Print

Woods Hole Sea Grant: Fisheries and Aquaculture

Snapshot

WHOI Sea Grant's investment in fisheries and aquaculture has resulted in the development of better management practices and policies for shellfish harvest and shellfish aquaculture and better understanding of the life history and environmental requirements of commercially important species of fish and shellfish.

Related Files

» PDF: Fisheries and Aquaculture

Background

In Massachusetts, the fishing and aquaculture industries are tightly entwined as needs for both industries are recognized as complementing one another and aquaculture is viewed as an opportunity to fill the gap left by declining wild stocks. Southeastern Massachusetts is especially important in bridging the emerging aquaculture industry with the historically strong fishing industry. This region is the home of the fishing port of New Bedford, the largest fishery port on the U.S. East Coast. In addition, the region also consists of several smaller fishing ports, including Chatham, Woods Hole, Rock Harbor, Sandwich, Scituate, Provincetown, and Plymouth. Southeastern Massachusetts (including Cape Cod and the Islands) is also the focal point for all of the Commonwealth's marine aquaculture industry, focused primarily on the rearing of two bivalve species, the quahog (Mercenaria mercenaria) and the American oyster (Crassostrea virginica). In terms of economic impact, the combined annual income of the fishing industry to this region of Massachusetts was approximately $114 million in 1996 or about 50 percent of the total Massachusetts landings. For aquaculture products, the regional income was $4.5 million in 1995 or about 53 percent of the total Massachusetts income.

In 1995 Massachusetts Coastal Zone Management issued "Massachusetts Aquaculture White Paper," a major document outlining policy needs, technology implementation, and impediments to the aquaculture industry in Massachusetts. From this document a five-year strategic plan for aquaculture was developed. Critical to the development of this plan was the recognition that aquaculture would not replace wild fisheries but serve as an enhancement of wild stocks and create new economic opportunities especially for those displaced by the loss of groundfish resources. WHOI Sea Grant, through the involvement of Dale Leavitt, played a very important role in all aspects of the development of the aquaculture strategic plan for Massachusetts. It is within the context of these efforts that WHOI Sea Grant has focused its Fisheries and Aquaculture theme as a single complimentary unit addressing the problems of wild stocks and aquaculture activities.

Objectives

WHOI Sea Grant's theme in Fisheries and Aquaculture is consistent with the needs for better information on commercial fisheries and the development of new approaches for sustainable aquaculture programs. Within the framework of the NOAA Sea Grant Strategic Plan, 1995-2005, these efforts are focused on three major portfolios: Economic Leadership, Coastal Ecosystem Health and Public Safety, and Education and Human Resources. Within these portfolios there are major strategic initiatives in advanced technology for commercial products, seafood production, coastal economic development, coastal ecosystem processes, public safety, technology transfer, and public outreach. To fulfill our objectives and mandate within the strategic plan, WHOI Sea Grant's theme in Fisheries and Aquaculture has focused on:

- Development of technology and programs to promote stock enhancement of natural fish and shellfish resources, including mechanisms to evaluate the effectiveness of such programs;
- Investigation of larval recruitment of fish and shellfish and the relationship with physical processes in coastal habitats;
- Examination of disease processes in marine organisms with an emphasis on management of diseased stocks to minimize losses to natural fisheries and aquaculture industries;
- Development of training programs to advance technical knowledge in the industry and to educate the general public, legislators, regulators, and researchers on fishery and aquaculture issues.

Sea Grant Involvement

Since 1990 the WHOI Sea Grant program has made an investment in attracting and supporting activities in the fields of fisheries and aquaculture. These efforts have focused on:

(1) Studies on basic life history requirements of commercially important species of fish and shellfish, interfacing with national programs such as GLOBEC and SABRE;

(2) Identification of diseases in marine shellfish and development of practices that minimize the transfer of disease to unaffected stocks;

(3) Application of the tools of molecular biology to better understand the reproductive biology and development of commercially important stocks; and

(4) Development of advisory and outreach activities to foster information transfer, education and development of fisheries and aquaculture programs.

Since 1997 WHOI Sea Grant has carefully integrated its activities in fisheries and aquaculture with those of Barnstable County via the Cape Cod Cooperative Extension and the Southeastern Massachusetts Aquaculture Center (SEMAC). Through Dr. Leavitt's involvement in each of these efforts WHOI Sea Grant presents a well integrated and cooperative effort among academic scientists, regional and state

government, and industry.

