



# **Connecticut Sea Grant 2006-2007 Annual Report**

**For the time period from March 1, 2006 – February 28, 2007**

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## INTRODUCTION

This annual report summarizes the activities and accomplishments of the Connecticut Sea Grant College Program from March 1, 2006 to February 28, 2007. The University of Connecticut (UConn) is the formally designated Sea Grant College for the State of Connecticut, serving as the “flagship” university for the Connecticut Sea Grant College Program (CTSG). While a small marine extension program began in 1974 in conjunction with the Cooperative Extension System, the program did not receive formal designation as a Sea Grant College until 1988, marking its maturation as a full-fledged, comprehensive Sea Grant program. The program is located within the new, state-of-the-art marine sciences center on the UConn Avery Point campus, in the southeastern coastal town of Groton. A detailed history of CTSG is summarized in Appendix B of *Blueprint for a Coastal Legacy: Connecticut Sea Grant Strategic Plan 2007-2011*.

In comparison to older Sea Grant programs established in the 1960s and 1970s, CTSG is generally characterized as a small program, with an annual base budget of just under \$1M, a current staff of 11 people and a total of 8.55 FTE. Located in a state bordering Long Island Sound, “the Urban Sea”, along the highly populated Northeast corridor between New York City and Boston, the number of relevant opportunities for Sea Grant involvement are far greater than the staff and resources available to address them (see Appendix A of *Blueprint for a Coastal Legacy: Connecticut Sea Grant Strategic Plan 2007-2011*, for a description of these opportunities and challenges). As such, CTSG clearly recognizes that both its long-term impact and legacy depend critically on the program’s ability to develop and foster long-term partnerships and leverage funds and resources to achieve its planned outcomes.

In addition to the traditional research, extension, education and communication activities of CTSG, a number of major events demanded primary attention of the program during 2006-2007. Each of these activities required significant and coordinated efforts of the CTSG staff, as overseen by the CTSG management team. The first major event was the preparation of, participation in, and response to the program’s 2006 Program Assessment Team (PAT) visit. Although the PAT took place from October 15-19, associated preparations and responses required substantial allocations of staff time and resources for nearly the entire 2006-2007 reporting period. We are pleased to report that as a result of these efforts, the Connecticut Sea Grant College program was placed in Category 1, indicating the highest level of overall performance compared to other Sea Grant programs and a one-step improvement relative to the program’s 2001 evaluation. A second major event was the completion and formal approval of the program’s new strategic plan, *Blueprint for a Coastal Legacy: Connecticut Sea Grant Strategic Plan 2007-2011*. The plan includes a detailed summary of the strategic planning process, including activities during the time period covered by this annual report.

A third major accomplishment of the program during 2006-2007 was the selection and hiring of a new permanent program director, Dr. Sylvain De Guise. As Dr. De Guise had already been serving in the capacity of Interim Director, his selection by the search committee for the permanent directorship contributed to the continuity and success of the program during the reporting period. A fourth major event that required concerted program efforts during 2006-2007 was the preparation of our 2008-2010 Omnibus submission. Associated efforts included preparation of the *Connecticut Sea Grant College Program Call for Preliminary Proposals: 2008-2010 Omnibus Funding Cycle*, review of preliminary research proposals, and selection of

proposals to move forward to the full proposal stage. As of the writing of this annual report, progress continues towards the preparation of our 2008-2010 Omnibus proposal.

Finally, 2006-2007 witnessed a number of actions designed to enhance the long term success and viability of the program, initiated by the CTSG management team in coordination with program staff and partners. These included the procurement of additional University funding for the program, in the form of additional long-term salary support for CTSG staff. The program has also, in collaboration with partners, employed a new assistant extension educator in residence to assist with the program's Coastal Community Development program, and provide additional extension expertise regarding the stewardship of coastal habitats. These and other new partnership initiatives have positioned the program to have an even greater capacity to foster sustainable use and conservation of coastal and marine resources for the benefit of the environment and current and future generations of residents of Connecticut and the Region.

The remainder of this annual report highlights the primary accomplishments and impacts of the Connecticut Sea Grant College Program, under the reporting guidance provided by "Guidance for Annual Reports 2006/07," as promulgated by the National Sea Grant Office on March 28, 2007.

## SECTION I AWARD REPORTING

The following award reporting section reports on progress for the following individual CTSG Awards that were active between March 1, 2006 and February 29, 2007. Project titles and numbers are taken directly from NOAA Grants Online.

**Award Number:** NA06OAR4170072

**Project Title:** CONNECTICUT SEA GRANT COLLEGE PROGRAM OMNIBUS 2006-2008: CONTINUING SEA GRANT COLLEGE SUPPORT FOR MARCH 2006 THROUGH FEBRUARY 2008

**Award Number:** NA16RG2253

**Project Title:** CONNECTICUT SEA GRANT COLLEGE PROGRAM: PROGRAM PLAN FOR CONTINUING SUPPORT FOR MARCH 2002 THROUGH FEBRUARY 2003 (This is the CTSG Omnibus award for 2004-2006, currently extended through 5/31/2008.)

**Award Number:** NA16RG1364

**Project Title:** CONNECTICUT SEA GRANT LONG ISLAND SOUND LOBSTER RESEARCH INITIATIVES

**Award Number:** NA07OAR4170026

**Project Title:** CONNECTICUT SEA GRANT PROGRAM KNAUSS MARINE POLICY FELLOWSHIP, 2007, CHRISTOPHER MEANEY E/K-14

**Award Number:** NA06OAR4170170

**Project Title:** TUNICATE: RESEARCH ON TUNICATE CONTROL AND THE EFFECTS OF ECOLOGICAL BOTTLENECKS IN THE CONTROL OF NON-NATIVE TUNICATES IN NEW ENGLAND - PI WHITLATCH

## SECTION I-A

### AWARD REPORTING

#### CONNECTICUT SEA GRANT COLLEGE PROGRAM OMNIBUS 2006-2008: CONTINUING SEA GRANT COLLEGE SUPPORT FOR MARCH 2006 THROUGH FEBRUARY 2008

**Grantee:** University of Connecticut, Connecticut Sea Grant College Program

**Award Number:** NA06OAR4170072

**Project Title:** Connecticut Sea Grant College Program Omnibus 2006-2008: Continuing Sea Grant College Support for March 2006 through February 2008

**Time Period:** 03/01/2006 - 02/28/2008 (This report covers the period March 1, 2006 – February 28, 2007)

**Accomplishments and Outcomes:** See Below

The Connecticut Sea Grant Omnibus comprises multiple projects, including those funded through our core federal funding and national strategic investment projects (NSIs). Hence, accomplishments and impacts for NA06OAR4170072 are presented by individual project and (internal CTSG) project number. Projects for which information is provided are as follows:

**M/PA-1:** Program Management: Administration and Planning

**M/PD-1:** Program Development

**M/PD-4:** Multi-Program and Regional Development

**A/E-1:** Sea Grant Extension Program

**E/T-11:** Sea Grant Educator Program

**M/CP-1:** Core Communications Program

**A/E-3:** Yale/Sea Grant Coastal Internship Program

**R/LR-17:** Impacts and Spread of the Non-indigenous Rhodophycean Alga, *Grateloupia turuturu*, on Long Island Sound

**R/ER-25:** Evaluating the Benefits of Salt Marsh Restoration and Management for Globally Vulnerable Birds

#### Substantial Research Development Projects

1. *Hydrilla verticillata* in Connecticut
2. Analysis of the genetic population structure of the putatively invasive tunicate, *Didemnum* sp.
3. Molecular markers of cancer in cartilaginous fishes
4. Identification of Molecular Markers of Cell Division in the Toxic Dinoflagellate *Alexandrium fundyense* by cDNA Microarray

## **Progress Report for CTSG Core Programs 2006-2008 Omnibus, NA06OAR4170072**

### **M/PA-1 Program Management: Administration and Planning**

Program management and administration is led by the Sea Grant Director, Dr. Sylvain De Guise, in collaboration with the Associate Director, Dr. Robert J. Johnston. The management team is comprised of De Guise and Johnston, together with Extension Program Leader Nancy Balcom and Communications Coordinator Peg Van Patten. The management team meets as required, roughly once a week to every other week. As recently defined in a new document on office procedures, the management team “advises the director in the performance of its duties related to programmatic decisions. For example, the management team will help define policies relative to existing or new situations, review and advise on funding decisions relative to development fund requests, and perform other related functions upon the director’s request.”. Advisory boards providing input into program direction, planning, and management are detailed in the CTSG Implementation Plans, which are duly filed each biennium with the National Sea Grant Office.

CTSG is located in the \$28M Marine Sciences Center (MSC) at the Avery Point Campus of the University of Connecticut. The campus provides infrastructure, office space and administrative services, while the MSC provides state-of-the-art infrastructure to support the continued growth of the marine science community. CTSG capitalizes on these facilities and location to expand its education and outreach programs, access the research capabilities of PIs at the facility, coordinate with other programs, and interact with coastal stakeholders. The University of Connecticut is the designated Sea Grant College for the State of Connecticut and serves as the flagship university for CTSG. A memorandum of understanding signed on December 17, 1999 defines the role of CTSG within the University. Under this agreement, CTSG reports directly to the Vice Provost for Research and Graduate Education, who also chairs the SAB.

#### *Major Program Management Events and Accomplishments, 2006-2007*

In addition to the day-to-day management and planning activities of CTSG program management during 2006-2007, a number of longer-term initiatives demanded the primary attention of CTSG management. Each of these initiatives required significant and coordinated efforts of the CTSG staff, as overseen by the CTSG management team. These initiatives have led to a significant improvement in the ability of the program to have positive impacts on the use, preservation and management of coastal and marine resources.

1. The hiring of Sylvain De Guise as the new permanent Director of CTSG. As part of the hiring negotiations, De Guise was able to secure additional University funding for the program, in the form of additional salary support for CTSG staff.
2. The hiring of Juliana Barrett as an assistant extension educator in residence to assist with the program’s Coastal Community Development program, and provide additional extension expertise regarding the stewardship of coastal habitats.
3. Completion and formal adoption of the new Connecticut Sea Grant Strategic Plan, *Blueprint for a Coastal Legacy: Connecticut Sea Grant Strategic Plan 2007-2011*.
4. Preparation for and completion of the Program Assessment Team (PAT) visit, which occurred during the week of October 15, 2006. This included preparations for the PAT,

implementation of PAT visit activities during October, and response to PAT materials in the months following the PAT. We are pleased to report that CTSG was given a “highest performance” rating by the National Sea Grant Office, as a result of the PAT evaluation.

5. Preparation for submission of our 2008-2010 Omnibus proposal, including the preparation of the *Connecticut Sea Grant College Program Call for Preliminary Proposals: 2008-2010 Omnibus Funding Cycle*, review of preliminary research proposals, and selection of proposals to move forward to the full proposal stage. As of the writing of this annual report, progress continues towards the preparation of our 2008-2010 Omnibus proposal.
6. Development and review of core program elements, leading to initial materials for the CTSG 2008-2010 Implementation Plan. This included development of new tracking systems for program outputs and impacts.
7. Commencement of the process through which CTSG will seek to hire a new part-time fiscal officer to assist Director De Guise and Associate Director Johnston, as well as a part-time expert to assist in the development and upkeep of the CTSG web site.
8. CTSG has issued a comprehensive report of the program’s highlights, accomplishments and impacts over the course of the last five years, including the recognition of problems/needs, CTSG investments, outputs and impacts on society, the economy and the environment. The report received praise at levels as high as the UConn President’s office.
9. Participation in a new Regional Planning Grant for the Gulf of Maine, a new initiative from NSGO to help plan research and information needs on a regional basis. De Guise, on behalf of CTSG, has also agreed to lead the effort for a Regional Planning Grant for the New York Bight region, as part of the second year of the NSGO initiative.
10. Collaboration with the Department of Marine Sciences, the University of Connecticut National Undersea Research Center (NURC), and other partners towards several activities, including workshops with NOAA and State Department of Environmental Protection higher management, and development of a proposal for a NOAA Cooperative Institute and proposals for federal earmarks.
11. CTSG, in partnership with several UConn departments and external partners, has led an effort for a multidisciplinary NOAA Oceans and Human Health Traineeship Grant in support of graduate students and post-doctoral fellows in disciplines related to the relationships between ocean ecosystems and human health.

#### *Other Relevant Events and Accomplishments*

Other events influencing long-term program management included the awarding of tenure to Associate Director Robert J. Johnston as a faculty member in Agricultural and Resource Economics, ensuring his continued presence within the Connecticut Sea Grant program. Johnston was also awarded the University of Connecticut College of Agriculture and Natural Resources Research Excellence Award for 2006-2007, along with the Gamma Sigma Delta Faculty Award of Merit in Agriculture. Extension Leader Nancy Balcom was also promoted to full Extension Educator (from Associate). With the promotion of Dr. Johnston, CTSG has on staff three tenured associate professors (De Guise, Johnston and Pomeroy); two of whom serve on the management team.



## **M/PD-1 Program Development**

Development funds support new project initiatives and the development of new ideas, or extension of the scope of existing projects to useful products. To this effect, 61% of the individual project development funds were provided to initiate new research projects, most of which are in progress and have yet to provide quantifiable outcomes and impacts. Funds were also provided to organize workshops and conferences, supporting the presentation of research results and the sharing of ideas between colleagues. This accounted for 18% of the funds expended. Also, 10% of the funds were expended towards educational experiences. Finally, CTSG has teamed with the Department of Marine Science, the National Undersea Research Center and the Avery Point regional campus of the University of Connecticut to gain full membership in the National Association of Marine Laboratories (NAML) to be better informed and gain recognition at the national level (2% of funds). Outcomes and accomplishments for the more significant development projects are provided in following sections of this report. Additional details of funded development projects are provided in the Appendix to this progress report.

#### **M/PD-4 Multi-Program and Regional Development**

Multi-program development funds are available to promote initiatives that are often regional in scope and involve more than one Sea Grant program. Funds were expended to support a portion of a research project, in collaboration with the Long Island Sound Study program (43% of the funds). Funds were also provided to organize conferences, supporting the presentation of research results and the sharing of ideas between colleagues (57% of the funds). Additional details of funded development projects are provided in the Appendix to this progress report.

## **A/E-1      Sea Grant Extension Program**

The CTSG Extension Program is implemented by Tessa Getchis (aquaculture), Robert Pomeroy (fisheries, resource economics), John Rozum (coastal community development, NEMO), Nancy Balcom (seafood safety, aquatic invasive species, fisheries), and, as of November 2006, Juliana Barrett (coastal habitat quality). Through a partnership with the Center for Land use Education and Research (CLEAR), the Department of Extension, College of Agriculture and Natural Resources, and CTSG, the Extension Program was able to add this additional full-time position. In addition to Dr. Barrett's programmatic responsibilities that focus on coastal habitat quality, she also serves as an active member of the NEMO team.

Extension Program staff took part in the five-year federal performance review for the Connecticut Sea Grant College Program in October 2006, which elevated the overall program to a category one program. The outreach and education staff members are very pleased that the performance categories "Contributions to Extension, Communications and Education" and "Impact on Society, the Economy, and the Environment" were both ranked "highest performance", and that the category "Engagement with Appropriate User Communities" was ranked "exceeds benchmarks". These rankings reaffirm that our efforts to identify critical needs and critical audiences, and engage them in extension programming in a meaningful way resulting in measurable impacts, have been successful.

### Extension and Education Stakeholders Advisory Committee

Stakeholders serving on the extension / education advisory committee met with staff on December 13, 2006 to discuss programmatic priorities, in advance of the submission of the 2008-2010 plan of work in 2007. The three thematic areas highlighted in the 2007-2011 CTSG strategic plan were outlined, and specific on-going and potential issues and programs discussed.

### Project-Specific Advisory Committees

Extension staff set up advisory groups as appropriate to provide guidance on specific projects. These include:

- Long Island Sound ANS Working Group
- Baitworm vector steering committee
- Hull fouling vector steering committee
- Northeast Aquaculture Conference & Exposition steering committee
- Connecticut Aquaculture Permitting Workgroup

## **Major Accomplishments of CTSG Extension March 1, 2006 – February 28, 2007**

Extension inputs, outputs, and accomplishments are listed according to specific programs under each of the following three strategic theme areas:

## **Theme Area 1: Marine Aquaculture and Biotechnology**

### **1A. Marine Aquaculture**

#### **1A1. Aquaculture Law and Policy**

##### Student Advising / Graduate Assistants / Interns

Pomeroy, R., Getchis, T.S. (2007) Undergraduate, Dugan Tillman-Brown, Economic implications of reducing aquaculture permitting process duration.

##### Workshops, courses

Getchis, T.S. (multiple) Marine Aquaculture Permitting workshop  
(2006, December) producers  
(2006, October) regulators  
(2006, August) regulators  
(2006, April) local resource managers  
(2006, April) state and federal resource managers.

##### Presentations

Getchis, T.S. (2007) Shellfish aquaculture: a benign use of the coastal environment? 3rd Gathering of Shellfish Commissions, New Haven, CT

Getchis, T.S. (2007). Partnering to streamline the aquaculture permitting process. 2007 Northeast Extension Directors' Meeting, Chevy Chase, MD

##### Committees / Boards

Getchis, T.S. (2005-) Town of Stonington, Shellfish Commission Member

Getchis, T.S. (2001-) Chair, Connecticut Marine Aquaculture Permitting Workgroup

Getchis, T.S. (2007) Organizer, 3rd Annual Gathering of Shellfish Commissions, New Haven, CT

Getchis, T.S. (2005-) Atlantic States Marine Fisheries Commission, Interstate Shellfish Transport Committee.

#### **1A2. Aquaculture & the Environment**

##### Student Advising / Graduate Assistants / Interns

Jamie Vaudrey, Post-doctoral fellow, National Marine Aquaculture Initiative Grant

##### Publications

Vaudrey, J., Getchis, T.S., Britton, R. & Kremer, J. (2006). Effects of oyster depuration gear on eelgrass growth rate and eelgrass bed sediment characteristics. Northeast Aquaculture Conference & Exposition, Mystic, CT. Abstract.

Vaudrey, J., Getchis, T.S., Britton, R. & Kremer, J. (2006). Assessing impacts of shellfish aquaculture on eelgrass populations in eastern Long Island Sound. Milford Aquaculture Seminar, Meriden, CT. Journal of Shellfish Research. Abstract.

Cheney, D., Elston, R., Davis, J., Downey, R., Newell, C., Richardson, J., Getchis, T.S., Angel, D., Luckenbach, M., Rheault, R. & Pierson, M. (2006). Assessing environmental impacts of marine shellfish aquaculture in the USA. Annual meeting of the World Aquaculture Society. Florence, Italy. Abstract.

Richardson, J., Newell, C., Angel, D., Getchis, T.S., Suhrbier, A., Davis J. & Cheney D. (2006). CFD analysis of shellfish aquaculture gear used in intertidal and subtidal locations. Annual meeting of the National Shellfisheries Association. Monterey, CA. Abstract.

Vaudrey, J., Getchis, T.S., Britton, R. & Kremer, J. (2006). Assessing impacts of shellfish aquaculture on eelgrass populations in eastern Long Island Sound. Annual meeting of the National Shellfisheries Association. Monterey, CA. Abstract.

#### Presentations

Vaudrey, J., Getchis, T.S., Britton, R. & Kremer, J. (2006). Effects of oyster depuration gear on eelgrass growth rate and eelgrass bed sediment characteristics. Northeast Aquaculture Conference & Exposition, Mystic, CT.

Vaudrey, J., Getchis, T.S., Britton, R. & Kremer, J. (2006). Assessing impacts of shellfish aquaculture on eelgrass populations in eastern Long Island Sound. Milford Aquaculture Seminar, Meriden, CT. Journal of Shellfish Research.

Richardson, J., Newell, C., Angel, D., Getchis, T.S., Suhrbier, A., Davis J. & Cheney D. (2006). CFD analysis of shellfish aquaculture gear used in intertidal and subtidal locations. Annual meeting of the National Shellfisheries Association. Monterey, CA.

Vaudrey, J., Getchis, T.S., Britton, R. & Kremer, J. (2006). Assessing impacts of shellfish aquaculture on eelgrass populations in eastern Long Island Sound. Annual meeting of the National Shellfisheries Association. Monterey, CA.

Cheney, D., Elston, R., Davis, J., Downey, R., Newell, C., Richardson, J., Getchis, T.S., Angel, D., Luckenbach, M., Rheault, R. & Pierson, M. (2006). Assessing environmental impacts of marine shellfish aquaculture in the USA. Annual meeting of the World Aquaculture Society. Florence, Italy.

### **1A3. Aquaculture Economics**

#### Workshops/courses

Pomeroy, R.S. (2006) Aquaculture Business workshops, New Haven, CT.  
14 March, 21 March, 28 March, 13 April

Publications

Pomeroy, R., B.Bravo-Ureta, D.Solis and R. Johnston. 2006. Bioeconomic modelling and salmon aquaculture: an overview of the literature. *Int. J. Environment and Pollution*

Committees / Boards

Pomeroy, R. and T. Getchis. CT shellfish permit cost analysis (continuing)

**1A4. Cooperative Research in Aquaculture**

- Connecticut Sea Grant recently funded a development project for a cooperative research project involving Applied Sustainable Aquaculture Inc. and the Sea Grant Extension Program. The purpose of this study is to determine the most efficient foods and substrates for growing corals for hobbyists. This project could potentially increase demand for these resources, and increase revenues for their suppliers. The coral farmer is also initiating a demonstration project in the UConn Rankin Laboratory at the Avery Point Campus which will engage students in cultivation strategies for ornamental corals.

**1A5. Healthy Shellfish**

- Sea Grant Extension is collaborating with researchers on a project entitled, “Linking Marine Pathogens to Molluscan Shellfish: The Ecological Role of Marine Aggregates.” Extension assisted with project permitting, field site selection, safe interstate transfer of shellfish, and development and review of a project fact sheet.

Publication

Lyons, M.M., Ward, J.E., Getchis, T.S. (2006). Fact Sheet: Study of shellfish pathogens. UConn Marine Sciences Bivalve Physiology Laboratory. 1pp.

**1A6. Global Aquaculture**

Publications

Pomeroy, R. 2007. Public policy for sustainable grouper aquaculture development in Southeast Asia. Chapter 29 In Leung, P., C.-S. Lee, and P.J. O'Bryen, (Eds). *Species and System Selection for Sustainable Aquaculture*. Blackwell, Ames, Iowa, USA. 488 pp.

Pomeroy, R.S., K. Sugama, B. Slamet and Tridjoko. 2006. The Financial Feasibility of Small-Scale Grouper (*Cromileptes altivelis*) Aquaculture in Indonesia. *Asian Fisheries Science*. Vol.19, No.1 pp.27-42.

Committees / Boards

Pomeroy, R. Board of Directors, Association of Aquaculture Economics and Management

Pomeroy, R. Professional development committee, International Association of Aquaculture Economics and Management

**1B. Biotechnology**

## **Theme Area 2: Use and Conservation of Marine Resources, Ecosystems, and Habitats**

### **2A. Coastal Land Use and Community Planning**

CTSG's Coastal Community Development Program (CCDP) funds leverage other NEMO projects and support, in particular some of the innovative remote sensing-based research ongoing at NEMO's new parent unit at UConn, the *Center for Land use Education and Research* (CLEAR). Some of the projects with the greatest relevance and utility to the state's coastal communities are summarized below.

- *Tracking Connecticut's changing landscape.* This ongoing project tracks changes in the state's landscape over time (1985 – 2002), with an emphasis on increases in developed land and fragmentation of forest lands. The study has become a major resource for researchers, state agencies, regional and local planners, the public and the press. Currently, the project is being updated with 2006 data. The update will also include enhancements to the land cover classification system which will shed more light on trends in agricultural and residential land.
- *Impervious surfaces in the Long Island Sound watershed.* In this study conducted for the Long Island Sound Study National Estuary Program, CLEAR researchers used innovative remote sensing techniques to quantify impervious surfaces in the Connecticut and lower New York region from 1985 to 2002. Impervious surfaces like asphalt, rooftops and concrete are a reliable indicator of the impact of development on water resources. The information is being used to help track progress under the 2003 Long Island Sound Agreement, a management pact signed by the states of Connecticut and New York, and the federal EPA. An interactive web mapping site was created on the CLEAR website for interested parties to explore the data and maps.
- *Assessing invasive coastal plants via remote sensing.* This research effort, conducted in cooperation with Wesleyan University, the USDA Natural Resources Conservation Service and other partners, is developing new cutting-edge methods to characterize and track tidal wetland plant communities from satellite data. The emphasis is on the invasive reed *Phragmites australis*, which has replaced large swaths of native salt marsh vegetation along the East Coast and is the subject of control programs by the Connecticut Department of Environmental Protection and other organizations. By forging new research techniques, the project hopes to ultimately devise an accurate yet cost-effective way to track the distribution of invasive coastal plant species.
- *Assessing coastal streamside buffers.* In this study, funded by the Long Island Sound Study National Estuary Program, CLEAR researchers are assessing land cover and land cover change in the streamside (riparian) corridors of Connecticut's coastal watersheds. The national research base is increasingly finding that intact, vegetated riparian corridors are critical to protecting the health of our waterways. State and federal environmental officials intend to use the CLEAR study as a broad-scale guide to determining where to focus riparian buffer protection and restoration efforts.

- *Supporting a new approach to statewide water quality regulations* CLEAR faculty are working with the CTDEP Bureau of Water Protection and Land Reuse to investigate the relationship of watershed impervious surface to the health of aquatic invertebrates, a common indicator of overall stream quality. The work is providing the scientific foundation for CTDEP's new, nationally precedent-setting approach to implementing the *total maximum daily load* (TMDL) water regulation program.
- *Geospatial data to support a watershed management plan.* In support of a CTDEP funded project to develop a watershed management plan for the Niantic River Watershed in southeastern Connecticut, CLEAR's GTEP program created a detailed aerial photo-based land cover map for the watershed, and used *CommunityViz* software to do a "buildout" analysis showing potential future growth patterns.

### **2A1. Stormwater Training on Planning and Stormwater Techniques**

The NEMO program continues to provide workshops and publications on stormwater management and water quality protection to Connecticut land use decision makers. The use of the planning and stormwater principles espoused in these workshops continues to gain traction in the state, as demonstrated by the implementation of new subdivision design and changes to town regulations.

#### Workshops/courses

NEMO team members (2006) gave 50+ workshops to both local and regional decision makers on stormwater and land use-related topics.

### **2A2. Low Impact Development Database and Training**

- In 2006 the NEMO team created the Low Impact Development (LID) Database to provide some key case studies related to innovative stormwater management techniques to help address concerns by local communities about making changes to land development and land use policy.
- The website <http://clear.uconn.edu/tools/lid/index.htm> provides case studies on the panoply of LID techniques that have been developed, such as bioretention areas, permeable pavements, and vegetated roofs. Visitors can download a datasheet for each case study that include a description, pictures and detailed contact information for further follow-up.
- Town personnel and conservation members throughout Connecticut had a grasp of the "why" behind the use of low impact development (LID) techniques, but needed assistance in the "how" of installing these techniques in the field. This lack of understanding of proper installation techniques has been the cause of failures of LID practices in Connecticut and around the country.

#### Workshops/courses

NEMO Team (2006) Groton CT - LID Installation Training Workshop (40 contractors, engineers, town and state personnel)

### **2A3. LISS Buffer Research**



- In a study assessing coastal streamside buffers, funded by the Long Island Sound Study National Estuary Program, CLEAR researchers are assessing land cover and land cover change in the streamside (riparian) corridors of Connecticut's coastal watersheds. The national research base is increasingly finding that intact, vegetated riparian corridors are critical to protecting the health of our waterways. State and federal environmental officials intend to use the CLEAR study as a broad-scale guide to determining where to focus riparian buffer protection and restoration efforts.
- An extension program on riparian buffer zones is in development.

#### **2A4. Coastal Municipal NEMO Program**

- The "Municipal Initiative," developed in collaboration with the CT Department of Environmental Protection and now in its sixth year, allows the NEMO Team to focus more resources on a few municipalities, establishing relationships between the program and these towns from the initial educational workshop through implementation of on-the-ground changes.
- The Municipal Initiative has paid considerable dividends in the form of changes to local land use plans, policies, practices and procedures catalyzed by NEMO educational programs.
- The coastal towns of North Stonington and Waterford were the focus of the Municipal Initiative in 2006 (see impact section).

