

OVERVIEW

Fisheries and Aquaculture



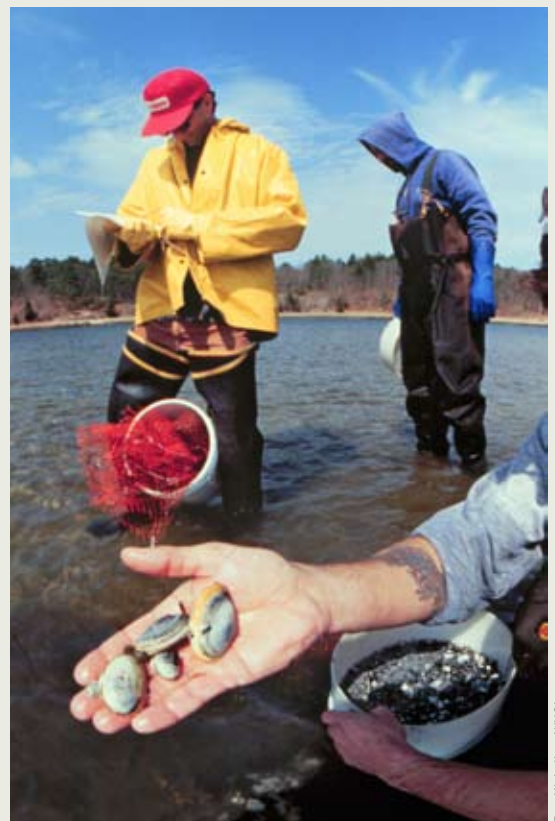
Over the past three decades, Woods Hole Sea Grant has invested in research, extension, and outreach in the programmatic theme area Fisheries and Aquaculture. **This investment has resulted in the development of better management practices and policies for shellfish harvest and shellfish aquaculture, a better understanding of the life history and environmental requirements of commercially important species of fish and shellfish, and quantitative assessments and subsequent improvements of restoration activities.**

Why Fisheries and Aquaculture?

In Massachusetts, the fishing and aquaculture industries are an integral part of the economic and cultural identity of coastal communities. This is particularly true in southeastern Massachusetts, home to the fishing port of New Bedford, the largest fishery port on the U.S. East Coast, and a slew of smaller fishing ports including Chatham, Woods Hole, Rock Harbor, Sandwich, Scituate, Provincetown, and Plymouth. Among the species fished, the sea scallop (*Placopecten magellanicus*) and the Atlantic surf clam (*Spisula solidissima*) are substantial fisheries with a combined landed value of over \$230 million (Massachusetts, 2003). These **deeper water fisheries** are complemented by **coastal shellfisheries** for wild populations of soft shell clams (*Mya arenaria*), quahogs (*Mercenaria mercenaria*), American oysters (*Crassostrea virginica*), and bay scallops (*Argopecten irradians*).

Additionally, southeastern Massachusetts (including Cape Cod and the Islands of Martha's Vineyard and Nantucket) is the focal point of a burgeoning shellfish aquaculture industry, with heavy concentrations of farms in Barnstable Harbor, Duxbury, Pleasant Bay, and Wellfleet Harbor. This industry focuses on the production of two bivalve shellfish species, the quahog (*Mercenaria mercenaria*) and the American oyster (*Crassostrea virginica*). Though small in comparison to the dollar value of the deeper water fisheries (with an estimated landed value of at least \$12 million), **there are now over 250 shellfish farms in Massachusetts, with approximately 200 of those located in southeastern Massachusetts.**

In addition to the economic importance of shellfish to the region, **shellfish are an important component of the tourist industry on Cape Cod.** On Cape Cod alone, towns sell thousands of non-resident shellfishing



Tom Kleindinst, WHOI



permits, raising revenue and attracting visitors to the region. Furthermore, many year-round residents—including members of the native Wampanoag tribes—consider **the ability to harvest fresh shellfish an important part of their lives and culture**. Finally, **shellfish are now recognized as important natural components of the ecosystem**. Increasingly, they are considered worthy of preservation and restoration efforts—aside from their commercial or recreational value—as species indicative of water quality (e.g., bay scallops), inherent habitat value (e.g., oyster beds), or as elements of nutrient cycles.

It is within the context of these issues and concerns that Woods Hole Sea Grant has focused its Fisheries and Aquaculture theme, addressing the problems of habitat restoration, coastal fisheries management and shellfish aquaculture.

