

NROC White Paper: Overview of the Aquaculture Sector in New England

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1. Background

This white paper provides an overview of the aquaculture sector in northeastern region of the United States (the coastal waters from Maine to Connecticut). It describes the current status of the sector as well as key issues and trends that are relevant to aquaculture, including issues that provide context but may not be related to ocean planning. The paper was commissioned by the Northeast Regional Ocean Council (NROC) to support NROC efforts to reach out and engage with stakeholders in the aquaculture sector. The paper's intent is to serve as a starting place for discussions between NROC and sector leaders and participants on key issues and challenges facing the sector, recognizing that the content of the white paper will likely be refined based on these discussions.

This draft paper was prepared by George Lapointe¹, consultant on marine fisheries and ocean policy, with input from NROC members. It is based on an analysis of key publications and reports on the sector; it has also been informed by interviews and a web-based survey involving 20 aquaculture sector leaders conducted by NROC staff during summer 2012, as well as feedback provided by sector representatives at a series of working sessions in Walpole, ME, Barnstable, MA, and Groton, CT in December 2012.

The white paper is organized into the following sections:

1. Background
2. Introduction
3. Status of the Marine Aquaculture Sector
4. Issues Facing Aquaculture
5. Inventory of Available Data

2. Introduction

Aquaculture is the farming of aquatic organisms such as fish, shellfish and plants. Aquaculture is conducted in land-based, freshwater, and marine facilities. Worldwide, aquaculture production is expected to grow to about 172,000,000 metric tons by 2021, an increase of 15% over 2009-2011 levels. Additionally, worldwide aquaculture is expected to exceed wild harvest food fisheries for the first time in 2018 and comprise 52% of food fish production in 2021².

¹George Lapointe is a consultant in marine fisheries and ocean policy. Mr. Lapointe served as Maine Commissioner of Marine Resources from 1998 to 2011 which entailed leading the agency's marine aquaculture policy development, site leasing and monitoring, interactions between aquaculture and other marine fisheries, and enforcement of aquaculture laws and regulations. The Maine aquaculture program, under Mr. Lapointe's leadership, worked cooperatively with aquaculture industry members, other fisheries interests, coastal stakeholders, and state, federal, and Canadian resource management agencies to advance sustainable aquaculture in Maine's coastal waters.

² FAO. 2012. The State of World Fisheries and Aquaculture 2012. Rome. 209pp.

In this context, New England aquaculturists are very interested in participating in this growth, taking advantage of the economic activity it entails and helping with worldwide efforts to feed the world's growing population. This paper focuses on marine aquaculture, i.e. aquaculture production in tidal areas of New England. Additionally, this paper focuses on aquaculture for commercial purposes as compared to aquaculture that may be used to enhance wild populations.

Marine aquaculture is the production of organisms, including shellfish, finfish, macroalgae or seaweed, crustaceans and echinoderms in tidal and marine waters, occurring in state waters (shore to 3 miles) and the federal Exclusive Economic Zone (EEZ) (3 miles to 200 miles offshore). Currently, marine aquaculture in New England occurs only in state waters. This is due to a number of factors, including proximity to shoreside infrastructure, sheltered conditions relative to offshore waters, and lack of a regulatory structure for aquaculture leasing and operation in the EEZ.

There is, however, interest by aquaculturists and federal government agencies^{3,4} in developing processes and production leases in offshore waters. There may be less public opposition to offshore aquaculture leases due to fewer conflicting uses of the marine environment, cleaner water, and fewer problems associated with anthropogenic impacts that are common in the near shore environment. A New England example of this interest is a mussel aquaculture operation is currently undergoing the permit review process in federal waters off northern Massachusetts.

Aquaculturists in New England, and elsewhere, participate in restoration aquaculture which uses aquaculture techniques to restore some component of the aquatic ecosystem. A major example of restoration aquaculture is rebuilding oyster reefs for water quality improvement, providing shore zone protection, and to enhance natural oyster populations. Other examples are hatcheries to restore wild fish populations or plant production facilities to provide eelgrass for ecosystem restoration.

3. Status of the Marine Aquaculture Sector

Marine aquaculture in New England currently takes place in each coastal state. This section provides an overview of the marine aquaculture activity in each New England coastal state followed by a summary under finfish, shellfish, and other aquaculture categories.

The state-by-state discussions below use the terms lease, license, or permit because the authority to conduct aquaculture in the individual states requires different types of permission, e.g. lease, license, or permit. The terms are used collectively when discussing multi-state or region-wide issues but the legally appropriate terms are used when discussing individual states.

³NOAA aquaculture policy. 1012.

http://www.nmfs.noaa.gov/aquaculture/docs/policy/noaa_aquaculture_policy_2011.pdf

⁴US Dept of Commerce Aquaculture Policy. 1012.

http://www.nmfs.noaa.gov/aquaculture/policy/2011_policies_homepage.html

3.1 Summary by State

3.1.1 Maine^{5,6}

The State of Maine has an active aquaculture leasing and monitoring system that been in place since the mid-1970's. The leasing process is managed by the Department of Marine Resources with environmental monitoring and compliance of finfish leases conducted by the Department of Environmental Protection for leases that require discharge permits under the Clean Water Act. There are 191 aquaculture leases in Maine waters; 28 finfish leases, 65 standard shellfish leases, 15 experimental shellfish/seaweed leases, and 90+ limited purpose aquaculture (LPA) permits. In total, aquaculture leases in Maine cover 1,333 acres, divided almost equally between finfish and shellfish/kelp/urchin leases. Finfish leases occur from Frenchman Bay to Cobscook Bay and shellfish leases occur from the Scarborough River to Cobscook Bay, and seaweed leases occur in Casco Bay. Many leases are authorized for multiple species. Multitrophic aquaculture is practiced on a number of finfish lease sites.

Species produced on Maine marine aquaculture sites include:

- American oyster
- Atlantic cod
- Atlantic salmon
- Atlantic sea scallop
- Blue mussel
- European oyster
- Green sea urchin
- Quahog (hard clam)
- Seaweed (kelp)
- Softshellclam

In 2010, Maine's aquaculture industry produced 25.5 million pounds of Atlantic salmon with a value of \$73.6 million. The Maine shellfish growers produced 2.9 million oysters (oysters are sold by the piece) with a value of \$1.7 million, and 1.4 million pounds of mussels, quahogs, clams and other shellfish with a value of approximately \$1.35 million. In 2009, the Maine aquaculture sector produced an estimated \$80 million of shellfish and finfish product to the market and produced 625 direct and 200 indirect jobs⁷.

3.1.2 New Hampshire^{8,9}

Aquaculture licensing and enforcement in New Hampshire are conducted by the New Hampshire Department of Fish and Game. There are currently six aquaculture licenses issued in New

⁵Marine Aquaculture in Maine.<http://www.maine.gov/dmr/aquaculture/index.htm>

⁶Maine Aquaculture Association, pers. comm

⁷Morse, D. and M. Pietrak. 2010. Aquaculture Situation and Outlook Report: Maine. Northeast Regional Aquaculture Center. College Park, MD. 11pp.

