

Aquaculture Strategic Plan

EXECUTIVE SUMMARY

Why Develop a Plan for Aquaculture in Massachusetts?

Aquaculture offers tremendous opportunities for the Commonwealth of Massachusetts, especially during a time when the state's fishing industry has been so hard hit by reductions in groundfish stocks. This growth industry can provide jobs that are much needed in the seafood sector of the economy. In addition, aquaculture represents a sustainable economic use of our coastal resources -- which means that aquaculture activities can be continued into the future, providing economic opportunity without depleting non-renewable resources.

With our wealth of diverse marine and freshwater resources, world class research institutions, concentration of marine technology firms, and strategic location to serve one of the world's largest seafood markets, Massachusetts is a natural place for extensive aquaculture. Up to this time, however, the full opportunities provided by aquaculture have not been seized upon, largely due to a number of regulatory barriers. Now is the time to develop a plan to remove these regulatory barriers so that the future of aquaculture in the Commonwealth can be secured.

The Aquaculture Strategic Plan explains where we are now and where we are going with aquaculture in Massachusetts. It is the tool that is needed to form a framework to support aquacultural activity, both private and public, and to encourage the growth of this industry during a critical stage of development.

Who Developed the Plan?

The plan was developed by three working groups: the Environmental Review Working Group, the Regulatory Reform Working Group, and Economic Development Working Group. These working groups were brought together by the Secretary of the Executive Office of Environmental Affairs, Trudy Coxe, at the request of Governor William F. Weld. These groups are made up of specialists in different aspects of aquaculture and resource management and have been overseen by an Aquaculture Steering Committee, led by Undersecretary of Environmental Affairs Leo Pierre Roy.

When Will the Recommendations Be Implemented?

The Aquaculture Strategic Plan has a five year horizon, concluding in the year 2000. The Plan proposes a series of both short and long-term recommendations. The short-term actions will not require any changes in legislation or regulations and

include projects that can be implemented utilizing existing or reprogrammed resources. Many of these short-term recommendations also require no funding, only redirected staff attention or policy change. The long-term recommendations require either legislative action, regulatory change, or significant financial appropriations. Now is the time, however, to begin the process so that these recommendations can be implemented by the turn of the century.

What Does the Plan Include?

The Aquaculture Strategic Plan includes 68 specific recommendations for the State to implement to overcome existing constraints and take advantage of opportunities in the aquaculture industry. Of these 68 recommendations, the following were identified as priorities for action:

- Initiate regulatory streamlining recommendations.
- Establish an interagency Aquaculture Coordination Team (ACT) to oversee implementation of Strategic Plan and to guide State aquaculture activities.
- Establish an Aquaculture Coordinator position to serve as a single point of entry for all existing and prospective aquaculturists. The Coordinator will lead ACT and provide the link between all State agency activities relating to aquaculture, both regulatory and promotional. Additionally, the Coordinator will be charged with spearheading the implementation of this Plan.
- Establish a broad-based Aquaculture Advisory Group to advise ACT on issues of concern.
- Direct all aquaculture related bond appropriations toward priorities identified in the Strategic Plan.
- Work with municipal officials, the Department of Marine Fisheries, and shellfish aquaculturists to improve and standardize the administration of shellfish licenses to improve the prospects for obtaining financing for aquaculture ventures.

These and the other recommendations are explained in detail throughout the plan, which is broken down into the following chapters:

- Chapter 1 defines aquaculture, characterizes the size and potential for the industry in Massachusetts, and justifies why the State should actively encourage aquaculture.

- Chapter 2 outlines the priority overarching recommendations of the Plan and includes the proposed agency framework.
- Chapter 3 summarizes specific steps to streamline aquaculture permitting.
- Chapter 4 includes the recommendations for promoting the economic development of aquaculture.
- Chapter 5 details a recommended approach for siting and monitoring the environmental impacts resulting from aquaculture.
- Chapter 6 summarizes the report and lists all the recommendations.
- A glossary which includes all acronyms utilized in report is found on page 63.



Chapter I

INTRODUCTION

What is Aquaculture?

On a technical level, aquaculture is defined as "the manipulation of marine or freshwater organisms and/or their environment before eventual release, harvest, or capture; the controlled cultivation and harvest of aquatic animals and plants" (USDA National Aquaculture Development Plan, 1983). On the popular level, however, aquaculture is sometimes referred to as "fish farming." For the purposes of this Strategic Plan, the term "aquaculture" will include all aspects of the technical definition and will discuss the industry and science as a whole.

"Marine aquaculture" or "inland aquaculture" will be used to differentiate between the location and nature of the type of aquaculture. "Marine aquaculture" includes structures (trays, pens, enclosures, nets, etc.) that are located in or on unaltered marine waters. "Inland aquaculture" includes facilities on land including, in some cases, freshwater wetlands. Inland aquaculture utilizes ponds, tanks, and enclosures that are dependent upon the culturist for maintenance of water quality, food supply, and waste removal. Certain facilities and culturing technologies that do not fit squarely within either category will be identified throughout this Plan. Examples of aquaculture that involves both inland and marine components are: the culture of anadromous and catadromous species, hatcheries, and recirculating systems that withdraw from and discharge into marine waters.

When the term "aquaculture" is used in this Plan it includes both public and private operations. There is widespread interest in the Commonwealth in both privately owned and operated aquaculture activities, as well as enhancement and propagation efforts that will augment recreational and commercial harvests. In addition, this Plan advocates public/private aquaculture partnerships.