#### **2A5. Focus on the Coast**

- The NEMO Focus on the Coast programs, website, and resource materials are undergoing review and revision.

#### **2A6. Coastal Open Space Program**

#### **2A7. Online Community Resource Inventory**

- The CRI Online provides mapping resources, tutorials, examples and other resources that will help local decision-makers begin natural resource-based planning.
- By working through the website, towns will be able to develop a basic inventory of their town's natural and cultural resources and from this base data, build a meaningful plan to protect water resources and chart the future of their communities.
- The CRI Online website is accessible from the Tools and Resources section of the NEMO website (<http://nemo.uconn.edu/tools.htm>).
- Between January – May 2007 the website has been viewed over 2,300 times.

### **2B. Habitat Restoration and Enhancement**

#### **2B1. Shellfish Habitat and Resource Enhancement**

- Each coastal town in Connecticut has a municipal shellfish commission. The charge of these commissions is to protect and manage the local shellfish resources. Each

commission manages a recreational shellfishing program and also leases shellfish beds for commercial fishing or aquaculture. Sea Grant organizes annual gatherings of municipal shellfish commissions to determine how we can better serve this community of stakeholders.

- An electronic list serv “SHELLCOMM-L” was developed in response to requests from commission members. The list serv serves as a means of communication among commissions and between the commissions and Sea Grant Extension.
- A resource handbook is under development which will contain information critical to the performance of these commissions including: shellfisheries statutes, permitting guidance and forms, guides to commercial and recreational shellfishing, restoration and enhancement guidance, standards for surveying shellfish beds, and various fact sheets on aquaculture management techniques and practices.

## **2B2. Coastal Habitat Restoration**

- Three federally-funded habitat restoration projects near the mouth of the Connecticut River are in progress in collaboration with the Lynde Point Land Trust, Fenwick CT.

### Publication

Metzler, K.J. and J.P. Barrett. 2006. The Vegetation of Connecticut A Preliminary Classification. State Geological and Natural History Survey of CT. Dept. of Environmental Protection. Report of Investigations No. 12. Hartford. 109 pp.

### Presentation

Barrett, J. and N.E. Barrett. 2006. Management for *Liatris scariosa* var. *novae-angliae* in a coastal meadow. Connecticut Conference on Natural Resources. March 9. Storrs, CT

### Committees / Boards

Barrett, J. 2006-2007. Member, Long Island Sound Study Habitat Restoration Workgroup (EPA).

## **2C. Aquatic Invasive Species**

### **2C1. Aquatic Invasive Species Management**

- The Connecticut ANS Management Plan, developed jointly by CTSG and the Connecticut Department of Environmental Protection was signed by Connecticut Governor M. Jodi Rell in March 2007.
- The CT Plan submitted to the federal ANS Task Force for final review and approval; (informal word was received that the plan was approved in early May 2007 by the ANSTF).
- A new externally-funded project (US EPA through New England Interstate Water Pollution Control Commission) was awarded to CTSG Extension Program to facilitate the development of an interstate ANS management plan for Long Island Sound in 2007.

Working group meetings:     January 11, 2007 Bridgeport CT  
  January 19, 2007 Bridgeport CT

Student Advising / Graduate Assistants / Interns

Kari Heinonen, Ph.D. candidate, Long Island Sound Interstate Aquatic Invasive Species Plan, 2006-2007.

Alexa Fournier, Masters Candidate, Stony Brook University, Long Island Sound Interstate Aquatic Invasive Species Plan, 2006-2007 (through EPA Long Island Sound Study Fellowship)

Publication

Balcom, N. 2006. *Grateloupia turuturu*: An invading red alga in Long Island Sound. Connecticut Sea Grant publication No. CTSG-06-09. 2pp. (fact sheet)

Presentation

Balcom, N., W. Hyatt, N. Murray, P. Bresnahan, and K. Heinonen. 2006. A comprehensive plan for addressing aquatic nuisance species in Connecticut and Long Island Sound. 8<sup>th</sup> Biennial Long Island Sound Research Conference. 25-27 October. New London, CT.

Committees / Boards

Balcom, N. Federal Appointee (2001-present), Northeast Regional Aquatic Nuisance Species Panel, a committee of the federal Aquatic Nuisance Species Task Force  
Balcom, N. Chair (2006-), Long Island Sound Aquatic Nuisance Species Working Group  
Barrett, J. 2006-2007. Member, Long Island Sound Aquatic Nuisance Species Working Group.

**2C2. Aquatic Invasive Species Vectors**

- A Northeast regional project developing outreach programs to address various ANS vectors is on-going.
- CTSG extension connected with CT/NY research group investigating live marine bait as vectors of ANS and HABs. This group is surveying regional bait wholesalers and bait and tackle shops about sources of bait, therefore decided to focus regional outreach efforts on educating users of live bait.
- Collected links to state resources on Clean Marina and Clean Boater programs, references to hull fouling cleaning practices, hull coating regulations, etc. for use in web site portal.
- Development of hull fouling outreach materials (posters) to complement pending web site on-going.
- Format for multi-lingual educational sticker to be either printed directly on bait boxes or affixed to the boxes in development; seeking graphic artist and acquiring multi-lingual translations of educational message; web-based “raffle” to evaluate effectiveness of sticker (e.g., is it being read?) in development.

Publication

Balcom, Nancy. 2006. "Hull fouling's a drag on boats and local ecosystems." *Wrack Lines* 5(1):14-17.

**2D. Use and Conservation of Marine Resources**

**2D1. U.S. Fisheries Management**

Publications

Balcom, N. and P. Howell. 2006. Responding to a resource disaster: American lobsters in Long Island Sound. CTSG Publication No. CTSG-06-02. 24 pp.

Horst, M.N., A.N. Walker, P. Bush, T. Wilson, E.S. Chang, T. Miller, and P. Larkin. 2007. Pesticide induced alterations in gene expression in the lobster, *Homarus americanus*. *Comparative Biochemistry and Physiology, Part D* 2:44-52.

Pomeroy, R.S. 2006. Integrating Cooperative Research and Management. pp. 207-215 In A.N. Read and T.W. Hartley (Eds.). *Partnerships for a Common Purpose: Cooperative Fisheries Research and Management*. American Fisheries Society, Symposium 52, Bethesda, Maryland.

Presentations

Pomeroy, R. (2007) Alternative fisheries management strategies for New England fisheries. Gulf of Maine Research Institute, Portland, Maine, 6 April

Pomeroy, R. 2006. Small-scale fisheries assessment in Hawaii. NOAA-NOS, Honolulu, HI, 9 December 2006.

Pomeroy, R. 2006. Co-management in US fisheries. Penobscot East Resource Center, Maine. October 21

Pomeroy, R. 2006. Socioeconomic assessment of US fisheries. NOAA-NOS, Silver Spring, MD, September 12, November 15.

Committees / Boards

Balcom, N. (2006-2007) Member, Northeast Lobster Shell Disease Executive Committee

Pomeroy, R. Gulf of Maine Regional Ocean Science Council (continuing)

Pomeroy, R. Technical assistance to the Penobscot East Resource Center, Maine on area based management initiative (continuing)

Pomeroy, R. Member, Atlantic States Marine Fisheries Commission.

Pomeroy, R. Economist Advisor, Socioeconomics, New England Fisheries Management Council

Pomeroy, R. Georges River Clam Management Committee, Maine. Program evaluation. October 2006 – February 2007

## 2D2. Global Fisheries Management

CTSG extension led development of an initiative to improve management of MPA sites by managers, planners, and other decision-makers through the development of tools and methods for assessing effectiveness of sites, with IUCN World Commission on Protected Areas (WCPA) Marine, the World Wide Fund for Nature (WWF), David and Lucile Packard Foundation, and NOAA.

- The 2004 guidebook (below), *How is Your MPA Doing?*, enhances the capability for adaptive management in MPAs.

Pomeroy, R.S., J.E. Parks and L.M. Watson. 2004. *How is Your MPA Doing? A Guidebook: Biophysical, socioeconomic and governance indicators for the evaluation of management effectiveness of marine protected areas.* IUCN World Commission on Protected Areas-Marine, World Wide Fund for Nature, and National Oceanographic and Atmospheric Administration. Gland, Switzerland and Silver Spring, Maryland.

- To date, the book has been translated into Spanish, French, Italian and Chinese. Parts of the book have been translated into seven other languages.
- Book has become the international standard for undertaking MPA management effectiveness analysis.
- NOAA, through its International Coral Grant Program and International Program Office, established an international grants program to fund regional activities at coral MPA sites that are utilizing the *How is Your MPA Doing?* handbook, in order to strengthen and achieve the site goals and objectives.  
<http://international.nos.noaa.gov/coralgrants.html>

### Publications

Malleret-King, D., A. Glass, I. Wanyonyi, L. Bunce and R. Pomeroy. 2006. *Socioeconomic monitoring guidelines for coastal managers of the Western Indian Ocean.* SOCMON-WIO. CORDIO East Africa Publication. Mombasa, Kenya. 108pp.

Pomeroy, R.S. and M. Ahmed. 2006. *Fisheries and Coastal Resources Co-management in Asia: Selected Results from a Regional Research Project.* WorldFish Center Studies and Reviews 30. Penang, Malaysia. 240p.

Pomeroy, R., Y.T. Garcia, M. M.Dey and L. R. Garces. 2007. *Regional Economic Integration of the Fisheries Sector in ASEAN Countries.* In *Fisheries and Poverty.* SEARCA, Los Banos, Philippines.

Pomeroy, R.S. 2007. *Conditions for successful fisheries and coastal resources co-management: lessons learned in Asia, Africa, and the wider Caribbean.* In D. Armitage, F. Berkes and N. Doubleday (eds.). *Adaptive Co-management: Collaboration, Learning and Multi-level Governance.* University of British Columbia Press, Vancouver.

McConney, P. and R. S. Pomeroy. 2007. Challenges facing coastal resources co-management in the Caribbean. In D. Armitage, F. Berkes and N. Doubleday (eds.). *Adaptive Co-management: Collaboration, Learning and Multi-level Governance*. University of British Columbia Press, Vancouver.

Pomeroy, R., M. Mascia and R. Pollnac. 2007. Marine Protected Areas: The Social Dimension. In *Workshop on Marine Protected Areas and Fisheries Management: Review of Issues and Considerations*. FAO Fisheries Report No. 825. FAO, Rome. 333p.

Pomeroy, R., J.Parks, R.Pollnac, T.Campson, E.Genio, C.Marlessy, E.Holle, M. Pido, A. Nissapa, S.Boromthanasarat and Nguyen Thu Hue. 2007. Fish Wars: Conflict and Collaboration in Fisheries Management in Southeast Asia. *Marine Policy*

Kuperan, K., N. Mustapha Raja Abdullah, R. Pomeroy, E.L.Genio and A.M. Salamanca. 2007. Measuring Transaction Costs in Fisheries Co-management. *Coastal Management*

Pomeroy, R., B.Bravo-Ureta, D.Solis and R. Johnston. 2006. Bioeconomic modelling and salmon aquaculture: an overview of the literature. *Int. J. Environment and Pollution*

Genio, E., and R. Pomeroy. 2006. Factors Affecting Fisherfolk's Support for Coastal Resource Management: The Case of Local Government-Initiated Mangrove Protection Activities. *Ocean and Coastal Management*

McConney, P. and R. Pomeroy. 2007. Co-management in the Caribbean. *Proceedings of the Gulf and Caribbean Fisheries Institute*. Volume 58.

US Agency for International Development Fisheries Opportunities Assessment. 2006. Coastal Resources Center, University of Rhode Island, and Florida International University. 104p.

Pomeroy, R.S., M.M. Dey, Y. Garcia and L. Garces. 2006. Study report on the Roadmap for the Integration of the Fisheries Sector in ASEAN countries. Association of Southeast Asian Nations (ASEAN) Secretariat, Jakarta, Indonesia and WorldFish Center, Penang, Malaysia.

McConney, P. and R. Pomeroy (editors). 2006. Reforming governance: Coastal resources co-management in Central America and the Caribbean. Final Report of the Coastal Resources Co-management Project (CORECOMP). CERMES Technical Report No.5. 63pp.University of the West Indies, Cave Hill, Barbados.

Pomeroy, R.S., M.D. Pido, J.F.A. Pontillas, B.S. Francisco, A.T. White, E.M.C. Ponce de Leon and G.T. Silvestre. 2007. Evaluation of policy options for the live reef food fish trade in the Province of Palawan, Western Philippines. *Marine Policy*. (in press)

#### Presentations

Pomeroy, R. (2006) How is your MPA doing? University of Belize, 11 July

Pomeroy, R. (2006) Co-management in Asia. Asia-Pacific Fisheries Committee. 16 August. Kuala Lumpur, Malaysia.

Pomeroy, R. (2006) Small-scale fisheries management, Ministry of Fisheries, Vietnam. Hanoi. 21 August

Pomeroy, R. (2006) Small-scale fisheries management, US Agency for International Development, Washington DC. 12 September

Pomeroy, R. (2006) Marine Managed Area Management effectiveness. Boston University. 19 September

Pomeroy, R. (2006) Fisheries co-management. Wageningen University and Research Centre, Netherlands. 23-24 October

Pomeroy, R. (2006) Co-management in the Caribbean. Gulf and Caribbean Fisheries Institute annual meeting, 7 November, Belize.

Pomeroy, R. (2006) Making co-management work. Department of Fisheries, Cambodia. 28-29 November. Phnom Penh.

Pomeroy, R. (2007) Marine Protected Area management effectiveness. Klagenfurt University. Austria. 8-9 February

Pomeroy, R. (2007) Scaling up marine governance. AAAS annual meeting, San Francisco, CA. 18 February

Pomeroy, R. (2007) Fish Wars, ARE seminar. Storrs, CT. 20 April

Pomeroy, R. (2007) Socioeconomic assessment for coastal management. Palawan State University, 5-7 March

Pomeroy, R. (2007) Pacific socioeconomic assessment of marine resources. University of the South Pacific. Suva, Fiji. 3-5 May

#### Committees / Boards

Pomeroy, R. US Agency for International Development, new fisheries policy development, July-October 2006.

Pomeroy, R. Board of Directors, Asian Fisheries Society

#### **2D3. Fisheries Economics**

Economic evaluation of the 2006 Connecticut commercial lobster industry initiated at the request of the Connecticut Commercial Lobstermen's Association (on-going)

## **Theme Area: Marine and Aquatic Science Literacy**

### **3A. Formal and Informal Education Efforts and Resources**

#### **3A1. Coastal and Marine Education**

##### Courses Taught

Pomeroy, R. (Spring 2007) ARE 299 Independent Study (Shawn Goulet, Dugan Tillman-Brown, Kathryn Levasseur)

Pomeroy, R. (Fall 2006) Integrated Coastal Management course (4 Brazilian exchange students under the UConn Sustainable Coastal Resources Management program: Vivien Green Short Baptista, Thais Rodrigues Lamana, Naete Barbosa Lima Reis, Tarsila F. Seara)

##### Presentation

Balcom, N. 2007. Marine Extension: Putting Marine Science to Work in the Community. Windemere School, Ellington, CT (2 classes; 48 grade 5 students) 28 March.

##### Publication

Balcom, N. and P. Van Patten. (2006) Long Island Sound Educational Resources (CD-ROM). Connecticut Sea Grant Publication No. CTSG-06-08.

##### Committees / Boards

Pomeroy, R. Coastal Studies Committee, UCAP  
Pomeroy, R. Maritime Studies Committee, UCAP

#### **3A2. Aquaculture Education**

##### Courses Taught

Pomeroy, R. ARE 250 Aquaculture Economics (7 students) Spring 2007  
Getchis, T.S. NRME 208 Introduction to Aquaculture (4 students) Fall 2006

##### Workshops, courses

Getchis, T.S. (multiple) NRAC Regional Aquaculture Extension Workshops

- 2007, May, Mystic, CT
- 2007, February, via conference call
- 2006, December, Cincinnati, OH

Getchis, T.S. (multiple) Guts: the biology and ecology of bivalve shellfish.

- 2007, May, Marine Science Day, Groton, CT
- 2006, October, Cornucopia Festival, Storrs, CT
- 2006, August, 4-H Marine Science Day, Groton, CT

Pomeroy, R. NACE conference session on business management and aquaculture, 7-8 December 2006 Mystic CT

##### Publications



Getchis, T.S., Pomeroy, R.S. (2007). Connecticut Aquaculture Situation and Outlook Report. NRAC 102-2007; Connecticut Sea Grant College Program. CTSG-07-04. 8pp.

Getchis, T.S. (2007). (Ed.) Northeast Aquaculture Situation and Outlook Report. USDA CSREES Northeastern Regional Aquaculture Center. NRAC 100-2007.

Getchis, T.S. (2005-). Northeast Aquaculture Conference & Exposition Web Page <http://www.northeastaquaculture.org>

Getchis, T.S. (2007). Bounty of the Bay: Blue Crab Industry in the Chesapeake. Newsletter of the National Shellfisheries Association. Issue 1, Jan 2007.

Getchis, T.S. (2007). Clam Heaven. Modified from *Wrack Lines* 6(1) for the UConn Home and Garden Center 2007 Spring Newsletter.

Getchis, T.S. (2006). Clam Heaven. *Wrack Lines*. Magazine of the Connecticut Sea Grant. College Program. 6(1):3-6.

Getchis, T.S. 2005-06. "What's putting aquaculturists in a 'foul' mood?" *Wrack Lines* 5: 8-10. Connecticut Sea Grant Program CTSG-06-04

#### Presentations

Getchis, T.S. (multiple) Aquaculture Information Booth

- 2006, December, Northeast Aquaculture Conference & Exposition, Mystic, CT
- 2006, August, Milford Oyster Festival, Milford, CT

Getchis, T.S. Introduction to Shellfish Aquaculture Management Practices.

- 2007, January, USDA Farm Service Agency, Groton, CT

Getchis, T.S. (2007) Introduction to Aquaculture (Local, National, International)

- 2007, February, Cheshire Grange, Cheshire, CT

#### Committees / Boards

Balcom, N. Secretary / Member, 2003-, State Consulting Committee for Agriculture Education, Connecticut Department of Education.

Barrett, J. (2007-present) Member, UConn Aquaculture Program Committee

Getchis, T.S. (2006-present) Member, UConn Aquaculture Program Committee

Getchis, T.S. (2005-) Chair, Northeast Aquaculture Conference & Exposition Executive Committee

Getchis, T.S. (2001-) Advisory Board, Bridgeport Regional Vocational Aquaculture School

Getchis, T.S. (2006) Chair, Northeast Aquaculture Conference & Exposition, Mystic, CT

Getchis, T.S. (2007-) appointed member, NOAA-USDA National Aquaculture Extension Committee

Pomeroy, R. (2006-present) Member, UConn Aquaculture Program Committee (A Proposal to Establish an Undergraduate Aquaculture Major at the University of Connecticut was submitted to the University administration April 2007).

### **3A3. Aquatic Invasive Species Education**

- Balcom and education coordinator Payne are working with colleagues from four Sea Grant programs nationwide (IL-IN, LA, OR and NY) as well as local formal and informal educators to add new material and activities to the “Nab the Aquatic Invader” web site to make it nationally-relevant, and to coordinate community-based service projects focused on aquatic nuisance species.
- Completed “rap sheets”, list of resources, and links to pictures for 10 East Coast Top Ten ANS (common reed, water chestnut, *Grateloupia* red algae, northern snakehead fish, lionfish, mute swan, Asian shore crab, *Styela clava* solitary tunicate, *Didemnum* sp. colonial tunicate, and rapa whelk); reviewed caricatures for each species developed by the project’s graphic designer.
- Contracted with several teachers to develop appropriate classroom activities for the East Coast species; began reviewing submissions

#### Publication

Getchis, T. and N. Balcom. 2007. Visual Guide, Long Island Sound Marine Invasive Species (set of 18 field cards). Connecticut Sea Grant Publication No. CTSG-07-01.

#### Workshops, courses

Balcom, N. 2006. (multiple) “Nab the Aquatic Invader”

- May 12, 2006 Marine Sciences Day (Long Island Sound Foundation and Connecticut Association of Schools), UConn Avery Point, Groton, 72 grades 5-8 students and teachers

Payne, D. and N. Balcom. 2006. Teacher Introduction to Nab the Aquatic Invader. Long Island Sound Educators Conference, Norwalk CT. 31 March.

### **3A4. Education of Underrepresented/Underserved Populations**

### **3A5. Technology-Based Science Education**

### **3A6. Seafood Education**

#### Publications

Balcom, N. (2007) HACCP drives safe seafood. *Wrack Lines* 6(2):13-18. Connecticut Sea Grant College Program. CTSG-06-12.

Balcom, N. and L. Pivarnik. (2006) *Safety Savvy: A HACCP Update*. Issue No. 12. Connecticut Sea Grant and URI Cooperative Extension and Sea Grant. 4pp. (mailed to 650 individuals and businesses; available via CTSG website)

#### Workshops, Courses

Balcom, N. Seafood HACCP Alliance training course (with RI Sea Grant)

- May 15-17, 2006 Narragansett RI (12 trained)
- October 24-26, 2006 Groton CT (22 trained)

Balcom, N. Segment Two Internet Course Practical (with RI Sea Grant)

- November 27, 2006 Carla's Pasta, South Windsor CT (7 trained)
- September 19, 2006 Groton CT (6 trained)

Balcom, N. "School to Career" Seafood HACCP training for senior high school students attending vocational technical and vocational-aquaculture schools to enhance employability

- March 9, 14, 15, 21, 2006 (22 trained)

#### Presentations

Balcom, N.C., Getchis, T.S. (multiple) Seafood Marketing and Promotion: Connecticut Seafood Council and Connecticut Department of Agriculture

- 2007, May, Chef's Event, Stonington, CT
- 2006, October, Chef's Event, Stonington, CT
- 2003-, September, Big E, West Springfield, MA
- 2003-, April, Legislator's Reception, Hartford, CT
- 2003-, March, Agriculture Day at the Capitol, Hartford, CT

Balcom, N. (2007) Training Seafood Processors and Wholesalers. UCONN Avery Point Economic Development Advisory Group. 6 March, Groton, CT.

Balcom, N. (2006) Safe Seafood Processing through HACCP. 1<sup>st</sup> Annual Connecticut Seafood- Connecticut Chefs Workshop. CT Seafood Council and CT Department of Agriculture. 4 October, Stonington, CT

Getchis, T.S. (2006-2007) Interview and appearance in documentary "Working the Land - The Story of Connecticut Agriculture." SimonPure Productions. Broadcast on Connecticut Public Television.

#### Committees / Boards

Balcom, N. Ex officio member (1997), Connecticut Seafood Council, State Department of Agriculture

Getchis, T. (2001-) Advisory Member, Connecticut Seafood Council, State Department of Agriculture

### **3A7. Fisheries Education**

#### Courses Taught

Pomeroy, R. (Spring 2007) ARE 237 Sustainable Fishery Systems (7 students) Pomeroy, R. (Spring 2007) ARE 110 Food, Population and the Environment (30 students)

#### Presentation

Balcom, N. (2007) Sustainable Fisheries (panel discussion). Northeast Organic Farmers Association annual conference. 10 March, Windsor, CT.

## **Theme Area 4: Academic and Professional Service**

#### **4A. Service to the Department**

Balcom, N. Program Leader (1995-), Connecticut Sea Grant Extension Program  
Balcom, N. Member, Management Team, Connecticut Sea Grant College Program  
Balcom, N. Member (2003-), Editorial Board, *Wrack Lines*, Connecticut Sea Grant College Program  
Balcom, N. (2006) Chair, Search Committee, Coastal Habitat Quality Assistant Extension Educator in Residence, Department of Extension and CT Sea Grant.  
Getchis, T.S. (2006-) PTR Committee, CANR Department of Extension  
Getchis, T.S. (2006-) Exchange Liaison, IT Coordinator, Connecticut Sea Grant  
Getchis, T.S. (2006) Search Committee, Coastal Habitat Quality Assistant Extension Educator in residence  
Getchis, T.S. (2005-) Early College Experience Coordinator, Department of Marine Sciences  
Pomeroy, R. Sea Grant Program review 15-19 October 2006. Groton, CT  
Pomeroy, R. Undergraduate Committee, Department of Agricultural and Resource Economics (ARE)  
Pomeroy, R. Economic Viability Team, Department of Agricultural and Resource Economics (ARE)  
Pomeroy, R. Lead, development of Aquaculture Business Management minor in ARE

#### **4B. Service to the School or College**

#### **4C. Service to the University**

Barrett, J. (2007-present) Member, UConn Aquaculture Program Committee  
Getchis, T.S. (2006-present) Member, UConn Aquaculture Program Committee  
Pomeroy, R. Coastal Studies Committee, UCAP  
Pomeroy, R. Maritime Studies Committee, UCAP  
Pomeroy, R. (2006-present) Member, UConn Aquaculture Program Committee  
Publication  
A Proposal to Establish an Undergraduate Aquaculture Major at the University of Connecticut. Submitted to the University administration April 2007.

#### **4D. Service to the Non-University Community**

Balcom, N. Secretary / Member, 2003-, State Consulting Committee for Agriculture Education, Connecticut Department of Education.  
Balcom, N. (2006-2007) Member, Northeast Lobster Shell Disease Executive Committee  
Balcom, N. Federal Appointee (2001-present), Northeast Regional Aquatic Nuisance Species Panel, a committee of the federal Aquatic Nuisance Species Task Force  
Balcom, N. Ex officio member (1997), Connecticut Seafood Council, State Department of Agriculture  
Balcom, N. Chair (2006-), Long Island Sound Aquatic Nuisance Species Working Group  
Balcom, N. (2005-2006) Chair-elect / Chair, Assembly of Sea Grant Extension

Program Leaders

Balcom, N. (2006) Ex Officio Member, Sea Grant Association External Relations Committee

Balcom, N. Treasurer (2006-) Baldwin Booster Club, Canterbury CT

Barrett, J. 2006-2007. Member, Long Island Sound Study Habitat Restoration Workgroup (EPA).

Barrett, J. 2006-2007. Member, Long Island Sound Aquatic Nuisance Species Working Group.

Barrett, J. 2006-2007 Mansfield Parks Advisory Committee

Barrett, J. 2006-2007 Chair, Scholastic Book Fair, Southeast Elementary School

Barrett, J. 2006-2007 Member, Mansfield Middle School Association

Barrett, J. 2006-2007 Member, Southeast Elementary School Parent Teacher Organization

Getchis, T.S. (2004-present) Associate Editor, *Journal of Extension*

Getchis, T.S. (2007-) Ad Hoc Proposal Reviewer, USDA Small Business Innovative Research Competition

Getchis, T.S. (2005-) Ad Hoc Proposal Reviewer, Maine Aquaculture Innovation Center

Getchis, T.S. (2005-) Ad Hoc Journal Reviewer, *Aquaculture*

Getchis, T.S. (2006-) Ad Hoc Proposal Reviewer, National Fish & Wildlife Foundation.

Getchis, T.S. (2005-) Chair, Northeast Aquaculture Conference & Exposition Executive Committee

Getchis, T.S. (2005-) Town of Stonington, Shellfish Commission Member

Getchis, T.S. (2001-) Advisory Member, Connecticut Seafood Council

Getchis, T.S. (2001-) Chair, Connecticut Marine Aquaculture Permitting Workgroup

Getchis, T.S. (2001-) Advisory Board, Bridgeport Regional Vocational Aquaculture School

Getchis, T.S. (2007) Organizer, 3rd Annual Gathering of Shellfish Commissions, New Haven, CT

Getchis, T.S. (2006) Chair, Northeast Aquaculture Conference & Exposition, Mystic, CT

Pomeroy, R. 2006-2007. National Oceanic and Atmospheric Administration, International Coral Grants. Peer reviewer

Pomeroy, R. 2006. US Agency for International Development, peer reviewer for international programs in fisheries

Pomeroy, R. SENEME strategic plan. 9 September 2006, Groton, CT

Pomeroy, R. Journal reviewer for *Aquaculture Economics and Management*, *Environmental Management*, *Ocean and Coastal Management*, *Coastal Management*, *World Development*, *Society and Natural Resources*, *Environment and Development*

Pomeroy, R. US Agency for International Development, new fisheries policy development, July-October 2006

Pomeroy, R. (December 2006- January 2007) AquaFish Cooperative Research Support Program proposal development

Pomeroy, R. Gulf of Maine Regional Ocean Science Council (continuing)

Pomeroy, R. Technical assistance to the Penobscot East Resource Center, Maine on area based management initiative (continuing)

Pomeroy, R. and T. Getchis. CT shellfish permit cost analysis (continuing)

Pomeroy, R. Member, Atlantic States Marine Fisheries Commission.