⁸New Hampshire Sea Grant, pers. comm

⁹LaValley, K. 2010. Aquaculture Situation and Outlook Report: New Hampshire. Northeast Regional Aquaculture Center. College Park, MD. 4pp.

Hampshire, up from 1 license three years ago. These include oyster leases, mussel leases, and one polyculture license in the Piscataqua River for steelhead and blue mussels. There was an offshore aquaculture site located near the Isle of Shoals in state waters that experimented with raising a number of species of finfish and shellfish. The site was licensed in 1999 and had a finfish aquaculture facility until 2009 when funding ran out. The site is now being used for ocean energy experiments and is available for aquaculture when funding is obtained for new work. Additionally, three mussel licenses are issued for New Hampshire offshore waters.

New Hampshire is also home to the Great Bay Aquaculture Company, which has experimented with a number of finfish species for suitability for marine aquaculture, including cod aquaculture in Maine. In addition to their activities with marine aquaculture, Great Bay Aquaculture has a land-based facility in New Hampshire that produces Atlantic cod, and black sea bass, summer flounder, European sea bass, and gildhead sea bream.

Species produced on New Hampshire marine aquaculture sites include:

- American oyster
- Blue mussel
- Steelhead trout

New Hampshire aquaculturists have expressed interest in the following species as having potential to be grown commercially:

- Atlantic cod
- Black seabass
- Bluefin tuna
- Lumpfish (for roe production)
- European oyster
- Razor clam
- Wolffish

3.1.3 Massachusetts^{10,11}

Aquaculture in Massachusetts is managed by the Division of Marine Fisheries and coastal municipalities. In 2011, 349 aquaculture license holders held 378 licenses totaling 1,030 acres. Over the past decade, the number of licenses has varied from 328 to 378 with acreage varying from 935 to 1030. There are no commercial finfish sites in the marine environment in Massachusetts. Permits are issued by municipalities, and there is variation among towns about the receptivity to aquaculture license issuance. Local decision makers are sometimes pressured not to issue permits for aesthetic, space competition, and other reasons.

Species produced on Massachusetts marine aquaculture sites include:

¹⁰ Aquaculture. www.mass.gov/agr/aquaculture/

¹¹ Murphy, D.C., W. Burt, J.K. Buttner, C. Goudy, and C. Hollingsworth. 2010. Aquaculture Situation and Outlook Report: Massachusetts. Northeast Regional Aquaculture Center. College Park, MD. 9pp.

- Oyster
- Quahog
- Soft shell clam
- Bay scallop
- Blue mussel

The 2010 production from these licenses was 71,831 bushels of oysters, 18,398 bushels of hard clams, and 1,815 bushels of soft shell clams valued at \$10.22 million, a significant increase in value from the years of 2001 to 2004 when approximately \$3.5 million of shellfish were produced annually.

A commercial mussel lease application in federal waters off Massachusetts is currently being reviewed. The application is based on an analysis that concluded that a US Army Corps of Engineers (USACOE) Rivers and Harbors permit would be sufficient to permit the activity in federal waters¹².

The issue of co-location of longline mussel aquaculture with the Cape Wind energy project off Nantucket Island was discussed in Massachusetts but has not gotten beyond initial discussions¹³.

3.1.4 Rhode Island^{14,15}

Marine aquaculture in Rhode Island is managed through the Coastal Resources Management Council (CRMC). In 2011, Rhode Island had 43 aquaculture leases totaling 160 acres, 85 acres in Narragansett Bay and 75 acres in South Coastal ponds. Acreage leased for aquaculture increased 12% in 2011.

Species produced on Rhode Island marine aquaculture sites include:

- Oyster
- Quahog
- Softshell clam
- Blue mussel

Oysters, hard clams, and mussels were produced in these leases, but the vast majority of production is oysters. In 2011, Rhode Island aquaculturists produced 4.1 million oysters, 58,400 hard clams, and 3,000 pounds of mussels. The Rhode Island aquaculture industry produced \$3.0 million of product in 2011; \$2.5 million for consumption and \$0.5 million for restoration. The restoration work involved 12 aquaculturists who participated in the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Environmental Quality Incentives Program (EQIP) Oyster Restoration in 2011.

¹²National Sea Grant Law Center. 2012. Offshore mussel culture operations: current legal framework and regulatory authorities. National Sea Grant Law Center. University, MS. 19pp.

¹³Mass. Dept. of Agriculture, pers. comm

¹⁴ Aquaculture in Rhode Island: 2011 Status Report. <http://www.crmc.ri.gov/aquaculture/aquareport11.pdf>

¹⁵Rice, M.A. and D. Leavitt. 2010. Aquaculture Situation and Outlook Report: Rhode Island. Northeast Regional Aquaculture Center. College Park, MD. 8pp.

The Rhode Island aquaculture industry employed 84 people in 2011.

3.1.5 Connecticut^{16,17}

Marine aquaculture in Connecticut is managed through the Department of Agriculture, Bureau of Aquaculture. Shellfish aquaculture leasing in Connecticut is done by municipalities and the state, with municipalities leasing approximately 20,000 acres and the state leasing 53,091 acres in 2010. The state leases are segregated into 674 franchised beds (over 100 years old and conferring some ownership provisions) of 22,422 acres and 326 shellfish leases of 30,669 acres.

Species produced on Connecticut marine aquaculture sites include:

- Oyster
- Bay Scallop
- Quahog
- Seaweed (Sugar kelp)

The Connecticut shellfish aquaculture industry produces over 450,000 bushels of hard clams and 200,000 bushels of oysters annually with a value of over \$30 million in 2010. Bay scallops and sugar kelp were grown commercially for the first time in 2012, but on a very small-scale. More specific production figures are not available, because some significant aquaculture producers in Connecticut stopped reporting of aquaculture production numbers after a legislative proposal to tax aquaculture production was made public.

The marine aquaculture industry in Connecticut supports about 300 jobs annually.

To promote its aquaculture industry, the state will submit a legislative proposal in 2013 to allow limited preferable treatment to small scale and start up aquaculture ventures obtaining shellfish leases and to create a licensing system for seaweed or algae production in state waters. The state has also improved the aquaculture permitting process. The state is also working to develop an incubator Aquaculture zone on 1000 acres of existing shellfish beds to assist aquaculture start-up operations.

3.2 Summary of Shellfish Aquaculture in New England

Shellfish aquaculture is widespread and common in New England, with over 1500 leases, permits, and licenses for place-based aquaculture. Leases, licenses, and permits are terms established in law or regulations to allow place-based aquaculture in the various states. They provide some time period of restricted or exclusive use of an area with protection of the shellfish stock in the area. The combined number of sites where aquaculture is practiced (which can be by lease, license and/ or permit as required by appropriate state statutory or regulatory framework) by state, is Connecticut - 998, Rhode Island - 43, Massachusetts - 300, New Hampshire - 6 and Maine – 164. Species raised on these leases include:

- American oyster

¹⁶Bureau of Aquaculture.<http://ct.gov/doag/cwp/browse.asp?A=1369>

¹⁷Getchis, T. and R. Pomeroy. 2010. Aquaculture Situation and Outlook Report: Connecticut. Northeast Regional Aquaculture Center. College Park, MD. 11pp.

