



AQUACULTURE  
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# An Assessment of the Needs of Connecticut's Shellfish Aquaculture Industry

*Tessa S. Getchis*  
*Connecticut Sea Grant Extension Educator*  
*Department of Extension*  
*University of Connecticut*

*“Aquaculture is the controlled cultivation and harvest, in the waters and tidal wetlands of the State, of aquatic animals and plants, including, but not limited to, oysters, clams, mussels and other molluscan shellfish, lobsters and crabs, fish and commercially important seaweed.”*

*-Connecticut Aquaculture Commission*

## **Abstract**

An assessment was conducted to identify the needs of Connecticut's shellfish aquaculture industry. Participants identified and prioritized issues of importance through a mail survey, personal interviews, and an industry summit. Government and public relations, or lack thereof, are major constraints to the industry. Industry members are in favor of streamlining the permitting process, and developing positive relationships with regulatory agencies. Most wish to increase public awareness and acceptance of aquaculture and improve support from other users of the marine environment. A working group is being developed to address these issues through collaborative research, outreach, and education programs.

## **Aquaculture in Connecticut**

Connecticut is a major producer of farm-raised shellfish, with forty companies culturing Eastern oysters (*Crassostrea virginica*) and northern quahogs (=hard clam) (*Mercenaria mercenaria*). Producers are also experimenting with culture techniques for blue mussels (*Mytilus edulis*), razor clams (*Ensis directus*), and macroalgae (*Porphyra* spp.), and have produced bay scallops (*Argopecten irradians irradians*) for restoration purposes. Licensed freshwater operations comprised of salmonids, baitfish, ornamental fish and plant culture remain a small fraction (<5%) of total aquaculture production in the State.

The shellfish industry collectively holds over 67,000 acres of leased bottom in Long Island Sound and generates greater than \$12 million dollars in revenues (Connecticut Department of Agriculture). Connecticut is currently ranked second in New England in aquaculture production and value (Cowan 2003). The State has a rich history in shellfishing and shellfish aquaculture, as scientists and historians have documented the importance of these industries for two centuries (Barber, 1836; Brooks, 1891; Kellogg, 1910; Loosanoff, 1954; Loosanoff and Davis, 1963; Kochiss, 1973; Korringa, 1976a; Matthiessen, 2001; MacKenzie *et al.*, 2002a,b; Carriker, 2004).

*continued on next page*

In the early 1800's, the oyster trade was the leading business in New Haven with more than 300 boats engaged in harvest (Barber, 1836). Milford also became a center for the shellfishing business with fifty to sixty people oystering during that time. Oyster cultivation remained a booming business until the early 1900's when labor shortages, human disease, pollution, habitat degradation, and overfishing all contributed to precipitous declines in harvests. The State's oyster populations rebounded in the early 1970's to 1990's, with nearly one million bushels harvested per year, only to be devastated by MSX disease (causative agent *Haplosporidium nelsoni*) in the late 1990's. Production during those years decreased by approximately 80% due to the infection (J. Volk, personal communication, April 17, 2001). Oyster harvests have remained low since then, varying from 36,000-196,000 bushels per year (Connecticut Department of Agriculture, 2004).

Hard clams were harvested in many locales during the 1800's, but to a lesser degree than oysters. Clam harvesting became more efficient with the introduction of bull rakes in the 1920s; however, the method was abandoned following the introduction of rocking dredges in 1946 (MacKenzie *et al.*, 2002b). In the 1950's, the hydraulic hard clam fishery began with modest harvests by fishermen who were seeking to supplement their income. The fishery and cultivation of clams became increasingly popular in the 1970's due to high market demand and unit value, and, in 2000, clams surpassed oysters as Connecticut's highest valued aquaculture product generating nearly 10 million dollars per year (Connecticut Department of Agriculture, 2004).