Pomeroy, R. Economist Advisor, Socioeconomics, New England Fisheries Management Council

**4E. Professional Organizations**

Balcom, N. (2006-2007) Member, Gamma Sigma Delta Honor Society of Agriculture

Getchis, T.S. (2007-) appointed member, NOAA-USDA National Aquaculture Extension Committee

Getchis, T.S. (2005-) Atlantic States Marine Fisheries Commission, Interstate Shellfish Transport Committee.

Getchis, T.S. (2007) Co-Chair, Session: Interactions of Shellfish Aquaculture & the Environment, Meeting of National Shellfisheries Association, San Antonio, TX

Pomeroy, R. Board of Directors, Asian Fisheries Society

Pomeroy, R. Board of Directors, Association of Aquaculture Economics and Management

Pomeroy, R. Professional development committee, International Association of Aquaculture Economics and Management

## E/T-11 Sea Grant Education Program

The CTSG education program is administered through the University of Connecticut as part of the Connecticut Sea Grant College Program. The Education Coordinator for CTSG, Diana Payne, is based in the Sea Grant offices at the Avery Point (Groton) campus of the University, and reports to the CTSG Director. CTSG considers its educational programming to be multifaceted in serving a number of distinct client groups that span an age range from the very young to senior citizens, and includes educators who serve the learning needs of client groups. Further, our education efforts are distinct from, but complementary to, the outreach programming provided by our Extension and Communications programs. For CTSG, education is defined not so much by the type of program or the subject matter, but rather by the target audience. The CTSG Education program has one or more of the following target audiences:

- Educators, both formal (K-12) and informal (aquaria, museums, etc.)
- Students from early childhood through adults, including
  - K-12 students in formal or informal settings
  - College and university students

Connecticut Sea Grant's overarching goal for education is to foster a better world through ecological and environmental knowledge and stewardship. Specific goals include:

1. To provide a) professional development and resource materials in the marine and aquatic sciences for pre-service, in-service, and informal educators, and b) assistance in meeting state and national level education standards;
2. To empower formal and informal educators to effectively use science-based educational materials and data resources;
3. To stimulate interest in careers in fields related to the marine and aquatic science and to support the training and development of a future cadre of scientists in those disciplines;
4. To modify existing and develop new interdisciplinary curricular materials that a) address emerging issues, b) incorporate the latest scientific knowledge and technology, and c) are aligned with state and / or national education standards;
5. To develop and disseminate curricular materials and programs to traditionally underrepresented and underserved groups;
6. To provide educators throughout the nation with tools and strategies for involving students of all ages in technology-based science discoveries;
7. To initiate projects that develop and refine appropriate assessment and evaluation strategies and practices for the marine and aquatic science education community;
8. To increase the opportunities for interaction and collaboration with a variety of partners.

Accomplishments and impacts of the Sea Grant Educator Program for 2006 – 2007 include:

### Publications

- **Payne, D.** (2007). Long Island Sound Mentor Teacher program. *Sound Update*, Spring, 8.
- **Payne, D.** (2007). News from NMEA: Regional, National and International Opportunities. *Nauplius*, 18(2), 12.

- **Payne, D. L.** (2006). Development and validation of the Science Teacher Beliefs About Science (STBAS) instrument. *Connecticut Journal of Science Education*, 44(1), 22-30.
- **Payne, D.** (2006). Under pressure: A study of issues in oceanography. *The Science Teacher*, 73(6), 30-35.

#### Presentations / Papers

- Babb, I., & **Payne, D.** (2007). From real science to reality “TV”: Developing and evaluating methods to broaden the impacts of marine science. Invited Brown Bag seminar, University of Connecticut, Groton, CT, February 28.
- **Payne, D.** (2007). Utilizing the Sea Grant model to foster ocean literacy. International Pacific Marine Educators Conference, Honolulu, HI. January 16.
- **Payne, D. L.** (2006). A Teacher Research Experience: Immersion into the world of practicing scientists. American Geophysical Union annual conference, San Francisco, CA, December 11.
- **Payne, D. L.,** & Mann, E. L. (2006). Challenging high ability elementary school science students. National Association of Gifted Children annual conference, Charlotte, NC, November 3.
- **Payne, D.** (2006). Ocean Literacy update. Invited presentation at the Southeastern New England Marine Educators annual conference, Groton, CT, October 14.
- **Payne, D.** (2006). LISICOS Education 2006. Invited seminar, University of Connecticut, Groton, CT, September 27.
- **Payne, D.** (2006). Problem solving in science. Confratute, Storrs, CT, July 12.
- **Payne, D.** (2006). Whale of a share-a-thon. Presentation at the National Science Teachers Association conference, Anaheim, California, April 6.
- **Payne, D.,** & Rader, L. (2006). Ocean Literacy: Connections through Science Education Standards. Long Island Sound Educators conference, Norwalk, CT, March 31.
- Balcom, N., & **Payne, D.** (2006). Nab The Aquatic Invader. Long Island Sound Educators conference, Norwalk, CT, March 31.

#### Education / Outreach Activities

- Coordinated the *Telling Your Story* workshop at UConn Avery Point October 6, 2006; a course developed by COSEE-NE to teach scientists how to share their “story” with K-12 educators and students; **16 participants**
- Facilitated the NOAA OE Professional Development Institute July 27, 2006 in Narragansett, RI; **17 participants**
- Facilitated the NOAA OE Professional Development Institute July 26, 2006 in Portland ME; **8 participants**
- Assisted in coordination of the Long Island Sound Educators conference: March 31, 2006; **193 participants**; CTSG, NYSG and US EPA LISS support; **2 presentations** (see above)
- Participated in the Quahog Bowl (CT / RI regional of the National Ocean Science Bowl); participated as Timekeeper; March 4, 2006
- Long Island Sound Mentor Teacher (LISMT) workshop *From Me to the Sea*, May 22, 2006. **10 participants**
- Long Island Sound Mentor Teacher (LISMT) workshop *Seine the Sound with CT Science Standards*, May 5, 2006. **18 participants**



- Long Island Sound Mentor Teacher (LISMT) workshop *Build It! A Hands-on Marine Ecology Workshop for 9-12 Teachers*, December 20, 2006. **2 participants**

Extended (Multi-day) Consultations with teachers

- 1 high school teacher
- 1 elementary school teacher

Externally Funded Projects

*National Oceanic & Atmospheric Administration (NOAA)*

- 2005-2007: (National Sea Grant) Nab The Aquatic Invader! – A Nationwide Online Educational Program to Direct Attention to AIS Issues and Inspire Action (PI: Goettel, Domske, Lindstedt, Luke, Balcom, Payne). Serve as Northeast Region Education Coordinator. **1 session with 27 participants at the LISEC conference**

Advisory

- Aquatic Invasive Species Toolkit Team. Advisory Board.
- Centers for Ocean Science Education Excellence (COSEE) – Ocean Systems. External Advisory Board.
- Team Researchers in a GLOBE-al Environment (TRIAGE). Advisory Board.

Service

- Association for Science Teacher Education (ASTE) Environmental Education Committee member.
- Connecticut BioBlitz 2007. Education Committee Co-Chair.
- Eastern Long Island Sound Advisory Council Education and Outreach subcommittee.
- EPA Long Island Sound Study Education and Public Outreach subcommittee.
- New England Ocean Sciences Education Collaborative (NEOSEC) Governing Council member.
- National Marine Educators Association (NMEA) - Southeastern New England Marine Educators (SENEME) Chapter Representative to NMEA.
- Sea Grant Educators Network (SGEN) Chair-Elect, 2007.
- Southeastern New England Marine Educators (SENEME) Development Committee Chair.

## **M/CP-1 Core Communications Program**

The core Communications project is CTSG's vehicle to link program components and to get Sea Grant's messages out to intended audiences. Staff includes one FTE, Margaret (Peg) Van Patten, Communications Director. Major duties during 2006 included planning and implementing Communications strategy, workplan, and budget, overseeing production of key program publications such as *Wreck Lines* magazine, publicizing program activities and events, and collaborating with UConn Communications on media relations efforts.

In addition, the program's 5-year national Program Assessment generated extra tasks in terms of compiling documentation of accomplishments and presenting them in a user-friendly format, and logistically preparing for a site visit by the Program Assessment Team (PAT).

### **Major Accomplishments**

- Designed cover, dividers, and handouts for the PAT briefing book.
- Compiled PAT materials into "Sea Grant: Making a Difference", an attractive 5-year accomplishment report of program activities and impacts.
- Produced 2 issues of *Wreck Lines* magazine.
- Developed and produced a "Some Common Seaweeds of Long Island Sound's Rocky Shores", a laminated field card that was distributed to educators and nature centers.
- Maintained the Connecticut Sea Grant program web site, and *Wreck Lines* web sites.
- Monitored product effectiveness by monitoring Web Trends and surveying readers of publications.
- Publicized major research activities via press releases, *Wreck Lines*, and UConn Advance articles.
- Supported program components with assistance in the form of editing, design, publicity for events, etc.
- Reviewed 30 proposals for potential funding by National Fish & Wildlife Foundation
- Through media relations efforts, stories about Sea Grant research, extension activities, or staff members were picked up by the news media.
- Created, coordinated, and implemented "Project Sea Urchin", a new marine outreach/education partnership program to reach at-risk children confined to shelters. Impacts: (1) Two youngsters communicated verbally and physically for the first time.
- A system was instituted for web site tracking showed that overall site usage was up by 12% over the previous year and provided information on what pages, documents, and keywords were used most frequently.

### **Regional and National Meetings Attended**

- Represented Connecticut Sea Grant at an Implementation Team meeting of the EPA Long Island Sound Study, Sept. 12, 2006, Milford CT.
- EPA LISS Futures Fund proposal reviewers' discussion meetings in Bridgeport, CT. April 28 2007
- Meeting of EPA LISS Communications subcommittee, May 3, 2007

- Manned Sea Grant booth at NACE conference, Dec. 2006 and Northeast Algal Society meeting, March 2007.
- Meeting of the EPA Long Island Sound Communications subcommittee, May 3, 2006
- 62nd Northeast Fish and Wildlife Conference
- Northeast Algal Society Meeting
- Long Island Sound Research Conference 2006

### **Boards and Committees Served**

- Long Island Sound Futures Fund Proposal Review Committee
- US EPA Long Island Sound Study Communications subcommittee
- Communications Evaluation Standards Committee (with Alaska and California Sea Grant)
- *Wrack Lines* Editorial Board, chair

### **Associations**

- Sea Grant National Communications Network
- Sea Grant National Webmasters Network
- Member of Phi Beta Kappa, Delta Chapter
- Member of Northeast Algal Society

### **Presentations Given**

- Seaweeds of LIS workshop for Long Island Sound Educators Conference Oct. 19, 2006 (SENAME conference). Approx. 25 teachers. A new packet of teacher resource materials and laboratory activities was compiled to accompany Seaweeds of LIS.
- Marine Sciences Day at UConn Avery Point, May 12, 2006: gave presentation to approx. 20 students and 2 teachers. Impact: enhanced awareness and knowledge of the algae of LIS and the existence of Sea Grant.
- Talk on marine communications careers given to class of Carmela Cuomo at University of New Haven, May, 2006. Approximately 16 students. Impact: Understanding of the pros and cons of careers in environmental communication and the challenges of science writing for lay audiences.
- "Project Sea Urchin," a presentation at Women's Center of Southeastern Connecticut shelter and Covenant House, both New London CT. July 17, 2006. Approx. 20 at-risk children (some minorities), 6 teen volunteers, and 6 staff. Partners: Project Oceanology, Mystic Aquarium, UConn Department of Marine Sciences, and JRW Design Studio.
- 4 creations exhibited in Regional Campus Faculty and Staff Arts and Crafts Exhibit at the UConn Stamford Campus, shown from August to November 2006.

### **Publications by PI**

Van Patten, Peg and Monica Allard Cox. 2007. "Research team studying tuna aquaculture in Mexico". *UConn Advance*, March 19 2007

- Van Patten, Peg. 2007. "Connecticut Sea Grant Welcomes New Director" press release, issued January 2, 2007, picked up by The Day, Jan. 5.
- Van Patten, Peg. 2007. "Pathobiologist named director of Connecticut Sea Grant Program" UConn Advance, Jan. 16.
- Smith, L. and P. Van Patten. 2006. "Seaweed –a natural bioremediator in finfish aquaculture". *Coastlines* 35(1): 10-11. New York Sea Grant Institute.
- Van Patten, Peg. 2006. "Letter from the editor" inside cover, *Wrack Lines* 6:2.
- Van Patten, P. 2006. "City Kids Meet Sea Life" *Wrack Lines* 6:1. A marine education partnership brings sea life and coastal habitat to children confined to protective shelter.
- Van Patten, Peg, editor. 2006. *Wrack Lines* 6:1. Print and electronic editions.
- Van Patten, Peg 2006. "Letter from the Editor". inside cover, *Wrack Lines* 7:1.
- Van Patten, Peg. 2006. "Find Your Way Around the Sound" *Wrack Lines* 6:2, p. 2.
- Van Patten, Peg 2006. "Mr. Meaney Goes to Washington...as a Sea Grant Knauss Fellow" A profile of Christopher Meaney. *Wrack Lines* 6:2, p. 6.
- Van Patten, Peg. 2006. "Beware of the Red Menace! Grateloupia is Invading Long Island Sound" Article on Sea Grant-sponsored invasive species research. *Wrack Lines* 6:2, p. 7-10.
- Van Patten, Peg. 2006. "Say Hola to Tuna from Mexico!" Article on Sea Grant work re tuna farming vs tuna ranching. *Wrack Lines* 6:2, p. 11-12.
- Van Patten, Peg. 2006. Research Team Assesses Tuna Aquaculture Practices in Mexico" *UConn Advance*, March 19.
- Van Patten, Peg. 2006. "New Faces at Connecticut Sea Grant". *Wrack Lines* 6:2, p. 15.
- Van Patten, Peg. 2006."New Coastal Habitat Quality Educator to give Coastal Communities a Helping Hand" (Juliana Barrett) press release. Reprinted in NEMO Newsletter, spring 2007.
- Van Patten, Peg. 2006 The Portuguese Man-of-War: Unwelcome in New England. Fact Sheet, Connecticut Sea Grant. CTSG-06-10. 1 p.
- Van Patten, Peg. editor. *Wrack Lines* Vol 6:2 . Connecticut Sea Grant. Print and electronic editions
- Van Patten, Peg. 2006. Guide to Some Common Seaweeds of Long Island Sound's Rocky Shores. 2-sided, illustrated laminated field card for macroalgae. Funded by EPA Long Island Sound Study. Supplied free to educators, Long Island Sound Foundation, etc.

### **Publications Produced by Program**

- |            |   |
|------------|---|
| CTSG-06-08 | Long Island Sound Educational Resources CD (Balcom and Van Patten)                          |
| CTSG-06-09 | <i>Grateloupia turuturu</i> fact sheet. N. Balcom. 1 p.                                     |
| CTSG-06-10 | Portuguese Man-o'-War fact sheet. Van Patten. 1 p.  |
| CTSG-06-11 | Some Common Seaweeds of Long Island Sound's Rocky shore (Laminated seaweed card) Van Patten |
| CTSG-06-12 | <i>Wrack Lines</i> 6:2 Van Patten, ed. Connecticut Sea Grant. 24 pp.                        |

- CTSG-07-01 Visual Guide Long Island Sound marine Invasive Species with comparison to some native species. (Waterproof cards on ring) Getchis and Balcom.
- CTSG-07-02 Connecticut Sea Grant: Making a Difference - Highlights, Accomplishments, and Impacts 2001-2006 (written by staff)
- PAT Briefing Book

### Press Clips

- De Guise Named director of Sea Grant Program. *The Day* Jan. 5, 2007. (from press release by P. Van Patten)
- Baldalli, A. Portuguese Men-of-War Raise Concerns at Beach. *The Day* July 26, 2006.
- Benson, J. Parasitic plant marches on. *The Day*, Aug. 19 2006.
- Benson, J. Investigating an Algal Invasion: Japanese seaweed gains foothold in the Sound. *The Day*. October 5, 2006. p. B1, B3. (Yarish, Whitlatch, Lin, etc.)
- Brown, M. G. In Search of suffocating sea squirt. *Connecticut Post* May 31, 2006.
- Dreyfuss, E. Were the Sound lobsters just too warm? *Shoreline News*. August 18, 2006
- Funkhouser, D. The Sinister Sea Squirt in Long Island Sound: A New Threat Invasive Animal may become Scourge of the Sound *The Hartford Courant*, p. 1-2. Jul 1, 2006
- Gainor, R. Sea squirt may pose threat to local shellfish. *The Sun*, October 1, 2006. (Westerly RI)  
(Whitlatch et al. project)
- Grant, Steve. No Bird In The Hand *The Hartford Courant*, 26 May, 2006. (Chris Elphick project)
- Lord, Peter. ENVIRONMENTAL JOURNAL - Web sites offer maps, aerial photographs of Rhode Island. The Providence Journal (Rhode Island), LOCAL NEWS; Pg. B-02  
March 19, 2006 (R. Pomeroy)
- Rose, N. Pathobiology and Veterinary Science faculty member appointed head of Connecticut Sea Grant. UConn CANR Journal. Spring 2007. p. 4
- Sea Grant contributes to the growth and diversity of Connecticut's Aquaculture industry. *E-Currents*. NOAA National Sea Grant.Office.
- Singer, K. Economist's work on land use policy looks at sprawl, preservation of land *UConn Advance*, March 19, 2007.
- Van Patten, P. Pathobiologist named director of Connecticut Sea Grant. *UConn Advance*. January 16, 2007.
- Varekamp, J.C. 2006. The Historic Fur Trade and Climate Change. *EOS* 87:52, p. 593, 596.

### TV and Radio Broadcasts/Interviews

- "Sea Squirts Threaten Lobsters" Interview of R.B. Whitlatch, Professor of Marine Sciences at the University of Connecticut, May 27, 2006. WTOP broadcast
- Working the Land*. Broadcast and CD produced by SimonPure Productions Inc. Includes interview of Tessa Getchis re aquaculture farming.

## **Progress Report for CTSG Research and Internship Programs 2006-2008 Omnibus, NA06OAR4170072**

### **A/E-3 Yale/Sea Grant Coastal Internship Program**

#### Principal Investigator(s) and Affiliation(s):

1. Peter Raymond / School of Forestry and Environmental Studies, Yale University
2. Martha Smith / School of Forestry and Environmental Studies, Yale University

#### Accomplishments and Outcomes

The broad objective of the Yale/CT Sea Grant Internship Program is to provide a linkage between academic research and the resource management challenges faced by coastal communities. This linkage is formed by graduate students who develop and implement applied research projects focused on the Connecticut coastline. The Program is funds a number of individual student projects related to CT coastal conservation issues. This is the only internship program specifically focused on coastal resources at the Yale School of Forestry and Environmental Studies. During this one year period, it has provided a unique opportunity for 5 students to gain practical experience on very different projects. For these specific projects, the end result has been a research report. In the broader picture, their research efforts contributed to the understanding of environmental concerns for coastal Connecticut and many other areas.

Individual projects are briefly described below.

#### **Trace Metals Analysis of Impounded Sediments in Raymond Brook Dam, Salmon River Watershed, CT** (Intern: Min Choy)

Min Choy collected and analyzed sediment samples for metals from the impoundment behind the Raymond Brook dam located in the town of Hebron, Connecticut. Raymond Brook is a tributary to the Salmon River, an area targeted for Atlantic salmon restoration efforts by partnering groups including the CT DEP, The Nature Conservancy, the Silvio O. Conte National Fish and Wildlife Refuge, and the University of Connecticut. This study was performed as part of the process of decommissioning the dam and opening the area to anadromous fish passage. Ms. Choy's analyses found sandy sediments in the channel area, with metal values below state recommended levels, and provided information necessary for the dam removal planning.

#### **Effects of Nutrients on Decomposition Rates in New England Salt Marshes** (Intern: Joanna Carey)

In recent years, salt marsh drowning has been observed in Long Island Sound. This drowning is characterized by the loss of elevation relative to the sea level and conversion of vegetated marsh to mudflat. It was the objective of this research to quantify the effect of

nutrients and other site factors on decomposition rates in salt marshes of Long Island Sound. Decomposition rates of sediment and macro-organic matter were measured at three marsh sites, each in a different state of ecosystem health; steady-state, or maintaining sediment elevation levels and vegetation, aggrading, and drowning. The steady-state site was amended with nitrogen and phosphorus additions. Results show insignificant changes in decomposition rates of sediment over a three month time period. Likewise, no significant differences in decomposition rates were found for macro-organic matter at the fertilized plots. However, significant differences were seen between marsh sites, specifically when comparing the drowning marsh, to the healthier marshes. These results indicate that drowning may occur in part due to elevated decomposition rates, but the reasons behind these increased rates remains unclear. Future sampling of the nutrient-amended plots is necessary, as the three month time span for this study was too short a duration to witness the possibly significant effects of nutrients on decomposition rates.

**Controls on Aboveground Productivity in Three Salt Marshes on Long Island Sound**  
(Intern: Jessica Darling)

Vegetative productivity was measured in plots at three Connecticut salt marshes as part of a long term study to determine factors causing widespread coastal marsh disappearance in Long Island Sound. Jessica Darling focused on above ground productivity and how it is affected by addition of nutrients (phosphorus and nitrogen). Results found that addition of nutrients stimulated productivity, but lower levels of nutrients did not seem to limit production. However, it was recognized that the relationship between productivity and nutrients is complex, and disentangling the effects of an individual factor on marsh health is difficult.

**Mercury Concentrations in New Haven County, CT Streams: The Effects of Watershed Urbanization** (Intern: Joel Creswell)

Joel Creswell studied mercury in New Haven area streams to test two hypotheses; 1) that mercury concentrations are positively correlated with the percentage of watershed impervious cover under storm water conditions, and 2) that mercury concentrations and impervious surfaces would show no correlation under base flow conditions. His study of four different streams found no correlation between mercury concentrations and impervious surfaces under baseflow conditions. The study of mercury concentrations under stormflow conditions was inconclusive due to a small data set.

**Evaluation of the behavior of caffeine in fresh watersheds and as a tracer of sewage contamination** (Intern: James McConaghie)

Nitrogen reduction is a primary objective to improve the ecological health of Long Island Sound. James McConaghie measured caffeine in the West River watershed to see if it could be used as an indicator of anthropogenic nitrogen pollution. Surface water measurements were collected for both caffeine and nitrogen along an urban-rural gradient exhibiting a variety of development intensity. Caffeine concentrations increased with urban density, however finding a relationship with nitrogen concentrations will require further study.

## Benefits and Impacts

As many of the projects are of a short-term duration of one year or less, their benefits will contribute to longer term or wider knowledge for both local and global conservation challenges. All the projects were conducted in Connecticut, where their findings will contribute to knowledge needed for understanding ecological conditions prior to restoration efforts.

The projects completed during this past year can be placed into three basic categories:

1. One project (Min Choy) evaluated sediments behind a dam prior to removal was part of an effort to restore anadromous fish passage in the lower Connecticut River watershed by group of conservation organizations. Raymond Brook Dam is slated for removal in 2007. Dam removal is important for both the ecological reasons of restoring habitat to anadromous species, and as a public safety measure as deteriorating dams can pose a danger.
2. Two projects (Joanna Carey and Jessica Darling) focused on identifying specific factors contributing to the widespread tidal marsh degradation in the Long Island Sound area. Tidal marsh loss is a huge problem, both as loss of important habitat for many different species, but also as vital flood protection for our increasingly urban coastline.
3. Two projects (Joel Creswell and James McConaghie) furthered the understanding of the relationships between the urban environment and surface water pollution (e.g. mercury, nitrogen.) Understanding the interplay of human development and water quality has important implications for ecological health, water supply, and watershed development. Teasing out specific factors detrimental to water quality will contribute in the efforts to improve water quality.

For the individual student, the internship experience has contributed to their education and understanding of coastal ecological challenges. They have also gained both practical research skills in field and lab, useful for future water related careers. As of May 2007, all of this year's CT Sea Grant interns are continuing to work or study in a water related activity. Some are continuing work initiated in their internship research (Creswell and McConaghie), while others are working in professional water related jobs.

- Min Choy is currently working as a hydrologist in Colorado with the Bureau of Land Management.
- Joanna Carey graduated in May 2007 and is taking a position with the Massachusetts Riverways Program, working on instream flow projects.
- Jessica Darling is currently working in Massachusetts as a Program Coordinator with the Ipswich River Watershed Association.
- Joel Creswell is currently enrolled in a doctoral program at the University of Wisconsin where he is continuing research on metals in surface waters. Mr. Creswell hopes to



continue this study of mercury in New Haven streams when additional analyses are completed.

- James McConaghie graduated in May 2007 and during the summer of 2007 will be continuing his study of caffeine and nitrogen in surface water.

Two student CT Sea Grant intern projects were featured in the Center for Coastal and Watershed System's spring newsletter:

- Carey, Joanna. 2007. The Effect of Nutrients on Decomposition Rates in New England Salt Marshes. *CCWS News, Spring 2007*.
- McConaghie, James. 2007. Espresso at Work: Evaluation of Caffeine as a tracer for sewage contamination in watersheds of Long Island Sound. *CCWS News, Spring 2007*.

## **R/LR-25 Spread & Impacts of the Non-indigenous Rhodophycean Alga, *Grateloupia turuturu*, on Long Island Sound**

### Principal Investigator(s) and Affiliation(s):

1. Charles Yarish, Department of Ecology & Evolutionary Biology, The University of Connecticut
2. Robert B. Whitlatch, Department of Marine Sciences, The University of Connecticut
3. George P. Kraemer, Department of Environmental Studies, Purchase College (SUNY)
4. Senjie Lin, Department of Marine Sciences, The University of Connecticut

### Accomplishments and Outcomes

Though the project is still underway, results will form a data set useful for predicting the extent and rate of spread, of ecological impacts at several trophic levels. We will test the predictions as *Grateloupia* expands its range. The results of the proposed project include basic information on relative importance of competition among macrophytes and herbivory in range expansion, utility of physiological measurements for prediction of range limits, important mechanisms of spread (spore release vs. “hop scotching” via fragmentation or human-mediated dispersal), and add to our knowledge of multi-trophic level ecological impacts of non-native species.

This information is obviously of acute interest to invasion biologists, but also has application in the realm of resource management. For example, *Grateloupia* can create dense stands that, like *Undaria*, may interfere with filter feeding bivalves that form the basis for an important aquaculture sector. Further, as potential fouling organisms, *Grateloupia* may settle on fishing lines, bivalve aquaculture systems, and perhaps on the bivalves themselves. This makes prediction of the eventual *Grateloupia* distribution important from the standpoint of allocating future research and development funds in support of bivalve-based aquaculture projects. The project has also an educational component, involving graduate students (2) and undergraduate research assistants (at least 4).

Detailed project findings, accomplishments and outcomes are as follows:

1. Compare reproductive phenologies and output by *Grateloupia* and its presumptive native competitor *Chondrus*: The population size of *G. turuturu* (and other macroalgae) was tracked over time along on the cobble beach where *G. turuturu* first was discovered. The percent cover of both *Grateloupia* and *Chondrus* fluctuates over time but was not found to follow any trend. Cystocarp densities of *G. turuturu* appear to show some periodicity, though conclusive determination awaits additional sample processing. Although there seems to be a temporal increase in the number of tetrasporangial density, conclusive determination awaits additional sample processing. The macroalgal flora inhabiting the rock cobble site was compared with one on a stable, solid rock platform. The platform was significantly more diverse (Table 1).