- European oyster
- Quahog
- Blue mussel
- Softshell clam
- Green sea urchin
- Atlantic sea scallop
- Bay Scallop

The value of shellfish aquaculture in New England is between \$45 and \$50 million of dockside value at point of first sale (also called farmgate value), with oysters being the most valuable product being raised.

Shellfish aquaculture is primarily a business of small, family owned companies in New England. Many of the aquaculturists come from fishing families and communities with many recent industry entrants looking for economic diversification from wild harvest fisheries that they are, or have been, engaged in.

The future growth potential for shellfish aquaculture in New England is significant. Current demand for high quality shellfish has resulted in a strong market for aquaculture shellfish. This optimism is tempered by other producers, who recall when significant increases in production in the past caused significant price drops that took a number of years to return to previous levels. This “boom and bust” cycle had very significant impacts on industry profitability.

3.3 Summary of Marine Finfish Aquaculture in New England

The vast majority of finfish aquaculture in New England is salmon aquaculture in Maine. Other finfish aquaculture in New England includes, or has included, cod and halibut in Maine and cod, steelhead trout, haddock, halibut, and black sea bass in New Hampshire. There are 27 finfish leases in Maine and 1 in New Hampshire.

The finfish aquaculture sector in New England produces over 25 million pounds of fish, almost entirely Atlantic salmon, with a market value of over \$73.5 million. This production comes from a small number of companies because all Atlantic salmon aquaculture production in the US is conducted by Cooke Aquaculture, a large New Brunswick based company. Most other finfish aquaculture companies or interests are small operations that are family owned or have investment backing, and much of the interest in aquaculture comes from people who are former or current fishermen, or come from a background that includes commercial fishing.

Cod aquaculture has been conducted in Maine and New Hampshire on an experimental or limited commercial basis. Factors influencing cod aquaculture include production costs, lack of suitable broodstock, and cost competition with wild harvest cod and other similar species.

Halibut aquaculture has been permitted in Maine but full-scale commercial operations will likely require sea cages with hatchery and early grow out being conducted on land. Halibut aquaculture in the rest of New England may develop over the next decade experimentally or as start up operations. The economics of halibut aquaculture will be helped by a limited supply of wild caught alternatives to farm raised fish and a consistently high market price for halibut.

Steelhead trout aquaculture in New Hampshire has potential because of favorable feed to fish conversion ratios, good market value, and the technologies for salmonid production are proven for Gulf of Maine waters.

Other finfish species that were mentioned for aquaculture production in New England are black sea bass, bluefin tuna, wolf fish, and lumpfish. The development of commercial scale aquaculture for these species will depend on:

- Understanding the reproductive cycle of these species for spawning and hatchery production of juveniles
- Production of broodstock with favorable growth rates, conversion rates, and disease resistance characteristics for aquaculture production
- Potential impacts on wild stocks similar to concerns about the impacts of farm raised salmon on endangered wild stocks
- Market demand and price relative to wild caught alternatives
- Availability and development of suitable sites and a sufficient number of sites for commercial scale production and processing

The economic outlook for finfish aquaculture will depend on many factors, including:

- Investor confidence in finfish aquaculture, which is influenced by:
 - Aquaculture investment potential in other countries and regions
 - Perceived opportunities for return on investment in New England states
 - Perception of regulatory stability and burden for aquaculture in New England states
 - Perception of aquaculture being on a level playing field relative to other ocean use activities in New England, i.e. is aquaculture prioritized as a legitimate activity in New England's ocean waters
- Availability of suitable lease sites for future activities
- Prioritization of aquaculture as a legitimate activity for economic growth relative to willingness of managers to “take the heat” for siting issues

3.4 Other Aquaculture Species or Interests

Production of seaweed or macroalgae on aquaculture sites is occurring in Maine and New Hampshire for food production and polyculture where plants are grown in association with shellfish and/or finfish. In Maine, there is currently one company producing kelp for food. This company has three leases but is interested in expanding to meet demand for its products. One permit has been granted and an application is undergoing review for small-scale kelp aquaculture in Connecticut. Regionally, there is much interest in kelp aquaculture ; a recent workshop on kelp aquaculture held in Maine was attended by people from as far as New Jersey. There have been aquaculture operations for nori, a seaweed used for sushi wrappers, in Maine in the past. Currently, some leases in Maine permit nori aquaculture but it is not being produced.

The New Hampshire lease site cultures steelhead trout and kelp together so that the kelp can take up nutrients released by the fish.

There is also interest in aquaculture production of nutraceuticals (products that reportedly provide health and/or medical benefits), pharmaceuticals, and kelp for fertilizer and fish feed, in addition to more traditional food production.

3.5 Existing Laws, Policies, and Programs Affecting Aquaculture in New England

This section discusses some federal actions, e.g. laws, policies, initiatives, that impact aquaculture in New England. There are many federal initiatives, such as funding or laws, that may impact aquaculture without mentioning it directly. This section concentrates on key federal issues impacting the aquaculture industry; briefly discussing the issues and describing potential impacts on the aquaculture industry.

3.5.1 Laws and Legislation

National Aquaculture Policy Act¹⁸

The National Aquaculture Policy Act of 1980 (P.L. 96-362, as amended) made it national policy to promote aquaculture industry and production, established a national aquaculture policy implementation plan, encourages public and private aquaculture activities, and establishes the Department of Agriculture as the lead federal agency for aquaculture information.

Although the law contains few requirements, it sets the tone for agencies, states, researchers, and companies to promote policies and spending to advance the interests of the aquaculture industry and to increase aquaculture production.

National Sustainable Offshore Aquaculture Act of 2011¹⁹

It is clear that much work remains to be done to follow the spirit of this law with respect to the promotion and development of sustainable aquaculture in the US. There have been numerous bills introduced in Congress to further define the Nation's aquaculture policies, including the permitting of aquaculture in the EEZ where much promise is seen for marine aquaculture expansion. The latest Congressional bill regarding offshore aquaculture permitting is H.R. 2372, the National Sustainable Offshore Aquaculture Act of 2011.

H.R. 2372 would establish an Office of Sustainable Aquaculture in National Marine Fisheries Service. Other provisions of the bill require preparation of regional programmatic Environmental Impact Statements (EIS) for permitting of offshore aquaculture. Further, it would prohibit the issuance of aquaculture permits until an EIS is completed. The bill also establishes a permitting system for offshore aquaculture sites and prohibits culture of species regulated under the Magnuson-Stevens Fishery Conservation and Management Act. H.R. 2372 prohibits permit issuance without concurrence of appropriate Regional Fishery Management Council and provides for state opt out and notice to the adjacent states for applications with locations less than 12 miles offshore.