Bay scallops have been cultured for the purposes of stock enhancement in the State; however, culture is not yet commercially viable for food production. Although a tremendous amount of research has been conducted on hatchery techniques of this species, largely by the Milford Laboratory of the National Marine Fisheries Service, only a small number of companies have successfully cultivated bay scallops to market size, and the focus of the industry has remained on the production of clams and oysters.

### ***Tides of Change***

During the past decade the industry has begun to evolve slowly from traditional on-bottom culture to surface and submerged culture of shellfish. Great advances in spawning and rearing methods for shellfish (Loosanoff, 1954; Loosanoff and Davis, 1963), and the advent of various types of submersible or floating grow-out gear such as cages, bag and rack systems, and longlines, were the impetus for this shift. The development of commercial-scale hatchery, nursery, and grow-out technology in the 1980's has shown the potential for increased profitability of some sectors of the industry, with the major benefits being ease of harvest, better survival, faster growth and superior product quality (R. Rheault, personal communication, November 15, 2002; K. Rivara, personal communication, February 25, 2003).

Use of this type of gear is, however, relatively new to Long Island Sound. The high visibility of the grow-out gear and associated markers, and the potential for user conflicts and navigational hazards, have caused considerable concern among marine resource users and coastal homeowners.

As marine aquaculture expands and diversifies in Long Island Sound, a number of environmental, regulatory, and socioeconomic concerns have the potential to constrain development of the industry. Therefore, a needs assessment was conducted to identify the key issues and concerns that could be addressed by industry associations, researchers, regulators, and extension personnel.

### ***The Study***

This report summarizes the results from a needs assessment of Connecticut's shellfish aquaculture industry conducted in 2003 by the Connecticut Sea Grant Extension Program. Data were gathered from producers, producer associations, regulators from the State departments of agriculture and environmental protection, and extension agents utilizing: (1) an outreach questionnaire, (2) personal interviews, and (3) a focus group discussion.

A brief questionnaire was sent to each of the 40 licensed commercial shellfish aquaculture companies. The company was asked to list what they believed to be the current top five issues of importance to their industry, and to suggest what those issues might be in five years. Personal interviews were also conducted to discuss these issues in further detail. The information from the questionnaire, personal interviews, and data from previous studies on the Northeast's aquaculture industry (Duff *et al.*, 2003; Leavitt *et al.*, 2003) were compiled and used as the framework for the focus group discussion held at an industry summit in November 2003.

The needs assessment was used to address the following:

- a) prioritize issues and needs
- b) set goals and objectives
- c) develop plan to address issues and needs

Connecticut Sea Grant endorsed this study in an effort to promote environmentally sustainable, socially responsible, and economically feasible marine aquaculture.

### **Industry Response**

Of 40 commercial shellfish aquaculture companies licensed in Connecticut, 17 completed a brief questionnaire and four participated in personal interviews. Individuals representing 30 commercial shellfish aquaculture companies including growers, harvesters, and shippers, and several industry groups and associations and members of the steering committee, met at the industry summit hosted by the Connecticut Sea Grant Extension Program. The results of the study show that government and public relations, or lack thereof, are among the highest priorities of the respondents (Table 1).

A recent change in the permitting system requiring review by several agencies has caused confusion and sometimes miscommunication between industry members and regulators. As the industry's practices have become more visible to the public, social issues have arisen as well, causing conflict with other uses of the marine environment. Growers commented that improving communication with these groups and clarification of the permitting process was a priority.

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Table 1. Responses to issues related to aquaculture.

Average rank of issue were prioritized on a scale of 1 to 3, or lowest to highest priority

Respondents also indicated that it was critical to increase public awareness of the economic and social impacts of shellfish and shellfish aquaculture, and particularly to understand the impacts of their cultivation practices on the environment. Each of the priority areas is discussed in detail in the following section.