2. Measure the limits of the recruitment of *Grateloupia* and *Chondrus* spores: *Grateloupia turuturu* and *Chondrus crispus* spores appeared almost exclusively in the >3  $\mu\text{m}$  fraction. The relative abundance of DNA from the >3  $\mu\text{m}$  fraction was 23- and 170-times greater than that in the 0.22  $\mu\text{m}$  fraction for *G. turuturu* and *C. crispus*, respectively. With the exception of late October, *Grateloupia* spores were relatively abundant from late September through early January. *Chondrus* did not appear to show such periodicity. The relative abundance of both *Grateloupia* and *Chondrus* spore DNA was much greater at 0 and 1 meter distance (combined) from the intertidal zone than at 10 and 100 meters. *Chondrus* spores appeared to travel further than *Grateloupia* spores; abundances of *Chondrus* spores at 10 and 100 meters (combined) averaged 30% of abundance at 0 and 1 meters, while *Grateloupia* spores at 10 & 100 meters were only 8% as abundant as at 0 & 1 meter distance.

3. Determine the niche boundaries of *Grateloupia* along three dimensions (light, temperature, salinity), and evaluate competitive outcomes for interactions between natives (*Chondrus crispus*, *Saccharina latissima* and *Grateloupia*): Work will begin summer 2007. A total of 13 unialgal tetrasporophyte cultures from three parental strains are in culture after one year. Blades have been successfully grown from carpospore.

4. Evaluate *Grateloupia* as habitat for local native and non-native invertebrates, and determine consequent community impacts: Algal compositions differ within the samples, with *C. crispus* constituting about 87% of the *Chondrus* samples with *Neosiphonia harveyi*, *Polysiphonia* spp, *Ulva* spp and *Sargassum filipendula* constituting the rest. This pattern was not observed within the *Grateloupia* samples; the majority of the samples were comprised of *G. turuturu* and *C. crispus*, (ca. 75% of total; Table 1). Abundance of other species are greater in *G. turuturu* samples than *C. crispus* samples. For example, *Ulva* spp constitutes ca. 12% of the *Grateloupia* samples, but only about 4% of the *Chondrus* samples. Epiphytic plants and animals also differ between the two biological substrates. Epiphytes and epizoans are more abundant *C. crispus* samples than in *G. turuturu* samples, suggesting that increased structural complexity (*C. crispus*) supports a greater taxonomic diversity.

In the early stages of identification, invertebrate abundance on *C. crispus* samples at Millstone and Fox Island sites are generally similar (Figure 6). The variability between the data points results from one taxonomic group (caprellid amphipods) in the samples. However, the *C. crispus* in the samples of *G. turuturu* at Millstone Point alters the invertebrate composition to make the sample similar to the *C. crispus* samples. This “*Chondrus* effect” also affects the taxonomic diversity seen among the samples, with a similar list of common invertebrate species associated with *G. turuturu* and with *C. crispus*.

5. Assess for local consumers the potential value of *Grateloupia* as a food source: Consumer choice experiments to validate field observations will commence in summer 2007.

## **R/ER-17 The Benefits of Salt Marsh Restoration to Globally Vulnerable Birds**

### Principal Investigator(s) and Affiliation(s):

1. Chris Elphick / University of Connecticut
2. Margaret Rubega / University of Connecticut

### Accomplishments and Outcomes

Saltmarsh restoration is widespread and costs millions of dollars. Few studies, however, have evaluated the long-term changes that result from restoration across multiple sites. In particular effects on vertebrates have rarely been tested. Our project will conduct such tests, determine whether past restoration activities are benefiting high priority animal species, and compare alternative approaches to restoration. We anticipate that our results will be useful to state and federal agencies, municipalities, and a variety of non-profit organizations that are involved in saltmarsh restoration, management, and protection. Data collected during this project will also contribute to a long-term data set that will be used to examine the conservation status of threatened saltmarsh species.

The primary objective of this study is to: (1) Determine saltmarsh sparrow responses to saltmarsh restoration, and compare restoration methods. Secondary goals are to: (2) Provide a comprehensive, quantitative meta-analysis to characterize the ability of management to create conditions that support breeding saltmarsh birds, and (3) Develop and test an outreach program that provides local community groups (e.g., bird-watching groups and land trusts) with protocols and training so that they can contribute to long-term evaluation of restoration and management work and to a developing saltmarsh bird monitoring program.

Field work for this project could not be initiated in 2006 as originally planned, because funding was not made available in time to start field work before birds began breeding. Consequently, all planned research was delayed by a year. This delay also meant that we needed to postpone admitting a graduate student to conduct the proposed research by a year. A well-qualified student has, however, been identified through a national search and was admitted in spring 2007 in time to initiate field work in May 2007. The first field season of field work is currently under way.

One minor change to the experimental design has been made, in response to data collected since the proposal was submitted. Originally, our goal was to compare data from plots in restored marshes to data collected in prior years from reference plots, in order also allow collection of data from control sites representing a pre-restoration state. Recent work (especially based on field work in 2006), funded through other grants, suggests that there might be significant differences in reproductive success among years due to inter-annual variation in weather and tidal flooding patterns. Consequently, we have decided that it is necessary to collect reference data simultaneously with data from restored areas in order to ensure an appropriate comparison. We have therefore set up restored/reference pairs of plots to contrast within each marsh system under study. This change gives precedence to determining how restoration sites currently

compare with the target conditions, rather than the starting conditions (which are presumed to be dominated by the invasive plant, *Phragmites*, and thus unsuitable for the target bird species, based on prior research). Fourteen plots have been set up for the summer 2007 field season, with the remainder due to be set up during the first week of June. Data collection has begun on plots and will continue through August. Work on the supplemental objectives (2) and (3) will begin in fall 2007.

## **Progress Report for CTSG Substantial Research Development Projects 2006-2008 Omnibus, NA06OAR4170072**

### ***Invasive Hydrilla verticillata* in Connecticut**

#### Principal Investigator(s) and Affiliation(s):

1. Donald H. Les, UCONN, Dept. of Ecology & Evolutionary Biology
2. Lori K. Benoit, UCONN, Dept. of Ecology & Evolutionary Biology

#### Accomplishments and Outcomes

*Hydrilla verticillata* (hydrilla) is a nonindigenous and highly invasive aquatic plant that has been found in four Connecticut water bodies located within the coastal boundary. This species poses a significant threat to the state's fresh and brackish waters. In order to develop an effective strategy to manage Hydrilla, it is imperative to determine the genetic composition of Connecticut populations in order to elucidate 1) whether herbicide-resistant strains occur in the state, 2) the origin of populations, and 3) their reproductive and ecological characteristics.

Anticipated benefits of this ongoing project include:

- The identification of herbicide resistant strains of *Hydrilla verticillata* will aid in management of this aquatic invasive plant in Connecticut. Application of herbicides to resistant strains would be a waste of money and should be avoided. Alternative control techniques should be used.
- Understanding patterns of spread will also aid in control efforts, enabling managers to more efficiently focus staff and limited funding on control and education efforts.

Notice of funding for this project came the last week of August 2006, the end of the field season. My graduate student did make progress over the summer of 2006 by collecting some Hydrilla samples and sequencing the internal transcribed spacer (ITS) region of hydrilla nuclear ribosomal DNA, but this work was unfunded. We will be applying the CT Sea Grant development funds to this project in 2007.

### **Analysis of the genetic population structure of the putatively invasive tunicate, *Didemnum* sp.**

#### Principal Investigator(s) and Affiliation(s):

1. Robert Whitlatch / University of Connecticut, Marine Sciences
2. Lauren Stefaniak / University of Connecticut, Marine Sciences

### Accomplishments and Outcomes

Invasive species exact extensive economic and ecological damage globally. While the presence of these organisms can have severe detrimental impacts, the identification of many of the most common of these exotic species remains unknown. Accurate identification is key in management of invasive pest species so as to allow transfer of effective management techniques from one region to another. This project will guide researchers and coastal managers to more educated choices and more effective management. We will also demonstrate that using cDNA libraries to isolate genes as molecular markers in non-model invasive species such as *Didemnum* sp. is a viable alternative to mitochondrial or ribosomal molecular markers which are subject to problems such as a lack of variation and non-target DNA contamination.

The project uses molecular techniques in an effort to track the movement of *Didemnum* sp. around the world with the goal of pinpointing native locations. In doing so, we are also testing the hypothesis that the various populations of *Didemnum* sp. found in Europe, New Zealand, New England, California, and the Pacific Northwest are the same species. To accomplish this, we are developing new nuclear molecular markers by sequencing random clones from a cDNA.

The project isolated a fragment of *tho2*, a gene involved with mRNA transport across the nuclear membrane, from *Didemnum* sp. The fragment of *tho2* includes five PCR-amplifiable introns for use in species-level phylogenetic analyses. Preliminary examinations of the data show that populations of *Didemnum* sp. in Connecticut, Georges Bank and the Pacific Northwest share alleles of one of the fragments of *tho2*. Phylogenetic analysis of *tho2* exons supports the hypothesis that the *Didemnum* sp. populations in France, Georges Bank, Connecticut, Puget Sound, British Columbia, Japan, and New Zealand are the same species.

## **Molecular markers of cancer in cartilaginous fishes-- Immunocytochemical study of PCNA, p-53, myc, and ras expression in neoplastic and hyperplastic tissues from sharks**

### Principal Investigator(s) and Affiliation(s):

1. Joanna D. Borucinska, University of Hartford

### Accomplishments and Outcomes

Archival formalin fixed tissues from wild-caught adult blue sharks *Prionace glauca* (Linnaeus, 1758) were used for immunocytochemical detection of proliferating cell nuclear antigen (PCNA), two oncoproteins from the oncogenes *c-myc* and *pan-ras*, and a protein product from the tumor suppressor gene *p-53*. All sharks were caught during summer months between 2000-2006 by recreational fisherman off the USA coast in the Northwestern Atlantic. The sharks were necropsied dockside and selected organ samples were collected into elasmobranch formalin and processed for paraffin embedding and light microscopy. Paraffin embedded sections from collected tissue were both stained with H&E and processed by immunocytochemical techniques

using antibodies raised against the PCNA, p-ras, c-myc, and p-53 proteins. The lesions examined in this study included two well differentiated adenomatous gastric polyps, a testicular capsular mesothelioma, a gingival fibropapilloma with elements of ameloblastoma, three liver tumors, two pericardial fibropapillomas and six cases of proliferative serositis (pericarditis and peritonitis). Normal and hyperplastic tissues from blue sharks, and human neoplastic tissues served as negative and positive controls, respectively. We detected upregulation of PCNA in many neoplastic, one dysplastic, and in some hyperplastic lesions, and positive p-ras and c-myc signals in some of the neoplastic lesions. None of the examined tissues showed positive p-53 signaling. This is the first literature report on ICC detection of molecular markers of cancer in sharks and in fishes in the Class *Chondrichthyes*.

### **Comparison of common thyroid morphology with description of thyroid lesions in three species of wild sharks from the northwestern Atlantic, the blue *Prionace glauca*, shortfin mako *Isurus oxyrinchus* and thresher *Alopias vulpinus*, sharks**

#### Principal Investigator(s) and Affiliation(s):

1. Joanna D. Borucinska, University of Hartford

#### Accomplishments and Outcomes

Although sharks are well known to develop goiter in captivity, and histological descriptions of goiter thyroids from sharks were published, little is known about normal variations in thyroid morphology in wild living sharks. This paper describes common histological patterns and lesions encountered in macroscopically normal thyroids collected during the summer months from three species of sharks from the northwestern Atlantic. Thyroids from 22 shortfin mako sharks (*Isurus oxyrinchus*), 24 thresher sharks (*Alopias vulpinus*), and 39 blue sharks (*Prionace glauca*) were examined. All sharks were collected by sports fishing gear between June and August in 2001, 2002 and 2004. Routine, H&E stained paraffin embedded sections were studied by light microscopy. Our results indicate that there is marked variation in histological patterns of thyroid follicles and thyroid stroma among the three different species of sharks, and that there is a minimal variation in morphological patterns within each species. The most common lesions in the examined thyroids included lymphofollicular hyperplasia, and non-suppurative, chronic thyroiditis. In addition, one case of a unique myxosporean infection was found. This study stresses the importance of the knowledge of variations in normal thyroid morphology for a given species of sharks, at any given time of the year and thus their stage of reproductive cycle. Such knowledge is needed for an accurate diagnosis of thyroid diseases including conditions resulting from exposure to endocrine disrupting environmental contaminants.



## **Mode of attachment and lesions associated with *trypanorhynch cestodes* in the gastrointestinal tracts of two species of sharks collected from coastal waters of Borneo**

### Principal Investigator(s) and Affiliation(s):

1. Joanna D. Borucinska, University of Hartford

### Accomplishments and Outcomes

Lesions associated with two species of tapeworms within the digestive tract of wild-caught specimens of the bull shark, *Carcharhinus leucas*, and the sicklefin weasel shark, *Hemigaleus microstoma*, from Malaysian Borneo are described. Portions of the glandular stomach and pyloric gut with parasites were removed and fixed in 10% formalin buffered in sea water. Whole mounts, histological sections of tissues with and without worms in situ, and scanning electron microscopy images of detached worms were examined. Both species of cestodes belonged to the trypanorhynch family Tentaculariidae. *Heteronybelinia estigmena* was found in large numbers parasitizing the pyloric gut of *C. leucas*; an unidentified tentaculariid was found in relatively small numbers in both the glandular stomach and pyloric gut of *H. microstoma*. Both species burrowed their scoleces deeply in the mucosa and attached via hooked tentacles and unciniiform microtriches of the scolex. The lesions induced by the parasites were marked in both sharks and ranged from acute necrotizing to chronic granulomatous gastroenteritis. Regenerative hyperplasia and intestinal metaplasia of gastric epithelium were also present. The severity and character of pathology was causally linked to the intensity of infection, the attachment mode of the parasites, and to the anatomophysiological relationships within the gut of the host shark.

## **Identification of Molecular Markers of Cell Division in the Toxic Dinoflagellate *Alexandrium fundyense* by cDNA Microarray**

### Principal Investigator(s) and Affiliation(s):

1. Senjie Lin, Department of Marine Sciences, University of Connecticut

### Accomplishments and Outcomes

The main goal of the project is to perform microarray analysis of gene transcripts of the toxic dinoflagellate *Alexandrium fundyense*, and find genes that are differentially expressed in different stages of the cell division cycle. The project will provide genetic resource for researchers to study regulation of growth in this dinoflagellate. It will also provide a model to identify molecular markers for growth and metabolism in harmful algae or other phytoplankton. A graduate student is being trained in this grant, which will lead to a Ph. D. dissertation based on the result.

Progress in this ongoing project includes:

- 1) Based on 1,200 complementary DNA clones, gene probes for array printing have been prepared.
- 2) Hybridization analysis is underway.
- 3) Different methods of RNA extraction were compared. We found that manual homogenization can provide best RNA yield but not consistent. The Pressure Bioscience high-pressure technique provided consistent but lower level of yield. This will be helpful for downstream work.

## SECTION I-B

### AWARD REPORTING: CONNECTICUT SEA GRANT COLLEGE PROGRAM OMNIBUS, 2002-2006

**Grantee:** University of Connecticut, Connecticut Sea Grant College Program

**Award Number:** NA16RG2253

**Project Title:** CONNECTICUT SEA GRANT COLLEGE PROGRAM: PROGRAM PLAN FOR CONTINUING SUPPORT FOR MARCH 2002 THROUGH FEBRUARY 2003 (This is the CTSG Omnibus award for 2002-2006, currently extended through 5/31/2007.)

**Time Period:** March 1, 2002 – May 31, 2008 (This report for period March 1, 2006 – February 29, 2007)

**Accomplishments and Outcomes:** See Below

The Connecticut Sea Grant Omnibus comprises multiple projects, including those funded through our core federal funding and national strategic investment projects (NSIs). Hence, accomplishments and impacts for NA16RG2253 are presented by individual project and (internal CTSG) project number.

Accomplishments and outcomes are only provided here for those individual projects that were active during the reporting period, and for which there are new results to report. Projects for which information is provided are as follows:

**R/ER-22:** The Connecticut ‘Hatting’ Industry as a Mercury Source for Long Island Sound

**R/BT-01:** Lobster Defenses to Shell Disease: Endocrine Control of Molting and Wound Healing

**R/ER-24:** Determining the Causes of Area-Sensitivity: A Prerequisite for Saltmarsh Bird Conservation and Restoration

**R/A-36:** Development of an oligotrich ciliate as a food organism for marine aquaculture

**R/ES-19:** Evaluation of the importance of ship hull fouling by privately-owned vessels as a vector for the transport of invasive species along the Eastern Seaboard (NSI)

**R/ES-20:** The control and economics of aquatic invasive species in marine aquaculture (NSI)

**N/A:** Earth Grant Geospatial Technology Extension Program

**N/A:** Nab the Aquatic Invader! A Nationwide Online Educational Program to Direct Attention to AIS Issues and Inspire Action (NSI)

**N/A:** Interrupting the Flow: A Northeast Regional Sea Grant Education and Outreach Collaborative Addressing Vectors of Marine Invasive Species Introductions in the Northeast Region (NSI)

**Progress Report for CTSG Research and NSI Programs  
2002-2006 Omnibus, NA16RG2253**

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

Principal Investigator(s) and Affiliation(s):

1. Johan C. Varekamp, Wesleyan University

Accomplishments and Outcomes

Scope of the research: In how far are the Hg point sources related to hatmaking in Danbury and Norwalk significant Hg sources for Long Island Sound and the watersheds that contribute to LIS. In addition, how does climate change influence the mobilization of contaminated sediment and deposition into Long Island Sound? The research was extended into the uptake of Hg by plants on heavily contaminated sites, on the one hand to gain insights into this novel approach of phyto remediation, and on the other hand to study in how far Hg-rich plant debris becomes a transport mechanism for Hg from the watershed into LIS.

We have analyzed 7 Long Island Sound cores for Mercury, which together with metadata (ages, density, sediment chemistry) provide records of Hg deposition in LIS over time. We have analyzed many sediments from the Still River, Housatonic River, and Norwalk River, the main transport venues for hatting-Hg into LIS. The Hg contamination started around 1820 AD, and many LIS core profiles show sharp Hg anomalies around 1900 and 1950-1970. The latter correlate with two wet periods in the climate record of southern New England and the Hg-spikes represent remobilization of Hg-rich sediment during major storms and extended wet periods or floods. Near New York (Execution Rock and further east) we found a Hg-enriched sediment layer, deposited in the 1970's, associated with coarse debris. We have not yet determined the origin of this layer, which seems unrelated to the hatmaking activities. Sediment cores from the rivers show much higher Hg concentrations (up to 100 ppm Hg) but the secular variations in Hg deposition are in many cases difficult to ascertain because of re-sedimentation and flood deposition/erosion. Nonetheless, we proved beyond doubt that these rivers are major arteries for Hg transport into LIS. We analyzed plant leaves and stems from natural cottonwood plants, together with a variety of other plants from Hg-contaminated sites. Leaves from genetically modified (GM) cottonwood that are used to remediate these contaminated sites in Danbury were analyzed as well. The Hg concentrations in the plant tissues varied with Hg concentration in the soils and with time over the growing season. The largest amount of Hg is stored in the bark, then the lower stem, and the smallest amount in the leaves. An extensive experimental program of plant growth in Hg-contaminated soils showed that Hg is taken both from the soils and from Hg in the vapor phase through the leaves. The latter creates a fairly mobile reservoir of Hg in the plant that may be released again into the atmosphere.

First order Hg budget estimates for LIS show that about 30% of Hg derives from Waste Water Treatment Plant effluents, 25 % from the hatmaking industry and the rest from atmospheric deposition, either directly on LIS or in the watershed with subsequent Hg-contaminated sediment

transport and deposition. Small unidentified point sources may contribute to the generic “contaminated sediment flux” from the Connecticut River as well.

Benefits and impacts of the project include:

- We have provided new insights into the mechanisms of Hg transport in watersheds with sites with “old Hg point sources” – Hg-contaminated sediment mobilization during wet periods and extraction of Hg from upland sites into plants with subsequent transport of plant debris to rivers and then into LIS.
- We have established a preliminary Hg budget for LIS
- We have found other sources of Hg to LIS near New York, as yet unclear in origin.
- We have established that phytoremediation of Hg-contaminated sites with genetically modified cottonwood plants is probably not very efficient.
- Towns/counties/state use our data on Hg ‘hot spots’ for considerations of dredged sediment disposal
- The town of Danbury probably will not continue the attempts at phytoremediation of the Hg-contaminated sites as a result of our work.
- Our work provides insights into the global cycling of Hg through plant uptake followed by leaf decay and re-release of Hg to the atmosphere.

## **R/BT-01 Lobster Defenses to Shell Disease: Endocrine Control of Molting and Wound Healing**

### Principal Investigator(s) and Affiliation(s):

1. Hans Laufer, University of Connecticut

### Accomplishments and Outcomes

Understanding how environmental stressors, shell wounding, wound healing, and SD affect the endocrine system in lobsters and how hormones and alkylphenols, known endocrine disruptors, are involved in the regulation of disease, and of the wound-healing process, will enhance our understanding of the lobster's natural defenses in warding off stressors such as SD. The disease affects a large, and increasing, proportion of the lobster population. A relationship between alkylphenols, known endocrine disruptors, and SD appears to exist. We have provided evidence that suggests alkylphenols interfere with shell hardening (tanning and sclerotization) and thus contribute to the disease. This should lead to strategies to prevent the occurrence of SD. A method to remediate the effects of SD was observed in deep-sea lobsters and may be useful in the future to aid in efforts to maintain healthy lobster populations. This study will benefit our knowledge of lobster defenses against SD and will have an impact on our knowledge of maintaining the health and viability of lobsters, which are a valuable natural and commercial resource.

### Findings and outcomes include:

- We have found that alkylphenolic compounds are detected by gas chromatography/ mass spectrometry (GC/MC) and were found to be present in lobster blood and some tissue from Western Long Island Sound. Alkylphenols are endocrine disrupting, anthropogenic compounds found in both greater frequency and in higher concentrations in lobsters with shell disease (SD).
- We have been able to show that lobsters have a defense against shell disease by increasing the production of the molting hormones, ecdysones. The molting hormone was quantified with a sensitive radioimmunoassay.
- This defense can be mimicked by shell abrasion (shell damage), and does not depend on invasion by microbes.
- Egg-bearing lobsters with shell disease have been found to have significantly higher levels of molting hormones, and will molt, while unaffected lobsters with eggs are not known to molt.
- Deep-sea lobsters appear to become decontaminated of alkylphenols over time, in cleaner less contaminated waters, while their embryos retain their alkylphenolic contaminants. Thus lobsters can be decontaminated by being maintained in water containing less alkylphenol contamination. Other means of reducing alkylphenol contamination in inshore environments should be sought. More thorough sewage treatment by treatment plants would seem to be a

logical place to start as well as recycling of plastics, a major source of alkylphenols in the marine environment (Laufer, Demir, Capulong, Pan, and Biggers, 2006).

- The mechanisms of alkylphenol action in SD was investigated. The data suggest strongly, through several lines of evidence that alkylphenols interfere with shell hardening (tanning and sclerotization). They appear to be incorporated into the cuticle, competing with the alkylphenolic amino acid, tyrosine, and its metabolic derivatives, which normally function to cross-link proteins in the shell hardening process. We predict that SD can be induced by treating lobsters with high doses of alkylphenols during the molting process, making them subsequently more susceptible to microbial invasion. This hypothesis needs to be investigated further in future research experiments to be performed, and others performed and published (to be published).
- Crustacean hyperglycemic hormones are a family of neuropeptides (mostly 72-76 amino acids in length), CHHs from the crustacean eyestalk sinus gland – x organ complex control numerous endocrine functions. These include productions of molt inhibiting hormones (MIHs), MOIH mandibular gland inhibiting hormones, hyperglycemic hormones (CHHs), vitellogenin inhibiting hormones (VIHs), gonad inhibiting hormones (GIHs), among others. We have recently conducted bioassays using recombinant proteins synthesized by a yeast vector for lobster CHHa, and CHHb. Our bioassays indicate that these neuropeptides are functional and possess all of the above mentioned bioactivities in the same neuropeptides. These results suggest that many of the CHHs' described in the literature are not only members of the same neuropeptide family, they are a family of evolving neuropeptides with overlapping similar multiple functions.

## **R/ER-24 Determining the Causes of Area-Sensitivity: A Prerequisite for Saltmarsh Bird Conservation and Restoration**

### Principal Investigator(s) and Affiliation(s):

1. Chris Elphick / University of Connecticut
2. Margaret Rubega / University of Connecticut

### Accomplishments and Outcomes

The overriding objective of this study is to evaluate multiple potential causes of area-sensitivity in saltmarsh breeding birds, so as to provide prescriptions for enhancing bird protection in Connecticut's limited saltmarsh habitats. Specifically, we will test hypotheses that attribute the absence of certain species from small marshes to: (1) increased predation on eggs and nestlings, (2) reduced survival of fledglings or adults, (3) an altered food supply, (4) systematic differences in plant distributions that might influence habitat selection, (5) increased vulnerability of nests to flooding, and (6) random settlement patterns.

Field work for this project has been completed. Laboratory work (sorting and identification of invertebrate samples) has also been completed and all data compiled. Preliminary analyses of most data sets have been conducted and a draft report outlined and partially written. A simple simulation model has been created to test whether patterns of area sensitivity can be explained by simple random settlement patterns, but simulations have not yet been run. Remaining data analyses include analysis of the invertebrate data, and analyses using the random settlement model. Several manuscripts, to which this project contributed either directly or indirectly, have been completed with others in draft form. Two undergraduate students have developed and conducted independent projects in association with this grant (financial support for these projects came from other sources, but the work would not have been possible had the larger project not been under way). Three new graduate students have entered our research group and are developing thesis projects that will build upon and expand this study.

Teasing apart the potential mechanisms that could account for observed patterns of area-sensitivity in saltmarsh birds is a prerequisite for devising management actions that will increase use of small marshes. Even if it is not possible to devise such strategies, then this work will provide information necessary to prioritize saltmarsh management actions across the state and regionally, and to manage for saltmarsh bird populations most efficiently. By focusing on saltmarsh sparrows we will add to our knowledge of the conservation needs of two species that have been ranked among the highest priorities for avian conservation research in eastern North America. Moreover, our work also will provide similar information for other saltmarsh birds, and we believe that much of this research has broad relevance for managing saltmarsh communities. For example, our analysis of food supply has relevance to all insectivorous species that use salt marshes as well to the conservation of the invertebrates themselves.

More generally, area-sensitivity is a pervasive phenomenon, occurring in a variety of habitats and affecting numerous species. Yet, few attempts have been made to distinguish the relative



importance of different possible mechanisms in any system. Our work, therefore, will both broaden our knowledge of area-sensitivity to an additional habitat and highlight the multifaceted nature of the problem by testing multiple explanations within the same system.

Preliminary analyses suggest that many of the explanations for area-sensitive occurrence patterns in other systems are not supported by our data. If this result holds true, it would suggest both that salt marshes might differ from those systems in which most area sensitivity studies have occurred (primarily forests, and to some extent grasslands), and that an understanding of the phenomenon in other systems may be more complex than has been thought. Additional hypotheses (not included in the original study) have thus been developed and we are now initiating new work to address those. We have also initiated a major study to collate and analyze patterns of area sensitivity in birds across studies, which will place the Sea Grant funded work in a broad global context.

## **R/A-36 Development of an oligotrich ciliate as a food organism for marine aquaculture**

### Principal Investigator(s) and Affiliation(s):

1. George McManus, University of Connecticut

### Accomplishments and Outcomes

In last year's report, we detailed our efforts to quantify growth rates of *Strombidium stylifer*, to evaluate the effect of the age of isolates (time in culture since original isolation) on physiological vigor, and to measure the effects of different light levels on growth. During the past year, we focused on quantifying feeding rates and calculating growth efficiency, and on measuring lipid and protein content of the ciliate. We also continued our assessment of the global distribution of *S. stylifer* by verifying its presence in samples from Scotland, Canada, California, and Peru.

*S. stylifer* is capable of feeding at high rates (up to  $115 \pm 11$  ng Carbon *S. stylifer*<sup>-1</sup> day<sup>-1</sup>). However, because it is mixotrophic (capable of both heterotrophic and autotrophic nutrition), it can survive and grow at lower food concentrations as well. Gross growth efficiency (ciliate carbon produced divided by carbon ingested, or GGE) was above 0.4 at mid to high food levels. This is a typical value, or a little on the high side, for heterotrophic protists. However, at low food levels GGE was greater than 1, which would be impossible except for the ciliate's ability to perform photosynthetic growing on inorganic carbon. It appears that this organism supplements its food supply with photosynthesis at high food levels, but grows essentially autotrophically at low food levels, ingesting food mainly to replenish chloroplasts. In aquaculture, such a high growth efficiency would imply lower levels of food input for growing the ciliate, with correspondingly lower amounts of waste.