An analysis of this bill by the preparer of this report suggests that, while establishing a system to protect the environment and other ocean uses, the regulatory and legal process established in the bill

¹⁸National Aquaculture Act of 1980. http://www.nmfs.noaa.gov/sfa/sfweb/aqua_act.htm

¹⁹National Sustainable Offshore Aquaculture Act of 2011. <http://www.gpo.gov/fdsys/pkg/BILLS-112hr2373ih/pdf/BILLS-112hr2373ih.pdf>

would do very little to encourage offshore aquaculture development or experimentation. The programmatic EIS requirements, monitoring and enforcement requirements, costs for permits and resource rent, and lawsuit provisions create a financial and regulatory burden sufficiently high to discourage aquaculture development in the EEZ.

3.5.2 Policies

National Ocean Policy, National Ocean Policy Implementation Plan

The National Ocean Policy²⁰, developed by the current Administration, recognizes that America's stewardship of the ocean and coasts is linked to environmental sustainability, human health and well-being, national prosperity, adaptation to climate and other environmental change, social justice, foreign policy, and national and homeland security. The National Ocean Policy Implementation Plan²¹, written to provide for coordinated ocean policy implementation at the federal level, identifies aquaculture in two sections. The first discussion emphasizes providing scientific information to support emerging sustainable uses of resources including renewable energy, aquaculture, and biotechnology. The second discuss emphasizes improving the efficiency of permitting of ocean, coastal, and Great Lakes uses, with an initial focus on aquaculture permitting.

NOAA reports that there is progress being made on permitting efficiencies in shellfish aquaculture with the USACOE moving toward a programmatic permit for routine leases, applying models developed in Maryland and Virginia. This is described as a streamlined process for “in the box” permits, i.e. those that are routine in design and scope. Larger, more complex, and controversial projects will still require individual permits.

NOAA, Commerce Aquaculture Policies²²

In 2012, NOAA and the US Department of Commerce issued policy statements on aquaculture, which are very similar. The NOAA Policy statement is that “a successful NOAA program will meet public needs for aquaculture development and environmental protection” which will focus on: 1) research, development, and technology transfer; 2) financial assistance to businesses; 3) environmental safeguards including regulatory and permit procedures; and, 4) coordination. It states further that these priorities will be incorporated into the aquaculture-related activities of NOAA agencies.

3.5.3 Programs

²⁰Final Recommendations of the interagency Ocean Policy Task Force.2010.
http://www.whitehouse.gov/files/documents/OPTF_FinalRecs.pdf

²¹National Ocean Policy Draft Implementation
Plan.<http://www.whitehouse.gov/administration/eop/oceans/implementationplan>

²²NOAA aquaculture policy. 1012.
http://www.nmfs.noaa.gov/aquaculture/docs/policy/noaa_aquaculture_policy_2011.pdf

National Shellfish Sanitation Program²³

The National Shellfish Sanitation Program (NSSP) is the federal/state cooperative program recognized by the U.S. Food and Drug Administration (FDA) and the Interstate Shellfish Sanitation Conference (ISSC) for the sanitary control of shellfish produced and sold for human consumption. The purpose of the NSSP is to promote and improve the sanitation of shellfish (oysters, clams, mussels and scallops) moving in interstate commerce through federal/state cooperation and uniformity of State shellfish programs. Participants in the NSSP include agencies from shellfish producing and non-producing States, FDA, EPA, NOAA, and the shellfish industry.

The NSSP affects all shellfish production in the US, including shellfish aquaculture. The public health provisions of the NSSP have significant impacts on aquaculture producers in New England through growing area closures, product handling requirements, and labeling. Growing area closures and product handling requirements impact shellfish producer's ability to harvest and market their product. Restricted ability to provide product to market at the times and quantities needed by dealers and retailers makes New England aquaculture products less viable in regional and national markets.

Bureau of Ocean Energy Management (Department of Interior)

In the last few years, there has been discussion and interest in co-locating aquaculture operations with offshore wind energy projects. This interest is concurrent with the growing interest in offshore, renewable energy production. The co-location offers promise because of infrastructure associated with the offshore energy project such as mooring systems and transportation between shoreside facilities and offshore wind energy sites, infrastructure that could be used to support aquaculture facilities. Co-location is also seen as a way to take advantage of site evaluation and leasing processes for energy projects and to avoid conflicts between aquaculture and other ocean users because of site use restrictions for offshore energy leases, e.g. fishing and boating limits or prohibitions, aimed at protecting energy production infrastructure also serving to protect aquaculture production infrastructure.

The suitability of wind energy sites further offshore for aquaculture may be reduced because of longer travel times needed to get to and from shore to wind energy sites and offshore weather and sea conditions requiring stronger, likely more expensive cage systems to withstand offshore conditions. Additionally, the recent expansion of natural gas production with a concomitant decrease in natural gas prices will likely have a significant dampening effect on the development of operational offshore wind energy projects or sites.

A recent research paper concluded that collaboration between offshore energy production and mussel aquaculture would mainly suit the mussel farmer and that there is a very weak incentive for a

²³National Shellfish Sanitation Program.<http://www.fda.gov/Food/FoodSafety/Product-specificInformation/Seafood/FederalStatePrograms/NationalShellfishSanitationProgram/default.htm>

wind farmer to cooperate from a balance sheet perspective. Increases in risk and transactions costs from collaboration may further erode the minimal incentives for co-location²⁴.

Co-location of aquaculture and ocean wind energy facilities is being done in Europe but the permitting, energy cost recovery, and regulatory foundation for the wind energy industry in European countries may be sufficiently different from what is found in the US making comparisons between the US and Europe of limited value.

Regional Aquaculture Centers, USDA / NRAC

The USDA Northeast Regional Aquaculture Center (NRAC) was established by federal law in 1987 to encourage cooperative and collaborative aquaculture research and extension educational programs with regional application. It serves as a focal point to assess needs, establish priorities, and implement research and extension educational programs in twelve states, Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, West Virginia, and the District of Columbia. NRAC also provides coordination of interregional and national programs through a National Coordinating Council for Aquaculture (NCC).

NRAC periodically produces a series of documents on the status of aquaculture in all northeastern states (Maine through Virginia) which discuss trends and issues affecting the aquaculture operations and institutions in the region. The last published version of these updates was in 2009; a 2012 version is being prepared for each state in the region.

4. Issues Facing the Aquaculture Sector

The aquaculture sector in New England faces many issues, both short term (1-2 years) and long-term (5-10+ years), which are briefly described in the following paragraphs. Not all of these issues directly relate to regional ocean planning, but they are all important to understand aquaculture sector issues in broad regional context.

4.1 Business Development / Economic Issues

4.1.1 Demand for Quality Seafood

Domestic per capita consumption of seafood has remained fairly steady, between 15 and 16 pounds per capita, since 2000²⁵. Worldwide, per capita consumption of fish products for food has increased from 38 pounds to 41 pounds kg from 2006 to 2011²⁶. This consumer demand for healthy protein and food creates an economic climate that is attractive to the aquaculture industry. Additionally, there is an emphasis on reducing the US trade deficit; domestic aquaculture producers want to be a part of this shift.

4.1.2 Workforce / Professional Development, Ongoing Education

²⁴Griffen, R. 2011. The economics of integrated offshore wind energy and aquaculture. Integrative Graduate Education and Research Traineeship poster. National Science Foundation. Washington, DC

²⁵NMFS. 2011. Fisheries of the United States 2010. Current Fisheries Statistics No. 2010. Washington, DC. 102pp.