### ***Government Relations***

A number of local, state, and federal agencies are involved in shellfish aquaculture regulation in Connecticut. The State Department of Agriculture's Bureau of Aquaculture is the lead agency for aquaculture; however,

multiple agencies including, but not limited to the U.S. Army Corps of Engineers, Connecticut Department of Environmental Protection, and municipal shellfish, harbor management and conservation commissions share roles in various aspects of business planning including site selection, the lease and tenure process, structure permitting, navigational safety, harvesting and water quality, processing and seafood safety, and marketing and promotion.

Often, difficulties in permitting arise because of lack of knowledge or misinformation about the permitting process. This can be exacerbated, especially when several agencies have differing permitting requirements for a single project. The respondents stressed the need to promote the development of a streamlined leasing and permitting process.

#### ***Recommendations:***

- Create opportunities for experimental or exploratory cultivation practices
- Have all local, state and federal permitting information available in one location
- Develop guidelines for aquaculture siting that would promote co-existence with other user groups
- Utilize Connecticut Department of Agriculture, Bureau of Aquaculture, Connecticut Department of Environmental Protection, U.S. Army Corps of Engineers, Municipal commissions, National Marine Fisheries Service's Milford Laboratory, and Connecticut Sea Grant Extension to complete these tasks.



Connecticut's aquaculture industry was built upon the oyster cultivation practices that occurred throughout the 1800's.

### ***Public Relations***

In the past decade, the number of growers utilizing shellfish grow-out gear, e.g. bottom cages, has increased substantially. Within the past five years, the commercial use of grow-out gear has expanded to longlines, and other types of floating and/or submerged aquaculture gear such as trays, pearl and lantern nets, and rack and bag systems. The public has many concerns regarding conflicting and/or competing uses, and these concerns must be addressed. The respondents wish to increase the acceptance of "water column" aquaculture and improve support by marine resource users and coastal land-owners.

**Recommendations:**

- Investigate the causes of social conflicts of the marine aquaculture industry
- Develop a process to prevent user conflicts, focusing on pre-lease application efforts
- Develop an outreach program to educate marine resource users and coastal land owners about the impacts of shellfish and shellfish aquaculture on the environment, economy and society
- Utilize Connecticut Department of Agriculture, Bureau of Aquaculture, Connecticut Department of Environmental Protection, U.S. Army Corps of Engineers, Municipal commissions, Connecticut Sea Grant Extension, and Connecticut Farm Bureau to complete these tasks.



Larry Williams, of Jessie D. Shellfish L.L.C., hauls mussels from his experimental longline system in Milford, Connecticut

**Habitat and Resource Enhancement**

Extensive efforts have focused on enhancing shellfish populations for the ecological role they play in water quality improvement and habitat services they provide for a myriad of marine fishes, invertebrates, and waterfowl, and to supplant recreational and commercial harvesting. Municipal efforts have tended to focus on small-scale enhancement projects, while the State's enhancement program has focused on maintaining historical natural shellfish beds for cultivation purposes.

Due to lack of adequate resources, the natural beds have been neglected and habitat enhancement projects have not been funded. Thus, respondents thought it was critical to design a plan to enhance Connecticut's shellfish resources.

**Recommendations:**

- Evaluate the economic feasibility of rehabilitating the State's natural shellfish resources
- Modify the current annual funding program for the State's natural oyster beds
- Support community-based programs to enhance municipal shellfish resources
- Utilize university researchers, Connecticut Department of Agriculture, Bureau of Aquaculture, Connecticut Department of Environmental Protection, municipal commissions, National Marine Fisheries Service's Milford Laboratory, and Connecticut Sea Grant Extension to complete these tasks



Seed oystermen look forward to rehabilitation of the State's natural shellfish beds. Greater than 80% of Long Island Sound oysters were devastated by MSX and Dermo in the 1990's and populations have not yet recovered.