Woods Hole Sea Grant Involvement

In Fisheries and Aquaculture, Woods Hole Sea Grant has identified two priority areas that best fit within the academic and research environment within the region: revitalizing our nation's fisheries and development of sustainable aquaculture. These areas are very closely linked technologically and culturally within New England. *Thematic elements include:*

- Development of technology and programs to promote stock enhancement of natural fish and shellfish resources, including mechanisms to evaluate the efficacy of enhancement programs and the overall effectiveness of such programs;
- Investigation of larval recruitment processes for fish and shellfish and development of means to understand the relationship between recruitment and physical and chemical characteristics of the environment;
- Investigation of disease processes in marine organisms with an emphasis on prophylactics and management of diseased stocks to minimize economic losses to the natural fisheries and aquaculture industries; and
- Promotion of business and industrial development through expanding efforts in coastal management and through understanding of the economics of marine related businesses.

INVESTMENT

Woods Hole Sea Grant's Investment, 2000–2006

Research Project Title	P.I.(s)	Years Funded
<i>Determining Reproductive Success of Commercially Valuable Squid in New England with DNA Fingerprinting</i> (R/B-163)	Roger Hanlon, Marine Biological Laboratory	2000–2001
<i>Augmenting the Lobster Catch: Oyster Aquaculture in Modified Lobster Traps</i> (R/A-43)	Dale Leavitt, SEMAC/Sea Grant; and Joe Buttner, Salem State College	2000–2002
<i>Effects of the Asian Shore Crab, Hemigrapsus sanguineus, in New England: Changes in Resident Crab Populations?</i> (R/B-161)	Nancy O'Connor, UMASS at Dartmouth	2000–2002
<i>Investigations into the Prevalence and Mortality Associated with SSO and SSO-like infections of Crassostrea virginica on the U.S. East Coast</i> (R/B-156)	Roxanna Smolowitz, Marine Biological Laboratory	2000–2002
<i>Developmental Effects of Contaminants on Salinity Preference and Seawater Survival for Atlantic Salmon: Integrating Physiology and Behavior</i> (R/B-165)	Steve McCormick, Darren Lerner, and Emily Monosson, University of Massachusetts at Amherst	2002–2004
<i>Larval Spread and Population Mixing Between Onshore and Offshore Lobster Populations</i> (R/O-34)	Steve Palumbi, Stanford; Sarah Cohen, San Diego State University; and Colleen Cavanaugh, Harvard University	2002–2004
<i>Tidal Exchange Among Soft-Shell Clam Populations Using Natural Tags</i> (R/O-35)	Lauren Mullineaux and Simon Thorrold, Woods Hole Oceanographic Institution	2002–2004
<i>Resolving Population Structure with Molecular Genetics to Enhance Management of the Highly Exploited Squid Fishery</i> (R/B-166)	Roger Hanlon, Marine Biological Laboratory; and Jon Brodziak, NMFS	2002–2004
<i>Delineation of Critical Inshore Spawning Grounds for Commercially Valuable Squid Fisheries on the U.S. East and West Coasts</i> (R/B-167)	Roger Hanlon, Marine Biological Laboratory; and Ken Foote, Woods Hole Oceanographic Institution	2003–2005
<i>Reconstructing Dispersal Pathways of Haddock Larvae from ICP Mass Spectrometric Analyses of Trace Elements and Stable Isotopes in Otoliths</i> (R/P-72)	Simon Thorrold, Woods Hole Oceanographic Institution	2004–2006
<i>Development and Application of Molecular Methods for Detection of QPX Organisms in Environmental Reservoirs</i> (R/B-168)	Becky Gast, Woods Hole Oceanographic Institution; and Roxanna Smolowitz, Marine Biological Laboratory	2004–2006
<i>Innovative Approaches to Identifying Bivalves and Characterizing Habitat Using Advanced Image Processing Techniques</i> (R/O-39)	Sanjay Tiwari and Scott Gallagher, Woods Hole Oceanographic Institution	2004–2006

In addition to the formal projects identified above, program development funds (“New Initiatives”) have also been used to initiate new projects, provide opportunities for students to attend conferences to present their work, respond to emergency funding requests, jump-start a research program or test a new technique, and support workshops relevant to the research conducted under this theme.

Research Support, 2000–2006

Sea Grant Funds:	\$1,592,490
Matching Funds:	\$ 917,695
TOTAL:	\$2,510,185

Student Support, 2000–2006

Graduate Student Support:	3 Students	18 Months' Student Support
Undergraduate Student Support:	10 Students	18 Months' Student Support



PROFILE – Darren Lerner

Darren Lerner is a doctoral student at the University of Massachusetts at Amherst's Organismic and Evolutionary Biology program. Along with his advisor, Steve McCormick, director of the S.O. Conte Anadromous Fish Research Center in Turners Falls, Mass., Lerner had Sea Grant funding to study Atlantic salmon that have been exposed to PCBs and nonylphenol (NP). In particular, they were interested

in finding out whether exposure to contaminants effects salinity preference and/or seawater survival in Atlantic salmon.