²⁶FAO. 2012. The State of World Fisheries and Aquaculture 2012. Rome. 209pp.

A significant issue for the New England aquaculture industry is workforce and professional development opportunities, including continuing education. As with other developing fields, aquaculture is rapidly evolving and the industry workforce needs to remain current to maintain competitiveness. Consequently, some aquaculture interests think that investment is needed in professional development and ongoing education.

In New England, there are currently high school aquaculture programs in Connecticut, Rhode Island, Massachusetts, and Maine. Additionally, there are post-secondary aquaculture education programs in all five New England coastal states.

4.1.3 Funding Opportunities and Capital for Aquaculture

As a relatively new industry which has public controversy associated with it, opportunities for funding and acquiring capital are limited relative to other industries. The result of this is that small companies find it challenging to get the financial backing needed for aquaculture business start-up or expansion. Some aquaculture stakeholders believe that this issue is a major impediment to expansion of marine aquaculture in New England.

4.1.4 Marketing Program Development

Many aquaculture interests think that developing a coordinated product marketing program would benefit the aquaculture industry broadly, which could then benefit individual aquaculture businesses by increasing demand for aquaculture products. This is an issue that is mentioned as a competitive disadvantage relative to other countries (see paragraph below).

4.1.5 Uneven Competitive Advantage Relative to Other Countries

An issue that is raised by New England aquaculture interests is their lack of competitiveness relative to the aquaculture industry in other countries. Factors that contribute to this competitive disadvantage include:

- government subsidies directly to industry
- government funding of marketing and promotion
- government development and maintenance of aquaculture broodstock
- national trade policies favoring internal commodity production
- national environmental policies,
- labor costs
- insurance
- permitting process relative to other countries

4.1.6 Lack of industry wide insurance programs to cover catastrophic losses

Some aquaculture interests think that the lack of an industry wide insurance program, similar to crop insurance programs for agricultural products, as well as disaster assistance, is a significant economic issue facing the industry. Although there have been some instances of government programs to help cover losses from events such as widespread red tide events, there is not an comprehensive insurance or disaster assistance program available for the entire aquaculture industry. Some growers may buy private insurance policies but the cost is significant, or can be prohibitive, depending on the

size and financial strength of individual companies. Aquaculture interests also see the issue of subsidized crop insurance being provided to some parts of agriculture as one of overall fairness; i.e. equivalent programs should be available to all food producers.

One program for insuring aquaculture products does exist. The USDA Risk Management Agency has a pilot crop insurance program for quahog aquaculture²⁷

4.2 Research and Development Issues

4.2.1 Development of Offshore Aquaculture Techniques

The development of aquaculture in the EEZ will require equipment and techniques that will withstand the higher energy environment of offshore areas. While relatively little work has been done on offshore aquaculture equipment technology in the US, there is much work being conducted in other countries. For development of aquaculture in the EEZ, technology development will include adapting technologies developed elsewhere to US waters and conditions. Aquaculture interests believe that this can best be done with a public / private partnership for the information transfer, fabrication, and testing of offshore equipment and to determine the aquaculture techniques that are needed for successful grow out of aquaculture species and workplace safety and operational issues unique to offshore aquaculture.

4.2.2 Land-based aquaculture with a connection to marine waters

Land-based aquaculture that is directly connected to marine waters is an important issue for New England aquaculturists. Shellfish hatcheries that provide oysters for grow-out on aquaculture sites use flow-through seawater systems to provide clean water needed for reproduction and growth of oyster spat. There is also interest in land-based production of finfish which allows stable grow-out facilities as compared to the more dynamic marine conditions that are subjected on floating pens. Issues associated with land-based aquaculture include local zoning requirements, permits required for discharge water, and construction and operating costs.

4.2.3 Broodstock Development and Maintenance

The development and maintenance of broodstock for aquaculture species is a foundation issue for the success of shellfish and finfish aquaculture operations. Aquaculture broodstock development selects for growth, survival, and disease resistance, which are all critical elements of successful aquaculture operations. Broodstock development and maintenance is often seen as a function that public institutions can do effectively so that broodstock is maintained and developed as well as being available for smaller aquaculture operations. Other states and countries support their aquaculture industry by engaging in broodstock development and maintenance, e.g. disease resistant oysters in Virginia or salmon broodstock in Norway. For New England aquaculture operations to be competitive relative to producers in other countries, there needs to be an investment in broodstock development and maintenance. Limited broodstock production facilities could limit expansion of aquaculture in New England.

²⁷ USDA. 2012. Cultivated clam pilot crop insurance underwriting guide. www.rma.usda.gov/handbooks/24000/2012/24100.pdf

Development and maintenance of broodstock with growth and disease resistance traits provides industry members with an advantage in survival, growth and, ultimately, economic return. An example was provided by an industry member that cod aquaculture experiments in Maine yielded fish of the same stocking class that ranged in size from 12 to 22 inches. Selecting broodstock from the faster growing fish would provide future fish for stocking with superior growth rates as had been done with Atlantic salmon aquaculture.

4.2.4 Disease Resistant Oysters

Successful oyster aquaculture requires the availability of broodstock resistant to diseases such as MSX and Dermo, both of which can cause significant mortality in wild and aquaculture stocks. Because disease organisms persist in the environment once introduced in an area, the long term viability of oyster aquaculture in New England requires that disease resistant oysters be available for stocking and grow out. The issues associated with developing disease resistant oyster strains are one component of broodstock development and maintenance, which is discussed in the previous paragraph.

4.2.5 Development of New Aquaculture Species

An issue of interest to aquaculturists is the development of new species for aquaculture production. New species production would allow for expansion into new markets, possible diversification within companies and states, and expansion into areas that may be less suited for the commonly produced aquaculture species. Development of new aquaculture species requires determining what the reproductive cycle of new species is so that aquaculture stock can be raised for grow out, determining appropriate culture techniques and equipment for successful production of new species, and finding or developing a market for products from the new species.

An example of a potential new species is the razor clam - a case where numerous parties in New England are cooperating to determine how to spawn and grow out razor clams for commercial production, currently funded by the Northeast regional Aquaculture center (USDA).

4.2.6 Development of Nutraceuticals and Pharmaceutical Products

The development and culture of nutraceutical (products that reportedly provides health and/or medical benefits) and pharmaceutical products is seen as a potential growth area for New England aquaculturists. For example, the Gulf of Maine has approximately 1,800 species of which about 50 are used commercially. The potential use of some of the species that are not currently used for nutraceuticals and pharmaceuticals may lead to the culture of new species by New England aquaculturists.

4.3 Management and Regulatory Issues

4.3.1 Understanding of Regulatory Requirements

The state and federal regulatory requirements for aquaculture site exploration, leasing, and maintenance, aquaculture operation and management, public health issues, and environmental compliance are complex, voluminous, and often hard to understand. This is clearly not an issue

narrowly focused on aquaculture in New England but it has significant impacts on the investment and business climate for aquaculture.

Additionally, the overlapping jurisdiction of multiple agencies at the state and federal level can lead to a significant slowing of permitting and review processes, confusion and sometimes competition among agencies, and lack of clarity for aquaculture interests.