## Coastal Development

An increase in non-water based uses of the coastal zone has resulted in a lack of adequate waterfront workspace for industry. Cost and demand for waterfront property and dock space is increasing dramatically, and fishermen and aquaculturists are forced to leave or be relocated away from coastal areas. Also, the intrusion of energy lines across Long Island Sound has threatened to render some shellfish beds unusable. Respondents claimed it was necessary to promote a regulatory environment which supports and values the economic, ecological, social and cultural benefits provided by the aquaculture, a water-dependent use.

### Recommendations:

- Demonstrate the economic, ecological, social, and cultural benefits of shellfish aquaculture to government officials, marine resource users and coastal landowners
- Make aquaculture a major component of coastal planning commissions including harbor management
- Protect habitat essential for the growth of shellfish
- Utilize university researchers, Connecticut Department of Agriculture, Marketing Bureau, Connecticut Seafood Council, Connecticut Sea Grant Extension to complete these tasks



Bob Fontana and Luning Sun, of Mohegan Aquaculture L.L.C., grow bay scallop (*Argopecten irradians irradians*) seed for cultivation and restoration purposes.

## Shellfish Aquaculture and the Environment

Shellfish play a critical role in filtering nutrients from the water column, in clarifying water, and in providing essential habitat to a variety of marine organisms. However, submerged and floating shellfish cultivation gear may also have negative impacts on essential marine habitats.

Shellfish cultivation gear, among many other sources, has been implicated as a possible impact to eelgrass (*Zostera marina*) populations, an essential habitat for juvenile fish and shellfish. Eelgrass is the dominant marine plant in Long Island Sound and is protected by State government. Eelgrass is now found predominantly in central to eastern Long Island Sound, but its numbers have decreased dramatically in recent years. Because of the ecological importance of eelgrass, the respondents deemed it is necessary to determine what the impacts were, the degree of such impacts, and to minimize and/ or reduce those impacts on eelgrass.

### Recommendations:

- Evaluate the degree to which shellfish and shellfish aquaculture can affect water quality
- Evaluate the direct and indirect impact of shellfish cultivation gear on eelgrass beds in eastern Long Island Sound
- Utilize university researchers, National Marine Fisheries Service's Milford Laboratory, and CT Sea Grant Extension for these tasks



Use of submerged aquaculture gear, such as cages, racks and bags can increase productivity and growth rates in shellfish, however, there is concern about the interaction with these types of gear and submerged aquatic vegetation.

## Industry Communication

The Connecticut Aquaculture Association is not an active growers association, and thus, there is not a formal communication network for the industry. The Connecticut Seafood Council strives to represent the interests of the State's shellfishing industry; however, it is also responsible to other seafood producers such as lobstermen and fishermen. The Seafood Council is not always able to act on an issue because it may present a conflict of interest among its members. The respondents wished to foster the development of an industry that works together and speaks with a common voice.

### Recommendations:

- Develop a formal Connecticut Grower's Organization, with a Director dedicated to lobbying and running everyday affairs
- Become more involved in local and regional associations such as the CT Seafood Council and the East Coast Shellfish Growers Association
- Utilize marine aquaculture industry and Connecticut Seafood Council to accomplish these tasks.



Ed and Laurie Popadiac, of Pepe's Cream of the Crop, sort hard clams for market. Growers have faced fluctuating market prices recently due to an influx of clams from southern states.

## Market Competition

Due to increased competition in shellfish markets, growers have experienced depressed prices for product. Oyster growers have relied heavily on hard clams since MSX and Dermo decimated oyster populations in the mid-1990's. Lobstermen have also utilized hard clams since their fishery experienced a major die-off in 1999. The Connecticut Seafood Council hosted a Buyers Meeting to discuss strategies to promote sales of Connecticut shellfish in supermarkets. The Council is also attempting to penetrate new regional and national markets. The State Department of Agriculture is attempting to differentiate Connecticut products through its "Home Grown" marketing program. There is a need to find niche markets, and produce value-added products. Respondents wish to maintain a reputation for fresh, high quality, Connecticut-cultured shellfish.