Producing Significant Results

Research Support

Investigations into the Prevalence and Mortality Associated with SSO and SSO-like Infections of Crassostrea virginica on the East Coast, U.S., Roxanna M. Smolowitz, Marine Biological Laboratory (R/B-156)

Reducing the Risk of Open Ocean Aquaculture Facilities to Protected Species, Walter Paul and Keith von der Heydt, WHOI Applied Ocean Physics and Engineering Department, and Hauke Kite-Powell, WHOI Marine Policy Center (R/M-43)

Augmenting the Lobster Catch: Oyster Aquaculture in Modified Lobster Traps, Joseph K. Buttner, Salem State College, and Dale F. Leavitt, SouthEastern Massachusetts Aquaculture Center (R/A-43)

Effects of the Asian Shore Crab Hemigrapsus sanguineus in New England: Changes in Resident Crab Populations, Nancy J. O'Connor, University of Massachusetts-Dartmouth Biology Department (R/B-161)

Laboratory Based Transmission of the QPX Parasite in Cultured Hard Clams and Studies on the Progression of the Disease, Roxanna M. Smolowitz, Marine Biological Laboratory, and Dale F. Leavitt, SouthEastern Massachusetts Aquaculture Center (R/A-39)

Understanding the Potential of Offshore Marine Aquaculture: A Bioeconomic Approach, Porter Hoagland, Di Jin, and Hauke Kite-Powell, WHOI Marine Policy Center (R/A-40)

Reproductive Strategies and their Contribution to Genetic Diversity and Life Cycle Flexibility in the Commercially Important Squid, Loligo pealei, Roger T. Hanlon, Marine Biological Laboratory Marine Resource Center (R/B-141)

Behavioral and Hydrodynamic Components of Postlarval Bivalve Transport in Coastal Embayments, Lauren S. Mullineaux, WHOI Biology Department (R/B-142)

Predatory Impact of Lobate Ctenophores on Commercially Important Fishes and their Prey, Laurence P. Madin, WHOI Biology Department (R/B-143)

School Structure and Individual Feeding Behavior of Bluefin Tuna, Thunnus thynnus, Francis Juanes, University of Massachusetts-Amherst Department of Forestry and Wildlife Management (R/B-138)

Development of Phenotypic Markers for Identification of Seeded Scallops, Hemant Chikarmane and Alan M. Kuzirian, Marine Biological Laboratory (R/A-34)

Statistical Modelling of Environmental Effects on Recruitment in Georges Bank Haddock, Andrew R. Solow and John H. Steele, WHOI Marine Policy Center (R/O-31)

Development of Laboratory and Field-Based Techniques for the Detection of Illegally Altered Lobsters, Robert A. Bullis and Roxanna M. Smolowitz, Marine Biological Laboratory (R/E-20)

Toxic Red Tides in Massachusetts Bay: Nearshore Processes and Transfer of Toxins Through the Pelagic Food Web, Donald M. Anderson, WHOI Biology Department, and Jefferson T. Turner, University of Massachusetts-Dartmouth Biology Department (R/B-121)

Biomarkers of Reproductive Damage in Coastal Shellfish Populations from Contaminated Habitats, Dale F. Leavitt, WHOI Biology Department (R/P-54)

Nutritional and Ecological Importance of Protozoans in the Diet of First-Feeding Winter Flounder Larvae, Pseudopleuronectes americanus, Scott M. Gallager, WHOI Environmental Systems Laboratory (R/B-101)

Shellfish Toxicity in Southern New England, Donald M. Anderson, WHOI Biology Department (R/B-100)

Enhancement of Soft-Shell Clam Recruitment in Flow-Generated Larval "Sinks", Lauren S. Mullineaux, WHOI Biology Department (R/B-104)

Extension Support

WHOI Sea Grant Focal Points, fact sheets for legislators and coastal decision-makers:

- Shellfish Diseases and their Control in Local Waters
- Shellfish Aquaculture in Massachusetts
- Shellfish Resource Management in Massachusetts

WHOI Sea Grant Marine Extension Bulletins, technical fact sheets for regional industry, agencies, and professional organizations:

- Federal Crop Insurance for Massachusetts Quahog Farmers
- Clam Tents: A New Approach to Soft-shell Clam Culture and Management

The following workshops:

- Shellfish diseases (Feb. 2000)
- Shellfish constable training (1998-2000)
- Sea scallop aquaculture symposium (World Aquaculture Society meeting, 1998)
- Shellfish upweller nursery (1998)
- Shellfish broodstock genetics (1999)
- Massachusetts sea scallop culture (1994, 1999)
- QPX research (1995-present)
- Review of local (offshore) oil spill contingency plans (1991)