NP is widely found in effluents from sewage treatment plants and industrial sites due to its use in detergents, plastics, cleaning products, and pesticides. A direct consequence of this widespread use is its presence in rivers and estuaries. Investigators examined the effects of estradiol (E2) and environmentally relevant concentrations of aqueous NP on larval survival and smolt development in Atlantic salmon and found clear differences in life history sensitivities to estrogenic compounds: exposed larvae exhibited delayed mortality at an environmentally relevant dose, whereas there were no mortalities of fish treated as juveniles.

Additionally, Lerner and McCormick examined the effects of these estrogenic compounds on stress response of juvenile Atlantic salmon, a stage referred to as parr. The transition from parr to smolt is a critical and highly sensitive life history stage.

Ultimately, say the investigators, any changes in physiological and behavioral preparedness for seawater entry and residence may result in increased vulnerability to predation and reduced ocean survival. Both Lerner, who is on track for earning his Ph.D. in 2006, and McCormick say that project results should be "broadly applicable to other aquatic invertebrates," and indicate a need for improvement and modification to sewage treatment plants, commercial waste protocols, pesticide applications, and remediation efforts.

Research Dividends, 2000–2006

Research Highlights

Research projects supported in 2000–06 have yielded numerous advances and discoveries within the scientific community. A few highlights include:

- Research scientists characterized the infective nature of QPX (quahog parasite unknown) to *Mercenaria mercenaria* populations, allowing for the implementation of a disease management program for a fishery valued at over \$5 million annually in Massachusetts. Sea Grant extension agents, working collaboratively with Woods Hole Sea Grant-funded researchers, worked with state and local fishery managers and agencies to help shellfish managers and aquaculturists protect uninfected stocks.
- Woods Hole Sea Grant researchers documented the offshore origin of the species responsible for harmful algal blooms in New England waters (*Alexandrium*). This information was used by the Maine Department of Marine Resources to set up an offshore monitoring station for paralytic shellfish poisoning as an early indicator of blooms in coastal waters. More recently, offshore monitoring stations played a role in detecting the extensive red tide bloom during the spring and summer 2005, alerting state agencies in Maine, New Hampshire, and Massachusetts to the extent of the offshore bloom.
- A bioeconomic model for open ocean finfish aquaculture operations was developed to determine what factors provide optimum grow-out conditions. Aquaculturists can use the model to determine the economic viability of a proposed facility (see below).

The Risky Business of Offshore Marine Aquaculture

by Tracey Crago

Sea Grant investigators looking at the feasibility of offshore aquaculture from two major angles—operations and markets—started by developing bio-economic feasibility models of grow-out operations for blue mussels and sea scallops, and then looked at finfish: cod, salmon, and flounder.

Di Jin, Hauke Kite-Powell, and Porter Hoagland, policy analysts at the Woods Hole Oceanographic Institution (WHOI) Marine Policy Center, combined financial business planning with risk assessment techniques to account for the many unknowns associated with an offshore operation.

To develop the models, researchers considered, individually, everything that could go wrong—and the likelihood that it would—and quantify that likelihood by assigning a numerical value or range of values. These values were factored into a model to determine profits or losses. Investigators estimated the economic feasibility of one operation at one location and determined the minimum efficient scale of operations. In other words, at what level of production could the venture be considered profitable?

Benefits to this model include its ability to analyze: the cost structure of prospective growout operations, examine the effect on profitability of changing input costs, and growout site selection. As the model is used and refined further, say analysts, it will contribute to the economic development of open ocean aquaculture in New England and in other regions.

- DNA fingerprint analysis for studying squid population structure has revealed five distinct populations of the commercially harvested squid *Loligo pealei* between Cape Cod and Virginia. By understanding the variation in population structure, fisheries managers will be better able to set harvesting regulations appropriate to specific regions. The squid fishery on the East coast of the United States is valued at approximately \$20 million annually.
- Genetic markers have been used to identify the connectivity between near shore and offshore populations of the American lobster (*Homarus americanus*)—information that is vital to management plans for a fishery valued at approximately \$278 million in New England (2003). If shifts in fishing effort from near shore to offshore areas are to occur, managers can use this research to better understand the consequences of such shifts in fishing effort to lobster populations.

Listening to What Fish Tell Us

by Tracey Crago

Of the 150-plus East Coast U.S. fishes that make sounds, Rodney Rountree has heard from a dozen or so and documented about half that number. Different species of fish use different mechanisms to vocalize. “Most fish sounds are associated with the swim bladder, which acts as a drum or an amplifier,” says Rountree. Pharyngeal teeth, located in the throat of some fish, produce sound when ground together. Rountree says even fish without swim bladders can produce sound: longhorn sculpin, for example, vibrate the bones of their pectoral girdle to produce a humming sound.