*S. stylifer* has a C:N of 4.8, similar to that of the rotifer *Brachionus* sp. (5.3), which is commonly used as a first feed in aquaculture, and lower than that of its phytoplankton food (6.6 for *Tetraselmis* sp. clone PLY 429). Bulk protein content of *S. stylifer* was 14.2 ng protein ciliate<sup>-1</sup> ( $\pm 1.6$  SD) for an isolate from Brazil and 9.0 ng protein ciliate<sup>-1</sup> ( $\pm 1.2$  SD) for one from Scotland. The lipid profile of *S. stylifer* includes the essential fatty acids stearidonic acid (SDA,  $\omega$ -3), linoleic acid (LA,  $\omega$ -6), alpha linoleic acid (LNA,  $\omega$ -3), arachidonic acid (AA,  $\omega$ -6), eicosapentaenoic acid (EPA,  $\omega$ -3) and the sterol cholesterol.

All of this research was carried out by graduate and undergraduate students. Much of it comprised the MS research of Katharine Haberlandt, who graduated in Spring 2007 with a MS in Marine Sciences from UConn. Part of the research will also go into the PhD dissertation of Barbara Costas.

This project provided some preliminary information about a marine planktonic ciliate, *Strombidium stylifer*, that we hypothesized might be useful as a first food in some aquaculture applications. Our results indicate that it is distributed widely around the world, easy to isolate from tide pools, grows rapidly and efficiently on low food levels, and has a favorable nutritional profile. Although we did attempt some preliminary feeding trials with cod larvae, we found that

we did not have the requisite facilities or expertise to pursue this aspect very far. Based on conversations with aquaculturists, this ciliate would most likely find a use in cultivation of fish larvae such as red snapper (*Lutjanus campechanus*), which have a small gape at first feeding.

## **R/ES-19 Evaluation of the importance of ship hull fouling by privately-owned vessels as a vector for the transport of invasive species along the Eastern Seaboard (NSI)**

### Principal Investigator(s) and Affiliation(s):

1. Robert B. Whitlatch, University of Connecticut
2. Richard W. Osman, Smithsonian Environmental Research Center
3. Nancy Balcom, University of Connecticut

### Accomplishments and Outcomes

Once aquatic nuisance species have invaded a particular region, they are very difficult or impossible to control. Defining the vectors of invasive species transport is critical to our understanding of alien species movement and how to manage the vectors in order to reduce/eliminate transport of the non-native species. Vessel hull fouling is recognized as a primary transport vector of many marine invaders and privately-owned vessel hulls represent an important transport vector along the eastern seaboard. Our proposed work will identify the extent of annual movements of non-native species along the eastern seaboard via privately-owned craft and evaluate protocols to reduce the transport of these species.

The four objectives of the project are: 1. Determine the degree of hull fouling on privately-owned sail and power vessels which make regular voyages between the east coast of Florida and New England, 2. Examine the survivorship of hull fouling species as the vessels move from southern to northern eastern seaboard waters to assess which species are most likely to become established in New England waters, 3. Assess the effectiveness of different hull maintenance protocols and/or vessel transit pathways for reducing or eliminating the transport of hull fouling species, and 4. Work with Sea Grant Marine Advisory Programs located along the eastern seaboard to provide information to marina operators and vessels owners regarding potential problems of hull fouling as a transport vector of invasive species.

While we are still in the process of analyzing information collected, to date we have sampled the hulls of more than 80 vessels and the pilings and floating docks of 15 marinas ranging from Florida to Rhode Island. The vessels examined ranged in size from 34' to 155'; 32% were sailing vessels and remaining 68% were power craft. Sampling consisted of diver surveys which recorded the percentage of fouling on the hull, keel, rudder, propeller shaft, propeller and, when available, the bow thruster. Underwater digital photographs were taken when fouling was discovered in order to provide a quantitative estimate of percent cover of fouling organisms as well as permanent record of which species were found on particular sections of the hull. Voucher specimens were taken with an underwater suction sampler in order to confirm taxonomic identifications. Marina sampling consisted of taking 10 haphazardly positioned quantitative underwater photographs and 5 quantitative suction-samples at each of several locations in addition to diver surveys in order to obtain representative estimates of the species and relative percent coverage of fouling organisms on docks and pilings.

The degree of hull fouling on the vessels varied from zero to heavily fouled and no correlation was found between the degree of fouling and vessel size or where the vessel was moored at the time of sampling. The hulls of sail boats had a slightly higher number of fouling species on them than power craft. Of the vessels sampled, 75% had some degree of fouling ranging from lightly (1-10%) to heavily fouled (81-100%) surfaces. The highest level of fouling (~20-40% cover) was typically found to occur on the rudders, propeller and propeller shafts of the vessels. Most of the vessel hull fouling ranged from 0-10% cover, while the keels of the vessels normally had little (<5% cover) to light (5-10% cover) fouling. A variety of taxa were found on the vessel hulls with the most common groups being barnacles, bryozoans and polychaete worms. Less common groups included ascidians, sponges, and bivalves.

Preliminary analysis indicates the species fouling the vessel hull were generally correlated with the fouling fauna found where the vessel was moored in its winter port. Several vessels arriving in Mystic, CT and Newport, RI from the Ft. Lauderdale area had extensive fouling of non-native species. Many of these species appeared to be stressed or moribund.

Our preliminary findings indicate that vessels moving from southern to northern waters take a variety routes along the eastern seaboard. Some rely heavily on using the inland coastal waterway while others transit in coastal waters with 2-4 stopovers during their journey. A few vessels leave Florida, move to Bermuda and then transit to CT or RI waters. We found that while many vessels had their 'winter' port in Florida, the vessels would often make cruises into the Carribean; thus potentially acting as a vector of transport of hull fouling species from this area into Florida. While present sample size is relatively small, our hull fouling surveys seem to suggest that vessels traveling northward and spending more time in brackish water conditions (e.g., upper Chesapeake Bay) were less fouled than vessels which transited in more open water conditions.

Most vessel operators followed a very regular schedule of hull maintenance. This usually involved yearly or bi-yearly renewal of bottom anti-fouling paints and periodic inspection of the hull to assess the degree of hull fouling. Most operators relied on copper-based anti-fouling paints. Some operators used brushes or coarse, woven clothes to periodically remove fouling organisms from their vessel hulls.

An article was written by N. Balcom in 2006 entitled "Hull fouling's a drag on boats and local ecosystems" describing the hull fouling project. (*Wrack Lines* 5(1):14-17). Balcom also submitted a poster presentation to the 5<sup>th</sup> International Conference on Marine Bioinvasions, scheduled for May 2007 in Cambridge, MA.

## **R/ES-20 The control and economics of aquatic invasive species in marine aquaculture (NSI)**

### Principal Investigator(s) and Affiliation(s):

1. Robert B. Whitlatch, University of Connecticut
2. Richard W. Osman, Smithsonian Environmental Research Center
3. Sandra E. Shumway, University of Connecticut
4. Charles Adams, University of Florida
5. Tessa Getchis, CT Sea Grant College Program

### Accomplishments and Outcomes

This research will quantify the threat of invasive species to commercially-important shellfish, test various methods that can be used to eliminate or control these invaders, and assess the economic implications of fouling and alternative control measures. This information will be important to both mariculturists and managers of these resource species.

Goals and objectives of the project include: 1. Determine the degree to which the invasive ascidians affect the growth and mortality of shellfish that they foul. 2. Determine the effectiveness of biological control to prevent or impede the recruitment of invasive ascidians into shellfish populations. Studies will focus on the use of native gastropods *Mitrella lunata*, *Anachis lafresnayi*, *Anachis avara* that we have shown to consume large quantities of ascidian recruits but not shellfish. The potential advantage of preventive biological control is that once inoculated with the predators, future treatment may be unnecessary. 3. Determine the effectiveness of treatment of shellfish populations to control fouling and damage by invasive ascidians. Studies will focus on the use of calcium oxide (quicklime), brine, or freshwater. These low-cost treatments have the potential to kill the ascidians with little or no impact on the shellfish. 4. Determine the economic implications associated with fouling by invasive species and the economic cost/benefits associated with treatment and biological control.

We conducted a series of preliminary experiments examining the effects of the recent invasion colonial ascidian, *Didemnum* sp., on the growth and survival of blue mussels, bay scallops and eastern oysters. These experiments consisted of using different size classes of shellfish (20 large and 50 small shellfish per bag with 7 replicates per treatment) and enclosing them in vexar mesh bags and adding colonies of the ascidian to the bags. The bags were deployed at a field site near the Avery Point campus for two months. Upon retrieval the bags were processed to obtain the following information: individual shellfish growth and survival. Digital photographs were taken of the bags and shellfish to determine the extent of ascidian growth. The shellfish were frozen for latter estimates of condition index. While we are still processing the data, preliminary results indicate the ascidian had no significant effects on the survival of oysters, scallops and mussels. Scallop growth was negatively affected by an increasing amount of *Didemnum* overgrowth.

A mail survey was conducted in an effort to compile information regarding the extent to which biofouling is an on-going problem with marine, shellfish growers. The survey solicited information on growers perceptions of biofouling as a production and marketing problem, methods of dealing with biofouling, and the costs associated with controlling biofouling within their production system. The survey was sent to seven regions of the country where marine, shellfish culture is a viable industry. These regions included the West Coast, Northeast Coast, Florida, North Carolina, Virginia, South Carolina, and Georgia. A total of 1,333 surveys were mailed out, with 509 surveys being returned. This provided for a 38% return rate. The findings from this survey show that biofouling is indeed a major problematic issue for shellfish growers in most regions where commercial culture occurs. A wide range of control methods are utilized, many of which involve large amounts of labor and fuel to implement. The control of biofouling accounts for a large percentage of the total annual operating costs for these businesses, with some reporting that biofouling control is their largest cost. Methods to control biofouling and mitigate the costs associated with biofouling were recognized to be in high demand by the survey respondents.

We also organized a special session on biofouling at the 98th Annual Meeting of the National Shellfisheries Association, Monterey, CA, March 26-30, 2006. The special session consisted of 13 scientific presentations: B. Hayden (NIWA, New Zealand), S. Bullard (University of Hartford), A. Brand (University of Liverpool), L. Rodriguez (University of California, Davis), J. Greene (University of New Hampshire), P. Barnes (Malaspina University-College), B. Dewey (Taylor Shellfish, WA), P. Gribbon (University of New South Wales, Australia), C. Carver (Mallet Research Services, Newfoundland), V. Maxwell (Louisiana Sea Grant Development Program), N. LeBlanc (Atlantic Veterinary College, Prince Edward Island), S. Fisher (Pittsburg, Paint and Glass), C. Adams (University of Florida). Approximately 150 individuals attended the special session.

Co-PI Getchis hosted the 2006 Northeast Aquaculture Conference and Exposition in Mystic, CT, December 8-11. A special session of the meeting "Biofouling and Shellfish Aquaculture" was organized by co-PI Shumway and Bill Walton (WHOI Sea Grant). The special session was attended by approximately 80 individuals, including shellfish aquaculturists and scientists. Getchis also helped develop a set of field cards on waterproof papers that provides picture and information on the 25 recent invaders (less than 50 yrs), past invaders (> 50 yrs), seasonal invaders, and native species in Long Island Sound. The information is designed to provide users groups (including aquaculturists) with information on non-native species in the Sound and how to recognize them.

## **N/A (no internal tracking number) Earth Grant Geospatial Technology Extension Program**

### Principal Investigator(s) and Affiliation(s):

1. Michael (Sandy) Prisløe, University of Connecticut
2. Dan Civco, University of Connecticut
3. Chester Arnold, University of Connecticut

### Accomplishments and Outcomes

Accomplishments and outcomes for various project tasks are summarized below:

Task 1.1 The writing of a manual on techniques to estimate impervious surfaces was postponed due to changes in the methods being investigated to estimate impervious surfaces from land cover and demographic data.

Task 1.2 An overview of techniques to measure impervious surfaces was conducted for the National NEMO Network's U4 conference in Washington, DC held April 2005. A formal ½-day training was held in Middletown, CT at NEMO U5 in October 2006.

Task 1.3 An impervious surfaces section has been added to the NEMO website at [http://nemo.uconn.edu/impervious\\_surfaces/index.htm](http://nemo.uconn.edu/impervious_surfaces/index.htm)

Task 1.4 Due to activities at the federal level, in particular the development of Geospatial One Stop (<http://gos2.geodata.gov/wps/portal/gos>) which serves as a portal to federal, state and local geographic data, it was determined that maintaining a National Datasets page on the Connecticut Geospatial Technology Program website was duplicative and no longer of value. While the site is still online, plans are to remove it in the near future.

Task 1.5 The development of web-based information on mapping *Phragmites australis* has expanded significantly. Additional grant funds and data were acquired from the Institute for the Application of Geospatial Technology, EPA, the Connecticut Department of Environmental Protection and the NOAA Coastal Services Center. These resulted in the acquisition of multiple dates of Quickbird imagery covering the lower Connecticut River tidal marshes for the 2004 - 2006 growing season; high-resolution ADS40 aerial ortho-imagery for Connecticut's coastal municipalities acquired September 2004; very high-density LiDAR data for Connecticut's coast from the Quinnipiac marshes in Hamden to New Haven Harbor to the Connecticut River and north to Chester; and funding from the DEP to conduct a detailed floristic inventory with maps of the Ragged Rock tidal marsh in Old Saybrook. These datasets were used to investigate methods to analyze remote sensing data to identify and map *Phragmites australis* and to assess mitigation opportunities and efficacy.



The Connecticut Department of Environmental Protection has correlated watershed impervious surface estimates provided by the project to macro invertebrate surveys and has found a strong relationship. The department was successful in getting EPA Region 1 to allow use of impervious surface metrics as a component of Connecticut's TMDL program. The PI attended a meeting of the New England Interstate Water Pollution Control Commission and demonstrated IS estimation techniques to support this programmatic change.

Members of the national NEMO Network are using the Impervious Surface Analysis Tool, developed jointly by the NOAA Coastal Services Center and the Geospatial Technology Program, to estimate impervious surface area of watersheds of concern in their respective states. A plan to incorporate ISAT into a 3-day 3-module training program aimed at increasing the use of remote sensing and satellite-derived land cover is underway and will involve NOAA Coastal Services Center, the National Geospatial Technology Extension Network, the National NEMO Network and the National Association of Counties. A "Train the Trainers" workshop has been scheduled at NOAA CSC for November 2007.

Methods and maps of *Phragmites australis*, derived from satellite remote sensing and LiDAR data, are being used by the Connecticut DEP and the Connecticut Chapter of The Nature Conservancy to develop and direct their *Phragmites* eradication efforts in brackish tidal marshes of the lower Connecticut River.

**N/A (no internal tracking number) Nab the Aquatic Invader! A Nationwide Online Educational Program to Direct Attention to AIS Issues and Inspire Action (NSI)**

Principal Investigator(s) and Affiliation(s):

1. Nancy Balcom, Connecticut Sea Grant and Department of Extension
2. Diana Payne, Connecticut Sea Grant

Accomplishments and Outcomes

Extension educator Balcom and education coordinator Payne are working with colleagues from four Sea Grant programs nationwide (IL-IN, LA, OR and NY) as well as local formal and informal educators to add new material and activities to the “Nab the Aquatic Invader” web site to make it nationally-relevant, and to coordinate community-based service projects focused on aquatic nuisance species.

Accomplishments and outcomes to date include:

1. Participated in planning conference calls and in planning meeting in Chicago IL (August 2005).
2. Surveyed Sea Grant colleagues along East Coast and developed list of ten representative candidate ANS from the East Coast
3. Conducted workshop for formal and informal K-12 educators on Nab and invasive species – introducing them to the website and its resources, and provided paperwork to teachers interested in participating in the development of activities for the East Coast species; 31 March 2006, LIS Educators Conference, Norwalk CT
4. Completed “rap sheets”, list of resources, and links to pictures for 10 East Coast candidate ANS
5. Reviewed caricatures for each species
6. Contracted with several teachers to develop appropriate classroom activities for the East Coast species; began reviewing submissions
7. Conducted “Nab the Aquatic Invader! Workshops for 54 grades 5-8 students and teachers as part of University of Connecticut’s Marine Sciences Day.

**N/A (no internal tracking number) Interrupting the Flow: A Northeast Regional Sea Grant Education and Outreach Collaborative Addressing Vectors of Marine Invasive Species Introductions in the Northeast Region (NSI)**

Principal Investigator(s) and Affiliation(s):

1. Nancy Balcom, Connecticut Sea Grant and Department of Extension

Accomplishments and Outcomes

1. Participated in two regional planning conferences
2. Worked with steering committee members on hull fouling and baitworm sub-projects
3. Connected with CT/NY research group investigating live marine bait as vectors of ANS and HABs. This group is surveying regional bait wholesalers and bait and tackle shops about sources of bait, therefore decided to focus efforts on educating users of live bait (see No. 6)
4. Collected links to state resources on Clean Marina and Clean Boater programs, references to hull fouling cleaning practices, hull coating regulations, etc. for use in web site portal.
5. Continued development of hull fouling outreach materials (posters) to complement pending web site
6. Developed format for multi-lingual educational sticker to be either printed directly on bait boxes or affixed to the boxes; seeking graphic artist and acquiring translations of educational message. Developing web-based “raffle” to evaluate effectiveness of sticker (e.g., is it being read?)
7. Wrote article on hull fouling as vector for CTSG *Wrack Lines* magazine.
8. Presented poster on hull fouling research and outreach at 5<sup>th</sup> International Bioinvasions Conference, May 21-24, 2007, Cambridge MA.

## SECTION I-C

### AWARD REPORTING: CONNECTICUT SEA GRANT LONG ISLAND SOUND LOBSTER RESEARCH INITIATIVES

**Grantee:** University of Connecticut, Connecticut Sea Grant College Program

**Award Number:** NA16RG1364

**Project Title:** CONNECTICUT SEA GRANT LONG ISLAND SOUND LOBSTER RESEARCH INITIATIVES

**Time Period:** 07/01/2001 - 12/31/2006 (This report for period March 1, 2006 – December 31, 2006 and also serves as the **FINAL PROJECT REPORT**)

**Accomplishments and Outcomes:** See Below

#### **Lobster Research Initiative (Development funds):**

(For the period 4/1/06 – 12/31/06)

1. Lobster development funds provided support for the research project “Sumithrin toxicity in the American lobster (*Homarus americanus*) upon experimental exposure” conducted by Milton Levin and Sylvain De Guise at the University of Connecticut, and Bruce Brownawell at Stony Brook University in New York. The conclusion of the work was that sumithrin degrades rapidly in salt water and did not exert significant toxicity in lobsters (it neither killed lobsters nor induced immunotoxicity) at the concentrations tested. Therefore it is unlikely that sumithrin contributed to the 1999 lobster resource disaster in Long Island Sound.
2. The balance of the lobster development funds were used in support of an economic impact assessment of the Connecticut commercial lobster industry. Initially planned as a quick survey of industry members and state resource managers to provide material for a one-pager and a fact sheet on the industry that lobstermen could use when talking with state and federal legislators, the impact assessment has expanded into a more in-depth economic impact study which will continue in 2007. The work is being conducted by Nancy Balcom and Robert Pomeroy of the Connecticut Sea Grant Extension Program in collaboration with the Connecticut Commercial Lobstermen’s Association and the Connecticut Department of Environmental Protection, Marine Fisheries Division.

#### **Lobster Extension Program**

(For the period 4/1/06 – 12/31/06)

1. CT SG extension educator Balcom and NYSG fisheries extension specialists Antoinette Clemetson co-authored an article, “Lobster Resource Failure in Long Island Sound, Fisheries Extension, and Litigation”, which was published in *Fisheries* 31(6):276-284.
2. see No. 2 above.

#### **FINAL PROJECT REPORT**

##### **Problems/Needs:**

During the fall of 1999, the Long Island Sound bi-state lobster fishery, valued at \$18-40M/year ex-vessel and \$100M overall, and supporting about 1,200 lobstermen, suffered a massive mortality event. Commercial harvests declined to 64% - 91% of the previous year’s landings.

The commercial lobster fishery was declared a marine resource disaster by the Secretary of Commerce in January 2000.

**Inputs/Investments:**

- \$13.9M in federal disaster relief funds appropriated to research the cause of the die-off and provide economic relief to the lobstermen. \$6.4M in non-federal funds supported the effort.
  - A national research initiative investigating the potential cause(s) of the lobster mortalities was undertaken by the Steering Committee for Lobster Disease Research, a sub-committee of the Atlantic States Marine Fisheries Commission's Lobster Management Board, established in 2000. Eleven representatives of state and federal regulatory agencies, Sea Grant, and the lobster industry comprised the Steering Committee.
  - Twenty-one projects involving 65 scientists at 30 institutions nationwide investigated the effects of environmental stressors and disease on American lobsters over three years.
    - CTSG managed 6 major grants and 4 smaller grants supported with lobster development funds (\$1.31M plus \$550K match)
1. Stress Indicators in Lobsters: Hormones and Heat Shock Proteins (LR/LR-1); Ernest Chang – Bodega Marine Laboratory, UC Davis
  2. Development of Assays for the Evaluation of Immune Functions of the American Lobster as a Tool for Health Assessment (LR/LR-2); Sylvain De Guise – University of Connecticut
  3. Determination of the Toxicity and Sublethal Effects of Selected Pesticides on the American Lobster (LR/LR-3); Sylvain De Guise – University of Connecticut
  4. Oligonucleotide-based detection of Pathogenic *Paramoeba* Species (LR/LR-4); Rebecca Gast – Woods Hole Oceanographic Institution
  5. Phenotypic and Molecular Identification of Environmental Specimens of the Genus *Paramoeba* Associated with Lobster Mortality Events (LR-LR-5); Patrick Gillevet – George Mason University
  6. Acute Effects of Methoprene on Survival, Cuticular Morphogenesis and Shell Biosynthesis in the American lobster (LR/LR-6); Michael Horst – Mercer University School of Medicine
  7. LIS Lobster Disease Research Management (LMP/A-1); Edward Monahan – CTSG
  8. LIS Lobster Program Development (LMP/D-1); Edward Monahan – CTSG
    - Comparative Pathology of Shell Disease in the American (*Homarus americanus*) and Caribbean Spiny (*Panulirus argus*) Lobsters: Characterization of Gross, Light Microscopic and Ultrastructural Pathology; Richard French, University of Connecticut
    - Monitoring of Bottom Water and Sediment Conditions at Critical Stations in Western Long Island Sound; Carmela Cuomo, Yale University
    - Maintenance of a *Paramoeba* culture and exploration of a mitochondrial cytochrome *b* genetic marker; Senjie Lin, University of Connecticut
    - Sumithrin immunotoxicity in the American lobster (*Homarus americanus*) upon Experimental Exposure; Sylvain De Guise, University of Connecticut
  9. LIS Lobster Extension Program (LA/E-1); Nancy Balcom – CTSG Extension

- A \$350K regional lobster outreach program was implemented by the CT and NY Sea Grant Extension and Communications programs. CTSG staff invested at least 4 months / year over four years (\$165K and \$84.5K match)
- Laufer, H. and R. Smolowitz. 2004-2006. Lobster defenses to shell disease: endocrine control of molting and wound healing. (\$140K plus \$59K match).

### **Outputs:**

#### Training

- Joint meeting of state lobster biologists (MA, RI, CT, NY) to standardize the method for monitoring/recording incidences of shell disease during sea sampling

#### Educational Resources

- [www.seagrantsunysb.edu/LILobsters](http://www.seagrantsunysb.edu/LILobsters) (a joint NYSG-CTSG website to document progress on research and outreach efforts)
- Four public Lobster Health Symposia (2000, 2001, 2003, 2004)
- Two internal working meetings of the lobster research community
- Extensive media relations (print, TV, radio)

#### Outreach Presentations

- Balcom, N. 2005. Piecing Together the Lobster Mortality Puzzle. Northeastern Mosquito Control Association. November 28-30. Northhampton MA.
- Balcom, N. 2005. Long Island Sound lobster health initiative: piecing together the mortality puzzle. Coastal Perspectives Lecture, 29 March, Groton CT
- Balcom, N. and A. Clemetson. 2004. When Extension Meets Partners and Litigants: the Case of the Long Island Sound Lobster Mortality. 134<sup>th</sup> Annual meeting of the American Fisheries Society. 21-24 August. Madison, WI.
- Balcom, N. 2003. Lobsters, Litigation and Extension. "Handling Controversy" panel discussion, National Sea Grant Week, 28 April, Galveston TX
- Balcom, N. 2003. Briefing on status of lobster research to Lobster Management Board of Atlantic States Marine Fisheries Commission, 10 June, Alexandria VA.
- Balcom, N. 2001. Responding to a Lobster Fishery Failure in Long Island Sound. SETAC North Atlantic Chapter 7<sup>th</sup> Annual meeting, 26-28 April, Plymouth MA
- Pearce J. and N. Balcom. 2004. Identifying the driving forces behind the 1999 lobster mortality event – fitting together the pieces of the puzzle. Fourth Long Island Sound Lobster Health Symposium. 4 October. Stony Brook NY.
- Van Patten, M. and N. Balcom. 2001. Holistic Response to a Lobster Fishery Failure and Ecosystem Mystery in Long Island Sound. USGS 26<sup>th</sup> Annual Eastern Fish Health Workshop, 23-26 April. Shepardsstown WV
- Van Patten, M., N. Balcom, R. French, P. Focazio, and C. LoBue. 2000. Responding to a Lobster Fishery Disaster and Ecosystem Enigma in Long Island Sound. Fifth Long Island Sound Research Conference, Nov., Stamford, CT
- Van Patten, M., N. Balcom, R. French, E. Beckwith and B. Young. 2000. The Plan of Action for the Long Island Sound Lobster Fishery Failure. Sixth International Conference and Workshop on Lobster Biology and Management, 10-15 September, Key West FL. (Poster)

Research Publications (from all projects)

- Calabrese, A., N. Balcom, and A. Clemetson (Guest Eds.) 2005. Contributions to the Long Island Sound Lobster Research Initiative, 2001-2004. Special issue of the *J. Shellfish Res.* 24(3):687-875 (24 manuscripts\*)
- \*Anderson, R.S. & A. Beaven. 2005. *In vitro* activation of hemocytes from the American lobster, *Homarus americanus*, as measured by production of reactive oxygen species. *J. Shellfish Res.* 24(3):699-703
- Biggers, W. J. and H. Laufer. 2004. Identification of juvenile hormone-active alkylphenols in the lobster, *Homarus americanus*, and in marine sediments. *Biol. Bull.* 206: 13-24.
- Chang, E. S. 2005. Stressed-out lobsters: crustacean hyperglycemic hormone and stress proteins. *Integrat. Comp. Biol.* 45:43-50.
- \*Chistoserdov, A. Y., R. Smolowitz, F. Mirasol & A. Hsu, 2005. Culture-dependent characterization of the microbial community associated with epizootic lesions in the American lobster, *Homarus americanus*. *J. Shellfish Res.* 24(3): 741-747
- Chistoserdov A., F. Mirasol & R. Smolowitz. 2002. Characterization of microbial assemblages involved in the development of shell disease in the American Lobster, *Homarus americanus*. *J Shellfish Res.* 21: 410
- \*Crivello, J. F., D. F. Landers, Jr. & M. Keser. 2005a. The contribution of egg-bearing female American lobster populations to lobster larvae collected in Long Island Sound by comparison of microsatellite allele frequencies. *J. Shellfish Res.* 24(3): 831-839
- \*Crivello, D. F. Landers, Jr. & M. Keser. 2005b. The genetic stock structure of the American lobster (*Homarus americanus*) in Long Island Sound and the Hudson Canyon. *J. Shellfish Res.* 24(3): 841-848
- \*Cuomo, C., R. Valente & D. Dogru. 2005. Seasonal variations in sediment and bottom water chemistry of western Long Island Sound: implications for lobster mortality. *J. Shellfish Res.* 24(3):805-814
- \*De Guise, S., J. Maratea, E. S. Chang & C. Perkins. 2005. Resmethrin immunotoxicity and endocrine disrupting effects in the American lobster upon experimental exposure. *J. Shellfish Res.* 24(3): 781-786
- \*De Guise, S., B. Morsey, J. Maratea, M. Goedken, I. Sidor & J. Atherton. 2005. Development of assays to evaluate cellular immune functions in the American lobster, (*Homarus americanus*). *J. Shellfish Res.* 24(3):705-711
- De Guise, S., J. Maratea and C. Perkins. 2004. Malathion immunotoxicity in the American lobster (*Homarus americanus*) upon experimental exposure. *Aquat. Tox.* 66: 419-425.
- \*Dove, A. D. M., B. Allam, J. J. Powers & M. S. Sokolowski. 2005. A prolonged thermal stress experiment on the American lobster, *Homarus americanus*. *J. Shellfish Res.* 24(3):761-765
- Dove, A. D. M., C. LoBue, P. Bowser and M. Powell. 2004. Excretory calcinosis: a new fatal disease of wild American lobsters. *Dis. Aquat. Org.* 58: 215-221.
- \*Draxler, A.F.J., R. A. Robohm, D. Wiczorek, D. Kapareiko & S. Pitchford. 2005. Effect of habitat biogeochemicals on survival of lobsters (*Homarus americanus*). *J. Shellfish Res.* 24(3):821-824

