased the survival and abundance of invaders. Declining biodiversity thus facilitates invasion in this system and potentially accelerates the loss of biodiversity and the homogenization of the world's biota. This study has experimentally demonstrated that invasion potential is related to biodiversity; the first such demonstration in a marine environment. This information can be used by coastal managers to assess which marine habitats might be most vulnerable to invasions. The team has also identified the ecological role of the Asian shore crab in Southern New England, indicated that it is replacing intertidal populations of the Green crab (*Carcinus*), and showed that it is an important predator of juvenile blue mussels *(Mytilus*).

R/ER-15 The Long Island Sound Paleo-Environment Program: Connecting Past and Present

Primary Investigator: Ellen Thomas, Ph.D — Wesleyan University

The environmental health of the Long Island Sound estuary is a matter of ongoing local and federal concern, yet remarkably little has been known about its history. This project, now complete, documented environmental changes in Long Island Sound over different time scales, with emphasis on the last 50 years and the last three centuries (time of European settlement). The project reconstructed LIS environments from the sedimentary record on time scales from hundreds to thousands of years, evaluated the effects of anthropogenic factors on environmental variability, and placed them in the context of natural environmental fluctuations over the last 15,000 years. (*See also the CTSG Annual Report 2001.*)

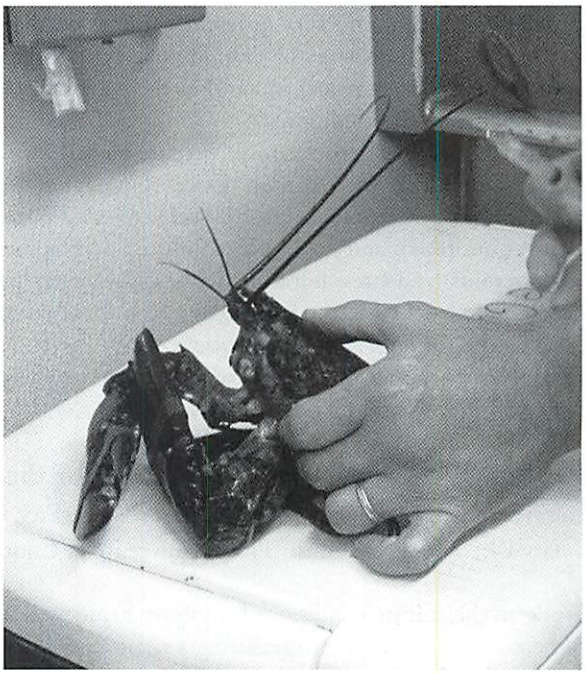
Sediment core analyses told Thomas and Wesleyan co-investigators Johan Varekamp and Kristina Beuning that there was no major eutrophication (excess nutrients resulting in algal blooms) of LIS from the time that it was flooded by the sea, about 15,000 years ago, to the time of European settlement, but eutrophication occurred from ~1850 on. From that time on, organic carbon concentrations increased in central and especially in western LIS, as did the accumulation rates of biogenic silica. Diatom floras decreased in species richness and increased in the centric/pennate ratio (C:P; an indicator of eutrophication and increasing water turbidity). The abundance of foraminifera, particularly those that consumed diatoms, increased, reflecting the greater food supply. As a result of the oxidation of organic carbon in the bottom waters, carbon isotope values of foraminiferal shells became lighter.

This evidence suggests that the increase in nitrogen, coincident with the advent of waste water treatment plants, caused eutrophication in the mid-19th century. More recently, (post-1960's), however, there were major changes in the LIS ecosystem with even higher nitrogen loading; there was so much nitrogen that diatoms in the resulting algal blooms used up all the silica (which they need to form valves) long before the nitrogen was depleted. Diatoms then could no longer bloom, and other types of algae, such as dinoflagellates, took over. Many organisms, including many foraminifera prefer eating diatoms. The decrease in diatoms, organisms at the very base of the food chain, thus brought about major changes cascading through the rest of the food web. There may have been additional influence from rising temperatures, but these were probably not nearly as strong as the changes in the N/Si ratio. Changes in this ratio have also been linked to major ecosystem changes in other coastal regions of the nation, such as the Gulf of Mexico.

The Long Island Sound Lobster Research Initiative

Since 2000, Connecticut Sea Grant has been involved in a multi-state, multi-agency collaboration with the lobster industry to address the mass mortality of the lobster resource in the fall 1999. An official member of the ad hoc Lobster Disease Research Steering Committee, established by the Lobster Management Board of the Atlantic States Marine Fisheries Commission, CTSG works with numerous federal and state agencies, organizations, and industry to oversee the LIS Lobster Research Initiative, a $4.5 million effort supported by federal and State of Connecticut dollars.

There are 17 primary and five secondary research efforts underway, at academic institutions in Connecticut, New York, Massachusetts, Maine, Maryland, Georgia, California, and Virginia, examining a variety of possible factors in the lobster mortality event. These factors range from environmental and physiological stressors such as high water temperature, ammonia and sulfides, to pesticides used for mosquito control, to a parasitic paramoeba, to an assemblage of bacteria causing lobster shell disease.



This lobster is a test subject for research on the effects of the pesticides on crustaceans, as part of the Long Island Sound Lobster Research Initiiative. UCONN Pathobiologist Sylvain De Guise is about to deliver an injection of malathion.

As part of this research initiative, CTSG handed out $1.3 million to six research teams. The projects are mid-way through the two year period for the awards, and preliminary results are beginning to emerge. Planning is underway for a meeting in January 2003, at which CTSG will host a working meeting of all the researchers, where they will be able to update each other on their progress, share ideas and methodology, and start to "connect any dots" from the results of their various projects. In March 2003, the Third LIS Lobster Health Symposium will be held in Bridgeport, hosted by CTSG on behalf of the Steering Committee. Researchers will be presenting integrated talks, featuring the preliminary results of several related projects. Extension Educator Nancy Balcom is responsible for coordinating the lobster extension effort in collaboration with Antoinette Clemetson, her New York Sea Grant counterpart, on behalf of the Lobster Steering Committee. This includes organizing the meetings and symposia, working with press, meeting with members of the lobster industry, and developing fact sheets and a newsletter to describe the status of the research effort and the lobster resource.

The research projects are scheduled to end during 2003, but the activities of the Steering Committee will continue, examining the results, assessing any "gaps" that need to be addressed by additional research, and determining how best to use the wealth of information generated by these research projects to the benefit of the lobster resource. This collection of widely-diverse research topics funded for a similar purpose has been an unusual and beneficial collaboration, a fact remarked upon by many of the faculty involved. It's truly bringing science, industry, and resource management together to address a fishery disaster that has, unfortunately, shown little signs to date of recovery.

A Long Island Sound Lobster Information website with a wealth of information, including the latest research abstracts and summaries, can be accessed at **http://www.seagrant.sunysb.edu/LILobsters/** .

Ongoing Progress of LIS Lobster Research Projects, as of October, 2002

LR/LR-1 Stress Indicators in Lobsters:...Hormones and Heat Shock Proteins

Primary P.I.: Ernest S. Chang, Ph.D, Bodega Marine Laboratory, University of California-Davis

- Experiments on the effects of different salinities on the hemolymph (blood) osmotic concentration in lobsters were conducted. Various tissues of these animals were taken and assayed for heat shock protein (HSP) analyses by both Western analysis (for proteins) and Northern analysis (for RNA). Significant changes were observed in both hypo- and hyper-osmotic conditions.
- New methods (for this laboratory) were developed for the more efficient analysis of HSP proteins and messenger RNA (mRNA). Work began on the development of a rapid enzyme-linked immunosorbent assay (ELISA) for HSPs.
- Embryos from three female lobsters were collected during embryonic development, heat-shocked, and assayed for changes in protein and mRNA levels during development. They were also assayed for levels of molting hormones (ecdysteroids) and stress hormone (crustacean hyperglycemic hormone or CHH).
- Larvae were hatched in the laboratory and precisely timed stages during larval development are being assayed for HSPs and hormones as described above.
- Tissues have been received and inventoried from colleagues at the Univ. of Connecticut (Dr. R. French), and will be assayed for HSPs and CHH.

LR/LR-2 Development of Assays for the Evaluation of Immune Functions of the American Lobster *(Homarus americanus)* as a Tool for Health Assessment

Primary P.I.: Sylvain De Guise, Ph.D, University of Connecticut

- Work on the culture conditions for lobster hemocytes suggest that sea water is the best medium for short-term culture of hemocytes. Attempts at measuring a respiratory burst in lobster hemocytes have so far been unsuccessful. The evaluation of cell surface molecules in lobster hemocytes appears interesting. It appears that CD14 is expressed constitutively on lobster hemocytes, while the expression of Toll-Like Receptor (TLR)-4 is inducible upon exposure to LPS. The results for TLR-2 are not yet conclusive. The expression of those molecules in different sub-populations of hemocytes as defined by flow cytometry is being evaluated.
- Hemocyte proliferation upon stimulation with LPS has been induced, and the optimal parameters are being defined.
- Tests to quantify immune functions in lobsters are being evaluated. This will help clarify how different stressors influence immune functions and define the defense mechanisms of lobsters in relation to pathogens, defining how they react and why they are susceptible or resistance to the development of diseases.