The following programs or special events:

- Development of Best Management Practices (BMPs) for coastal shellfish aquaculture (1999-present)
- Cape Cod Bay Scallop Restoration Project (1999-present)
- Nantucket Bay Scallop Restoration Project (1999)
- Barnstable Harbor Shellfish Restoration Project (BHSREP) (1995-96)
- Conflict Resolution training for Fishermen (1998)
- HAACP Information Workshop for Aquaculturists (1998)
- HAACP training workshops (1997-98)
- Alternate species workshops (shellfish and finfish)/options for aquaculturists (1997)
- Roundtable discussions on growing surf clams and bay scallops (1998)
- Sea Scallop Working Group (1995-present)
- Hard Clam Farmer's Training Program (1996-97)
- Aquaculture for Regulators (1995)
- Quahog farmer's Forum (1996-present)
- Grant writing assistance with Fishing Family Assistance Centers (1994)

Contributions to the Scientific Community

Research projects supported between 1990-2000 have yield numerous advances and discoveries within the scientific community. A few highlights include:

- A study investigating the importance of protozoans in the diet of commercially valuable winter flounder larvae revealed their role in enhancing the growth and survival of young winter flounder, which were shown to assimilate protozoa within 48 hours of hatching. The results of this study were important in understanding the energetics of field populations of winter flounder for the GLOBEC project and for the developing aquaculture industry.
- Several key indicators of reproductive damage in soft-shell clam populations related to high and low contaminant burdens resulted from a mid-1990s study. The project also linked observations of reproductive damage to populations processes, such as reproductive effort. The study also served as the basis for a Ph.D. student thesis.
- Phenotypic markers used for identifying seeded vs. natural bay scallops were the result of a Sea Grant study important to municipal seeding and restocking programs. Bay scallops are one of the most prized shellfish species in Massachusetts and towns invest significant resources (time and money) in ensuring a successful harvest. This project showed that it is possible to identify, and therefore track, seeded scallops and thus document a cost-benefit analysis.
- In different studies, hydrodynamic factors (currents, tides, and waves) were studied for their role in larval transport of commercially important shellfish species. These processes were studied in natural settings and controlled laboratory conditions (a 17-meter flume) and documented.
- Long-finned squid are a commercially valuable species in New England. A series of Sea Grant-supported projects is close to determining whether inshore and offshore populations are distinct. Methods for determining paternity, along with detailed investigations of mating behavior and success, have been analyzed. The research is now in its second phase, implementing molecular tools and techniques for more detailed paternity studies.

- A recent study to determine the economic feasibility of offshore aquaculture operations resulted in a bioeconomic analysis for five species: blue mussels, sea scallops, summer flounder, cod, and haddock. The completed analyses serve as blueprints for the up and coming offshore aquaculture industry and resulted in a test operation growing blue mussels in Rhode Island Sound.
- Shellfish diseases result in huge losses to the shellfish industry -- both wild populations and cultured species -- each year. Understanding the factors controlling disease is crucial. One example, QPX, quahog parasite unknown, is a disease infecting cultured hard clams. Sea Grant investigators were successful in culturing the QPX organism, which allows for transmission of the disease in controlled laboratory experiments. This is a key step in gaining fundamental knowledge about the organism, its mode of infection and transmission, and, eventually, the development of a disease-resistant organism.

Investment in Education

Graduate Student Support: 32 students; 70.95 months
Undergraduate Student Support: 9 students; 7.75 months

Extension-led Teacher Training Workshops on:

- Aquaculture (1998)
- Shellfish Biology (1999)
- Massachusetts Aquaculture in the Classroom (1998-99)

Extension Program courses taught (in collaboration with the Massachusetts Maritime Academy Fisheries Program):

- Shellfish aquaculture (1997-98)
- Shellfish hatchery techniques (1998-99)
- Shellfish culture technology (1999-00)
- Finfish aquaculture (1998)
- Raising fish in your basement (2000)

What it Cost

Research Support (1990-2000):

Sea Grant Funds: $1,543,788
Matching Funds: $968,520
Total: $2,512,308

Last updated: November 6, 2012

Copyright ©2007 Woods Hole Oceanographic Institution, All Rights Reserved.
Mail: Woods Hole Oceanographic Institution, 266 Woods Hole Road, Woods Hole, MA 02543, USA.
E-Contact: info@whoi.edu; press relations: media@whoi.edu, tel. (508) 457-2000
Problems or questions about the site, please contact webdev@whoi.edu