To determine when, where, and why fish vocalize, Rountree uses a repertoire of non-invasive sampling strategies. “The ‘backyard science’ method, says Rountree, is a way to get basic biological, behavioral, and spatial information. It requires a hydrophone (the \$200 type) and a basic underwater camera.

To get a sense of what fish are in what location requires simply going to a site, putting a hydrophone in the water, and listening. “By recording locations where you hear—and don’t hear—a particular fish, you can plot a map of fish calling locations,” says Rountree.

This method led Rountree to discover an abundance of striped cusk-eels, *Ophidion marginatum* in Cape Cod waters. This species was previously thought to occur from New York to Florida, and only as a rare stray to Cape Cod. Extensive sampling with conventional gear (seines and trawls) had failed to collect cusk-eels in the area, demonstrating, says Rountree, “the usefulness of passive acoustics as a tool to supplement other types of sampling in fish surveys.”

Another benefit to fish vocalization research relates to the fact that many fish vocalize when spawning. The ability to identify fish spawning grounds by species means that Rountree’s research will likely play an important role in the identification of essential fish habitat (EFH).



Rountree, a postdoctoral fellow at the University of Massachusetts Dartmouth, is an expert in the field of soniferous fishes—fish that vocalize.

Courtesy of Rodney Rountree

- Phosphatic clay suspensions have been used to determine the feasibility of such suspensions for removing harmful algal species in fish culture operations, a practice common in Asia. In laboratory experiments, clay flocculation appeared to be effective in removing >80 % background and bloom micro-flagellates in salmon pen cultures.
- Sea Grant researchers developed a framework for evaluating the economic impacts of harmful algal blooms (HABs). The framework can be applied at the county, state, regional and national levels to allow the estimation of direct, indirect and induced output; value added; and employment impacts for each industrial sector (tourism, fishing, public health, etc.) and for aggregate sectors. Estimates for the national direct output impacts average \$75 million per year; the indirect impacts average \$27 million per year; and the induced impacts average \$56 million per year. This approach will provide policy makers, resource managers, and stakeholders a tool to better understand the scale of impacts from HABs as well as the distribution of impacts across economic sectors.

Research Publications, 2000–2006

Scanning Electron Microscopy Investigation of Epizootic Lobster Shell Disease in *Homarus americanus*

Hsu, A.C. and R.M. Smolowitz
Biol. Bull., Vol. 205, pp. 228-230, 2003
WHOI-R-03-003

Bacterial Assemblages Involved in the Development and Progression of Shell Disease in the American Lobster

Chistoserdov, A., R. Smolowitz, and A. Hsu
In: *Third Long Island Sound Lobster Health Symposium, March 7, 2003, Bridgeport, Connecticut*, pp. 61-64, 2003 WHOI-R-03-004

Techniques for the Identification of Bivalve Larvae

Garland, E.D. and C.A. Zimmer
Marine Ecology Progress Series, Vol. 225, pp. 299-310, 2002 WHOI-R-02-003

Habitat and Diet of the Non-native Crab *Hemigrapsus sanguineus* in Southeastern New England

Ledesma, M.E. and N.J. O'Connor
Northeastern Naturalist, Vol. 8, No. 1, pp. 63-78, 2001 WHOI-R-01-002

Estimating the Number of Fish in Atlantic Bluefin Tuna (*Thunnus thynnus thynnus*) Schools using Models Derived from Captive School Observations

Hanrahan, B. and F. Juanes
Fish. Bull., Vol. 99, pp. 420-431, 2001
WHOI-R-01-006

Effects of Caging on Retention of Postlarval Soft-shelled Clams (*Mya arenaria*)

Gulmann, L.K., L.S. Mullineaux, and H.L. Hunt
Journal of Shellfish Research, Vol. 20, No. 1, pp. 135-142, 2001 WHOI-R-01-008

Microsatellite DNA Markers Indicate a High Frequency of Multiple Paternity Within Individual Field-Collected Egg Capsules of the Squid *Loligo pealeii*

Buresch, K.M., R.T. Hanlon, M.R. Maxwell, and S. Ring
Marine Ecology Progress Series, Vol. 210, pp. 161-165, 2001 WHOI-R-01-010

Identification of Proliferating Cells in Hard Clams

Hanselmann, R., R. Smolowitz, and D. Gibson
Biol. Bull., Vol. 199, pp. 199-200, 2000
WHOI-R-00-005