LR/LR-3 Determination of the Toxicity and Sublethal Effects of Selected Pesticides on the American Lobster *(Homarus americanus)*

Primary P.I.: Sylvain De Guise, Ph.D, University of Connecticut

- The effects of experimental exposure to the pesticide malathion on the health of lobsters in 20 gallon tanks was examined. The direct toxicity of malathion on lobsters was determined, as well as sub-lethal effects on the immune system (cell counts and evaluation of phagocytosis using flow cytometry). The concentration of malathion that killed 50% of the animals exposed (LC_{50}) after a 96-hour exposure was determined as 33.5 mg/L upon single exposure.
- Malathion degraded rapidly, with 65-77% lost after one day and 83-96% lost after three days. Phagocytosis was significantly decreased three days after a single exposure to water concentration as low as 5 ppb (the lowest concentration tested), when measured water concentrations were as low as 0.55 ppb. Cell counts did not differ significantly upon exposure to malathion.
- Data suggest that evaluation of phagocytosis using flow cytometry is a sensitive indicator of subtle sub-lethal effects of malathion, and that transient exposure to relatively small concentrations of malathion (6-7 times lower than the LC_{50}) can affect lobsters defense mechanisms, even with rapidly decreasing water concentrations.
- Results from this project will allow the understanding of the risk for lobster health of pesticides used to control mosquitoes, both retrospectively (including a better understanding of the role of pesticides in the lobster die-off) and prospectively. This will allow better risk assessment and management.

LR/LR-4 Oligonucleotide-based Detection of Pathogenic *Paramoeba* Species

Primary P.I.: Rebecca J. Gast, Ph.D, Woods Hole Oceanographic Institution

- Efforts were focused on two aspects of the project: obtaining the paramoeba-like ribosomal DNA sequence from infected blue crab and lobster samples and conducting monthly sampling of Long Island Sound water and sediments for future analysis.
- The recovery of paramoeba-like ribosomal sequences from tissues has not worked, and methods of blocking host ribosomal sequences have been ineffective.
- New primers for PCR amplification based upon the recently released free-living *Paramoeba* sequences have been designed, and, in collaboration with the team at the University of Connecticut, these will be tested on infected lobster tissue samples.
- Environmental samples are being processed in preparation for future work on the detection of paramoebae in the environment. All water samples have successfully gone through nucleic acid extractions and work will now begin on extracting DNA from sediment samples.

LR/LR-5 Phenotypic and Molecular Identification of Environmental Specimens of the Genus *Paramoeba* Associated with Lobster Mortality Events

Primary P.I.: Patrick M. Gillevet, Ph.D, George Mason University

- A manuscript was submitted, discussing the phylogeny of the genera *Korotnevella, Neoparamoeba* and *Vexillifera*, all genera related to the genus *Paramoeba*. A second manuscript will provide a phylogenetic analysis that will include representatives of all described genera in the families Paramoebidae and Vexilliferidae.
- The process of developing amplicon length heterogeneity (ALH) fingerprinting for the unambiguous detection of the lobster *Paramoeba* in the environment is underway, with special reference to finding reservoirs for the species and detecting infestations at low cell density.
- Initial attempts to identify the isolate the *Paramoeba* from infected tissue failed, but a novel community of amoebae that apparently colonize the carapace of the lobster was isolated. A crayfish neuronal cell line has been established, for use in further attempts to cultivate the *Paramoeba* from infected lobsters tissues.

LR/LR-6 Acute Effects of Methoprene on Survival, Cuticular Morphogenesis Shell Biosynthesis in the American Lobster, *Homarus americanus*

Primary P.I.: Michael N. Horst, Ph.D, Mercer Univ. School of Medicine

- Results indicate that both stage II larvae and postmolt adult lobsters are extremely sensitive to low levels of the insect larvicide, methoprene. Future mosquito control applications to either inshore waters or estuaries should be quantitated to insure that such toxic levels are never attained. The current lowest level of pesticide where significant mortality was observed is 100 parts per trillion.
- Two-dimensional electrophoresis was employed, using IPG strips to analyze various lobster samples, including serum proteins. Following methoprene treatment, increased and/or decreased expression of individual hemolymph protein components was demonstrated. This technique allows the rapid screening of ~1000 individual proteins in each sample tested and may offer a precise way to detect pesticide effects in living animals by simply collecting a small volume (2-5 mL) of blood for subsequent analysis.
- A method was devloped for rapid detection of chitin-binding proteins in biological samples that utilizes SDS-PAGE and a subsequent "ligand blot" procedure using biotinylated chitin. This technique allows the rapid and sensitive detection of chitin binding proteins, such as chitinases, which are known to be produced by chitinolytic bacteria associated with black shell disease in lobsters, blue crabs and other crustaceans.

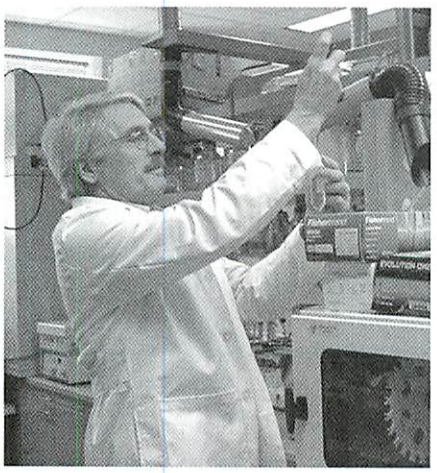


Photo: Peg Van Patten

Dr. Michael Horst is examining the effects of methoprene, a larvicide used for mosquito control, on lobster larvae and postmolt adults.

see also page 31 for financial information

DEVELOPMENT PROJECTS

M/PD-4 Phytoplankton Dynamics in Long Island Sound: Influence of Environmental Factors on Naturally Occurring Assemblages

Principal Investigator: Evan Ward, Ph.D University of Connecticut Department of Marine Sciences

If you wanted to know more about a neighborhood, you might begin by finding out who the residents are, and more about them and their lifestyles. Likewise, to understand large aquatic ecosystems better, we need first to identify the permanent and seasonal residents, their lifestyles, needs, and impacts on their surroundings. Plankton comprise a critical portion of the living populations in Long Island Sound (LIS) and form the base of the food web.

Photo: Peg Van Patten

Professor Evan Ward and his team are getting a handle on "who's who" amongst the plankton assortment found in Long Island Sound waters, using a method that is more rapid than traditional ones.

Unfortunately, not enough information has been collected in years past to give an accurate picture of what species are present at various times of the year, and how abundant they are. This Sea Grant-supported project, headed by Evan Ward, Associate Professor in the University of Connecticut Department of Marine Sciences, will help to fill that void. Assisted by Post-Doctoral Fellow Kevin Strychar, research scientist Gary Wikfors (NMFS, Milford), and undergraduate Dustin Kach, Ward uses technology adapted from the medical field to identify assemblages of plankton in Long Island Sound. The technique, flow cytometry, has frequently been used in hematology to separate white blood cells from red. Basically it uses a laser beam as a light source directed at particles (in this case plankton) moving through a fluid (Sound water). The particles can then be distinguished by the way they scatter light, which varies according to characteristics such as size, shape, and type of pigments. The fluorescence and scattering properties are assigned numerical values and recorded digitally on a computer for rapid comparison. Ward's research team has found that they can identify five or more phytoplankton species simultaneously, quite a bit faster than the old method of visually keying out individual specimens under a microscope.

To date, they have observed species of *Thallassiosira, Nitzschia, Rhodomonas, Chlorella, Prorocentrum*, and a number of ciliates within a mixed water sample. This finding will enable the researchers to compare and contrast plankton and grazer assemblages, examining how various nutrients from different LIS locations (East, Central, West) affect plankton assemblages. Ward's team also use fluorescent dyes to label various biochemical components of the cells to examine internal physiology of the plankton. Combined with flow cytometry, they are able to identify specific internal changes within individual cells that were influenced by various external nutrients existing in the water column. Flow cytometry, coupled with biochemical labeling, may facilitate better future predictions regarding how nutrient dynamics in the Sound affect primary producers and grazer populations. Benefits from this study may include a more rapid laboratory assessment of phytoplankton populations sampled in the field, including a better evaluation of the effects of human-generated pollution on phytoplankton assemblages.