- \*Draxler, A. F. J., R. M. Sherrell, D. Wieczorek, M. G. Lavigne & A. J. Paulson. 2005. Manganese concentration in lobster (*Homarus americanus*) gills as an index of exposure to reducing conditions in western Long Island Sound. *J. Shellfish Res.* 24(3): 815-819
- \*Factor, J. R., K. Orban, D. H. Szarowski, G. Lin, T. LaRocca, A. Becker & K. Jacoff-Kapusta. 2005. A method for assessing removal of foreign particles from the blood by fixed phagocytes of the American lobster, *Homarus americanus*. *J. Shellfish Res.* 24(3):713-717
- Figler, M. H., H. V. S. Peeke, M. J. Snyder and E. S. Chang. 2004. Effect of egg removal on territoriality, amines, and stress indicators in ovigerous lobsters (*Homarus americanus*). *Mar. Fresh. Behav. Physiol.* 37:43-54.
- Horst, M. N., A. N. Walker, P. Bush, T. Wilson, E. S. Chang, T. Miller, and P. Larkin. 2007. Pesticide induced alterations in gene expression in the lobster, *Homarus americanus*. *Comparative Biochemistry and Physiology Part D. Genomics and Proteomics.* 2:44-52.
- \*Howell, P., J. Benway, C. Giannini, K. McKown, R. Burgess & J. Hayden. 2005. Long-term population trends in American lobster (*Homarus americanus*) and their relation to temperature in Long Island Sound. *J. Shellfish Res.* 24(3): 849-857
- \*Laufer, H., N. Demir & W. J. Biggers. 2005. Response of the American lobster to the stress of shell disease. *J. Shellfish Res.* 24(3): 757-760
- \*Lin, S. & H. Zhang. 2005. Isolation of mitochondrial cytochrome *B* gene and development of a real-time quantitative PCR assay for detecting *Neoparamoeba aestuarina*. *J. Shellfish Res.* 24(3): 733-739
- \*Miller, R. L., J. R. Wands, K. N. Chytalo & R. A. D'Amico. 2005. Application of water quality modeling technology to the investigation of the decline in Long Island Sound lobsters (*Homarus americanus*) during the summer of 1999. *J. Shellfish Res.* 24(3): 859-864
- \*Mullen, T. E., K. R. Nevis, C. J. O'Kelly, R. J. Gast & S. Frasca, Jr. 2005. Nuclear small-subunit ribosomal RNA gene-based characterization, molecular phylogeny, and PCR detection of the *Neoparamoeba* from western Long Island Sound Lobster. *J. Shellfish Res.* 24(3): 719-731
- Mullen, T., K. S. Russel, M. Tucker, J. L. Maratea, T. Burrage, C. Koerting, L. Hinkely, C. Perkins, S. De Guise, S. J. Frasca & R. A. French. 2004. Paramoebiasis associated mass mortality of American lobster (*Homarus americanus*) in Long Island Sound, USA. *J. Aqu. An. Health* 16: 29-38.
- Peglar, M.T., L. A. Amaral Zettler, O. R. Anderson, T. A. Nerad, P. M. Gillevet, T. E. Mullen, S. Frasca Jr., J. D. Silberman, C. J. O'Kelly & M. L. Sogin. 2003. Two new small-subunit ribosomal RNA gene lineages within the subclass Gymnamoebia. *J. Eukaryot. Microbiol.* 50:224-232.
- \*Pearce, J. & N. Balcom. 2005. The 1999 Long Island Sound lobster mortality event: findings of the comprehensive research initiative. *J. Shellfish Res.* 24(3): 691-697
- \*Robohm, R. A., A. F. J. Draxler, D. Wieczorek, D. Kapareiko & S. Pitchford. 2005. Effects of environmental stressors on disease susceptibility in American lobsters: a controlled laboratory study. *J. Shellfish Res.* 24(3): 773-779
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- Valente, R. & C. Cuomo. 2005 Did multiple sediment-associated stressors contribute to the 1999 lobster mass mortality event in western Long Island Sound, USA? *Estuaries* 28(4):529-540.
- \*Walker, A. N., P. Bush, T. Wilson, E. Chang, T. Miller & M. N. Horst. 2005. Metabolic effects of acute exposure to methoprene in the lobster, *Homarus americanus*. *J. Shellfish Res.* 24(3): 787-794
- Walker, A. N., Bush, P., Puritz, J., Wilson, T., Chang, E. S., Miller, T., Holloway, K. and Horst, M. N. 2005. Bioaccumulation and metabolic effects of the endocrine disruptor methoprene in the lobster, *Homarus americanus*. *Integr. Comp. Biol.* 45:118-126.
- \*Wieczorek, D. & A. F. J. Draxler. 2005. A method for exposing lobsters to multiple simulated habitat biogeochemicals and temperatures. *J. Shellfish Res.* 24(3): 767-771
- \*Wilson, R. E. and R. L. Swanson. 2005. A perspective on bottom water temperature anomalies in Long Island Sound during the 1999 lobster mortality event. *J. Shellfish Res.* 24(3): 825-830
- \*Wilson, R. E., H. Crowley, B. Brownawell & R. L. Swanson. 2005. Simulations of transient pesticide concentrations in Long Island Sound for late summer 1999 with a high resolution coastal circulation model. *J. Shellfish Res.* 24(3): 865-875
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#### Outreach Publications

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- Balcom, N. and P. Howell. 2006. Responding to a resource disaster: American lobsters in Long Island Sound. CTSG-06-02. 24 pp.
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**Impacts:**

- Lobster industry members participated in all key decisions through their formal representatives on the Steering Committee.
- 21 research projects were integrated topically and presented by five individuals at the 3<sup>rd</sup> and 4<sup>th</sup> public symposia (a practice which challenged researchers to collaborate on the interpretation and integration of disparate results for the public, to address the overall question, "What happened to the lobsters in 1999?").
- Researchers cited the internal working meetings as extremely beneficial and suggested that they serve as the standard for future multi-disciplinary efforts.
- The LIS Lobster Health Research Initiative collectively-produced results that determined the impacts of natural and human environmental stressors on the health of the American lobster stock in the Sound, and provided lobster biologists and resource managers with extensive new information to help guide management decisions.
- State and local review and revision of mosquito control pesticide usage was undertaken. The use of malathion has been reduced or eliminated altogether, coupled with a stronger push for the use of BT.
- Civil lawsuits filed by commercial lobstermen against three manufacturers of pesticides used for mosquito control were settled for ~\$16M.
- Commercial lobstermen and state resource managers are initiating a v-notching program for female lobsters in LIS as a resource conservation measure, with support from the State of Connecticut.
- Extensive press coverage (print, TV, radio), generated through press releases, briefings, and interviews arranged with researchers, Sea Grant staff, and commercial lobstermen, kept the issue in the public eye
- The CT-NY Sea Grant lobster outreach team was awarded the Northeast Sea Grant Extension Network's Outstanding Outreach Program Group Award in 2004.

- Balcom was recognized with a Special Achievement Award by the University of Connecticut in 2001, upon recommendation of the Steering Committee Chairman.

**SECTION I-D**

**AWARD REPORTING: CONNECTICUT SEA GRANT PROGRAM  
KNAUSS MARINE POLICY FELLOWSHIP, 2007, CHRISTOPHER  
MEANEY E/K-14**

**Grantee:** University of Connecticut, Connecticut Sea Grant College Program

**Award Number:** NA07OAR4170026

**Project Title:** CONNECTICUT SEA GRANT PROGRAM KNAUSS MARINE POLICY FELLOWSHIP, 2007, CHRISTOPHER MEANEY E/K-14

**Time Period:** 02/01/2007 – 01/31/2007 (This report for period March 1, 2006 – February 29, 2007)

**Accomplishments and Outcomes:** See Below

As of March 1, 2006 the Knauss Marine Policy Fellowship for Christopher Meaney had just commenced. Mr. Meaney has been assigned as an Executive Fellow with the National Marine Fisheries Service Habitat Conservation Program. Additional substantive reporting will not be available until after the completion of the fellowship experience.

## SECTION I-E

### **AWARD REPORTING: TUNICATE: RESEARCH ON TUNICATE CONTROL AND THE EFFECTS OF ECOLOGICAL BOTTLENECKS IN THE CONTROL OF NON-NATIVE TUNICATES IN NEW ENGLAND - PI WHITLATCH**

**Grantee:** University of Connecticut, Connecticut Sea Grant College Program

**Award Number:** NA06OAR4170170

**Project Title:** TUNICATE: RESEARCH ON TUNICATE CONTROL AND THE EFFECTS OF ECOLOGICAL BOTTLENECKS IN THE CONTROL OF NON-NATIVE TUNICATES IN NEW ENGLAND - PI WHITLATCH

**Time Period:** 07/01/2006 – 06/30/2008 (This report for period March 1, 2006 – February 29, 2007)

#### Goals and Objectives

Guided by our previous studies which have focused on abiotic and biotic factors limiting the distribution of non-native ascidians in coastal habitats, we are undertaking a series of field studies designed to examine factors which may help to regulate the distribution and abundance of the most recent non-native ascidian invader *Didemnum*.

Specifically we are addressing the following questions:

1. What are the predators of *Didemnum* and how do they influence different life stages of the ascidian? Is there a critical bottleneck in the ascidian's life history that regulates the abundance of the species? If so, does the critical bottleneck vary between shallow- and deep-water habitats?
2. What is the relationship between resident biodiversity and the ability of *Didemnum* to invade and does the relationship vary between shallow- and deep-water sites? Are less diverse communities more vulnerable to invasion by the ascidian?
3. How do variations in environmental conditions (e.g., depth, salinity, habitat quality) influence the recruitment, growth and survival of *Didemnum*? Are there specific factors which restrict or limit the successful invasion of the ascidian?

We have initially focused our work on Objective 3 and have completed a study on the growth rates of the colonial sea squirt *Didemnum* sp. in Long Island Sound. We measured the growth of *Didemnum* sp. at different depths, salinities and associated with different land use patterns. We found that *Didemnum* sp. grew best at shallow sites, in high salinity areas and in areas with undeveloped coastlines.

#### Methods

Work was conducted near the University of Connecticut, Avery Point campus Groton, Connecticut. Study areas ranged from Noank, CT to several miles up the Thames River).

We prepared Vexar pouches (~15 cm wide) and placed pre-weighed pieces of *Didemnum* sp. colonies (~1-2 g each) inside them. We placed pouches under different environmental conditions (depths, salinities, land use patterns) and allowed colonies to grow for two weeks. At the end of this time, we recovered the pouches and re-weighed the *Didemnum* pieces to determine the change in biomass for each colony from each site. For the depth experiment, we deployed twelve pouches at three depths at three separate sites (for a total of 108 pouches deployed). Depths were 1 m, 2.5 m, and 4 m below the surface. Each site was at least 100 m apart. For analysis, we derived the mean change in biomass after two weeks for *Didemnum* sp. at each depth for each site and used ANOVAs to compare growth rates among depths ( $n = 3$ ).

For the salinity experiment we deployed twelve pouches at nine separate sites representing three different mean salinities (for a total of 108 pouches deployed). To obtain a salinity gradient, we deployed our salinity experiment in three sections of the Thames River. Each site was standardized to ~1-1.5 m depth at low tide and was at least 100 m apart. The sections of the river where we deployed our sites had distinct salinity ranges (high = 26-30 ppt, Medium = 15-28 ppt, Low = 10-26 ppt). For analysis, we derived the mean change in biomass after two weeks for *Didemnum* sp. for each salinity and used ANOVAs to compare growth rates among depths ( $n = 3$ ).

For the coastal land use experiments we deployed twelve pouches at nine separate sites representing three different coastal land use patterns: undeveloped, low/moderately developed, heavily developed (for a total of 108 pouches deployed). Each site was standardized to ~1-1.5 m depth at low tide and was at least 100 m apart. At each site snorkelers attached pouches to fixed PVC racks secured to the bottom. For analysis, we derived the mean change in biomass after two weeks for *Didemnum* sp. for each land use and used ANOVAs to compare growth rates among depths ( $n = 3$ ).

#### Accomplishments, Findings and Outcomes

We found significant differences in the grow rate of *Didemnum* sp. at different depths at two of the three sites we examined. At one site, *Didemnum* sp. grew faster at 1.0 and 2.5 m than at 4.0 m; at the other site *Didemnum* sp. grew the fastest at 1.0 m, intermediate at 2.5 m, and slowest at 4.0 m. When we pooled data for all sites were pooled we did not detect a difference in growth rates among depths ( $P = 0.184$ ); likely this was because of variability in growth rates among sites and because growth rates at Site 2 were very similar at all depths. Temperature loggers attached to racks at Site 2 recorded similar temperatures among depths; mean temperatures were for 21.8, 21.3, and 21.3 °C for the 1.0, 2.5, and 4.0 m depths respectively. Given the close proximity of all sites (all were within 200 m of each other and were in the same hydrodynamic setting), it is likely that temperatures were similar at all three sites.

We found highly significant differences in growth rate of *Didemnum* sp. at sites with different salinities. Growth rates were much higher in high salinity (known salinity range of 26-30 ppt) areas near the mouth of the Thames River, than in lower salinity areas higher in the river ( $P < 0.001$ ). Additionally, most of the *Didemnum* sp. colonies in the two lower salinity areas were bloated, slightly discolored and appeared to be dying by the end of the two week experiment.

We found significant differences in the growth rate of *Didemnum* sp. at sites with different coastal land use patterns. Two sites (one suburban and one undeveloped) were destroyed during a strong storm. The loss of these sites greatly limited our ability to rigorously compare growth rates among land use patterns from this experiment. However, results from a preliminary study conducted in 2005 demonstrate that *Didemnum* sp. grows best in areas with undeveloped coastline ( $P = 0.042$ ). Methods for the preliminary study was identical to the methods for this study and the study sites were in the same general areas.

Different environmental conditions (different depths, salinities, and coastal land use patterns) greatly affected the growth rate of the invasive ascidian *Didemnum* sp. The species grew best at shallow sites, in high salinity areas and in areas with little coastal development. It grew least well at deeper sites in low salinity areas; there was no difference in growth rates between suburban and urban areas.

*Didemnum* sp. grew better in shallow water (1.0 m) than relatively deep water (4.0 m). These results support the findings of a previous study where there was a trend ( $P = 0.127$ ) for *Didemnum* sp. to cover a greater amount of area on a rock surface at 1 m depth ( $19.9 \pm 5.7\%$  cover) than at 2 and 3 m depths ( $11.2 \pm 4.3\%$  and  $7.5 \pm 2.2\%$  cover respectively) (Bullard & Whitlatch *unpublished data*). Even so, these results were somewhat unexpected. Most of the largest infestations of *Didemnum* sp. have been found in deep water (>30 m) and a recent study found that *Didemnum* sp. grew better at cool temperatures (McCarthy et al. 2006), such as those that would be found at depth. *Didemnum* sp. may normally grow best in shallow water, but under natural conditions it may be prevented from doing so because of competition for space. *Didemnum* sp. is a very strong spatial competitor (Bullard et al 2006), but overgrowing other organisms likely requires considerable energy expenditure and may slow the lateral growth of colonies. *Didemnum* sp. tolerates deep water, and if more bare space is available at these sites it may be able to grow quickly and rapidly cover large areas. Differences in temperatures are unlikely to account for the differences in growth rates because temperatures were very similar at different depths (mean difference of 0.5 °C between 1.0 and 4.0 m) and the warmest waters were found at the 1.0 m depth.

*Didemnum* sp. grew best in high salinity areas; it grew poorly and often appeared dead or dying in low salinity areas. Ascidiates are marine organisms and do not generally grow well in low salinity areas. In an extensive survey we conducted of 33 Connecticut and Rhode Island docks (fall 2003), we never found ascidiates growing in areas with salinities of < 20 ppt (Whitlatch *unpublished data*).

This project represents an initial effort to understand *Didemnum* sp.'s basic ecology. Given the species widespread distribution, rapid growth and strong competitive abilities, *Didemnum* sp. could become a major pest species along both coasts of the U.S. and in Long Island Sound. The potential impacts of the species has recently been the subject of several articles in the popular press (e.g., *USA Today*, *The Hartford Courant*) and coastal managers, governmental officials and lay people are becoming aware of its potential effects. The results obtained by this study represent a critical first step before larger-scale efforts can be mounted against this species to protect Long Island Sound and its wildlife.

## SECTION II IMPACTS

### **Connecticut Sea Grant Strengthens Vocational Agriculture/Aquaculture Education:**

- CTSG extension facilitates connections between teachers and researchers, and recruits students into UConn marine science and aquaculture programs by serving on advisory boards/planning committees for the schools in Bridgeport, New Haven, and Groton.
- CTSG extension is promoting interest in the University's aquaculture and marine science programs by facilitating early college experience (ECE) courses for 30 students attending the Bridgeport Vocational-Aquaculture High School. ECE is an academic program that enables students to take college courses at their high school. CTSG interacts with teachers and students, evaluating progress. Students acquire new knowledge and skills to prepare them for higher education or a career in aquaculture.
- CTSG extension partners with UConn campuses, colleges and departments to expand and enhance student opportunities in aquaculture science through the development of both minors and majors in aquaculture, and teaching courses to enhance the aquaculture curriculum (introduction to aquaculture, aquaculture economics, and extension methods for sustainable coastal resource management) and satisfy student demand.
- CTSG extension serves on the State Consulting Committee for Agriculture Education, providing advice and raising issues of concern with the Commissioner of Education, on behalf of 19 regional centers and 3,000 agriculture education students in Connecticut.

#### **Impact:**

- 2 graduate and undergraduate students received financial support (i.e., assistantships, part-time employment) through CTSG research grants awarded for 2005. (1 undergraduate, 1 graduate student received support through NMAI grant in 2006)
- 9 students at the Storrs and Avery Point campuses have benefited from the teaching and expertise of CTSG staff in subjects including aquaculture, fisheries management, and resource economics. (4 students, NRME 208; 4 students, NRME 299; 1 student, ARE 299 in 2006)

**Connecticut Sea Grant Facilitates the Aquaculture Permitting Process:** CTSG convened multiple workshops for state and federal agencies involved in aquaculture permitting decisions to review the current policies and application process, and develop a more streamlined, straightforward permit application process. Progress towards this long-term goal includes two draft documents (a Guide to Marine Aquaculture Permitting in CT and a Comprehensive Guide to Aquaculture in CT) written by CTSG extension in collaboration with the regulatory agencies. These documents are now being reviewed by state and federal agencies. Five workshops were held to familiarize municipal commissions and aquaculture industry members with the permitting process.



**Impact:**

- The state and federal agencies that regulate aquaculture operations have a better, more efficient working relationship. Individuals/businesses applying for permits have improved lines of communication with resource managers.
- The average duration of time from application submission to permit approval has been reduced from 12 months to 6 months.

**Connecticut Sea Grant Contributes to the Growth and Diversity of the CT Aquaculture Industry:** CTSG extension initiated a successful cooperative research program with aquaculture producers for the development of new species and practices/applications to diversify the products cultivated in Connecticut. Although shellfish culturists possess the knowledge and skill to carry out research projects, they are often limited by time, manpower, and money. CTSG extension involvement provides resources and expertise in (1) business planning and decision-making, (2) field research coordination, (3) commercial implementation, and (4) technology transfer. Coupled with the potential economic benefit of new industries, alternative species culture may alleviate harvest pressure on traditional species. This program provides new skills to producers, and promotes an ability to earn additional profits with a minimal amount of investment and risk. It is the only program of its type available to CT aquaculture producers.

**Impacts:**

- Getchis is working with an industry member to develop a recirculating system for coral propagation. A demonstration project by assisting the grower with his 501c3 application and other business start-up forms necessary for him to apply for federal grants and co-authoring a proposal with the industry member to the National Sea Grant office and State Sea Grant office.
- CTSG Extension Program is assisting the grower with the coordination of a regional coral bank, and attempting to enter coral propagation into the curriculum of Vo-Ag and aquaculture-themed magnet schools in the region.

**Connecticut Sea Grant Supports Northeast Aquaculture Industry Growth through Professional Development:** CTSG extension has played a major role in developing the Northeast Aquaculture Conference & Exposition (NACE<sup>TM</sup>), the purpose of which is to provide freshwater and marine aquaculturists with opportunities to acquire new skills and information that will enhance production and/or marketing facets of their industry. By enabling producers to diversify their operations, undertake new promising ventures, or culture new species, this effort helps ensure that they will have a sustainable resource into the future.

**Impact:**

- 350 people were exposed to over 100 oral, poster and technology transfer presentations on aquaculture topics in 2006.

**Connecticut Sea Grant Elucidates Impact of Oyster Depuration Gear on Eelgrass:** The impact of aquaculture on essential habitats, especially in view of the coast-wide decline of eelgrass beds, is an emerging concern. Eelgrass beds provide critical ecological functions; however, there are many sources of impact which have caused cumulative damage to the

resource. In many areas, bivalve aquaculture coexists with eelgrass, and the gear provides essential habitat and refuge for estuarine fish and invertebrates. Cultured bivalves also have the potential to alleviate eutrophication by converting phytoplankton blooms into biomass, which is then removed and marketed. However, there is also potential for local negative gear impacts, from uprooting, scouring, shading and increased organic deposition. Due to the increasing loss of eelgrass, significant attention has been focused on investigating potential impacts to the resource, and determining methods to minimize these impacts without affecting economic growth.

**Impact:**

- The results of the habitat study will enable researchers, extension specialists, and resource managers to place the potential impacts from aquaculture in perspective with other anthropogenic impacts, providing critical information that can be used in the development of an eelgrass management plan for Connecticut.
- The results will assist managers in balancing the needs of economic development with sustainable use of existing resources.
- USDA Natural Resources Conservation Service has partnered with Sea Grant to develop best management practices for the industry and is developing an incentive plan to help conserve threatened marine resources.

**Connecticut Sea Grant Promotes Integrated Coastal Management:** To address the need for improved scientific communication and to equip policy makers to use sound science in coastal resource management decision-making, the Coastal Studies Consortium (CSC), comprising the University of Connecticut (UConn), the Universidade Federal da Paraiba (UFPB), California State University, Fullerton (CSUF), and the Universidade Federal Fluminense (UFF), developed an international coastal management concentration to enhance a range of majors from coastal studies to natural resources management, ecology, and development studies. This unique program provides students with the scientific background and the essential interdisciplinary skills required to effectively communicate science in policy forums. Through formal courses and research opportunities offered by participant campuses, students acquire a scientific understanding of the processes and ramifications of resource degradation while developing both an understanding of the socioeconomic issues involved in coastal management and the skills needed to bring science to the decision-making table in efforts to develop sound coastal resource policies.

In the Fall semester 2006, Robert Pomeroy taught a course in Integrated Coastal Management (ICM) for four Brazilian undergraduate exchange students who were here as part of the Sustainable Coastal Resource Management program funded by the US Department of Education. The purpose of this course was to explore the theory and practice of ICM; to introduce students to the major concepts, processes, tools and methods involved in ICM; and to analyze United States and international prescriptions on ICM. The students were exposed to a range of ICM concepts, processes, tools and practices.

**Impact:**

- The four students are now able to integrate marine science with policy-related knowledge and skills, and to contribute to the formulation of sound international and national environmental policies and protocols.
- A cohort of coastal resources specialists with expertise on the U.S. and Brazil and the language proficiency necessary to collaborate on future projects was created.
- A collaborative research program on Brazilian and US marine and coastal resources has expanded.

**Connecticut Sea Grant Creates Tool to Assess Marine Protected Area Management Effectiveness:** Broad expectations have been placed on marine protected areas (MPAs) to protect marine biodiversity and ecosystem function, to reduce poverty, and to provide for healthier coastal communities with a strong foundation for economic growth. MPAs are severely challenged in achieving their objectives, for example, insufficient financial and technical resources, lack of trained staff, or lack of data for management decisions. Performance evaluation plays a critical role in providing for and demonstrating long-term positive impacts on biodiversity and the human communities that depend on these resources. Management effectiveness is the degree to which a protected area is used to achieve its goals and objectives. Assessing management effectiveness is a way to document how the management of a protected area influences its success. Evaluating management effectiveness should ultimately lead to improved project planning, accountability, and adaptive management.

**Impact:**

- IUCN World Commission on Protected Areas (WCPA) Marine and the World Wide Fund for Nature (WWF) are collaborating to improve the management of marine protected areas (MPAs) by providing managers, planners and other decision-makers with methods for assessing the effectiveness of MPA sites.
- The handbook, *How is Your MPA Doing?* (Pomeroy et al 2004), aims to enhance the capability for adaptive management in MPAs. It has been translated into Spanish, French, Italian and Chinese, and parts of the book have been translated into seven other languages.
- This book is the international standard for undertaking MPA management effectiveness analysis.
- NOAA, through its International Coral Grant Program and International Program Office, has established an international grants program to fund regional activities at coral MPA sites that are building an adaptive management and evaluation program, and will conduct an assessment of management effectiveness, using the “How is your MPA Doing?” handbook, in order to strengthen and achieve the site goals and objectives. The Management Effectiveness category will emphasize regional capacity building in the WCPA-Marine/WWF methodology. <http://international.nos.noaa.gov/coralgrants.html>
- Marine protected areas around the world are improving their capability to undertake adaptive management through a guidebook on management effectiveness and support from the US government.

**Connecticut Sea Grant Promotes Safe Processing of Seafood:** CTSG extension, in partnership with RI Sea Grant / Cooperative Extension and state and federal agencies, regularly offers seafood and shellfish HACCP training, enabling seafood and shellfish businesses in southern New England to remain in compliance with FDA-mandated training. A regional training partnership was established to (1) ensure that industry members in southern New England have access to required training courses on a regular basis; (2) engage instructors from state and federal regulatory environments to broaden perspective and expertise available to course participants; (3) provide pertinent, timely HACCP and food safety-related information post-training through print/electronic newsletters; and (4) share responsibility for organizing/teaching the courses.

**Impact:**

- 47 seafood processors, importers, and dealers received HACCP training in the past year, enabling them to remain in business and bringing the total trained since 1997 to almost 700 individuals. 127 CT seafood-related businesses ranging in size from <\$100,000 per year to >\$10 million in gross income per year, and employing 1-100+ employees, benefit from the training.
- Availability of local training courses and modest registration fees reduce costs associated with meeting training requirement. Reduced costs allow southern New England businesses to train 2-3 employees and often more, easing HACCP program implementation, improving company efficiency and profitability, and ensuring greater safety for seafood consumers.
- FDA inspection data comparing results of all domestic HACCP inspections versus New England-based inspections indicate percent compliance in key areas by New England firms is equal to or better than the national percent compliance. The percent of New England-based seafood processors complying with key sanitation areas is significantly higher.
- 22 senior high school students from two vocational high schools were trained in the principles of HACCP as a “School to Career” training opportunity. 3 of 83 HACCP-trained students currently known to be employed by CT seafood wholesalers and shellfishermen; one is responsible for implementing the company’s HACCP program.
- One issue of *Seafood Safety Savvy: A HACCP Update* was mailed to approximately 650 individuals and businesses in 2005-2006. Ongoing Sea Grant communication enables HACCP-trained individuals to keep their training current, and provides a means for alerting them to changes in regulations, etc.