### Recommendations:

- Investigate the potential for product to be distributed through new markets
- Develop stronger marketing programs for Connecticut aquaculture products
- Develop culture techniques for new shellfish aquaculture species in Long Island Sound
- Utilize university researchers, National Marine Fisheries Service's Milford Laboratory, Connecticut Department of Agriculture (aquaculture and marketing), Connecticut Seafood Council, marine aquaculture industry, Connecticut Farm Bureau, and Connecticut Sea Grant Extension to complete these tasks.



Razor clams, a new candidate species for small-scale aquaculture in Connecticut, are cultivated by Captain John Wadsworth of Niantic Bay Shellfish L.L.C.

## Shellfish Health

Connecticut is fortunate to have a shellfish health program led by the Connecticut Department of Agriculture. The State conducts monitoring programs for water quality, water classification, and disease and harmful algal blooms. Diseases of cultured shellfish, such as MSX, Dermo, JOD, SSO and QPX, are a major concern to Connecticut's aquaculture industry. Although these diseases affect shellfish, not humans, their effects can decimate stocks and cause large financial losses to the industry. For example, in the mid-1990's, the State's shellfish resources were severely impacted by disease when more than 78% of the oyster population was destroyed by MSX, and to a lesser degree, Dermo. Harmful algal blooms (HABs) also pose a serious threat to the shellfish industry as they may impact human health. With continuous monitoring, and rapid-response plans in effect, shellfishing areas can be closed and human health protected from these threats. Respondents suggested that in order to have a sustainable shellfish aquaculture industry, it must be based on a healthy and diverse resource.

### **Recommendations:**

- Continue to develop and provide funding for the State's Shellfish Health Program including disease monitoring, management, and the production of disease-resistant shellfish
- Develop rapid-response tests for diseases and harmful algal blooms, and transfer the technology to the grower
- Develop disease resistant shellfish strains and depositories so that seed are readily available to growers
- Develop management practices to prevent the spread or transfer of shellfish diseases
- Utilize university researchers, National Marine Fisheries Service's Milford Laboratory Connecticut Department of Agriculture Bureau of Aquaculture, and marine aquaculture industry to complete these tasks.



Lori Romick serves up fresh Connecticut oysters while educating the public about seafood safety at the Eastern States Exposition. Lori is an environmental analyst with the State Bureau of Aquaculture.

## Research and Outreach

There is minimal interaction among the industry and university researchers. There is a continuous need for scientific and technical support for the aquaculture industry. Research and outreach programs have the ability to answer questions and solve problems. The respondents recommended development of collaborative research and outreach programs that address applied aquaculture issues in Connecticut.

### **Recommendations:**

- Publicize industry needs and priorities through distribution of an annual report.
- Create a formal interaction among industry members, industry associations, educators, regulators, extension agents, and the interested public to develop implementation plans for industry goals and objectives.
- Increase awareness of the economic, social, cultural, and ecological benefits of shellfish aquaculture
- Utilize Connecticut Sea Grant Extension, marine aquaculture industry, Connecticut Farm Bureau, National Marine Fisheries Services's Milford Laboratory, and university researchers to complete these tasks.



The Noank Aquaculture Cooperative, located on the Mystic River, produces oyster, hard clam, and bay scallop seed for its founding companies and also for the State's industry. The Cooperative is also used as an aquaculture teaching facility for vocational-agriculture students across the State.

## ***Fouling Organisms***

Several species of native and invasive fouling organisms such as tunicates, seaweeds, and mollusks, among others, have impacted aquaculture operations by settling on grow-out gear. These fouling organisms not only compete for food but also increase the weight of the gear substantially, causing drag and reducing or restricting water flow. Consequently, labor and maintenance costs can increase dramatically when fouling organisms are present. The respondents stressed the importance of reducing the impact of native and invasive fouling organisms.