Pilot ("spin-up" and small-scale) Research Projects

Systematic approach for designating essential habitats for economically important fishes

Peter J. Auster, Ph.D, and Rosamonde R. Cook (National Undersea Research Center & UCONN)

This study focused on evaluating and demonstrating optimization models for identifying essential fish habitat (EFH) and Habitat Areas of Particular Concern (HAPC) within the context of the Sustainable Fisheries Act of 1996. A secondary goal was to evaluate whether areas that might be focused on habitat conservation of economically important species that can serve as umbrellas for conserving marine biological diversity based on representation of regional faunas. The study addresses how one might prioritize sites for special protection that would offer the greatest benefit to the largest number of species while minimizing impacts to the fishing industry. One way to minimize impacts would be to identify the smallest set of sites that contain sufficient amounts of preferred habitat for all species of concern. This represents a type of mathematical optimization problem, for which certain computer algorithms are ideally suited where there are target levels of representation for the algorithms to achieve. The preferred model was one called "simulated annealing", in which a number of overlapping parameters are combined in various ways, each iteration narrowing the choices until the most desirable selection is left.

The effect of sonoluminescence on marine organic matter

Annelie Skoog, Ph.D, UCONN Department of Marine Sciences

The grant funded two months of half time salary for Penny Vlahos, a postdoctoral investigator. She has assembled the electronics circuit and calibrated the system to achieve stable sonoluminescence. Preliminary results indicate that cavitation and sonoluminescence increase the amount of conjugated bonds, as evidenced by increases in fluorescence characteristic of humic substances. This is an important finding, since no humification process is previously known. In addition, these results show that there are chemical modifications to the structure of marine organic compounds as a result of cavitation and sonoluminescence. Cavitation and sonoluminescence have never been studied in the context of the marine carbon cycle, and the investigators believe that these processes may play roles in hydrothermal systems and possibly also in the surface ocean. These mechanisms could be a new part of the carbon cycle of extreme systems, which have been identified by several research organizations as priority study areas for the next decade.

Acute and chronic effects of ... recreational and commercial fishing gear in large pelagic sharks

Joanna Borucinska, DVM, Ph.D, University of Hartford

The project examined the impacts of retained fishing hooks on the survivability of sharks, to facilitate their conservation. Dr. Borucinska and collaborators attended three shark fishing tournaments in Montauk Point on Long Island. During the tournaments they examined 24 sharks, from which nine sharks underwent full body necropsies. Of the nine sharks, one had a retained fishing hook within the lower esophagus, and the remaining eight had no macroscopic evidence of retained fishing hooks, and thus were considered the control group. The retained fishing hook was of the straight "J" type. Histological examination of the tissues of four sharks revealed some interesting findings, including mononuclear fibrosing hepatitis with nodular hyperplasia, a gastric polyp and an epulis. Bacterial cultures obtained from all necropsied sharks resulted in isolation of *Pseudomonas* spp. from four, *Vibrio* spp. from two, and *Pasteurella* sp. from one fish.

Laboratory investigations of food selection by the Asian crab ... algal vs. animal preference

Diane Brousseau, Ph.D, Biology Dept., Fairfield University

Laboratory food selection experiments were conducted to determine whether the Asian shore crab exhibits a preference for either animal (mussels and barnacles) or algal (*Enteromorpha* spp. and *Chondrus crispus)* food items. The availability of food type and crab density were also tested with respect to food preference. Asian crabs exhibited an overwhelming preference for mussels and barnacles regardless of crab sex, relative food availability or crab density. Information about the selectivity of *Hemigrapsus sanguineus* when provided with a choice between macroalgal and animal food under controlled conditions results in a clearer understanding

continued next page

continued from previous page

of the dynamics of Asian crab feeding and aides in assessing the potential impact of this invader in non-native habitats. This study supports the hypothesis that predation by *H. sanguineus* may seriously limit mussel populations in areas where the two species co-occur, and may be significant enough to alter overall community structure within rocky intertidal habitats.

Initiation of Molecular Characterization of CLO/RLO from Arctic Char

Salvatore Frasca Jr., Ph.D, DVM, University of Connecticut Department of Pathobiology

CTSG funds were used for graduate student summer salary to initiate and advance molecular characterization of the chlamydia-like/rickettsia-like (CLO/RLO) bacterium infecting gill of aquaculture-reared Arctic char. Research to date has resulted in amplification and sequence analysis of a 300-bp region from the 16S rRNA gene of the Arctic char CLO/RLO. In addition, research has investigated primer combinations potentially useful in amplification of the entire 16S rRNA gene from genomic DNA samples of Arctic char infected with the CLO/RLO. Application of particular 16S primer pairs has been successful in amplifying 16S rDNA from a CLO infecting farmed Atlantic salmon, and the course of future research will be to use these primers to continue amplification of the entire 16S rRNA gene from the CLO/RLO of Arctic char, which is believed to be related to the CLOís and RLOís from other farmed salmonids.

Workshops, Conferences, and Meetings Sponsored or Co-sponsored

(This list is intended to be representative, rather than comprehensive.)

• The Long Island Sound Educators Conference, held at the Maritime Aquarium in Norwalk on April 12, featured hands-on workshops, field studies, lectures, and networking opportunities for teachers. The theme was "bringing research into the classroom" and featured University of Connecticut pathobiologist Richard French as special guest speaker. SENEME, NY Sea Grant, NYSMEA and the EPA Long Island Sound Study joined Sea Grant in sponsoring this popular event.

• The National Fisheries Law and Policy Symposium on June 28, 2002 at the Roger Williams University. This day-long symposium addressed recommendations to the U.S. Ocean Commission, aquaculture legal rights, jurisdiction over owners and operators of fishing vessels, and case law on international fisheries emerging from the International Law of the Sea.

• The National Shellfisheries Association meeting in Mystic, Connecticut on April 14-18.
Attendees included academic researchers, graduate and undergraduate students, state and federal regulators, and industry representative.

• The 14th International Pectinid Workshop, held in St. Petersburg, FL, April 23-29, 2003.

• Thames River Floating Workshop for Decision Makers - Wastewater Discharges
The Thames River Basin Partnership
This project involved two floating workshops, implemented by the Thames River Basin Partnership, utilizing the *EnviroLab II* boat operated by Project Oceanology staff. The first workshop, (funded in 2001 but deferred to 2002) was held in June with 40+ participants focusing on hypoxia issues in Norwich Harbor. The target audiences for this event includes area legislators, municipal CEO's, municipal land use commissions, wastewater facility operators, some agency representatives (including CT DEP, USDA-Natural Resources Conservation Service, USEPA, Farm Services Bureau, Quinebaug-Shetucket Heritage Corridor, Inc., Windham and New London Soil and Water Conservation Districts, and three eastern CT regional planning agencies) and other river and watershed stakeholders. A second workshop in the fall drew 50 participants.

• **The 6th Biennial Long Island Sound Research Conference/NEERS Meeting**
This LISRC meeting, the only multi-disciplinary research conference focused wholly on Long Island Sound, teamed up with NEERS to meet in October.. It is sponsored in conjunction with the Long Island Sound Foundation. A proceedings is in preparation, by CTSG's Communications Office.

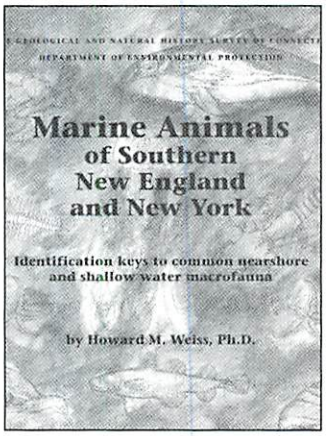
• **Taste, Touch and Smell of Science**
This popular annual summer program allows middle school children to attend a fun "camping" experience, while learning that science can be fun from UCONN Marine Sciences graduate students.

Youngsters dig right into hands-on marine science at last summer's "Taste, Touch, and Smell of Science" event, held at UCONN's Avery Point campus. Graduate students organize and implement this event..

Travel

Development funds are also sometimes used to facilitate travel for researchers, so that they can present their finds in the appropriate scientific forum. For example, Dr. Tom Chen's travel to Yokohama and Honshu Island was facilitated to allow his participation, by invitation, in the 31st US-Japan Cooperative Program in Natural Resources Aquaculture Panel Meeting, held in October, 2002.

Development-Sponsored Publications



Marine Animals of Southern New England and New York
by H. Weiss, Project Oceanology

Development funding allowed the reprinting of the popular hardcover book, *Marine Animals of Southern New England and New York*, by Project Oceanology's H. "Mickey" Weiss, in hard cover. This book, an illustrated taxonomic key to regional coastal fauna, was produced as a collaboration with the State Department of Environmental Protection, and is also provided to teachers in our Long Island Sound Mentor Teacher program.

Southeastern Connecticut Marine Resources Directory
SECTER (SouthEast Connecticut Technology Enterprise Region)

The research project culminated in the compilation of the Southeastern Connecticut Marine Resources Directory. Sea Grant funds sponsored an undergraduate intern, Katie Beauchamp, to obtain and compile practical information for those who use waterways for transportation and shipping. The Directory, which was produced and distributed widely, included information such as: Anchorage; Arrival; Cargo Handling Facilities; Caution; Communication; Customs; Dangerous Cargo Regulations; Density; Development; Documents; Entrance; Fire Fighting Tugs; Garbage Removal; Harbor; Harbor Authorities; Health and Medical; Ice; Lighters; Maximum Size; Obstructions; Pilotage; Port Limits; Port State Control Inspection; Port Working Hours; Radio; Repair Facilities; Safety Regulations and Inspections; Situation; Slop Reception; Supplies; Tides and Currents; Towage; Trade and Shipping; Vessel Traffic Separation; Warning; Watchmen; Wind and Sea for the waterways in the State. Information in the directory was published on the Thames Maritime Coalition's web page and the National Harbor Safety web site. This directory can be accessed via the SouthEastern Connecticut Enterprise Region web page at www.secter.org.