**Connecticut Sea Grant Partners Develop CT Aquatic Nuisance Species (ANS) Management Plan:** Addressing aquatic plants, freshwater vertebrates and invertebrates, and marine species, the plan implements a coordinated approach to minimizing the ecological, socioeconomic and public health impacts of ANS in the State of Connecticut, and coordinates myriad research, educational, monitoring, and regulatory efforts that currently exist to focus on commonly-identified priorities, strategies, and tasks. The plan, drafted in concert with CT DEP and CT Institute of Water Resources, with input from numerous stakeholders, was signed by the

Commissioner of DEP and Governor M. Jodi Rell in March 2007. It subsequently was approved by the federal ANS Task Force in May 2007.

**Impact:**

- Connecticut now has a blueprint for management, research, and outreach that outlines priority goals, objectives and actions for a five-year period. As the plan is implemented, CT will benefit from a comprehensive and coordinated approach to address early detection and monitoring, rapid-response, control and eradication, spread prevention, and policy / legislative needs with respect to aquatic nuisance species in a timely manner. Coupled with appropriate research to address local/regional problems and educational programs targeted at a range of audiences to raise awareness of the issue, the result should be more efficient use of available resources to address priority ANS problems in CT, better coordination among involved parties, and a greater awareness of the problems ANS cause locally, nationally, and globally.
- Analyses produced for ten marine species of concern informed an evaluation of the potential risk to Long Island Sound if they were to be successfully introduced.
- Marine ANS priorities are being addressed comprehensively in an interstate management plan for Long Island Sound, currently in development.

**NEMO Provides New On-line Mapping Resource for Connecticut Communities:** The protection and improvement of water quality is directly linked to land use. The goal of the NEMO program is to help towns develop effective land use practices that will protect their water resources now and into the future. The development of these practices requires careful planning and specific knowledge of local natural and cultural resources. To date, the development of a geographic “database” of these resources required specific technical knowledge of GIS software and data – a skill many towns do not possess and cannot afford. NEMO and CT DEP through the FY05 319 funds developed the Community Resource Inventory (CRI) On-line to help bridge the gap between the GIS haves and have-nots.

- The CRI Online provides mapping resources, tutorials, examples and other resources that will assist local decision-makers get started with natural resource-based planning. By working through the website, towns will be able to develop a basic inventory of their towns natural and cultural resources and from this base data, build a meaningful plan to protect water resources and chart the future of their communities. The CRI Online website is accessible from the Tools and Resources section of the NEMO website (<http://nemo.uconn.edu/tools.htm>).
- Between January – May 2007 the website has been viewed over 2,300 times.

**Coastal Towns Participate in NEMO’s Municipal Initiative:** The “Municipal Initiative “is a unique program developed in collaboration with the CT Department of Environmental Protection, that allows the NEMO Team to focus more resources on a few municipalities, establishing relationships between the program and these towns from the initial educational workshop through implementation of on-the-ground changes. Because of the time commitment required for this program, the NEMO Team can only focus on a few towns per year, however,

the chosen towns then serve as case studies and examples to other towns in Connecticut. Selected towns must designate a contact person for the initiative who will be responsible for facilitating communication both between the program and the town, and among various commissions within the town. In addition, a NEMO Task Force must be established whose membership includes, at a minimum, members of the following commissions or boards: planning, zoning, inland wetlands, conservation and the office of the chief elected official (town council; board of selectmen, mayor's office). Other groups, such as town departments, land trusts and economic development commissions are also encouraged to participate.

**Impact:**

The Municipal Initiative, now in its six year, has paid considerable dividends in the form of changes to local land use plans, policies, practices and procedures catalyzed by NEMO educational programs. As part of the Sea Grant CCDP, the Municipal Initiative has included several coastal towns.

***North Stonington***

- The chairman of the Planning and Zoning Department initiated North Stonington's effort. They set many ambitious goals, including the development of a resource inventory to inform an open space plan, regulation updates and a better understanding of the roles of boards and commissions. The NEMO team met with the task force and designed an educational workshop schedule that took place over several months. Over the education period, over 10 workshops were given ranging in topics from roles and responsibilities of commissions, to low impact development and open space planning.
- As a consequence of these workshops, the town started assembling a resource inventory. This set of maps, which also include an exhaustive inventory of open space parcels and easements, will become the basis of the open space plan, which as of May 2007 is still under development. The town also had significant interest in low impact development techniques and innovative stormwater management.
- Early in the process, the Planning and Zoning Commission adopted a stormwater management regulation with the purpose to protect and preserve the resources within the town by managing stormwater flows in accordance with CT DEP's Stormwater Quality Manual. The regulation addresses both stormwater flow and volume and is triggered for any site plan or subdivision that disturbs over 1-acre of land. Currently the town is reviewing its regulations to begin to require low impact development techniques as part of the overall stormwater management process in new development or re-developments. The town is specifically looking to address road standards and parking requirements.

***Waterford***

- The town of Waterford has had a long relationship with the NEMO program, being one of the pilot towns for the program back in the mid-1990's. The home of the "Jordan Cove Project," an EPA National Monitoring Water Quality Project, Waterford is familiar with innovative water quality techniques. Despite this knowledge, the town has not yet adopted regulations that mandate the use of LID and innovative stormwater management.

- Waterford's town planner contacted the NEMO team in late 2006 to see if they could join the Municipal Initiative. Upon meeting with key town staff, it was decided to adopt a modified process because of the large town staff. The NEMO team is using a "roundtable" process, where NEMO will hold a series of meetings with a task force consisting of Waterford's planning and engineering staff, public works and public safety. Working with this group through the summer of 2007, the group will identify key sections of the town's plan and regulations that need to be changed to encourage and/or mandate key LID techniques. The town will also look at elements related to commercial development and buffer protection. NEMO will then do a series of educational programs in the fall of 2007.

**Long-term Jordan Cove Urban Watershed Project Yields Results:** The NEMO team is working on the completion of a multimedia CD-ROM and website that details the study design and results of the Jordan Cove Urban Watershed National Monitoring Project. The Jordan Cove project was a ten year study in Waterford, Connecticut designed to determine the water quantity and quality benefits through the development of an urban subdivision using pollution prevention best management practices (BMPs). The project was funded, in part, through the Connecticut Department of Environmental Protection (CT DEP) by the U.S. Environmental Protection Agency's (EPA) Section 319 program. The CD is scheduled for completion in June, 2007.

- The Jordan Cove project used the paired watershed study design. Stormwater runoff from three watersheds, a control, a traditionally developed subdivision, and a low impact development (LID) subdivision, were monitored for ten years (see an aerial view of the watersheds here). Each development was monitored before, during and after construction. Monitoring included runoff volume measurement and water quality sampling.
- A variety of BMPs were employed in the LID subdivision, including grass swales, rain gardens, a bioretention area in the cul-de-sac, a pervious roadway, several pervious driveways, a cluster layout with shared driveways, low-mow areas, and homeowner education. Results from this one-of-a-kind study have significantly supported the use of these practices in protecting water resources.

**Connecticut Sea Grant Creates Tool for Socioeconomic Assessment and Monitoring for Coastal Management:** Coastal management is about managing people, not fish" is an increasingly common phrase in the marine conservation community as managers recognize the importance of understanding and incorporating community conditions into the management process. Information on the social, cultural and economic foundation of communities that rely on coastal resources is as critical as understanding the behavior, migration patterns and habitat requirements of the marine ecosystems. In contrast to the acknowledged need for greater socioeconomic information of coastal communities, little exists in comparison with biophysical information. Moreover, there is relatively limited understanding of how to develop a socioeconomic monitoring program. Recognizing this need for clear, concise guidance on how to monitor socioeconomic conditions for the benefit of coastal management, the U.S. National Oceanic and Atmospheric Administration (NOAA), in collaboration with the Global Coral Reef

Monitoring Network, coordinates the Global Socioeconomic Monitoring Initiative for Coastal Management (SocMon). The goal of this initiative is to help coastal managers better understand and incorporate the socioeconomic context into coastal management programs. This initiative is being implemented at the global and regional levels. CTSG extension staff have been central to the develop of this initiative and the accomplishments to date.

**Impact:**

- **Publication of the Socioeconomic Manual for Coral Reef Management**  
A tool to help coral reef managers better assess and manage the human communities that use and depend on coral reefs (published in November 2000). The manual provides practical, step-by-step guidelines on how to conduct socioeconomic assessments of reef stakeholders, including: preparatory activities; planning and reconnaissance; field data collection; and, data analysis. The manual was written for reef managers in developing countries to assist them in conducting socioeconomic assessments and developing monitoring programs in their communities.
- **Publication of Region-Specific Socioeconomic Monitoring Guidelines.**  
SocMon Caribbean (October 2003), SocMon Southeast Asia (March 2003), and SocMon Western Indian Ocean (April 2006) were developed to compliment the GCRMN Socioeconomic Manual for Coral Reef Management by providing more standardized guidelines on how to conduct socioeconomic monitoring specific to each region. SocMon SEA has been translated into Vietnamese, SocMon Caribbean has been translated into Spanish, and SocMon Western Indian Ocean has been translated into Swahili, French, and Portuguese. A new guideline for the Pacific is being prepared.
- **Regional and National Training Workshops.**  
Workshops have been conducted around the world to help reef managers incorporate socioeconomic assessments and monitoring into their reef management programs.
- **Site Monitoring**  
Funding has been provided through the NOAA Coral Grants program and the NOAA SocMon seed funding program to enable over 30 sites around the world in the Caribbean, Western Indian Ocean, South Asia, and Southeast Asia, and Pacific to assess and incorporate socioeconomics into management actions.

**Connecticut Sea Grant Provides Information Necessary for the Planning of Dam Removal and Restoration of Fish Passage:** CTSG funded a research effort that collected and analyzed sediment samples for metals from the impoundment behind the Raymond Brook dam located in the town of Hebron, Connecticut. Raymond Brook is a tributary to the Salmon River, an area targeted for Atlantic salmon restoration efforts by partnering groups including the CT DEP, The Nature Conservancy, the Silvio O. Conte National Fish and Wildlife Refuge, and the University of Connecticut. This study was performed as part of the process of decommissioning the dam and opening the area to anadromous fish passage.

**Connecticut Sea Grant Traces the Spread & Impacts of the Non-indigenous Rhodophycean Alga, *Grateloupia turuturu*, in Long Island Sound:** Results of this ongoing research project will form a dataset useful for predicting the extent and rate of spread of Non-indigenous Rhodophycean Alga, *Grateloupia turuturu*, in Long Island Sound, as well as the ecological impacts of this invasive species at several trophic levels. This information is of acute interest to



invasion biologists, but also has application in the realm of resource management. For example, *Grateloupia* can create dense stands that, like *Undaria*, may interfere with filter feeding bivalves that form the basis for an important aquaculture sector. Further, as potential fouling organisms, *Grateloupia* may settle on fishing lines, bivalve aquaculture systems, and perhaps on the bivalves themselves. This makes prediction of the eventual *Grateloupia* distribution important from the standpoint of allocating future funds in support of bivalve-based aquaculture projects.

**Connecticut Sea Grant Investigates Sources, Impacts and Remediation of Mercury in Long Island Sound:** CTSG researchers investigated mercury levels in cores of sediments from tributaries in western Connecticut. Today, extremely high levels of mercury remain in the nearby soil and river sediments, and bio-accumulates in the food chain.

**Impact:**

- The City of Danbury, CT contracted with UConn for a follow-up risk assessment of the mercury levels in Danbury. Data has been shared with CT DEP. Public lectures, flyers, news articles, and signs are used to alert local residents about behaviors associated with higher risk of mercury exposure (e.g., consumption of fish caught in local waters).
- Remote sensing of contaminated areas is being used experimentally to outline areas where plant reflectance spectra indicate the underlying soil is mercury-contaminated.
- With EPA-funded scientists, CTSG researchers are using genetically-modified cottonwood plants for phytoremediation (extractions) of soils with high mercury concentration.
- This research provides new insights into the mechanisms of Hg transport in watersheds with sites with “old Hg point sources” – Hg-contaminated sediment mobilization during wet periods and extraction of Hg from upland sites into plants with subsequent transport of plant debris to rivers and then into LIS.
- The research establishes a preliminary Hg budget for LIS
- The research has found other sources of Hg to LIS near New York, as yet unclear in origin.
- The research has established that phytoremediation of Hg-contaminated sites with genetically modified cottonwood plants is probably not very efficient. The town of Danbury probably will not continue the attempts at phytoremediation of the Hg-contaminated sites as a result of these findings.
- Towns/counties/state use our data on Hg ‘hot spots’ for considerations of dredged sediment disposal
- This work provides insights into the global cycling of Hg through plant uptake followed by leaf decay and re-release of Hg to the atmosphere.

**Connecticut Sea Grant Identifies Potential Role of Endocrine Disruptors in Lobster Shell Disease:** CTSG sponsored research has contributed to the understanding how environmental stressors, shell wounding, wound healing, and shell disease (SD) affect the endocrine system in lobsters and how hormones and alkylphenols, known endocrine disruptors, are involved in the

regulation of disease, and of the wound-healing process. This enhances our understanding of the lobster's natural defenses in warding off stressors such as SD. Among key findings are that Alkylphenols— endocrine disrupting, anthropogenic compounds—are found in both greater frequency and in higher concentrations in lobsters with SD. The data suggest strongly, through several lines of evidence that alkylphenols interfere with shell hardening (tanning and sclerotization), and may render lobsters more susceptible to microbial invasion (although the latter hypothesis is subject to future testing).

**Connecticut Sea Grant Explores Patterns and Causes of Area-Sensitivity in Salt Marsh Birds:** This CTSG sponsored study investigates potential causes of area-sensitivity in saltmarsh breeding birds, so as to provide prescriptions for enhancing bird protection in Connecticut's limited saltmarsh habitats. Teasing apart the potential mechanisms that could account for observed patterns of area-sensitivity in salt marsh birds is a prerequisite for devising management actions that will increase use of small marshes. This work both broadens our knowledge of area-sensitivity to an additional habitat and highlights the multifaceted nature of the problem by testing multiple explanations within the same system. Analyses suggest that many of the explanations for area-sensitive occurrence patterns in other systems are not supported by data from Connecticut salt marshes. If this result holds true in further testing, it would suggest both that salt marshes differ from those systems in which most area sensitivity studies have occurred (primarily forests, and to some extent grasslands), and that an understanding of the phenomenon in other systems may be more complex than has been thought.

**Connecticut Sea Grant Explores an Oligotrich Ciliate as a New Food Organism for Marine Aquaculture:** This project provides information about a marine planktonic ciliate, *Strombidium stylifer*, that might be useful as a first food in some aquaculture applications. Results indicate that the organism is distributed widely around the world, easy to isolate from tide pools, grows rapidly and efficiently on low food levels, and has a favorable nutritional profile. Based on conversations with aquaculturists, this ciliate would most likely find a use in cultivation of fish larvae such as red snapper (*Lutjanus campechanus*), which have a small gape at first feeding.

**Connecticut Sea Grant Evaluates the Importance of Ship Hull Fouling as a Vector for the Transport of Invasive Species along the Eastern Seaboard:** Vessel hull fouling is recognized as a primary transport vector of many marine invaders and privately-owned vessel hulls represent an important transport vector along the eastern seaboard. This ongoing work seeks to identify the extent of annual movements of non-native species along the eastern seaboard via privately-owned craft and evaluate protocols to reduce the transport of these species. Preliminary analysis indicates the species fouling the vessel hull were generally correlated with the fouling fauna found where the vessel was moored in its winter port. Several vessels arriving in Mystic, CT and Newport, RI from the Ft. Lauderdale area had extensive fouling of non-native species. Many of these species appeared to be stressed or moribund. While present sample size is relatively small, our hull fouling surveys also suggest that vessels traveling northward and spending more time in brackish water conditions (e.g., upper Chesapeake Bay) were less fouled than vessels which transited in more open water conditions.

**Connecticut Sea Grant Quantifies the Threat of Invasive Species to Commercially-Important Shellfish:** Preliminary experimental results suggest that the colonial ascidian,

*Didemnum* sp. had no significant effects on the survival of oysters, scallops and mussels. Scallop growth was negatively affected by an increasing amount of *Didemnum* overgrowth. Findings from a survey of shellfish growers, however, show that biofouling is a major problem in most regions where commercial culture occurs. A wide range of control methods are utilized, many of which involve large amounts of labor and fuel to implement. The control of biofouling accounts for a large percentage of the total annual operating costs for these businesses, with some reporting that biofouling control is their largest cost. Methods to control biofouling and mitigate the costs associated with biofouling are in high demand by the survey respondents.

**Connecticut Sea Grant Assesses Sumithrin Toxicity in the American Lobster:** CTSG provided support for the research project “Sumithrin toxicity in the American lobster (*Homarus americanus*) upon experimental exposure” conducted by Milton Levin and Sylvain De Guise at the University of Connecticut, and Bruce Brownawell at Stony Brook University in New York. The conclusion of the work was that sumithrin degrades rapidly in salt water and does not exert significant toxicity in lobsters (it neither killed lobsters nor induced immunotoxicity) at the concentrations tested. Therefore it is unlikely that sumithrin contributed to the 1999 lobster resource disaster in Long Island Sound.

**Connecticut Sea Grant Quantifies Non-Market Economic Value of Land Preservation in the Coastal Zone:** CTSG staff conducted a choice experiment survey which assessed the amount that Connecticut residents would be willing to pay in taxes and fees to preserve farm or forest land in Connecticut, including coastal communities. Results quantify the value that Connecticut residents have for different types of farm and forest preservation. Results indicate that the value of farm and forest preservation can be substantial, and can vary widely depending on the kind of land under consideration, the method used to prevent development, and the risk of future development on unpreserved parcels. Based on model results, the average statewide value *per acre of preserved farm or forest* in Connecticut is \$6,595 per year, or \$109,914 in total capitalized value. This value reflects the benefits that Connecticut residents derive from the preservation of undeveloped land. These values are not captured in prices paid for farm and forest land in market transactions. As a result, market prices underestimate the true value of farm and forest to Connecticut residents.

**Connecticut Sea Grant Develops Model to Quantify Non-Market Economic Benefits of Surface Water Improvements:** Drawing from studies conducted nationwide and in coordination with public and private partners, CTSG staff have developed a meta-analytic model that allows forecasting of the economic value of water quality improvements in aquatic habitats. The model is particularly useful for benefit transfer, or the approximation of local economic values for sites in which primary research studies have not been conducted. Results show significant non-market values associated with aquatic habitat improvements, and provide a simple method to approximate economic values in a wide range of policy contexts.

**Connecticut Sea Grant Assesses the Spread of a New Aquatic Invasive Species While Teaching the Next Generation of Scientists:** CTSG has sponsored research to study the spread of the aquatic invasive sea squirt *Didemnum* in Long Island Sound, in collaboration with the National Undersea Research Center for the North Atlantic and Great Lakes, using remotely

operated vehicles. Live stream from the ROV was transmitted directly to schools, with narration by expert scientists and interactive on-line questions from students.

**Connecticut Sea Grant Helps Discover Relationships between Toxins and Dolphin Health:** CTSG director Sylvain De Guise participated in the health assessment of wild populations of bottlenose dolphins along the Atlantic and Gulf of Mexico coasts, performing immune function measurements. One of the populations had suffered from repeated exposure to brevetoxin, a biotoxin released from harmful algal blooms. The results of immune testing showed abnormalities in this population, which also exhibited high counts of eosinophils in their blood. This work, done in partnership with NOAA scientists, will help identify possible relationships between exposure to biotoxins, high eosinophil counts and abnormal immune functions.

**Connecticut Sea Grant Connects Teachers to Marine Science through Research Experiences and Regional Professional Development Institutes:** The CTSG education coordinator, in partnership with the UConn-based NOAA National Undersea Research Center (NURC) and the NOAA Office of Ocean Exploration (OE), has been innovatively connecting educators with scientific and educational research communities through participation in research cruises and access to information generated through these cruises. This award-winning, richly diverse set of educational opportunities and products enhances ocean science literacy among teachers and students. The CTSG education coordinator served as the education and outreach coordinator on six cruises off the east coast of the U.S., responsible for incorporating educational components into the research cruises.

**Connecticut Sea Grant Identifies the Impacts of Teacher Research Experiences in Marine Science:** A Teacher Research Experience (TRE) can offer a sustained relationship with scientists over a prolonged period of time, with scientists serving as role models and “coaches” for teachers – a practice that has been shown to dramatically increase the transfer of knowledge, skill, and application to the classroom. Presently, the educational research is limited regarding the impact of a TRE, and much of the data is anecdotal. The CTSG education coordinator, as a part of her dissertation research at The University of Connecticut’s Neag School of Education, identified the effects of TRE on participating teachers. Results indicate that a change in beliefs about science and scientists occurred for all participating teachers, and that the teachers’ beliefs about science teaching were affected in a variety of ways after participating in the TRE. Additional results identified valuable components of the TRE as identified by participants, including the advanced resources (e.g., samples, DVD, data), a feeling of rejuvenation in teaching, a new perspective on science and scientific research, and first-hand experiences in science.

**Connecticut Sea Grant Resources Enhance Learning:** CTSG develops a variety of educational products to meet the learning needs of its myriad clientele. Materials cover topics ranging from invasive species to lobsters, aquaculture to fisheries, seafood safety to seaweeds. Many materials are provided to Connecticut teachers and/or schools free of charge, and are utilized by educators with The Maritime Aquarium in Norwalk, Mystic Aquarium & Institute for Exploration, Soundwaters, Project Oceanology, Schooner Inc., and the Living Museum, among others, for programs, camps, and workshops offered to students and teachers throughout the region throughout the year.

**Connecticut Sea Grant Teaches the Teachers Regarding Marine Sciences:** The CTSG education coordinator spearheads the Long Island Sound Mentor Teacher program, which seeks to better integrate Long Island Sound and marine sciences topics into K-12 curricula statewide. Since its inception in 2002 with funding from the US EPA LISS, the 17 mentor teachers have held nine professional development workshops, reaching 111 educators and through them, more than 5,445 students. The program has reached teachers and students in 33 Connecticut towns, including some of Connecticut's poorest and most underserved.

## SECTION III PERFORMANCE MEASURES

**Measure 1: Return on investment from the discovery and application of new sustainable coastal, ocean, and Great Lakes products.**

### Summarized Metrics

Metric	2006 Outcome	2007-2008 Anticipated
<b>Private Companies Assisted</b>	36	42
<b>Jobs Created</b>	3 Verified. Data not available to estimate full number.	Data not available to estimate.
<b>Revenues Generated</b>	~\$100,000 verified	~\$100,000 verified

### Source of Reported Outcomes

*Project A/E-1 (N. Balcom)*

A 1995 NOAA Fishing Industry Grant awarded to a fishing family in Stonington Connecticut resulted in the discovery of deep sea royal red shrimp, *Pleoticus robustus*, in sufficient quantities to support a seasonal, part-time fishery. Over ten years, the fishery has provided income to 1-4 Connecticut fishing families annually, enabling them to diversify their fishing effort. The shrimp average \$3.5/lb ex-vessel but are sold retail for \$10-15 per pound. The local market name is “Stonington Reds”. Companies Assisted 2006: 2 Anticipated Companies Assisted 2007-2008: 2. Jobs and Revenues Created: < 1job per year; over 12 years, 170,000 pounds landed with ex-vessel value of \$881K

*Project: A/E-1 (N. Balcom)*

Trained 47 members of the seafood industry in the principles of basic seafood or shellfish HACCP so that they can meet FDA regulatory training requirements and remain in business as seafood processors (in cooperation with RI Sea Grant). Companies Assisted 2006: 34. Anticipated Companies Assisted 2007-2008: 40. Jobs and Revenues Created: Unknown.

*Project: A/E-1 (N. Balcom)*

Trained 22 high school seniors in the principles of basic seafood or shellfish HACCP to enable them to obtain a marketable skill by meeting the FDA regulatory training requirements for seafood processors, as part of CTSG’s School-to-Career partnership with local regional vocational-agriculture and vocational technical high schools. Students trained 2006: 22. Anticipated high school seniors trained 2007-2008: 26. Jobs and Revenues Created: 3 students have been hired by industry members in Connecticut; 1 is in charge of implementing the company’s HACCP plan.

**Measure 3: Percentage/number of tools, technologies, and information services used by NOAA partners/customers to improve ecosystem-based management.**

**Summarized Metrics**

<b>Metric</b>	<b>2006 Outcome</b>	<b>2007-2008 Anticipated</b>
<b>Number of Tools, Technologies, and Information Services</b>	46	40

**Source of Reported Outcomes**

*Project: A/E-1(Pomeroy)*

Fisheries Co-management: A Practical Handbook, was authored by Dr. Pomeroy and published by CAB International Publishing in 2004. The manual, which describes methods of community-based co-management for use by fisheries specialists, and initiators and facilitators of co-management including government, non-governmental organizations, community members, and practitioners, has now been translated fully into 4 languages (Spanish, French, Italian, and Chinese) and sections of the manual have been translated into 7 other languages. This manual has become the international standard for undertaking MPA management effectiveness analysis. NOAA through its International Coral Grant program has established an international grants program to fund regional activities at coral MPA sites that are utilizing this manual. Tools 2006: 11. Additional Tools Anticipated 2007-2008: 0.

*Project: A/E-31 (N. Balcom)*

The State of Connecticut Aquatic Nuisance Species (ANS) Management Plan was formally adopted by the State of Connecticut, and approved by the federal ANS Task Force. The plan will guide a coordinated approach to minimizing the ecological, socioeconomic and public health impacts of aquatic invasive species in Connecticut waters. Tools 2006: 1. Additional Tools Anticipated 2007-2008: 1.

*Project: A/E-1 (N. Balcom)*

Working with the EPA Long Island Sound Office and building off the CT ANS Management Plan and the State of New York's Invasive Species Plan, a CT-NY framework will be developed to jointly address the protection of Long Island Sound's biodiversity, key commercial species, and marine and coastal habitats from the impacts of introduced aquatic species. Tools 2006: 0. Additional Tools Anticipated 2007-2008: 1.

*Project: A/E-1 (N. Balcom)*

CTSG is collaborating with several Northeast Sea Grant partners to develop and distribute outreach and educational materials regarding vectors for aquatic invasive species introductions, including 1) *non-shipping vectors*, e.g., marine bait industry, live and fresh seafood industry, recreational divers, and related activities; and 2) *vessel-related vectors*, e.g., fouled hulls of recreational boats and ballast water, to appropriate audiences. Tools 2006: 0. Additional Tools Anticipated 2007-2008: 2.

*Project: A/E-1 (N. Balcom)*

Five (5) state public health inspectors were trained in the principles of basic seafood or shellfish HACCP (in cooperation with RI Sea Grant). Tools 2006: 1. Additional Tools Anticipated 2007-2008: 1.

*Project: A/E-1 (N. Balcom) / E/T-11 (D. Payne) / M/CP-1 (Van Patten)*

A CD-ROM containing educational resources about Long Island Sound facts, habitats, flora and fauna was produced for middle and high school teachers, including a Powerpoint presentation that compliments the print version of *Living Treasures; the Plants and Animals of Long Island Sound*, an image library, and a PDF of the popular CTSG publication *SoundFacts*. Funding from EPA LISS allowed this CD-ROM to be produced and distributed to educators in Connecticut and New York. A Long Island Sound resource guide with classroom activities aligned to state educational frameworks is in development. Tools 2006: 1. Additional Tools Anticipated 2007-2008: 1.

*Project: A/E -18 NEMO/Coastal Community Development (Rozum)*

CTSG will provide geospatial and science-based information about land use impacts on water quality and coastal resources for coastal communities and their land use decision makers, and assist selected coastal communities in their efforts to incorporate planning and policy tools into their regulations for coastal resource protection. Tools developed include workshops and materials explaining how coastal communities can utilize geospatial information in the management of coastal resources, and an updated and improved state-of-the-art companion website, Community Resource Inventory (CRI) On-line <http://nemo.uconn.edu/tools.htm> that provides users on-line access to the geospatial data. Tools 2006: 2. Additional Tools Anticipated 2007-2008: 2.

*Project: A/E -18 NEMO/Coastal Community Development (Rozum)*

CTSG will partner with the CTDEP Office of Long Island Sound Programs in prioritizing coastal properties for public access and open space preservation, by conducting land cover and land cover change analysis of immediate coastal zones (“coastal boundary”) and combining land cover information with parcels, ownership, and other data to identify areas of special interest with regard to shoreline open space/public access. Tools 2006: 0. Additional Tools Anticipated 2007-2008: 1.