For small aquaculture operations, understanding the regulatory requirements can be difficult and can add significant burdens on already busy entrepreneurs. For larger operations, regulatory compliance adds significant cost and time burdens on companies. The difficult regulatory requirements can also be an impediment to new investment and participation in aquaculture.

The aquaculture industry has long sought a more streamlined leasing / permitting / licensing process that would allow one government point of contact, i.e. “one stop” permitting, for needed government approval by state and federal agencies.

4.3.2 Development of New Management Strategies for Multiple Use

Some states and the federal government have policies in place promoting the expansion of environmentally and economically sustainable aquaculture. However, these policies are not effective without implementation strategies to address significant issues such as how to share the ocean environment. Aquaculture interests think that the status quo for managing ocean uses does not work effectively or efficiently for uses that don't currently occur in some areas or for uses that want to move into areas that are currently being used by other activities.

Some aquaculture interests have expressed a concern that siting and multiple use strategies favor commercial fishing and other users and work against aquaculture interests in spite of shellfish aquaculture taking place for many years in most New England states. They think that a new, more comprehensive multiple use strategy is needed to allow aquaculture to expand significantly.

Many aquaculturists express the concern that they are the “last priority use”, i.e. that they are only able to get use of areas that nobody else is interested in and that they are held to a higher standard of review and monitoring than other, more traditional ocean users. They believe that this results in benign neglect or actual discrimination by legislators and policy makers toward aquaculture interests.

4.3.3 Improving Leasing, Licensing, and Permitting Systems for State Waters

The leasing, licensing or permitting system that controls aquaculture siting and monitoring in state waters in New England is seen by some aquaculture interests as slow, expensive, and cumbersome which retards expansion of aquaculture. Some aquaculture interests think that state leasing, licensing, or permitting systems can be improved significantly to reduce the time and investment needed for proper regulatory consideration of lease requests and maintenance. Other aquaculturists expressed the view that permitting processes had improved significantly, were understandable, and that the time required for permit consideration was not too long.

The involvement of multiple state agencies in aquaculture permit review is perceived by most aquaculture interests as an impediment to development of the industry because it slows policy

development and review processes, can result in agency “turf” guarding, and can reduce investor interest in the aquaculture sector.

An issue that varies among the states is what regulatory process is used to allow aquaculture and the stability that provides for business development and operation. Some states use a permitting process to allow aquaculture while other states provide leases. Permits are seen as being shorter term as compared with leases and are also seen as being more vulnerable to changes in permit conditions and restrictions that could impact aquaculture operations and profitability.

4.3.4 Development of Federal Waters Aquaculture Permitting System

Expansion of shellfish and finfish aquaculture in the US EEZ (3-200 miles offshore) will require a number of issues to be addressed before significant investment will be made in offshore aquaculture in New England. One major impediment is the lack of a permitting system for US EEZ aquaculture operations. There have been discussions about what an effective permitting system should include and there have been bills introduced in Congress to establish a federal waters permitting system. However, as described later in this paper, a number of the bills contain provisions that will effectively block, rather than promote, aquaculture development in the EEZ. Aquaculture interests think that an effective leasing system for federal waters operation is a necessary first step in allowing serious consideration and investment in federal waters.

Another issue in the development of a federal aquaculture system is whether permission is granted via a permit as compared with a lease. Similar to state waters aquaculture, a lease is seen as being more long-term and less likely to have provision changes as compared to a permit.

Many aquaculture interests believe that a coordinated program of technology development and transfer, financing assistance, and affordable crop insurance are critical components of developing offshore aquaculture in New England.

4.3.5 Lack of Trust in Management and Regulatory Agencies

Some aquaculture interests lack trust in management and regulatory agencies. Part of this lack of trust may be due to various government agencies having different, potentially conflicting, roles with respect to aquaculture, e.g. three agencies with permitting, environmental oversight, and promotion, respectively, of aquaculture. This is not solely an issue between aquaculture and management / regulatory agencies but reflects a larger trend in society. Regardless of the reasons for the lack of trust, future expansion of aquaculture in state or federal waters requires enough trust for appropriate working relationships and partnerships to develop between the aquaculture industry and government agencies.

4.3.6 Management and Regulatory Agencies Ability to Support Aquaculture

Government oversight, support, and promotion of aquaculture, as it currently exists, requires staffing and funding to conduct the required leasing / permitting / licensing, monitoring, compliance, enforcement, and promotion of aquaculture activities. At the state level, budget and staffing restrictions limit agency ability to conduct ongoing and new activities, including aquaculture. Aquaculture interests are concerned that these constraints will make it harder to obtain and maintain leases, and to expand into new aquaculture areas or species.

Although the federal government has been less constrained by funding and staffing issues as compared with states, the current federal fiscal climate of large deficits and the trend toward curtailed federal spending will likely result in federal funding and staffing constraints similar to those seen in states.

4.4 Space Use and Leasing Issues

4.4.1 Working Waterfront Access

Activities that occur on coastal waters such as aquaculture and commercial fishing require waterfront space that allows consistent, largely unrestricted use of docks, piers, landings, and other shoreside facilities to store equipment, provide access for aquaculturists to their vessels and lease sites, and to bring product to shore for processing and shipping. The shift in US population to coastal areas, the ability of noncommercial users to pay high prices relative to affordability by aquaculturists and other commercial users, and the shift away from facilities dedicated to traditional ocean users all impact the amount of working waterfront sites available to aquaculture operations. This makes water access and usual business practices harder to find or maintain and takes more time on the part of aquaculture operators. The availability of adequate working waterfront facilities is seen as a critical component of developing the aquaculture industry in offshore waters.

Conversion of working waterfronts is a nation-wide issue. Aquaculture interests are concerned that the ongoing loss of working waterfront sites reduces the business viability of current aquaculture operations and lessens interest in expansion of aquaculture in New England as well as in other areas. Many aquaculture interests think that there is insufficient government attention and funding being directed at this issue because once sites are converted away from working waterfront there is a very low likelihood of reconversion to aquaculture or commercial fishing industry use.

4.4.2 Aquaculture Site Availability

The availability of suitable sites for shellfish and finfish aquaculture limits the ability of current aquaculture operations to expand and for new aquaculture businesses to get started in New England. For example, salmon aquaculture in Maine requires three sites for rotational management that is required for disease management. In shellfish, close proximity to other sites raises concerns about shellfish disease transmission and, in some areas, competition for algae available for filtering in a given area is raised as an issue that could limit leases. Consequently, aquaculture operations look for additional sites that meet business and environmental constraints to begin or expand operations. Site availability can be constrained by environmental conditions, proximity to landside components to aquaculture operations, the leasing / permitting / licensing systems in New England states, social constraint issues (as discussed below), and competing ocean space users. Aquaculture interests believe that social and political pressures are the greatest impediments to aquaculture in New England.