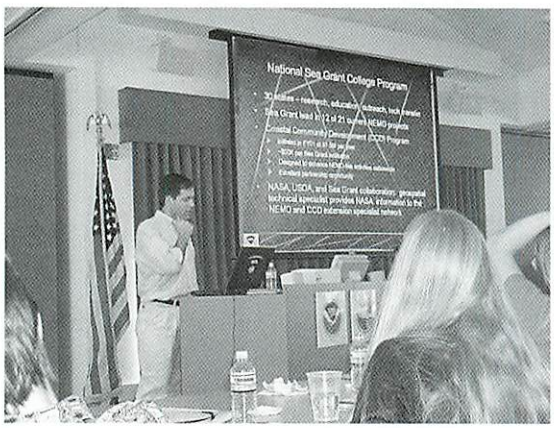
A/E-18 Land Use Education and Tools for Coastal Communities

Nonpoint Education for Municipal Officials (NEMO): Connecticut Model Now Used Nationwide

Principal Investigator: Chester L. Arnold University of Connecticut Cooperative Extension System

Land use is at the core of many pressing issues in communities, and generates much of the State's nonpoint source runoff pollution. It is determined at local levels by people serving on town and county boards and commissions, who may not have resources at hand to help them make decisions. Connecticut's 169 municipalities hold a large number of local officials and volunteer commissioners who seek knowledge about the causes, effects, and best ways to manage polluted runoff. NEMO, an educational program for municipal officials, fills this need by addressing the relationship between land use and natural resource protection, with a focus on water resources. The NEMO project was created in 1991 by the University of Connecticut Cooperative Extension Service (UCONN/CES), in partnership with Connecticut Sea Grant. A number of federal and state agencies now support NEMO along with Sea Grant: the USDA/Cooperative Research, Education, and Extension Service Water Quality Program, the University of Connecticut, the Connecticut Department of Environmental Protection, the National Oceanic and Atmospheric Administration, and the Environmental Protection Agency.

NEMO helps communities to plan their future development with the impacts on water quality and community character in mind. The project uses advanced technologies such as geographic information systems (GIS), and remote sensing, as a sort of "crystal ball", to see what will likely take place in the future if particular actions are taken now. NEMO presentations, publications, and World Wide Web-based services form an integrated package of information centered around the theme of natural resource-based planning. The project also offers follow-up presentations and materials to help communities move forward on the two major aspects of natural resource-based planning, namely, planning for areas to be preserved and planning for developed or developing areas.



Peyton Robertson, then NOAA coastal nonpoint source program coordinator, explained the FY02 NOAA Coastal NEMO Enhancement Grants program at NEMO U2 in Jan. 2002.

As Connecticut Sea Grant's NEMO Coordinator, Laurie Giannotti worked with the rest of the NEMO team, including Project Director Chet Arnold and National NEMO Coordinator John Rozum. She developed and produced the NEMO newsletter.

After 11 years of the NEMO Program, there is concrete evidence that Connecticut municipalities are giving greater consideration to water quality in their land use planning and regulatory programs than in years past. Many towns are now working together to develop watershed-based plans, protecting more than 1,800 acres of open space in the watershed. UConn/CES foresters have worked with landowners to develop forest stewardship plans on almost 500 acres and provided information that is being used to manage another 2,500 acres of forestland. The project was also instrumental in helping to build a fish ladder to restore access to upstream habitat for alewives and blueback herring for the first time since the early 1700s.

In Old Saybrook, a suburban coastal town, the Zoning Commission reduced the number of required parking spaces in several site plans to reduce the amount of impervious surface where fewer cars were likely, and landscaping regulations were revised to require the breaking up of "seas of asphalt" through the use of landscaped islands and buffers. Alternative construction designs and storm water management practices have been incorporated directly from NEMO Project design principles in many instances.

National NEMO

NEMO has evolved into a popular national model. Connecticut Sea Grant sponsored the second "NEMO UNIVERSITY" workshop in 2002, held in Charlestown, South Carolina, and the third, NEMO U-3, at UCONN's Avery Point campus in Groton, Connecticut in 2003. These workshops brought existing and new NEMO coordinators from around the nation together to share ideas and strategies and brainstorm over which techniques worked best for their communities and states.

The UConn NEMO Project is the hub for the National NEMO Network, a growing network of projects around the country adapted from the Connecticut project. The network Hub initially focused on helping to develop new programs, tailored to individual state and local needs. By the end of 2002, the emphasis had shifted towards helping the programs strengthen their technological base and develop new educational tools. As a result of NEMO's success in Connecticut, 26 states have established or are planning to establish programs based on the NEMO model. A national competition was held, coordinated by the Connecticut Sea Grant Program, to establish these programs. More than 500 presentations have now been given to municipal officials For more information about the NEMO Project, visit http://nemo.uconn.edu online, or request a copy of the National NEMO Network 2002 Progress Report from John Rozum, national NEMO Coordinator, <jrozum@canr.uconn.edu>.

NEMO Awards to other states in 2002:

Berkeley-Charleston-Dorchester (SC) Council of Governments	$25,000
Univ. of New Hampshire	$24,663
Cornell University	$13,507
Partnership for Envir. Technology Education	$20,811
Ohio State University	$24,775
Texas A&M University	$75,000

See pages 28 and 30 for complete funding information.

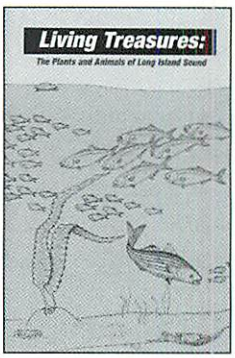
NEMO U-2, held in Charlestown, South Carolina, attracted 65 network participants from 19 programs.

Extension Outreach

A/E-1 The Connecticut Sea Grant Extension Program

The Sea Grant Extension Program transfers technology amongst the research community and marine resource users, industries, and coastal communities. This year the staff expanded to include a fisheries specialist in addition to the three extension educators working in the areas of aquaculture, water quality, aquatic nuisance species, and safety.

Living Treasures



Extension Educator Nancy Balcom undertook a major revision and update of the popular booklet, *Plants and Animals of Long Island Sound,* reprinting it as *Living Treasures: The Plants and Animals of Long Island Sound.* Funding for the project was provided by the U.S. Environmental Protection Agency, Long Island Sound Study office. New line art was added, the text was revised to align with habitat type, and information on aquatic nuisance species was added. More than 25,000 copies were printed, and are being distributed, free of charge upon request, to schools, organizations, and individuals in Connecticut and New York.

Professor Robert Pomeroy, CTSG's new fisheries extension educator.

Enhancing our Fisheries Extension Capabilities

CTSG was pleased to bring aboard Robert Pomeroy as the new part-time fisheries extension specialist, a benefit of the new Congressionally-mandated fisheries extension enhancement program. Dr. Pomeroy, a marine resource economist with extensive experience working on fisheries research projects in the United States and overseas, has an international reputation as a leading marine resource economist on such topics as co-management, marine protected areas and fisheries management. This new fisheries extension program in Connecticut will address three areas: exploring fisheries management opportunities for the State; identifying livelihood diversification opportunities for fishers; and analyzing issues and opportunities for seafood marketing. He also has an appointment as an Associate Professor in the Department of Agriculture and Resource Economics, in the College of Agriculture and Natural Resources.

Fostering the Growth of Aquaculture

During 2002, Extension Educator Tessa Getchis played an integral part in the planning of the first joint Northeast Aquaculture Conference & Expo (NACE). This conference marked the birth of a bi-annual event, which united the region from Maine to New Jersey, in a coordinated effort to promote aquaculture commerce and to welcome members from other regions with shared interests. Nearly 300 people attended the conference including: finfish and shellfish growers, educators, research scientists, vendors, regulating agencies, and extension agents. The NACE executive committee, consisting of mostly Sea Grant Extension agents, is shaping plans for the next NACE, to be held in Manchester, New Hampshire in 2004.

Permitting and aquaculture do not go easily hand in hand. Multiple agencies and jurisdictions have oversight over various aspects of the industry, and confusion over the application process can lead to long delays in applying for and receiving all the necessary permits. These obstacles hinder the growth of aquaculture. To address these problems in Connecticut, Tessa Getchis is arranging a series of workshops on aquacul-

continued next page

ture policy and the permitting process. Partners in the effort include the U.S. Army Corps of Engineers, the Connecticut Department of Agriculture and the Department of Environmental Protection, and municipal shellfish and harbor management commissions, which aid in workshop development. The series includes workshops specialized for various stakeholders, including growers, policy-makers, extension, researchers, educators, and the general public. The intent of these workshops, which will continue in 2003, is to provide stakeholders with information on Connecticut's aquaculture permitting process from local, state, and federal perspectives, to address any questions / concerns, and to facilitate communication and information-sharing among the groups.