*Project: A/E -18 NEMO/Coastal Community Development (Rozum)*

CTSG introduced Connecticut coastal communities to a new technical stormwater resource, the CT Stormwater Quality Manual, produced by the CT Department of Environmental Protection, and promoted adoption by coastal land use decision makers of the manual’s recommended stormwater control techniques. Tools 2006: 1. Additional Tools Anticipated 2007-2008: 0.

*Project: A/E -18 NEMO/Coastal Community Development (Rozum)*

In 2006 the NEMO team created the Low Impact Development (LID) Database to provide key case studies related to innovative stormwater management techniques to help address concerns by local communities about making changes to land development and



land use policy. The website <http://clear.uconn.edu/tools/lid/index.htm>, developed for development professionals and local land use decision makers, provides case studies on the panoply of LID techniques that have been developed, such as bioretention areas, permeable pavements, and vegetated roofs. Tools 2006: 1. Additional Tools Anticipated 2007-2008: 1.

*Project: A/E -18 NEMO/Coastal Community Development (Rozum)*

CTSG is collaborating in conducting a 20-year land cover analysis of riparian areas in Connecticut's coastal zone, and investigating the use of high resolution remote sensing imagery in providing detailed riparian area land cover/land use information for coastal managers and municipalities. The information on riparian land cover/land cover change will be provided to coastal municipalities and others via the NEMO "Focus on the Coast" web site. Tools 2006: 0. Additional Tools Anticipated 2007-2008: 3.

*Project: A/E -18 NEMO/Coastal Community Development (Rozum)*

CTSG staff are working with the CTDEP Bureau of Water Protection and Land Reuse to investigate the relationship of watershed impervious surface to the health of aquatic invertebrates, a common indicator of overall stream quality. The work is providing the scientific foundation for CTDEP's new, nationally precedent-setting approach to implementing the *total maximum daily load* (TMDL) water regulation program. Tools 2006: 0. Additional Tools Anticipated 2007-2008: 1.

*Project: A/E -18 NEMO/Coastal Community Development (Rozum)*

the NEMO "Focus on the Coast" web site provides a tool for users (coastal municipalities and others) to generate customized maps of riparian land cover/land cover change that are intended for use to improve the capacity for coastal management. Tools 2006: 1. Additional Tools Anticipated 2007-2008: 0.

*Project A/E – 1 (Pomeroy)*

Recognizing the need for clear, concise guidance on how to monitor socioeconomic conditions for the benefit of coastal management, the U.S. National Oceanic and Atmospheric Administration (NOAA), in collaboration with the Global Coral Reef Monitoring Network, coordinates the Global Socioeconomic Monitoring Initiative for Coastal Management (SocMon). The goal of this initiative is to help coastal managers better understand and incorporate the socioeconomic context into coastal management programs. This initiative is being implemented at the global and regional levels. CTSG extension staff has been central to the development of this initiative and the accomplishments to date, including two publications, workshops, and site monitoring. Tools 2006: 3. Additional Tools Anticipated 2007-2008: 0

*Project: E/T-11 ( D. Payne)*

The CTSG marine educator provided a program evaluation to the NURC NA & GL 2006 Aquanaut program. Tools 2006-07: 1. Additional Tools Anticipated 2007-08: 0.

*Project: E/T-11 ( D. Payne)*

Lesson plans and curricular resource materials will be developed by the six teachers who participated in the CanyBal cruise. Tools 2006-07: 2. Additional Tools Anticipated 2007-08: 4.

*Project: E/T-11 ( D. Payne)*

A doctoral dissertation will be completed by the CTSG marine educator. Data collected via pre and post CanyBal cruise classroom observations, student surveys and teacher journals from the CanyBal cruise comprise a major component of the data set. Tools 2006-07: 0. Additional Tools Anticipated 2007-08: 1.

*Project: E/T-11 ( D. Payne) / A/E-1 (Balcom)*

Twenty-seven formal and informal K-12 educators from the Northeast were trained about the status of AIS in their region and the roles people can play in preventing new introductions and further spread through a clear understanding of impacts and appropriate control measures. Tools 2006-07: 1. Additional Tools Anticipated 2007-2008: 0.

*Project: E/T-11 ( D. Payne) / A/E-1 (N. Balcom)*

The CTSG marine education specialist is engaging Connecticut teachers to develop, pilot and evaluate new AIS descriptions and online activities applicable to the Northeast for the IL-IN Sea Grant “Nab the Aquatic Invader” website, aligned with Connecticut and National content standards, and cross-cutting science, math, language arts, geography, and social studies. Tools 2006: 0. Additional Tools Anticipated 2007-2008: 1.

*Project: E/T-11 ( D. Payne) / A/E-1 (N. Balcom)*

Up to 85 formal and informal K-12 educators from the Northeast will be trained about the status of AIS in their region and the roles people can play in preventing new introductions and further spread through a clear understanding of impacts and appropriate control measures. Up to ten new web-based activities will be developed by participating teachers, offering interesting curriculum formats and encouraging critical thinking through problem-based learning scenarios. Tools 2006: 0. Additional Tools Anticipated 2007-2008: 1.

*Project: E/T-11 ( D. Payne) / A/E-1 (N. Balcom)*

The “Suspect Profile” section of the Nab the Aquatic Invader! site will include a new set of the “Top 10 Suspects” in the North Atlantic region. Profiles, or rap sheets, were written on 10 additional aquatic invaders including their characteristics, how they got here, their disruptive traits, and what is being done to control them. At least 1,500 Northeast students will learn how they can be stewards of their waterways through new online teacher-developed activities. Tools 2006: 1. Additional Tools Anticipated 2007-2008: 1.

*Project: E/T-11 ( D. Payne)*

Teachers in grades 5-8 attended a workshop to increase their awareness and understanding of the importance of Long Island Sound (LIS) and its watershed from teachers who already incorporate LIS into their curricula. Resources and connections to

CT Science Frameworks were included. Funded by EPA LISS, the workshops will continue in 2007. Tools 2006-07: 1. Additional Tools Anticipated 2007-2008: 3.

*Project: E/T-11 ( D. Payne)*

Teachers in grades 9-12 attended a workshop to increase their awareness and understanding of the importance of Long Island Sound (LIS) and its watershed from teachers who already incorporate LIS into their curricula. Resources and connections to CT Science Frameworks were included. Funded by EPA LISS, the workshops will continue in 2007. Tools 2006-07: 1. Additional Tools Anticipated 2007-2008: 1.

*Project: E/T-11 ( D. Payne)*

CTSG marine educator helped facilitate the annual Southeastern New England Marine Educators conference in October 2006 at Project Oceanology in Groton, CT. The conference attracts participants from Connecticut and Rhode Island. Tools 2006-07: 1. Additional Tools Anticipated 2007-2008: 1.

*Project: E/T-11 ( D. Payne)*

Funding from EPA LISS helped facilitate the biennial Long Island Sound educators conference in March 2006 at The Maritime Aquarium in Norwalk, CT. The conference attracted 193 participants from Connecticut and New York. Funding from EPA LISS will help facilitate the biennial Long Island Sound educators conference in March 2008 at The Maritime Aquarium in Norwalk, CT. Tools 2006-07: 1. Additional Tools Anticipated 2007-2008: 1

*Project: M/PA-1 (R. Johnston)*

CTSG Associate Director Johnston, in coordination with partners from the University of Delaware, developed a matrix of open space values to enable managers to assess the economic value of different types of farm and forest conservation in coastal areas of Delaware and Connecticut. These tools are currently under use by non-profit organizations and government representatives in both states.

Tools 2006-07: 4. Additional Tools Anticipated 2007-2008: 4

*Project: M/PA-1 (R. Johnston)*

CTSG Associate Director Johnston, in coordination with partners from the Gulf of Maine Research Institute and the University of California, Davis, is developing a guidance document for the Massachusetts Ocean Partnership Fund, illustrating the appropriate use of economics to guide ecosystem based management in Massachusetts.

Tools 2006-07: 0. Additional Tools Anticipated 2007-2008: 1

*Project: R/ER-22 (J. Varekamp)*

Research of PI Varekamp established that phytoremediation of Hg-contaminated sites with genetically modified cottonwood plants is probably not very efficient. This information product provides findings relevant to the continuance of the attempts at phytoremediation of the Hg-contaminated sites, and is being applied by at least one Connecticut municipality (Danbury). Tools 2006-07: 1. Additional Tools Anticipated 2007-2008: 0.

*Project: N/A (S. Prisloe)*

Methods and maps of *Phragmites australis*, derived from satellite remote sensing and LiDAR data, are being used by the Connecticut DEP and the Connecticut Chapter of The Nature Conservancy to develop and direct their *Phragmites* eradication efforts in brackish tidal marshes of the lower Connecticut River. Tools 2006-07: 1. Additional Tools Anticipated 2007-2008: 0.

*Project: A/E-1 (Getchis)*

Assisted individual in completing an application for a 501c3 educational organization. A closed-system coral demonstration project is in development at the University of Connecticut. This type of aquaculture is being used as a teaching tool in grade 9-12 classrooms. Tools 2006-07: 1. Additional Tools Anticipated 2007-2008: 0.

*Project: A/E-1 (T. Getchis)*

Assisted perspective industry members by providing information and skills related to aquaculture business management and husbandry. Tools 2006: 1. Anticipated Tools 2007-2008: 1.

*Project: A/E-1 (T. Getchis)*

Assisted in the streamlining the permitting process for marine aquaculture in Connecticut. A new application for aquaculture operations was developed. A compliance guide for aquaculture operations and a standard operating procedures manual for regulators are in development. Tools 2006: 1. Anticipated Tools 2007-2008: 1.

*Project: NOAA National Marine Aquaculture Initiative (T. Getchis)*

Based on ongoing research on the environmental impacts of shellfish aquaculture, tools will be developed to assist producers and policy-makers in site selection for shellfish aquaculture operations in Long Island Sound. This study addressed issues raised in Connecticut's Eelgrass Management Plan and has led to the development of measures that will promote aquaculture while conserving the eelgrass resource. Tools 2006: 1. Additional Tools Anticipated 2007-2008: 1.

*Project: A/E-1 (T. Getchis, R. Pomeroy)*

A framework has been developed in order to implement the 'Sea Grant Model' in multiple international sites including Baja California (Mexico), and Paraiba (Brazil). To date we have trained five graduate students from Universities in these regions in extension programming methods. Tools 2006: 1. Additional Tools Anticipated 2007-2008: 1.

*Project: A/E-1 (T. Getchis)*

Provided information services to over 100 stakeholder (state, regional) who requested information on marine aquaculture including: species, predators, pests and diseases, husbandry, business management, environmental issues, educational opportunities, etc. Tools 2006: 1. Additional Tools Anticipated 2007-2008: 1.

*Project: A/E-1 (T. Getchis)*

2006: Provided informational workshops to producers and municipal shellfish commissions regarding the aquaculture permitting process for marine aquaculture in Connecticut. 2006-2008 Anticipated: Assisting same groups plus new industry entrants with existing and new regulations and policies set forth for marine aquaculture. Tools 2006: 1. Additional Tools Anticipated 2007-2008: 1.

*Project: A/E-1 (Getchis)*

One hundred and fifty students from Connecticut, ranging from grades 5-12 were trained about molluscan shellfish biology, ecology and aquaculture through the *Guts!* Program. This program demonstrates the remarkable filtration capacity of bivalves, and the important link between shellfish and water quality. Tools 2006-07: 1. Additional Tools Anticipated 2007-2008: 0.

*Project: M/PA-1 (S. De Guise)*

CTSG Director De Guise, in coordination with partners from the State University of New York, Stony Brooks, evaluated the toxicity of sumithrin on lobsters, providing a new tool for risk assessment and decision making relative to use of pesticides near Long Island Sound when concerned with potential lobster exposure. Tools 2006-07: 1. Additional Tools Anticipated 2007-2008: 0

*Project: M/PA-1 (S. De Guise)*

CTSG Director De Guise is evaluating the relative toxicity of different PCB congeners on mouse, marine mammal and human immune cells. This new, species-specific approach will provide a new tool when assessing the potential risk that PCBs may pose to different species.

Tools 2006-07: 0. Additional Tools Anticipated 2007-2008: 1

*Project: M/PA-1 (S. De Guise)*

CTSG Director De Guise has established reference values for immune function measurements in stranded seals in Long Island Sound. This new tool will be potentially useful in assessing the health and prognostic for stranded marine mammals.

Tools 2006-07: 0. Additional Tools Anticipated 2007-2008: 1

## SECTION IV APPENDICES

### Management Metrics

#### a. Staff Composition

<b>Sea Grant Staffing</b>	<b># of Individuals</b>	<b># of FTEs Funded by Sea Grant Dollars<sup>1</sup></b>	<b># of FTEs Funded by Non-Sea Grant Dollars (including match)</b>
Administration	3	0.70	1.70
Communications	1	1.00	0.00
Extension	6	2.39	2.26
Education	1	0.51	0.00
Research PIs	18	0.63	0.62
<b>TOTAL</b>	<b>29</b>	<b>5.23</b>	<b>4.58</b>

<b>Management Team Member</b>	<b>Position</b>	<b>FTEs Devoted to Sea Grant</b>
Sylvain De Guise	Director	0.85
Robert Johnston	Associate Director	0.54
Nancy Balcom	Extension Leader	1.00
Peg Van Patten	Communications Director	1.00

Notes:

1. Includes National Strategic Investment Funds for Research PIs.

**b. Program Development Projects**

<b>Project Title or Description</b>	<b>PI</b>	<b>Federal Funds<sup>1</sup></b>
NAML dues	Babb	500
Cinco de Nemo	Arnold	1,000
Hydrilla as AIS	Les	1,507
Marine Sc. Library conf.	Heckman	433
Conf. Bio diversity	Visgilio	750
Coral aquaculture	Getchis	3,170
6th grade education	Knowlton	360
Didemnum genetics	Whitlatch	3,000
Coastal Perspectives lectures	Kremer	1,500
HAB division marker	Lin	5,000
Quahog bowl	C. Knowlton	1,000
Seal video	Tucker	2,500
6th grade education	J. Knowlton	360
Quahog bowl	C. Knowlton	1,000
LISS 06	Yarish	5337
9th Int. Conf. on Shellfish Restoration	De Voe	500
Estuarine Research Federation	Weinstein	1000
LISS conference	McNamara	3500
SENEME	Payne	1000
Lobster conference	Lavallee	1000

## Notes:

1. Although many development project include *informal* matching funds, to minimize administrative burden CTSG does not document official match for development projects. Hence, matching funds are not listed.

## c. List of Partnerships

Federal	Regional	Local & State	NGOs	International	Industry/ Business	Academic Institutions	SG Programs	Other
Academy of Natural Sciences	Atlantic States Marine Fisheries Commission	CT Agricultural Experiment Station	A Living Museum	Asian Development Bank	Abt Associates, Inc.	American School for the Deaf	IL-IN Sea Grant	Association of Food & Drug Officials
National Aeronautics and Space Administration	Interstate Environmental Commission	CT DEP—Inland Fisheries, Marine Fisheries, Wildlife, Water Management, Boating, Pesticides Program, Office of Long Island Sound Programs	Audubon Connecticut	AUSTRIA: Klagenfurt University	All Habitat Services, LLC – consulting firm	Bridgeport Regional Vocational Aquaculture School	FL Sea Grant	CT Bar Association
NOAA Coastal Services Center	New England Fisheries Management Council	CT Dept. of Agriculture, Bureaus of Aquaculture and Marketing / Promotion	Community Conservation Network	BARBADOS: University of the West Indies – Centre for Resource Management and Environmental Studies	Applied Sustainable Aquaculture	Center for Ocean Science Education Excellence – New England (COSEE-NE)	LA Sea Grant	CT Chapter of the American Planning Institute
NOAA Fisheries	New England Interstate Water Pollution Control Commission	CT municipal commissions	Connecticut College Arboretum	BELIZE: Belize Dept. of Fisheries	Aquarion Water Company	Connecticut College	Maine Sea Grant	CT Federation of Lakes
NOAA National Ocean Service	New York City Dept. of Environmental Protection	CT State Department of Education	Conservation International	BELIZE: Friends of Nature, Placencia	Aquatic Control Technology	Cornell Cooperative Extension	MIT Sea Grant	CT Invasive Plant Working Group
NOAA National Sea Grant	New York State, Coastal Resources Division		CT Working Lands Alliance	BELIZE: Toledo Association for Sustainable Tourism and Empowerment, Punta Gorda	City Fish Market	CT Institute of Water Resources	NH Sea Grant	CT Invasive Plants Council
NOAA Office of Ocean Exploration (OE)	New York State Parks		Eastern Connecticut Resource Conservation and Development Council	BELIZE: Wildlife Conservation Society, Belize City	CT Commercial Lobsterman's Association	CT school districts and teachers	NY Sea Grant	National Marine Educators Association
Quinebaug-Shetucket National Heritage Corridor	Rhode Island Dept. of Environmental Management		Environmental Defense	BRAZIL: Universidade Federal da Paraiba, Joao Pessoa	Cross Sound Ferries Services, Inc.	Fairfield University	OR Sea Grant	National NEMO Network
Silvio O. Conte National Fish &	Rhode Island Dept. of Health		Gulf of Maine Research Institute	BRAZIL: Universidade Federal Fluminense,	CT Farm Bureau	Institute for Applied Geospatial Technology	RI Sea Grant	Northeast Algal Society



Wildlife Refuge			Niteroi				
U.S. Agency for International Development	USDA Northeast Regional Aquaculture Center	Lake Waramaug Association	CAMBODIA: Inland Fisheries Research and Development Institute	CT Seafood Council	Marine Sciences Research Center, Stonybrook University	VT Sea Grant	Northeastern Agricultural and Resource Economics Association
U.S. Army Corps of Engineers—New England District	US EPA Long Island Sound Study	Long Island Sound Foundation	CHILE: University de Los Lagos	CT Shellfish Aquaculture Industry	ME Cooperative Extension	WHOI Sea Grant	Seafood HACCP Alliance
U.S. Food and Drug Administration	NOAA National Undersea Research Center-Groton, CT	Long Island Sound Watershed Alliance	CZECH: Academy of Sciences	Dominion Nuclear Millstone Environmental Laboratory	Purchase College-SUNY		Southeastern New England Marine Educators
U.S. Geological Survey (Connecticut and New York Districts)	NOAA Fisheries-Milford, CT Laboratory	Lynde Point Land Trust	GRENADA: Fisheries Division	East Coast Shellfish Growers Association	RI Cooperative Extension		UConn Avery Point campus administration
US Coast Guard Homeland Security Port, New London	US EPA Long Island Sound Study National Estuary Program	ME Aquaculture Innovation Center	IRELAND: Martin Ryan Marine Sciences Institute, National University of Ireland	First Pioneer Farm Credit	Rutgers Cooperative Extension		UCONN Office of International Affairs
US EPA National Center for Environmental Economics	US EPA Office of Water	Mystic Aquarium and Institute for Exploration	ITALY: Universita di Bologna		The Sound School		UCONN University Communications
US EPA Regions 1 and 2		Narragansett Bay Baykeepers	MEXICO, State Secretary of Agriculture	Great Bay Aquaculture, Portsmouth, NH	Smithsonian Environmental Research Center		UCONN Library System
		Nature Conservancy International	MEXICO: Autonomous University of Baja California		UCONN Center for Land Use Education and Research		
		New England Aquarium	MEXICO: Federal Dept. of Agriculture, Livestock, Rural Development, Agriculture, Fisheries and Food	Lockhart Environmental	UCONN Department of Extension		
US Fish & Wildlife Service (Southern New England-New York Bight Coastal Ecosystem		New York Aquarium	MEXICO: State of Baja California government	marinas and private boat owners	UCONN Depts. of Pathobiology and Veterinary Sciences, Agricultural & Resource Economics, Molecular & Cell Biology, Ecology &		

s Program)				Evolutionary Biology, Marine Sciences, Natural Resources Management & Engineering, Physiology and Neurobiology University of Delaware
US Food and Drug Administra- tion	Ocean Technology Foundation	PHILLIPINES: Southeastern Asian Fisheries Development Center, Aquaculture United Nations Food and Agricultural Organization	Northeast Farm Credit Ag Enhancement Program	
US Geological Survey (Connectic- ut and New York Districts) USDA Cooperativ- e State Research Education and Extension Service USDA Farm Service Agency	Project Oceanology		Pacific Shellfish Institute	University of Hartford
USDA Natural Resources Conservati- on Service	Property and Environment Research Center	VIETNAM: Cantho University	South Central Regional Water Authority	University of Maine
	Resources for the Future	World Bank	Southern New England Fisherman and Lobsterman's Association	University of Massachusetts, Dartmouth
	Save the Bay (Rhode Island)	World Fish Center		University of Nevada-Reno
	Schooner, Inc.			University of New Brunswick
	Soundwaters			University of New Hampshire
	The Maritime Aquarium at Norwalk			University of New Haven
	The Nature Conservancy, Connecticut Chapter			University of Oregon
	The Waterkeepers Alliance			University of Rhode Island
	Wildlife Conservation Society			Wesleyan University
	Women's Center of Southeastern Connecticut World Wildlife Fund			Williams College-Mystic Seaport
				Woods Hole Oceanographic Institute Yale University Western Connecticut State University

**d. Leveraged Funds (Not shown as match)**

<b>Project</b>	<b>Source</b>	<b>Amount</b>	<b>Years</b>
LIS AIS Management Plan	NEIWPCC (New England Interstate Water Pollution Control Commission) / EPA	\$53,814	1
LIS Mentor Teacher Program and LIS Fellows Program	EPA	\$135,607	2
Environmental and Technical Assessment of Alternative Shellfish Production Methods	NOAA	43,529	2
Alternative Shellfish Production Methods: Environmental Interactions and Regulatory Compliance	NOAA	36,253	2
Northeast Aquaculture Conference and Exposition Sponsorships	Private	5,000	1
Risk Management for Agricultural Producers	USDA	2,000	1
Ecological Role of Marine Aggregates in Diseases of Shellfish	National Institute of Health	2,007	3
Regional Aquaculture Extension Project	USDA	102,682	1
Governance Feasibility of Marine Ecosystem-Based Management: A Comparative Analysis	NCEAS/Packard Foundation	\$208,000	3
			2

Global Marine Managed Area Management Effectiveness Study	Conservation International/ Moore Foundation	\$200,000	
Small-Scale Fisheries Assessment for Hawaii	NOAA	\$60,000	3
Global Socioeconomic Monitoring Guidelines	Analysis Conservation International	\$21,000	1
Pacific Community-based Socio-economic Monitoring Guidelines	NOAA	\$46,000	1
CT DEP (section 319) Projects	CT DEP (section 319)	\$70,000	1
CT DEP (section 319) Projects	CT DEP (section 319)	\$50,000	1
EPA LISS	EPA LISS	\$90,611	1
CT DEP (section 319) Projects	CT DEP (section 319)	\$75,000	1
Jordan Cove Research Project	CT DEP	\$50,000	1
CT DEP Projects	CT DEP	\$47,400	1
CT OPM Projects	CT OPM	\$100,000	1
CT OPM Projects	CT OPM	\$56,000	1
Niantic River Watershed Protection Plan)	CT DEP OLISP	\$35,000	1
Evaluation of immune functions in free-ranging bottlenose dolphins	NOAA	\$40,746	1
Evaluation of immune functions as potential diagnostic and prognostic tools in stranded marine mammals, a regional approach.	NOAA/Prescott Grant	\$100,000	1
Coastal Habitat Restoration - Lynde Point Land Trust	NRCS	\$62,575	1
Seafood HACCP Training Courses	private	\$3,740	1

CLEAR CDD Coastal Habitat Quality	NASA	\$61,000	1
Exploring alternative management arrangements for new england fisheries	Surdna Foundation	\$15,000	1
Multi-State Hatch Project W-1133: Natural Resources Affecting Public and Private Lands	USDA	\$13,695	1
Evaluation of Recreational Fish Tags as a Rights-Based Management Approach for the Gulf of Mexico Reef Fishery	Environmental Defense	\$21,870	1
Massachusetts Ocean Partnership Fund. An Economic Analysis Framework and Data to Support Integrated Multiple-Use Ocean Management in Massachusetts	Moore Foundation / Massachusetts Ocean Partnership Fund	\$12,400	1
<b>TOTALS</b>	--	<b>\$1,820,929</b>	--

**e. Communications Metrics**

<b>Category</b>	<b>Number</b>
<b>Technical reports</b>	<b>11</b>
<b>Proceedings, symposia</b>	<b>10</b>
<b>Brochures, fact sheets, posters, etc.</b>	<b>3</b>
<b>Books, monographs</b>	<b>1</b>
<b>Peer-reviewed journal articles, book chapters</b>	<b>30</b>
<b>Videos/CDs/DVDs</b>	<b>3</b>
<b>Maps/charts</b>	<b>1</b>
<b>Handbooks, manuals, guides</b>	<b>1</b>

<b>Electronic publications</b>	<b>4</b>
<b>Theses, dissertations</b>	<b>6</b>
<b>Newsletters, periodicals</b>	<b>3</b>
<b>Media placements</b>	<b>17</b>
<b>Other</b>	<b>106</b>
<b>TOTAL</b>	<b>196</b>

#### f. Students Supported

<b>Category</b>	<b># of new students</b>	<b># of continuing students</b>	<b># of Degrees Awarded</b>
Knauss Fellowship	1		
Industry Fellowship	0	0	
NMFS/SG Fellowship	0	0	
State Fellowship	0	0	
Sea Grant Supported MS/MA Graduate Students	13	11	7
Sea Grant Supported PhD Graduate Students	3	8	1
Sea Grant Supported Undergraduate Students	26	11	2
Other	2	1	
<b>TOTAL</b>	<b>45</b>	<b>31</b>	<b>10</b>

#### g. Program/Staff Awards and Honors

1. Balcom: Chairman's Award for Outstanding Service to the Assembly of Sea Grant Extension Program Leaders
2. Getchis: USDA Cooperative State Research, Education and Extension Service Certificate of Appreciation Award for outstanding dedication and excellence in professionalism to support aquaculture in the Northeastern US through regional extension
3. Getchis: Northeast Extension Directors Program Award
4. Johnston: Gamma Sigma Delta Faculty Award of Merit in Agriculture.
5. Johnston: University of Connecticut College of Agriculture and Natural Resources Research Excellence Award.
6. Payne: Coastal America Partnership Award as a member of the Aquatic Invasive Species Toolkit Team.
7. Payne: Who's Who Among America's Teachers.

8. Pomeroy: Nominee, Pew Foundation Fellow in Marine Conservation
9. Pomeroy: Senior Research Fellow, WorldFish Center
10. Rozum: Outstanding Achievement Award, Renewable Natural Resource Foundation, Washington DC, for publication "Putting Communities in Charge"
11. Van Patten: Certificate of appreciation from the Women's Center of Southeastern Connecticut for role in Project Sea Urchin.

## V. Optional Metrics

### 1. K-16

<b>Professional Development for Educators</b>	<b>Elementary School</b>	<b>Middle School</b>	<b>High School</b>
Number of professional development sessions (workshops, institutes NOT for college credit)	2	3	3
Number of attendees at professional development sessions	18	65	27
Number of students reached through educators (NOTE: if you have this number, great, otherwise please use a multiplier for your state, e.g. most elementary teachers teach 25 students in your state.)	338	3,695	665
Number of curricula developed	1	1	1

<b>Courses for College Credit</b>	
Number of courses taught (for credit, college level)	18
Number of students/participants in courses	501

<b>Advisory (state standards, national standards)</b>	
Number of consultations	2

### 2. Informal Education/Free Choice Learning

<b>Professional Development for Educators</b>	
Number of attendees at professional development sessions	Unavailable

<b>Programs for children and families</b>	
Number of camps, programs, activities, clubs, etc.	5
Number of attendees	120
Number of class trips	Unavailable



### 3. Extension Metrics

<b>Number of SG-sponsored/organized meetings, workshops and conferences</b>	39
<b>Number of attendees in SG meetings/workshops</b>	782
<b>Number of Radio Interviews</b>	1 (BBC International)
<b>Number of TV appearances</b>	2 (town cable, CPTV)
<b>Number of Public Presentations</b>	19
<b>Number of attendees at presentations</b>	543
<b>Number of volunteer hours</b>	0