4.5 Public Health Issues

An issue of great concern to the aquaculture industry is water quality in the near shore environment, including bacterial pollution, hypoxia / anoxia stemming from coastal eutrophication, and toxic algal blooms. These environmental effects directly impact the ability of aquaculture operations to handle

or market their products. Aquaculture interests also have an interest in factors impacting water quality because clean water is a strong positive marketing factor for their products, i.e. better water quality produces better product. This is an important factor that can significantly impact market acceptance of aquaculture products if people perceive that the product isn't coming from clean water.

4.5.1 Red Tide and Bacterial Closures

Shellfish growing area closures occur in specific segments of the coast in response to elevated levels of biotoxin / pathogenic organisms, e.g. red tide, or bacterial contamination to protect public health. Shellfish growing area closures impact aquaculturists and wild harvesters. The unpredictability of the timing and size of shellfish growing area closures can have a significant impact on aquaculture operations by restricting when and where they can harvest shellfish from aquaculture sites which makes it very difficult for aquaculturists to market their product in a consistent, predictable way. A usual agreement between aquaculturists and shellfish retailers is to provide a specific amount of shellfish at a specific time, predictability that many retailers need to know in advance to advertise their products effectively. Shellfish growing area closures prevent the predictable delivery of aquaculture products to these markets.

Aquaculture interests are clearly interested in protecting public health but they are also concerned about public health regulations being more restrictive than necessary to protect public health. Aquaculture interests believe that public health regulations and restrictions should be risk based, i.e. based on examining available data to develop effective but not overbearing public health measures.

Some aquaculturists see public health regulations as preventing shellfish from being used for habitat restoration and water quality improvement projects. This prevents non-profit / public benefit aquaculture from being used for environmental improvement projects.

Additionally, aquaculture interests, and other shellfish harvesters, are concerned about the impacts of government budgetary and staffing reductions on the ability of the regulatory community to address public health closures and issues in a timely and effective way.

4.5.2 Impacts of Time and Temperature Restrictions on Aquaculture

The National Shellfish Sanitation Program (NSSP) requires that states implement shellfish regulations to protect the public from bacterial and biotoxin toxicity that may result from shellfish consumption. One component of NSSP regulations includes time and temperature requirements for shellfish handling. These regulations require a maximum time that shellfish can be held above a certain temperature, i.e. shellfish products must be cooled to a certain temperature within a specified time window to meet NSSP requirements. The time and temperature requirements apply to wild harvest and aquaculture shellfish products, impacting shellfish growers by requiring new and potentially expensive equipment. More significantly, the time and temperature requirements impact aquaculturist's work and market supply activities when harvesting shellfish off an aquaculture site. These requirements make it more difficult to supply markets in a timely, efficient way, resulting in reduced competitiveness.

Some aquaculture interests believe that public health regulations are developed with insufficient data resulting in overly restrictive regulations that do little to protect public health. Additionally, they believe that there is insufficient communication between agencies with public health responsibilities and aquaculture interests in the development and implementation of public health regulations, including time and temperature restrictions.

Many shellfish harvesters do not understand the need for additional public health restrictions on shellfish harvest when they perceive that the aquaculture industry has a good track record regarding public health.

4.6 Environmental Issues

4.6.1 Ocean Acidification

Climate change is a concern for many people in New England and the United States. Although controversial with some people, the general idea is that society has increased the emissions of carbon in the atmosphere which causes, among other things, increased temperature and increase deposition of carbon in the ocean. The deposition of carbon in the ocean results in the formation of acid compounds which causes pH to trend lower, i.e. acidifying the ocean.

This is a concern of aquaculturists for a variety of reasons. There is a general concern that factors negatively impacting the ecosystem are inherently bad for humans and the natural environment. Second, increased acidity stresses organisms which in turn reduces growth rates and reproduction, both of which are critical components of successful aquaculture operations. Last, acidification directly affects shellfish because of the calcium in their shells. Ocean acidification may reduce the ability of shellfish to reproduce, change from larval to adult form, grow, and reduce their ability to withstand attacks by shellfish predators. Ocean acidification may also change the species under cultivation as aquaculturist's adapt by selecting for species that are more tolerant of acidified conditions.

This is a long-term issue outside the control of New England aquaculture interests because controlling ocean acidification will require coordinated, long-term global efforts. It is included on this list of issues because of concern expressed by some members of the aquaculture industry.

4.6.2 Environmental Impacts of Aquaculture

One of the issues that is mentioned in discussions about the appropriateness of aquaculture is that shellfish and finfish aquaculture has environmental impacts that are unknown or harmful^{28,29}. These impacts can become influential parts of considering whether to grant an aquaculture lease, license, or permit. This paper does not claim to judge the strength or truth of the listed impacts but, rather, to note the range of impacts discussed by proponents and opponents of aquaculture

Negative impacts discussed range from excessive feed and waste deposition from finfish pens, escape of finfish into the marine environment, littering, deposition of pseudofeces (waste) from shellfish culture, to shellfish taking too much plankton out of the water column. Positive impacts

²⁸ Shumway, S.E. (ed.) 2011. Shellfish Aquaculture and the Environment. Wiley-Blackwell. Hoboken, NJ. 528pp.

²⁹Hargrave, B. (ed.) 2005. Environmental Effects of Marine Finfish Aquaculture. Springer Science-Business Media LLC. New York, NY. 467pp.

discussed include ameliorating coastal eutrophication by concentrations of shellfish in aquaculture operations and a reduced need to fish for stressed wild stocks.

Aquaculture interests believe that research should be done on these purported impacts so that discussions about aquaculture can be as factually based as possible and, when there is a negative impact, to work toward solutions that minimize or eliminate the impacts.

4.7 Social Issues

4.7.1 Coastal Community Acceptance

The acceptance of aquaculture operations by coastal communities is a major concern for aquaculture interests in New England and elsewhere. This concern can be divided into two broad categories.

The first, and primary, category is the public resistance or “not in my backyard” (NIMBY) views that many aquaculture interests have heard or been affected by in leasing / permitting / licensing proceedings. This concern is expressed in terms of a particular location not being suitable for aquaculture and that another location would be better suited for the aquaculture operation in question. This would not be a concern if the sentiment was infrequently voiced but the issue is heard commonly enough to impact individual aquaculture businesses and to dampen the investment and acceptance climate for aquaculture development in New England. Increased human population growth in New England coastal areas will likely increase this pressure in the future.

The second category of social acceptance is the categorization of aquaculture as a “dirty” economic activity from an environmental perspective by some advocacy groups or members of the public. Aquaculture interests view this broad brush approach as an unfair characterization of what they believe is a sustainable, environmentally benign activity. They believe that public policy on aquaculture should include an awareness or education process to show the positive impacts of aquaculture and to dispel misconceptions and false information about the industry.

4.7.2 Aesthetics of Aquaculture Operations

The aesthetics of aquaculture operations is a concern that has been voiced by members of the public and policy makers as a reason to not support aquaculture leases, licenses, and permits. The broad concern is that aquaculture operations “don’t look nice” or don’t fit into the local ambiance, which subsequently can affect people’s sense of place and the attractiveness of a location for residents and visitors. This concern is partially one of scale; larger operations with more equipment in the water have a larger visual profile as compared to smaller operations or bottom culture aquaculture. This issue has also been raised in part because some aquaculture operations are, or have been, messy or unattractive or that the cumulative impact of multiple aquaculture operations reduces the aesthetic appeal of a particular location.