Cooperative research demonstration projects focusing on the culturing of blue mussels on long lines (year 2) and the cage culture of razor clams in Long Island Sound in collaboration with two shellfishermen continued. The latter project was one of several complementary projects funded by the USDA Northeastern Regional Aquaculture Center focused on razor clams.

Sea Grant Extension Leader Nancy Balcom with Seafood Council Executive Director Barbara Gordon, at the Seafood Expo.

Environmental Stewardship Programs find New Audience

Linking local actions to local water quality and fostering a sense of environmental stewardship continue to be the focal point of Extension Educator Heather Crawford. This year, she cultivated a new audience for these important messages, by working with the Archdiocese of Hartford's Office of Urban Affairs. The Diocese is currently promoting an initiative called "Center Edge", which links the suburbs to central cities in addressing environmental, economic, and social justice issues. Tying into the environmental component, Heather Crawford gave presentations on the impact of development patterns on local water quality.

Crawford continues to serve as the liaison and resource person to graduate students at the Yale School of Forestry and Environmental Studies who are awarded Sea Grant internships. During 2002, five Master's degree candidates received these internships.

Showcasing Opportunities in Ocean and Marine Science

Nancy Balcom, working with a planning team, coordinated a day-long workshop hosted by the UCONN marine science community, in collaboration with Johns Hopkins University Center for Gifted and Talented Students. More than 130 gifted and talented 8th and 9th graders and their parents from throughout the Northeast participated in a workshop titled "Explorations in Ocean and Marine Sciences". Faculty, staff, and students from the Department of Marine Sciences, the NOAA National Undersea Research Center, the undergraduate Coastal Studies Program, Project Oceanology, and CTSG, offered workshop sessions or seminars on diverse topics in physical, geological, chemical, and biological oceanography, as well as marine biology, and remotely-operated vehicles. CTSG Extension Educator Tessa Getchis organized and held a workshop on aquaculture while Nancy Balcom gave a seminar on aquatic invasive species.

Using a petri dish as an analogy, Professor James Kremer explains to a gifted student the physiology of a diatom. Scientists and students mixed at the Johns Hopkins University workshop.

COMMUNICATIONS

M/CP-1 Communications Program

Sea Grant Director Ed Monahan and Terry Truss, spokesperson for Cross Sound Ferries Inc. hold two framed "*Sound Facts*" posters to be displayed at the ferry terminals in New London, CT and Orient Point, NY.

The Sea Grant Communications Office makes sure that messages and products are "packaged" in the best form to reach the target audience, and sees that the research results are distributed to users via the Sea Grant Library and other means. The Communications Director oversees media relations and the program's publications. In 2002 a second issue of *Wrack Lines* magazine was produced by partnering with the UCONN Department of Marine Sciences, and an editorial board was composed and convened. The magazine has been very successful but faces funding and understaffing challenges in order to produce on a more uniform schedule. In addition, Connecticut Sea Grant's website, <http://www.seagrant.uconn.edu>, was updated, expanded, and maintained, with some redesign. The site has grown from its modest original home page to currently some 50 pages, and now includes *Wrack Lines* online. Peg Van Patten, Communications Director, went to professional development workshops in creating web graphics, and in magazine advertising.

The Communications office worked with University Communications professionals to issue timely information on Sea Grant sponsored research, and also showcased other marine research at the University via *Wrack Lines*.

Sending our Message

To let the public know what Sea Grant research is accomplishing, and promote scientific literacy, the Communications Office "translates" science into layperson's language and each project showcased in some fashion. The mercury project (p.6) was featured in a broadcast on *Earth & Sky* radio in *Wrack Lines* magazine, as well as press releases. Communications assisted the ferry project (p.4) by creating a prototype poster for display on the ferry; other projects have appeared in this volume and on our website. One development project was featured in the *UCONN Advance.* The Communications office assisted with both media relations efforts and publications for the Lobster Health Symposium and research projects.

Another goal of the Communications Office is to promote appreciation and understanding of Long Island Sound and the issues that affect it. An external grant from the EPA Long Island Sound Study to Communications allowed the production and distribution of several hundred posters using our popular *Sound Facts* info-graphics. Thirty large framed posters went to museums, public agencies, education facilities, and ferry terminals for public display. For example, The Maritime Aquarium, the Mystic Aquarium, the Children's Museum, and Project Oceanology have the posters on display, as does the Cross Sound Ferry terminal. A series of 24 splash-resistant posters were printed on Tyvek for use near Mystic Aquarium's "touch tanks". Three hundred smaller, unframed posters were distributed to K-12 teachers who requested them or handed out at educator meetings.

Supporting and Linking Program Components

In addition to initiating Communications activities and products, the Communications Office provides support to all program components by serving on the management team, helping to identify priority information needs and timely issues, and deciding on the best way to convey the information to the audience. Services also include publicity for events and photography of sponsored activities for use in program publications.

Education

Connecticut Sea Grant's Education Initiatives

K-12 Teacher Resources

CTSG's formal K-12 education headquarters moved from Norwalk to Avery Point this year. A new mentor teacher program was developed and implemented, and training workshops for teachers to share Long Island Sound-related curricula and resource materials were held. The training helps teachers tie curricula to the National and State science standards, and work with formal and informal educators throughout the state to provide educational resources through a variety of venues. CTSG Educator Diana L. Payne works with K-12 educators and administrators, aquaria and science centers in Connecticut, disseminating materials and ideas.

CTSG staff have provided workshops and served as resource personnel for the Connecticut *Envirothon*, and the regional Ocean Sciences Bowl, "The Quahog Bowl". Educational programs and presentations were delivered to a variety of school groups, informal educators, and K-12 teachers. Additionally, CTSG staff are actively involved in local and national educational organizations, including the Connecticut Science Teachers Association (CSTA), Southeastern New England Marine Educators (SENEME), National Marine Educators Association (NMEA), COEEA (Connecticut Outdoor and Environmental Educators Association) and the National Science Teachers Association (NSTA).

CTSG Educator Diana Payne climbs into the *Alvin* submersible during preparation for the *Deep East 2001* expedition.

Office of Ocean Exploration

CTSG staff have been involved with the planning and development of NOAA's Office of Ocean Exploration (OE) Education programming. Diana Payne, CTSG's Marine Educator, was a member of the team asked to participate in the national education initiative *Deep East 2001: Voyage of Discovery to Deep Sea Frontiers off the U.S. East Coast.* This education team was awarded the Northeast Sea Grant Extension's Outstanding Achievement Award for this effort in May, 2002.

The first Long Island Sound mentor teachers pause to pose for a group photo with Sea Grant Educator Diana Payne (bottom left) and Extension Leader Nancy Balcom (lower right).

Professional Development for K-12 Pre- and In-service Educators

The Long Island Sound Mentor Teacher (LISMT) program was developed and began implementation. This program allows 10 K-12 teachers who presently teach Long Island Sound (LIS) concepts in their classrooms to provide workshop opportunities for their peers, working with CTSG's resources and staff. The goal is to encourage more teachers to use LIS in their curricula by having mentor teacher show their peers how it has been successfully implemented. Payne also worked closely with organizations such as the Connecticut Science Teachers Association (CSTA), Long Island Sound Educators,

continued next page

National Marine Educators Association (NMEA), National Science Teachers Association (NSTA), and the SouthEastern New England Marine Educators (SENEME) as well as selected schools and districts to assist educators in utilizing resources to enhance classroom instruction.

E/T-7 Integrating Sea Grant Resources with Systemic Educational Change in Connecticut

Principal Investigators: Jack Schneider, The Maritime Aquarium and Diana L. Payne, CTSG

Marine education efforts at The Maritime Aquarium (TMA) in Norwalk featured a Teacher Needs Assessment, consisting of written and oral surveys of professional classroom teachers and group analyses; continuation of the Sea Grant Teacher Resource Center, the summer Sea Grant Teacher Intern Program, and distribution of materials to teachers at workshops and conferences such as the Long Island Sound Educators Conference (held at TMA on April 12).

Gifted and Talented Education

CTSG staff worked with Johns Hopkins University and the UCONN Department of Marine Sciences to host a workshop for 130 gifted and talented children (see p. 21)

Education for the Deaf --- see page 24.

Higher Education

Approximately 19 masters students, 8 doctoral candidates, and 26 undergraduates were involved in CTSG-supported research projects for 2002.

John A. Knauss Sea Grant Marine Policy Fellowships 2002

Connecticut Sea Grant was fortunate to have two of its candidates selected as Knauss Sea Grant Marine Policy Fellows in 2002. These fellowships allow graduate students in their last year of study to work in key federal offices in Washington D.C. for a year. They each receive a $38,000 stipend during that year. The two fellows for 2002 were Laura Letson and Rebecca Weidman, both from the graduating class at Yale University.