Conditions Affecting the Growth and Zoosporulation of the Protistan Parasite QPX in Culture

Brothers, C., E. Marks III, and R. Smolowitz
Biol. Bull., Vol. 199, pp. 200-201, 2000
WHOI-R-00-006

Single-step Species Identification of Bivalve Larvae Using Multiplex Polymerase Chain Reaction

Hare, M.P., S.R. Palumbi, and C.A. Butman
Marine Biology, Vol. 137, pp. 953-961, 2000
WHOI-R-00-007

Pattern of Inheritance of Microsatellite Loci in the Squid *Loligo pealeii* (Mollusca: Cephalopoda)

Maxwell, M.R., K.M. Buresch, and R.T. Hanlon
Marine Biotechnology, Vol. 2, pp. 517-521, 2000
WHOI-R-00-011

Female Reproductive Output in the Squid *Loligo pealeii*: Multiple Egg Clutches and Implications for a Spawning Strategy

Maxwell, M.R. and R.T. Hanlon
Marine Ecology Progress Series, Vol. 199, pp. 159-170, 2000
WHOI-R-00-014

Extension and Outreach Publications, 2000–2006

Some Liability Issues for Massachusetts Shellfish Farmers

Walton, W. and S. Showalter
Marine Extension Bulletin, 4 pp., 2004
WHOI-G-04-002

Important Changes to the Federal Crop Insurance Program for Quahog Farmers

Walton, W. and J. Gallons
Marine Extension Bulletin, 4 pp., 2004
WHOI-G-04-003

Assessment of Shellfish Survival and Growth at Cape Cod Aquaculture Sites

Walton, B. and D. Murphy
Report prepared for the Southeastern Massachusetts Aquaculture Center, 25 pp., 2003
WHOI-S-03-001

Assessment of Shellfish Survival and Growth in the Pamet River System

Walton, B. and D. Murphy
Report prepared for the Truro Shellfish Advisory Committee, 17 pp., 2003
WHOI-S-03-002

Aquaculture Curricula Resource Guide. A Resource Tool for the Aquaculture Educator

Soares, S.J., J.K. Buttner, and D.F. Leavitt
Northeast Regional Aquaculture Center
Publication No. 01-001, 54 pp., 2001
WHOI-E-01-003

Shellfish Aquaculture in Massachusetts

Leavitt, D.F.
Focal Point, 4 pp., 2000
WHOI-G-00-002

Shellfish Resource Management in Massachusetts

Leavitt, D.F.
Focal Point, 3 pp., 2000
WHOI-G-00-003

Theme Booklet: Fisheries and Aquaculture Woods Hole Sea Grant

4 pp., 2000
WHOI-G-00-004

Control of Predators on Cultured Shellfish: Exclusion Strategies

Leavitt, D.F. and W.P. Burt
NRAC Publication No. 00-007, 4 pp., 2000
WHOI-G-00-008

IMPACTS

Fisheries and Aquaculture Extension

In Fisheries and Aquaculture, Woods Hole Sea Grant has focused on three priority areas: **restoration of living coastal resources, assistance with coastal fisheries management, and development of sustainable aquaculture.** In recognition of the economic and cultural importance of shellfish in the region, these areas are united by a focus on local shellfish, including oysters, hard shell clams (called quahogs locally), soft shell clams, and bay scallops.

Historically and currently an important commercial industry, shellfishing has expanded to include shellfish farming which is growing throughout the state. Additionally, many residents and visitors shellfish recreationally, and value the environment that supports this activity. Finally, shellfish act as important indicator species (e.g., bay scallops) and even provide valuable habitat (e.g., oyster banks).

Extension Support 2000–2006	
Sea Grant Funds:	\$366,287
Matching Funds:	\$332,785
TOTAL:	\$699,072



D. Murphy, CCCE

In the area of Fisheries and Aquaculture, staff members work with a diverse group of individuals, unified by their interest in shellfish. In addition, the program has a strong field research component.

Woods Hole Sea Grant’s extension program is guided by the Marine Outreach Guidance Group (MOGG), an advisory committee comprised of members of Sea Grant’s user community. The extension program is fully integrated with the Cape Cod Cooperative Extension Service and the University of Massachusetts Extension Program. With two full-time specialists—one in the area of Fisheries and Aquaculture, the other in Coastal Processes—and additional support from staff members from the Woods Hole Sea Grant Program and the County Extension Program, the Sea Grant Extension Program is well connected to its user groups and the communities it serves.