### ***Recommendations:***

- Investigate reproduction and development of fouling organisms and provide information to industry members
- Investigate methods for preventing or minimizing the impact of **fouling** organisms on grow-out structures and other gear.
- Develop management practices to prevent the spread or transfer of shellfish diseases
- Utilize university researchers and Connecticut Sea Grant Extension to complete these tasks.



Even native organisms can cause tremendous fouling problems for shellfish aquaculture gear.

## ***Interstate Trade Regulations***

Purchasing and transporting shellfish seed and market product have become major constraints to the industry. Laws vary from state to state making the permitting process difficult at best. The respondents recommended clarification of existing regulations for interstate transport of shellfish seed and product.

### ***Recommendations:***

- Improve coordination among state regulators with respect to health certification requirements for shellfish seed and product.
- Develop and distribute a list of "safe" shellfish shippers by region.
- Utilize USDA's Food and Drug Administration, Connecticut Department of Agriculture, Bureau of Aquaculture, various State environmental protection programs and departments of agriculture, Atlantic States Marine Fisheries Commission Interstate Shellfish Transport Committee, marine aquaculture industry, and Connecticut Sea Grant Extension to complete these tasks.



Shellfish seed must be certified disease-free and come from a State-approved shellfish hatchery before it can be transported into Connecticut.

## **Summary**

Connecticut seafood producers are a strong contributor to Connecticut's economy. The products they cultivate are consistent in size, shape, flavor and hardiness, and as the Connecticut Seafood Council would put it, "*As Fresh As It Gets!*"

The potential for growth and diversification of shellfish aquaculture in Connecticut is tremendous, but several factors have the ability to delay or prevent this from occurring. It is essential to address these issues in order to promote development of this economically and ecologically important industry.

Three of the eleven priority issues of Connecticut's shellfish aquaculture industry deal with communication and relationships among stakeholders. Previous studies have shown that these issues have been expressed industry-wide in the Northeast U.S. (Duff *et al.*, 2003; Leonard *et al.*, 2002; Maine Sea Grant, 2000; Massachusetts Office of Coastal Zone Management, 1995; Anderson *et al.*, 1998).

Industry members stated that a critical issue is most often a lack of understanding of aquaculture processes and methods by some regulators, marine resource users and the public, causing confusion and conflict regarding the siting of operations. State industry members felt it necessary to investigate and address the causes of such social conflicts in order to increase the acceptance of responsible aquaculture, and improve support of these stakeholders.

Extension personnel are now conducting an investigation to reach a better understanding of the nature of conflict over marine aquaculture in Connecticut, and are designing an aquaculture education, outreach and policy program targeted for the public and policy-makers in the State.

In response to the needs assessment, university researchers have also initiated a project to investigate the environmental impacts of shellfish aquaculture gear. The purpose is to provide the industry with the information and tools to move forward proactively in achieving the regulatory compliance needed to assure it can continue to operate in a sustainable manner.

A working group is currently discussing implementation strategies for additional industry goals and objectives. The results of this study have provided a wealth of information from which to draw, and should serve as the rationale for solving industry problems through the development of applied research, education and outreach programs.

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## ***Photo Credits***

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### **Connecticut Seafood Council**

Barbara Gordon  
Executive Director  
195 Wood Pond Road  
West Hartford, CT 06107  
ctseafoodcouncil@aol.com  
www.ctseafood.org

### **Connecticut Farm Bureau Association**

Erica Fearn  
Executive Director  
775 Bloomfield Avenue  
Windsor, CT 06095  
ericaf@cgba.org  
www.cfba.org

### **Ocean Technology Foundation**

Jack Ringleberg  
President  
1084 Shennecossett Road.  
Groton CT 06340  
info@oceantechnology.org  
www.oceantechnology.org

### **Connecticut Sea Grant Extension Program**

Nancy Balcom  
Program Leader  
1080 Shennecossett Road  
Groton, CT 06340-6048  
nancy.balcom@uconn.edu  
www.seagrants.uconn.edu