Laura Letson was placed in NOAA's Office of Ocean and Coastal Resource Management. Her primary project was to help NOAA and state coastal management programs (CMPs) develop a performance measurement system to assist them in evaluating the national success of the Coastal Zone Management Act (CZMA) program. She interviewed all of the managers in the 34 state and territory CMPs to determine the current methods of program evaluation, details about these methods, as well as what the programs are currently measuring. These results are assisting OCRM and the CMPs to develop a national set of indicators for CZMA. The fellowship was an opportunity to gain professional experience and make contacts.

During her Fellowship, Rebecca Weidman worked for the Estuarine Reserves Division at the National Oceanic and Atmospheric Administration (NOAA). as the National Estuaries Day Coordinator. National Estuaries Day is an interagency campaign to promote the importance of estuaries and the need to protect them. She worked with NOAA's 25 National Estuarine Research Reserves and the U.S. Environmental Protection Agency's 28 National Estuary Programs to develop and promote National Estuaries Day. In addition, she helped to produce **EstuaryLive**, the feature event for National Estuaries Day. **EstuaryLive** is an interactive field trip through our nation's estuaries, accessed via the Internet at: **http://www.estuaries.gov/elive.html**, and will occur on Sept. 25 and 26, 2003.

A/E-3 The Yale/Sea Grant Coastal Internship Program

Principal Investigators: Gaboury Benoit, Ph.D, and Martha Smith, Yale University School of Forestry and Environmental Studies

The Sea Grant Coastal Interns are graduate students in Yale University's Forestry and Environmental Studies program who welcome the opportunity to gain practical experience in science-based environmental policy-making. The internships are competitive and those whole project ideas are selected are linked with policy makers, resource managers, and citizens in the course of their efforts. To date, nearly 50 interns have been sponsored. In 2002, CTSG supported five interns doing five projects (see facing page for projects).

2002 Yale Sea Grant Intern Projects:

Application of the Hydromorphology of the River to Protect the Minimum Instream Flow According to Fish Habitat

Intern César Alcácer used the Aquatic Base Flow (ABF) method to evaluate Connecticut streams with the aim of understanding the minimum base flow protective for habitat at specific locations. His report, Application of the Hydromorphology of the River to Protect the Minimum Instream Flow According to Fish Habitat, evaluates flows and stream morphology at 28 stream or river sites in Connecticut. The evaluations will help managers to more effectively select the instream discharge flow velocity and depth necessary to ensure the protection of essential fish habitat.

Youth Riverkeepers Intern Program: An Environmental Education Project in Fair Haven Schools

Intern Emily Sprowls worked with a group of high school students, the Youth Riverkeepers, to create lesson plans and a river guidebook for use in local elementary schools. Riverkeepers were trained in canoeing and learned about the local plants, animals, "indicator species", and environmental concerns. Three plans with age-appropriate group activities were created and implemented in a coalition of 11 schools in the Fair Haven area. In addition to the lesson plans, a booklet, "The Rivers of Fair Haven" was created, comprising a collection of the natural history lessons learned and drawings by the students, printed in both English and Spanish.

Guilford Lakes Fishway

Interns Elizabeth Cullen and Joshua Zaffos worked together to design a plan to restore passage to fish spawning grounds in the Lower Guilford Lake for several anadromous fish species. A working, "natural" fish passage was designed, maintaining the aesthetics of the Guilford Lakes area, the integrity of the stream ecosystem, and the area's recreational values. The design was technically sound, minimized financial costs, incorporated aesthetic components of the site, and maximized aquatic habitat value and passage efficiency. The naturalistic approach designed for the fish passage will greatly reduce cost as compared to using the originally designed, larger, fish ladder alternative for the western spillway.

The Oyster River Coalition

In collaboration with The Nature Conservancy's Coastal Conservation Program, Intern Nicole Vickey helped to create a community-based watershed protection plan for Oyster River area in Old Saybrook, Connecticut, a key coastal site which is one of about 100 small tidal rivers that feed into Long Island Sound. A coalition was formed, including community residents, state and regional agencies, and local land trusts to come together to learn about the river, inform others, and develop specific restoration and protection goals and projects involving community leadership. Activities implemented included an oyster bed restoration project, volunteer monitoring of fish populations, educational boat tours, and *Pearls and Jazz*, a gala fund-raising event. The goal of the project, to form a self-sustaining community group dedicated to watershed protection was met.

projects continued on next page

Yale Sea Grant Intern Projects, continued from previous page

Understanding and Providing Public Access to Connecticut's Coast

Connecticut's coastline is one of the most densely populated in the nation, with about 3,235 people per square mile of shore. Yet 80% of the shoreline is privately owned. In a second project, intern Nicole Vickey developed a pocket-sized 18-page booklet, intended to serve as a guide for town planners and municipal officials. The guide talks about the public trust doctrine, the importance and status of public access to coastal areas in Connecticut, and steps that should be taken in planning to provide access. It includes definitions of relevant terminology, contacts for coastal zone management information, a discussion of the "takings" issue, and the difference between lateral access and perpendicular access. There is also a reference list for further reading. Text for the guide was completed and it will be published in 2003, provided to town planners and posted online.

E/T-10 Marine Science for the Deaf: Classroom of the Sea

Principal Investigators: Peter M. Scheifele and Ivar G. Babb, National Undersea Research Center, UCONN

This ongoing project, scheduled to end in 2002 but extended, bringsmarine science to deaf high school students in a hands-on at-sea experience, as described in previous CTSG annual reports. Another objective is to develop and establish new science vocabulary terms in sign language. Sea Grant supported the ship time.

Distance Learning Technology - Key project accomplishments in 2002 included the development and implementation of a wireless network infrastructure linking the UCONN research vessel, *R/V Connecticut,* and the American School for the Deaf. This linkage supported the project objective of live transmission of video from ship to the classroom at the American School for the Deaf (ASD) in Hartford. Upon completion of the project recommendations will likely be made to other learning institutions as to how to implement a similar system.

Science through Marine Science Curriculum - To date a complete set of academic standards that coalesce national, Connecticut State and Benchmark standards with marine science applications and standards have been written and are being used as the basis for classroom and laboratory instruction as well as for Problem-Based Learning (PBL) modules at sea. Testing and evaluation have found that the methods used significantly enhance science education of deaf students through the use of marine science. All three high school level basic sciences (physics, chemistry, and biology) have been incorporated into a coherent marine science based curriculum that centers on problem based learning pedagogy. This has been implemented using advanced technologies for distance learning.

Two PBL modules are being developed, centering on the two themes of "Harbor Seals in Long Island Sound" and "Application of Remotely Operated Vehicle (ROV) Technology for Quantitative Oceanographic and Cultural Studies. Sea Grant support of the vessel costs has made possible field activities associated with each of these PBL modules. To date four research cruises directed at the Harbor Seal activity and one focused on the ROV module have been conducted.

Signs for Science - Technical and scientific terminologies associated with each of the two PBL modules are being identified in relation to American Sign Language (ASL). The relationships being investigated include linguistic aspects, word and terminology signs, use of ASL classifiers and dissemination. This enhancement of the science vocabulary available to deaf students will make possible greater advancements.

The Connecticut Sea Grant support for the Classroom of the Sea was catalytic in development of the program to the point that it was mature enough to successfully compete for significant additional funding. This effort has brought together a team of researchers and educators that have the potential to make a significant contribution to improving STEM education for deaf learners, not only at ASD, but at other deaf learning institutions around the country.

Selected Journal Publications by Principal Investigators

Borucinska, J. 2002. *Journal of Fish Diseases, Vol. 25.*

Broom, J.E., W.A. Nelson, C. Yarish, W.A. Jones, R. Aguilar Rosas, L.E. Aguilar Rosas. In press. A reassessment of the taxonomic status of *Porphyra suborbiculata, Porphyra carolinensis* and *Porphyra lilliputiana* (Bangiales, Rhodophyta) based on molecular and morphological data. *European J. Phycology.* 14 pp.

Carmona, R., Chanes, L., Kraemer, G., Chopin, T., Neefus, C., Zertuche, J.A., Cooper, R., and Yarish, C., 2002 - Nitrogen uptake by *Porphyra purpurea*: its role as a nutrient scrubber. *In*: *Proceedings of the Fifth Biennial Long Island Sound Research Conference,* Stamford, USA: 87-91. P. Van Patten, ed. *Connecticut Sea Grant College Program, Groton, USA*, 152 pp.

Chopin, T., Buschmann, A.H., Halling, C., Troell, M., Kautsky, N., Neori, A., Kraemer, G.P., Zertuche-Gonzalez, J.A., Yarish, C., and Neefus, C., 2001 - Integrating seaweeds into marine aquaculture systems: a key towards sustainability. *J. Phycol.* 37: 975-986.