Woods Hole Sea Grant's Investments and Dividends, 2000–2006

Fi Extension projects supported in 2000–06 involved numerous partners and targeted wide-ranging issues and problems. These projects have yielded new techniques and tools, driven by the expressed needs of Sea Grant's identified user communities. A few highlights are described below:

Extension Goal

To maintain and improve diverse, healthy coastal marine habitats, and educate the community about these valuable natural resources.

Issue 1

Over the last two centuries, many once-productive tidal creeks and rivers were restricted by the building of dikes, railroad trestles, and roadways. The restoration of historic tidal flow to these bodies of water is a top priority for several groups, including the National Park Service. Some local residents have significant questions and concerns about the changes such restoration might have.

Actions:

Woods Hole Sea Grant...

- Designed, implemented, and trained volunteers with a standardized method for assessing shellfish habitat
- Provided a report and made a presentation to the Truro Shellfish Advisory Committee and the Wellfleet Harbor Conference
- Presented the method in a Woods Hole Sea Grant DVD, *Shellfish Aquaculture: Tools, Tips and Techniques* (2005)

Dividends:

- The Town of Truro's Shellfish Advisory Committee is incorporating data derived from this work into a comprehensive municipal shellfish management plan.
- The local shellfish officer and committee members in Truro continued this effort on their own in 2005.
- The National Park Service initiated a collaborative effort with the extension program to measure the effects of the tidal restriction in Herring River, Wellfleet.



Bill Walton, Sea Grant/CCCE

Woods Hole Sea Grant designed and implemented an objective measure of shellfish habitat, with a standardized measure of growth and survival, to provide local communities with scientific data to assess the effects of tidal restrictions and restorations.

Issue 2

Eelgrass beds, long recognized as a living marine resource of critical concern, have diminished across the southeastern region of Massachusetts. This decline has been attributed to disease, habitat loss and degradation, and eutrophication. Given the importance of eelgrass to the local bay scallop fisheries, and its value as nursery habitat to other species, numerous efforts have been initiated to restore eelgrass. Prior restoration efforts have been hindered by limited success or logistical problems.

Action:

After a drastic decline in eelgrass in the first half of the 20th century—attributed to a wasting disease—eelgrass beds in southeastern Massachusetts have still not recovered to pre-decline levels. Among other species, bay scallops, *Argopecten irradians*, are recognized as benefiting from the presence of eelgrass, and declines in bay scallops have been associated with the lack of eelgrass. Not surprisingly, this has led to a number of efforts to restore eelgrass.

Efforts to restore eelgrass are not new, but none have achieved unqualified success. To date, restoration efforts have required large investments of labor (often volunteered), exhibited poor success, or both. Despite these problems, the importance of eelgrass—as well as bay scallops—prompted Woods Hole Sea Grant to explore potential restoration options.



D. Murphy, CCCE

To harvest seeds, extension worked with a number of groups to collect the flowering stalks of eelgrass, which would normally be carried away by currents.



D. Murphy, CCCE

Eelgrass seeds, harvested from the collected flowering stalks, were planted at several sites as a pilot study of this method. The method is being evaluated in terms of effectiveness, cost, and required labor.

After reviewing the literature and contacting others involved in restoration efforts, Woods Hole Sea Grant identified a relatively new method that had shown good success and seemed relatively feasible: the collection, harvest, and subsequent planting of eelgrass seeds. In a typical population of eelgrass, maintenance and spread of the bed is primarily through vegetative growth, while over 99% of the seeds produced sexually are simply lost.

Using a method developed by Dr. Steven Granger of the University of Rhode Island, flowering stalks of eelgrass were harvested by hand in the summer of 2004. By the end of the summer, over 200,000 seeds were collected from these stalks. Later that fall, working with Dr. Granger, seeds were planted at five sites around Cape Cod. The test sites were selected in consultation with local natural resource managers who worked with extension staff to identify favorable areas.

In the spring of 2005, a preliminary assessment revealed mixed success (0 to 6% germination), indicating the importance of site selection but also the feasibility of this approach. This work is being replicated to assess inter-annual variability.

Dividends:

- In 2004, five sites were planted with this method in collaboration with local natural resource managers, with good growth and survival recorded at several sites the following spring.

Extension Goal

To enhance, restore, and maintain wild populations of living coastal resources, particularly shellfish and to ensure healthy and diverse fisheries.

Issue 1

In Massachusetts, shellfish natural resources are managed primarily at the local municipal level. While this poses an excellent opportunity for hands-on management, it also creates wide differences in the education and training of shellfish officers.

Actions:

Woods Hole Sea Grant...

- Developed the format and content of a unit of the state-approved shellfish officer certification course
- Coordinated, taught, and administered this unit to Massachusetts shellfish officers
- Conducted a follow-up qualitative survey of shellfish officers to evaluate the course



Massachusetts shellfish officers are involved in a wide array of activities.