There is a concern that the aesthetics of aquaculture operations or facilities are being singled out as compared to other ocean uses of a local area. For example, some shellfish operations using buoys to float shellfish or cages or to mark ropes have been described as being unattractive when lobster pot buoys or mooring buoys are viewed as being acceptable or even part of the attractive attributes of a local area. The OysterGro™ system, which raises oysters in floating cages through the production

cycle, was specifically mentioned as a newer technology the use of which was limited by concerns about aesthetics.

With respect to aesthetics and place, aquaculturists question whether they are being unfairly targeted because they are a new, non-traditional use of an area as compared with objective concerns about local aesthetics.

4.7.3 Impacts on Adjacent Land Values

Concern has been expressed by some members of the public that establishing aquaculture operations may diminish the value of adjacent properties. The potential for decreased property values is an obvious concern for landowners who are worried that their home values may be negatively impacted by a new aquaculture operation nearby. Potential property value reductions are also a concern of local and state officials because of concern for impacts on residents and homeowners and because of the impacts that reduced property values have on local revenues.

Aquaculturists believe that this issue should be researched objectively because they do not believe that the concern for reduced property values is supported by facts. Rather, they are concerned that this issue is used as a scare tactic in leasing, licensing, and permitting proceedings.

4.7.4 Education of public and policy makers about aquaculture

Aquaculturists are concerned that members of the public and policy makers do not have objective or sufficient information about aquaculture to assess the impacts of aquaculture operations on other issues of concern to the public, e.g. environmental impacts of aquaculture operations, impacts on property values, impacts on other ocean users, and the benefits of aquaculture operations.

To counter these concerns, aquaculturists think that a public education effort is needed to provide objective information about aquaculture so that the public and policy makers can make better informed decisions about individual lease / permit / license applications as well as the development of rational aquaculture policy at the state and federal levels.

Aquaculture interests see the need for more communication to the industry and about the industry to assist industry members and to improve the acceptability of aquaculture generally and individual lease sites in the future. The issues raised by industry members regarding communication include:

4.7.5 Permitting Information

Industry members would like better communication about the permitting process in a way that is clearly articulated and easy to find and access. Aquaculturists would also like to be informed about the anticipated timeline for the permitting process.

4.7.6 Use and potential use of different areas

Some aquaculture interests believe that it would be useful to have a compilation of all stakeholder uses of the resource, and identification of low conflict areas and high conflict areas for aquaculture development.

To assist with site selection, some industry members believe that more area specific information should be available including: pH levels, oxygen levels, water temperature, chlorophyll concentrations, and species distribution of algae.

4.7.7 Impacts and benefits of aquaculture

Industry members suggested that more information should be gathered and shared about the environmental impacts of aquaculture (at a useful scale, since data is often too general), as well as the quantified benefits of aquaculture (to illustrate whether perception matches reality).

4.7.8 General information about aquaculture

Aquaculture interests believe that policymakers should better understand how the industry works, what technology it uses, and what its needs are, as well as the financial implications of the regulations they impose. Proponents and practitioners of aquaculture think that the government should better understand that successful aquaculture works within the ecological limits of a site.

5. Inventory of Available Data

5.1 Federal

USDA Statistical Office, National Agricultural Statistics Office, Census of Aquaculture³⁰

A national compendium of aquaculture information that is done periodically, last published in 2005, is currently being updated. This document contains a (1) summary of aquaculture products by state, (2) species, size categories by state, (3) aquaculture acreage by state, (4) aquaculture employment and payroll by state.

This document has useful, comparative information for the states but does not contain detailed data beyond the comparison tables. This makes it interesting and useful for comparison but it is likely not a useful information source to inform ocean planning in New England.

Fisheries of the US³¹

An annual, national compendium of fishery (aquaculture and wild harvest) issues including management, production, price, and trade issues. Information tables on aquaculture include the US production and value of aquaculture species and the worldwide production of wild harvest and aquaculture species.

5.2 Maine

The following data sets are available on the Maine Department of Marine Resources website^{32,33}:

Number and location of aquaculture leases

³⁰2002 Census of Aquaculture. 2005. <http://www.agcensus.usda.gov/Publications/2002/Aquaculture/aquacen2005>

³¹NMFS. 2011. Fisheries of the United States 2010. Current Fisheries Statistics No. 2010. Washington, DC. 102pp.

³²Marine Aquaculture in Maine. www.maine.gov/dmr/aquaculture/index.htm

³³Public Health Shellfish Program. http://www.maine.gov/dmr/rm/public_health/index.htm

Pending lease applications
Aquaculture production by weight and value
Information on areas open for shellfish harvest

There are also maps of leases by area on the Maine Department of Marine Resources website³⁴.

5.3 New Hampshire

New Hampshire has information on areas open for shellfish harvest and areas that prohibit aquaculture, e.g. Great Bay Estuarine Reserve, available on maps. Information on individual lease site local is not publicly available³⁵.

Information on production volume or values is not available because of data confidentiality laws that prohibit publication of information that comes from less than three sources because of the concern that information on individual or individual operations could be deduced with fewer sources.

5.4 Massachusetts

Maps of shellfish growing areas for all Massachusetts coastal waters are available online³⁶.

Information on lease site location, size, species cultivated, and production is available upon request from the Massachusetts Division of Marine Fisheries.

5.5 Rhode Island

The following information is available on the Rhode Island Coastal and Marine Resources Council website³⁷ and in annual status reports written by the Council, e.g. 2011 Annual Status Report³⁸:

Number of leases
Location of leases by bay or pond
Aquaculture production by weight and value

Digital maps of coastal pounds with aquaculture lease sites are being developed by RI CMRC staff³⁹.

5.6 Connecticut

Connecticut has approved and pending aquaculture lease sites in geographic information system (GIS) format that is publicly available via a site selection tool⁴⁰ and mapped by area on the Department of Agriculture website⁴¹. The site includes data layers on shellfish area markers,

³⁴Aquaculture Lease Inventory. <http://www.maine.gov/dmr/aquaculture/leaseinventory/index.htm>

³⁵ Open / Closed Areas. http://des.nh.gov/organization/divisions/water/wmb/shellfish/open_closed.htm

³⁶ Designated Shellfish Growing Areas. <http://www.mass.gov/dfwele/dmf/programsandprojects/dsga.htm#shelsani>

³⁷ Aquaculture. <http://www.crmc.ri.gov/aquaculture.html>

³⁸ Aquaculture in Rhode Island: 2011 Status Report. <http://www.crmc.ri.gov/aquaculture/aquareport11.pdf>

³⁹ RI CMRC, pers. comm.

⁴⁰The Shellfisheries Mapping Atlas. <http://clear2.uconn.edu/shellfish/>

⁴¹Shellfish Area Classification & Maps. <http://www.ct.gov/doag/cwp/view.asp?a=3768&q=478054>

sampling stations, marinas, shellfish beds, shellfish growing area classifications, natural features, surface water quality, navigation and other features.