Chopin, T., Yarish, C., and Sharp, G., 2002 - Beyond the monospecific approach to animal aquaculture ... the light of integrated aquaculture. In: *Ecological and genetic implications of aquaculture activities.* T. Bert (Ed.). Kluwer Academic Publishers, Dordrecht.

Codiga, D.L., D.E. Waliser and R.E. Wilson. *in press*. Evolution of vertical profiles of stratification and Oxygen concentration sampled hourly for six weeks of Spring 2002 near Stratford Shoal. In: *Proceedings of the 6th Biennial Long Island Sound Research Conference/NEERS Meeting.* Peg Van Patten, ed. Connecticut Sea Grant /LIS Foundation.

Cuomo, Carmela *et al. in press*. Monitoring of bottom water and sediment conditions at critical stations in Western Long Island Sound. In: *Proceedings of the 6th Biennial Long Island Sound Research Conference/NEERS Meeting.* Peg Van Patten, ed. Connecticut Sea Grant and the Long Island Sound Foundation.

Kraemer, G.P., Carmona, R., Chopin, T., and Yarish, C., 2002 - Use of photosynthesis measurements in the choice of algal species for bioremediation. *In*: *Proceedings of the Fifth Biennial Long Island Sound Research Conference,* Stamford, USA: 113-117. Van Patten P. (Ed.). *Connecticut Sea Grant College Program, Groton, USA*, 152 p.

Laporta, M., D.A. Monte, and P.M. Scheifele. "Classroom of the Sea" *The Science Teacher* 67(3): 44-47.

Lohrer, A.M. and R.B. Whitlatch. 2002. Modeling life-stage based recovery dynamics of marine invertebrates in soft-sediment habitats: some implications for habitat conservation. Pages 191-213. In: M. Ruth and J. Lindholm (eds.), *Dynamic Modeling for Marine Conservation.* Springer-Verlag, NY.

Lohrer, A.M. and R.B. Whitlatch. 2002. Alien crabs in Long Island Sound: relative impacts of two exotic brachyuran species. *Marine Ecology Progress Series,* 227: 135-144.

McVey, J.P., Stickney, R.R., Yarish, C., and Chopin, T., 2002 - Aquatic polyculture and balanced ecosystem management: new paradigms for seafood production: 91-104. In: *Responsible Aquaculture.* Stickney R.R. and McVey J.P. (Eds.). CABI Publishing, Oxon, 391 p.

Rawson Jr., M.V., Chen, C., Ji, R., Zhu, M., Wang, D., Wang, L., Yarish, C., Sullivan, J.B., Chopin, T., and Carmona, R., 2002 - Understanding the interaction of extractive and fed aquaculture using ecosystem modelling: 263-296. In: *Responsible Aquaculture.* Stickney R.R. and McVey J.P. (Eds.). CABI Publishing, Oxon, 391 p.

Spees, J.L., Chang, S.A., Snyder, M.J. and Chang, E.S., in press. Osmotic induction of stress-res[pmsove gene expression in the lobster *Homarus americanus. Biol. Bull.*

Stachowicz, J.J., J.R. Terwin. R.B. Whitlatch, and R.W. Osman. 2002. Linking climate change and biological invasions: ocean warming facilitates non-indigenous species invasions. *Proceedings of the National Academy of Sciences* 99:24, pp.15497-15500.

Stachowicz, J. J., H. Fried, R. W. Osman and R. B. Whitlatch. 2002. Reconciling pattern and process in marine bioinvasions: how important is diversity in determining community invasibility. *Ecology:* 83: 2575-2590.

Troell, M., Halling, C., Neori, A., Buschmann, A.H., Chopin, T., Yarish, C., and Kautsky, N., 2002 - Seaweeds in integrated mariculture: asking the right questions. *Aquaculture* (accepted)

Varekamp, J.C., B. Kreulen, M.R. Buchholtz ten Brink and E.L. Mecray 2003. Mercury contamination chronologies from Connecticut wetlands and Long Island Sound sediments. *Environmenta Geology* 43:268-282.

FINANCIAL REPORT

MAJOR PROJECTS FUNDED 2002

(not including projects completed in Feb. 2002)

PROJECT NUMBER	TITLE	INVESTIGATOR
Core Program Elements		
M/PA-1	Program Management and 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
A/FE-1	Fisheries Extension Enhancement	E. Monahan, R. Pomeroy
A/FE-2	Better Information for Better Management: Fisheries Education Workshops (CT portion of regional project)	N. Balcom, T. Getchis
A/FE-5	Collecting and Mapping Fishing Gear Areas...Conflict Resolution Training (CT portion of regional project)	N. Balcom
A/E-18	Land Use Education and Tools for Coastal Communities	E. Monahan, C. Arnold
M/CP-1	Core Communications Program	M. Van Patten
Research Projects (not including those ending in Feb. 2002)		
R/A-21	A Ferry-based Observing System for Long Island Sound...Hypoxia	D. Codiga et al.
R/A-22	The Connecticut Hatting Industry as a Mercury Source	J. Varekamp
R/A-34	Integrated Recirculating Aquaculture System for use in Urban Aquaculture	C. Yarish
R/ER-19	Sediment Dynamics in Connectilcut Estuaries ...(trace metals and modelling)	G. Benoit
R/ER-23	Responses of Eelgrass Habitats to Land Use and Nitrogen Loading	J. Kremer
National Strategic Initiatives, Additional NOAA Awards, and External Awards		
T-11-02-CT	Development of an In-Situ Heat Flux Intrument and Measurement Program in LIS	J. Boyle
A/E-21	National NEMO Network Project Support	E. Monahan
A/E-22	NEMO Communications Services	C. Arnold, J. Rozum
	Activities in Support of the E.P.A. Long Island Sound Study	N. Balcom, E. Monahan
no number	Earth Grant Geospatial Technology	S. Prisloe
Education and Outreach Initiatives		
A/E-3	Yale Sea Grant Coastal Interns	M. Smith, G. Benoit
E/T-7	Integrating Sea Grant Resources with Systemic Educational Change in Connecticut	J. Schneider, D. Payne
E/K-6	John A. Knauss Sea Grant Marine Policy Fellowship	L. Letson
E/K-7	John A. Knauss Sea Grant Marine Policy Fellowship	R. Weidman

OMNIBUS AND NSI FUNDING

MULTI-YEAR LOBSTER FUNDING

GRAND TOTALS

INSTITUTION	$ FEDERAL FUNDS	$ STATE FUNDS	TOTAL FUNDS
University of Connecticut	199,875	243,606	443,481
University of Connecticut	30,000	0	30,000
University of Connecticut	43,700	0	43,700
University of Connecticut	142,997	72,485	215,482
University of Connecticut	35,000	0	35,000
University of Connecticut	19,093	0	19,093
University of Connecticut	13,731	0	13,731
University of Connecticut	50,000	25,269	75,269
University of Connecticut	133,000	0	133,000
University of Connecticut	100,936	81,687	182,623
Wesleyan University	33,250	21,691	54,941
University of Connecticut	102,734	0	102,734
Yale University	47,425	59,419	106,844
University of Connecticut	35,769	19,440	55,209
Western Conn. State University	93,000	86,000	179,000
University of Connecticut	200,000	0	200,000
University of Connecticut CES	50,000	0	50,000
University of Connecticut	67,150	0	67,150
University of Connecticut	100,000	0	100,000
Yale University	25,048	12,597	37,645
The Maritime Aquarium/UCONN	66,000	87,313	153,313
Yale University	38,000	0	38,000
Yale University	38,000	0	38,000
	$ 1,664,708	**$ 709,507**	**$ 2,374,215**
	$1,450,000	$ 601,890	$ 2,051,890
	$ 3,114,708	$ 1,311,397	$ 4,426,105

FINANCIAL REPORT continued

DEVELOPMENT PROJECTS M/PD-1

Long Island Sound Educators Conference	$ 2,000	D.L. Payne, The Maritime Aquarium
Earth & Sky radio broadcast	$ 2,250	P. Van Patten, UCONN (CTSG)
Thames River Floating Workshop	$ 1,000	E. Thomas, Thames River Basin Partnership
Coastal Perspectives Lecture Series	$ 750	C. Crosby/E. Anderson, UCONN
Marine Resources Directory	$ 2,400	E. Anderson, SECTER
Marine Animals... hardcover book	$ 5,000	S. Fish, CT DEP
Taste, Touch and Smell of Science	$ 350	Marine Sciences, UCONN
Shark Gear Retention	$ 4,200	J. Borucinska, U. Hartford
Designation Essential Fish Habitat	$ 4,389	P. Auster, NURC/UCONN
Molecular characterization of CLO/RHO from Arctic Char	$ 2,486	S. Frasca, UCONN J. Debak-Williams, Freshwater Institute (WV)
Mandibular Organ paper page charges	$ 398	H. Laufer, UCONN
"Our Changing Coast." conference	$ 4,600	G. Visgilio, Connecticut College
IAMSLIC conference travel	$ 363	J. Heckman, UCONN
Benthic Ecology Study attendance	$ 1,500	R. Whitlatch, UCONN