©Chris Linder

Dividends:

- Fifteen officers took the offered course and obtained certification as shellfish officers in Massachusetts in the program's first year
- Several officers have contacted Woods Hole Sea Grant extension for additional information and training

Sea Grant Assists with Shellfish Officer Certification Course

by Kate Madin

With the memory—and labor—of lifting 460 bags of harvested quahogs fresh in his mind, Westport Shellfish Constable Gary Sherman was glad to talk about Sea Grant Extension Agent Bill Walton and the course he gave. Walton developed a two-week shellfish officer certification course for shellfish officers in Massachusetts, and Sherman sat in on the course to critique it. Previous similar courses have not carried state-approved certification, as this one does. Walton coordinated the course, enlisted speakers on diverse topics, and taught the portion about shellfish hatcheries, larvae, and developmental stages.

Sherman put three of his own staff through the course. “Sometimes you need training and don’t even know you need it,” he says. “It was very beneficial to put shellfish officers through this training program, so they’re not cast out in the field blind,” he says. “There were no negatives about this course. It was eye-opening for those who had never taken a course like this, and was a great reminder for those who had seen the information before.”

Sherman says, “Bill’s very bright, and loves what he does. He was a shellfish officer in Wellfleet, and learned a lot there that he needed for his current work. He was also active with the Massachusetts Shellfish Officers Association.” He adds, “Bill’s a people person: he listens to people. He’s not one to say, ‘This is the way it’s going to be,’ and that personality is a definite plus.”

Issue 2

Though typically an isolated event in Massachusetts waters, a bloom of the dinoflagellate, *Alexandrium fundyense*, (commonly called red tide) in the spring of 2005 occurred across most of the coastline of Massachusetts. This outbreak of red tide closed both commercial and recreational shellfisheries, affected seafood consumption and worried visiting tourists. The potential danger and the economic impact raised a number of questions.

Actions:

Woods Hole Sea Grant...

- Made presentations to several groups, including a televised presentation to the Barnstable County Assembly of Delegates
- Provided information to numerous agencies seeking information about the shellfishing industry
- Distributed information on financial aid availability to shellfishermen and shellfish farmers
- Assisted with writing an informative brochure answering frequently asked questions about red tide



Bill Walton, Sea Grant/CCCE

With the 2005 outbreak of red tide, Woods Hole Sea Grant rushed to provide information about red tide to concerned fishermen, seafood consumers, visitors and government officials.

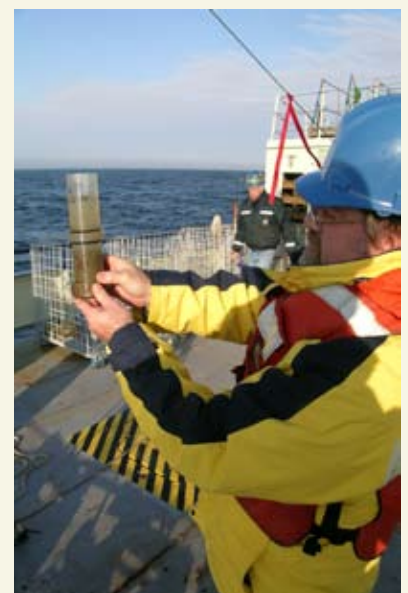
Dividends:

- With the passing of the red tide, fishermen and shellfish farmers reported that markets generally saw demand for local shellfish return to normal
- Over 3,000 informational brochures were printed and made available to various local agencies, and additional copies are available for any future outbreaks



Mike Cartowicz, WHOI

Aboard R/V Oceanus, WHOI scientists Deana Erdner (left) and Bruce Keafer collected Alexandrium-filled water samples for testing back in the laboratory. As luck would have it, the long-planned sampling trip to Massachusetts Bay took place in May 2005, just after the area's largest outbreak of red tide in 12 years had shut down shellfish beds along the coast. WHOI scientists Dennis McGillicuddy and Don Anderson, of the Woods Hole Center for Oceans and Human Health, oversaw the sample collection—the first in a five-year study of harmful algal blooms and their genetic diversity across the Gulf of Maine.



Mike Cartowicz, WHOI

Extension Goal

To develop and improve shellfish farming techniques and technologies appropriate for southeastern Massachusetts with minimal environmental impacts, making the local industry more competitive in a global economy.

Issue 1

A 2004 survey of Massachusetts shellfish farmers (initiated by Woods Hole Sea Grant and done in collaboration with other extension agencies) asked for industry training and information needs, and identified predation as the top concern, followed by fouling pests and diseases. Shellfish farmers indicated that they wanted to hear practical advice and techniques and wanted to learn from their peers.

Actions:

Woods Hole Sea Grant...

- Developed and coordinated a collaborative workshop series entitled “Improving Shellfish Production” that will focus on applied advice to shellfish farmers
- Coordinated and conducted three workshops on management of predation
- Developed waterproof identification cards of common shellfish predators, pests, and diseases which will be distributed to all workshop attendees, in addition to local and regional shellfish managers, agency personnel, and coastal decision-makers throughout the region.

Shellfish Growers Benefit from Sea Grant Outreach

by Jenny Boyce

Captain Andrew Cummings grows and harvests shellfish in the outer Cape Cod town of Wellfleet. For shellfish problems large and small, he turns to Bill Walton of the Woods Hole Sea Grant/Cape Cod Cooperative Extension Service for answers. His input is “incredibly useful on many different levels,” says Cummings. It ranges from advice on growing techniques to research into solving predator problems to site inspections on request—just to see how everything is going.

Walton’s assistance is “all-encompassing.” The benefits are too many and too diverse for Cummings to list, he says, although he singles out research mini-grants as having made an especially positive contribution to his operation.

“Accessibility is what it’s all about,” according to Cummings. “I work with some of the oldest aquaculturists in the area, and they’re really starting to get into” calling on Walton for help. “It’s not just the younger growers like me.” He says the extension agent is most valuable as a single resource; growers know whom to rely on for every kind of information. “They [WHSG/CCCE] make it very easy” for fishermen like him to get what they need.

A series of workshops sponsored by Sea Grant brought together scientists and guest aquaculturists from around the country to share ideas and techniques with local licensed shellfish growers. Captain Cummings was a speaker and participant in one of them, a session on predator management. He found the discussion extremely helpful, and since the majority of attendees were fellow growers, believes the benefit was region-wide.



Bill Walton, Sea Grant/CCOE

In workshops collaboratively sponsored by Woods Hole Sea Grant, shellfish farmers were invited to present their experiences, tips, and solutions to their peers.

Dividends:

- Over 80 licensed shellfish farmers attended the three workshops held to date
- The workshops received overwhelmingly positive response to the format and content of the workshops
- A collaborative research effort was begun with several shellfish farmers to test various predator deterrent methods

Issue 2

As the shellfish farming industry has blossomed in southeastern Massachusetts, local farmers have attempted to maintain or increase the price of their shellfish as well as enter new markets. To date, efforts have been largely limited to individuals or small associations of farmers working within a specific water body.

Actions:

Woods Hole Sea Grant...

- Assisted with the development of surveys of consumers and restaurant operators to determine their awareness of southeastern Massachusetts farmed shellfish
- Assisted with the development of a regional campaign *Cape Cod and Islands Cultured Shellfish*, identifying the region as a world-class producer of farmed shellfish
- Assisted with two invitation-only tasting events for chefs and restaurant owners in Massachusetts
- Provided technical input to a televised advertising campaign, sponsored by the Southeastern Massachusetts Aquaculture Center



D. Murphy CCOE

Shellfish farmers volunteered their time to promote the Cape Cod and Islands region at two chefs' events. By establishing a brand identity, farmers hope to obtain higher prices and enter new markets.

Dividends:

- Over 100 potential customers attended the two chefs' events, and several farmers have reported new business as a result
- The commercial garnered attention in several large-market newspapers
- At least one group of shellfish farmers has formed specifically to market their product together to take advantage of this marketing effort

Marketing Shellfish to Increase Profits

by Bill Walton

The good news is that the shellfish farming industry in southeastern Massachusetts is growing and succeeding. The bad news is that this means a potential flooding of the local market, and a drop in wholesale prices. Recognizing this, local shellfish farmers began advocating development of marketing efforts.

In response, Woods Hole Sea Grant worked with Cape Cod Cooperative Extension and the Southeastern Massachusetts Aquaculture Center to craft a regional marketing effort that created and promoted a clear "brand," similar to Napa Valley wines or Vidalia onions. Dr. Nora Barnes at the University of Massachusetts Dartmouth conducted a survey of consumers and restaurant owners and identified the strengths of the region's shellfish: respondents appreciated that the shellfish were from cold, clean waters, thought highly of the Cape Cod and Islands region, and were impressed with cultured (farmed) shellfish.

Building on this knowledge, the *Cape Cod and Islands Cultured Shellfish* campaign was launched, with a logo, branded gifts, a television commercial, and two invitation-only chefs' events where an array of local farmers presented their shellfish. Both events were well attended and in both cases attendees reported an overwhelmingly favorable response to the shellfish.

With this campaign, local shellfish farmers are exploring new markets and presenting their product as competitive globally.