REGIONAL AND MULTI-PROGRAM DEVELOPMENT PROJECTS M/PD-4

Phytoplankton Assemblages of Long Island Sound	$25,000	E. Ward, UCONN
14TH INTL Pectinid workshop	$ 1,500	N. Blake, USFL
Model Port Workshop at Roger Williams (RI)	$ 3,488	P. Tebeau, USCG
Northeast Aquaculture Conference & EXPO	$ 1,000	T. Simlick-Getchis, UCONN CTSG
Ocean Sciences Bowl	$ 2,500	G. Scrowcroft, URI
Reprinting of "Marine...." book by M. Weiss	$ 4,500	S. Fish, CT DEP
Travel (I. Babb) to Fish Acoustics meeting	$ 655	C. Chryssostimidis, MIT
National Fisheries Law Symposium	$ 1,000	B. Costa-Pierce, Rhode Island Sea Grant, URI
Int'l Conference on Shellfish Restoration	$ 500	R. DeVoe, South Carolina Sea Grant
Introduction of non-native oysters to Chesapeake	$ 3,000	M. Fritz, USEPA EPA Chesapeake Bay Office
6th Long Island Sound Research Conference	$ 3,500	S. MacNamara, LIS Foundation, with NYSGI
Travel (T. Chen) to US/Japan Aquaculture Panel	$ 600	T. Chen, UCONN
NEERS meeting	$ 1,400	P Kremer, UCONN
NE Regional Sea Grant Web Site	$ 1,250	A. Cohen, MIT
Replacement STD/DO Equipment for bi-state ferry project	$12,460	D. Codiga, UCONN

NEMO ENHANCEMENT AWARDS

Berkeley-Charleston-Dorchester (SC) Council of Governments	$ 25,000
Univ. of New Hampshire	$ 24,663
Cornell University	$ 13,507
Partnership for Envir. Technology Educ	$ 20,811
Ohio State University	$ 24,775
Texas A&M	$ 75,000
Project Management (CTSG)	$ 16,244

Lobster Research and Outreach Projects Funded:

LR/LR-1
Stress Indicators in Lobsters (*Homarus americanus)*: Hormones and Heat Shock Proteins
Primary P.I.: Ernest S. Chang, Ph.D, Bodega Marine Laboratory, University of California, Davis
2-Yr. Funding Totals: $170,115 (Sea Grant); Matching Funds: $155,197

LR/LR-2
Development of Assays for the Evaluation of Immune Functions of the American Lobster (*Homarus americanus*) as a Tool for Health Assessment
Primary P.I.: Sylvain De Guise, Ph.D, University of Connecticut
2-Yr. Funding Totals: $198,271(Sea Grant), Matching Funds: $67,734

LR/LR-3
Determination of the Toxicity and Sublethal Effects of Selected Pesticides on the American Lobster *(Homarus americanus)*
Primary P.I.: Sylvain De Guise, Ph.D, University of Connecticut
2-Yr. Funding: $140,000 (Sea Grant), Matching Funds: $70,201

LR/LR-4
Oligonucleotide-based Detection of Pathogenic *Paramoeba* Species
Primary P.I.: Rebecca J. Gast, Ph.D, Woods Hole Oceanographic Institution
2-Yr. Funding: $113,587 (Sea Grant) Matching Funds: $37,681

LR/LR-5
Phenotypic and Molecular Identification of Environmental Specimens of the Genus *Paramoeba* Associated with Lobster Mortality Events
Primary P.I.: Patrick M. Gillevet, Ph.D, George Mason University
2-Yr. Funding: $299,761 (Sea Grant), Matching Funds: $100,477

LR/LR-6
Acute Effects of Methoprene on Survival, Cuticular Morphogenesis Shell Biosynthesis in the American Lobster, *Homarus americanus*
Primary P.I.: Michael N. Horst, Ph.D, Mercer Univ. School of Medicine
2-Yr Funding: $230,000 (Sea Grant) Matching Funds: $100,000

LMP/A-1
LIS Lobster Disease Research Management
Primary P.I.: Edward C. Monahan, Ph.D, D.Sc, Connecticut Sea Grant College Program
2-year Funding: $35,000 (Sea Grant) Matching Funds $11,900

LMP/D-1
LIS Lobster Disease Program Development
Primary P.I.: Edward C. Monahan, Ph.D, D.Sc, Connecticut Sea Grant College Program
2-year Funding: $98,266 (Sea Grant) Matching Funds 0

Maintenance of a Paramoeba culture and exploration of a mitochondrial cytochrome b genetic marker
Primary P.I.: Senjie Lin, Ph.D, University of Connecticut $ 8,000

Monitoring of Bottom Water and Sediment Conditions at Critical Stations in Western Long Island Sound, Primary P.I.: C. Cuomo, Yale University, $10,000

The Comparative Pathology of Shell Disease in the American...and Spiny...Lobsters: characterization of Gross, Light Microscopic, and Utrastructural Pathology" R. French, Ph.D, DVM, UCONN $9,996

LA/E-1
LIS Lobster Extension Program
Primary P.I.: Nancy C. Balcom, Sea Grant Extension Program Leader
3-year Funding: $165,000 (Sea Grant) Matching Funds $58,700

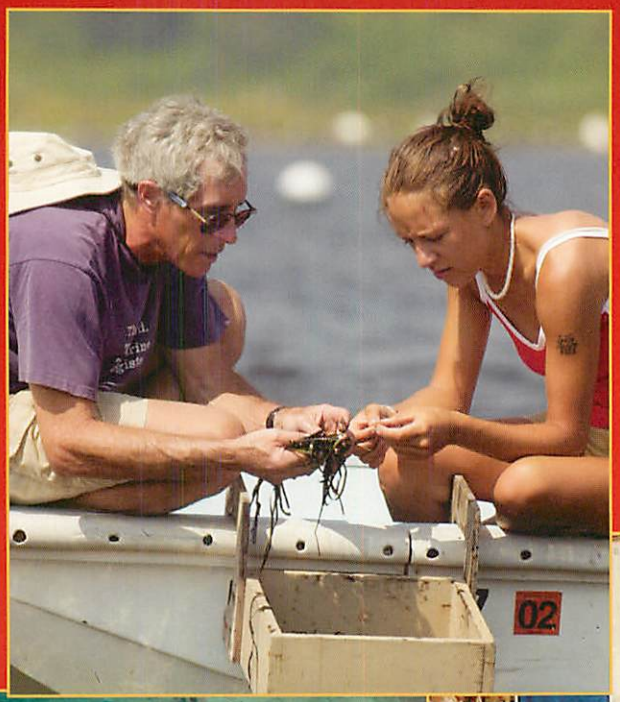
*Additional lobster projects were funded by the Connecticut Department of Environmental Protection, the NOAA National Marine Fisheries Service, New York Sea Grant, and the U.S. Environmental Protection Agency.

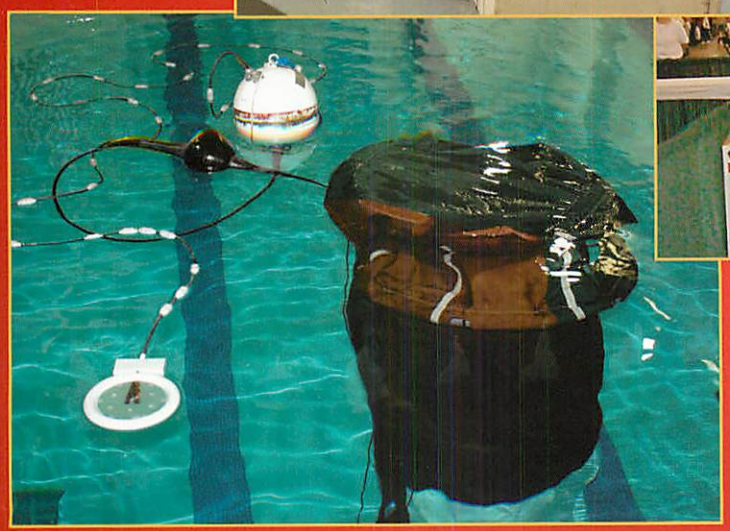
Connecticut Sea Grant Staff

Edward C. Monahan, Ph.D., D.Sc., Director
Robert L. Johnston, Ph.D., Associate Director
Capt. Charles H. Nixon, Executive Officer (retired 1 June, 2003)
Robert Pomeroy, Ph.D., Fisheries Extension Specialist
Nancy C. Balcom, Extension Leader
Peg Van Patten, Communications Director
Heather M. Crawford, Extension Educator
Diana L. Payne, K-12 Education Coordinator
Tessa L. Getchis, Aquaculture Extension Educator
Karen Massaro, Administrative Assistant
Irene Schalla, Secretary
Laurie Giannotti, NEMO Coordinator (resigned)

Connecticut Sea Grant Senior Advisory Board

Connecticut Sea Grant
The University of Connecticut
1080 Shennecossett Road
Groton, Connecticut 06340-6048


02




CONNECTICUT
SEAFOOD