What Is the Purpose of the Aquaculture Strategic Plan?

The economic realities of the fisheries declines coupled with the economic opportunities associated with increased demand for fish and fish products means that the interest in aquaculture is growing rapidly. While many other states and nations have taken steps to support aquaculture in their jurisdictions, Massachusetts has lagged behind. Currently, there are a myriad of regulatory and legal impediments to the development of a successful aquaculture industry in the Commonwealth. Now is the time, therefore, to break down these barriers and ensure that aquaculture can be effectively pursued in this state.

The Aquaculture Strategic Planning process marks the first coordinated effort to support aquaculture in Massachusetts. The Strategic Plan represents the foundation for addressing the complex, multifaceted issues associated with aquaculture and removing unnecessary impediments to the aquaculture industry. This effort represents a five year planning process and will build a long-term structure for aquaculture development. The Strategic Plan is not intended to "solve" all aquaculture related issues now, but rather it is designed to chart a course for identifying key issues and solving problems in a cooperative and comprehensive manner.

What Is the Aquaculture Strategic Planning Approach?

In December of 1994, Governor William F. Weld requested that the Executive Office of Environmental Affairs (EOEA) initiate a strategic planning process to investigate the potential for aquaculture in Massachusetts and determine why the Commonwealth lags so far behind many of our neighboring states in this industry. Governor Weld further directed EOEA to put together broad-based, but focussed, Working Groups to craft recommendations on how the State can overcome some of the constraints that aquaculture faces in Massachusetts.

In response to the Governor's request, Secretary Trudy Coxe organized three Working Groups: the Regulatory Reform Working Group, the Environmental Review Working Group, and Economic Development Working Group. These groups met regularly for the first half of 1995 and initiated a strategic planning process, which included site visits to aquaculture facilities, discussions with industry and potential aquaculturists, international literature reviews, four regional public meetings, and over 40 working meetings. The recommendations developed by the Working Groups are found in Chapters 2, 3, 4 and 5.

To provide oversight and direction to the Working Groups, a broad based Aquaculture Steering Committee comprised of representatives from private industry, academia, government, the Legislature, and the restaurant trade was formed. The Steering Committee met monthly with the Chairs of the Working Groups.

Aquaculture Projections

If the recommendations included in this Plan are successfully implemented, it is projected that by the year 2000 Massachusetts could realize¹:

- *An increase in marine acreage under commercial shellfish cultivation from 645 acres (1994) to 1600 acres.*
- *An increase in full and part-time aquaculture jobs from 131 today to 740.*
- *An increase in farm gate value of shellfish from approximately \$4 million (Bush and Anderson, 1992) to \$27 million.*
- *An increase in farm gate value of finfish produced in inland facilities from approximately \$4 million (Bush and Anderson, 1992) to \$16 million.*
- *An increase in farm gate value of shellfish and finfish produced in offshore facilities from zero today to \$2 million.*
- *A total farm gate production increase from \$8 million (NRAC, 1992) to \$45 million.*

What Is the Status of the Aquaculture Industry in Massachusetts?

Managed cultivation of shellfish and crustaceans in Massachusetts originated with the native Americans and was adopted by the early settlers on Cape Cod. It was not until the 1970's and 1980's, however, that efficient and viable hatchery and grow-out techniques were proven effective on a larger, commercial scale.

Today, aquaculture in Massachusetts is estimated to be about an \$8 million dollar industry (Bush and Anderson, 1993). The industry is roughly split between inland and marine aquaculture in terms of economic value. The inland industry is comprised primarily of a handful of highly technical recirculating facilities located primarily in the western part of the state (with one on Cape Cod). These facilities produce hybrid striped bass, tilapia, trout, and other finfish. The marine aquaculture industry in Massachusetts mainly produces quahogs (hard clams) and oysters, with small quantities of scallops, soft shell clams, and mussels. The marine

¹ Assumptions: 20% increase per year in shellfish leases over the course of planning period (five years). An estimated production value of \$30,000/acre for the most efficient, well-managed operations (640 acres or 40% of leased areas) and a lower average of \$8,000/acre for the remaining operators (960 acres or 60% of leased acres). The employment numbers were generated utilizing data compiled by NRAC on employment and production in the Northeast Region. Total estimated employment for both full and part time employees in the NE region (2,400) was divided by the total regional production (\$146,409,000) and resulted in an estimated \$61,004/employee. \$61,004 was then divided into the total Massachusetts production for the year 1992 (\$8,000,000) and into the projected 2000 production (\$45,000,000) to result in an estimated 131 jobs today and 740 jobs in the year 2000.

aquaculture industry is concentrated on Cape Cod and the Islands with some producers on the South and Southeastern Shores.

Put in perspective, the Massachusetts aquaculture industry is small. Worldwide Total Aquaculture Production in 1992 is estimated to be \$32.5 billion (FAO, 1995). The U.S. Total Aquaculture Production in 1993 was over \$810 million (NMFS, 1995). In the Northeast Region in 1992, Massachusetts was the fifth largest aquaculture producing state after Connecticut (\$61.7 million), Maine (\$42.9 million), Pennsylvania (\$11.9 million), and New York (\$9.6 million) (NRAC, 1993).

What Is the Potential for Aquaculture in Massachusetts?

Without a doubt, Massachusetts enjoys a competitive advantage for aquaculture in terms of access to fresh and marine waters, excellent port and processing facilities, world class research institutions, a highly educated work force, and established markets and distributions links. Despite the factors that inhibit aquaculture in the state (i.e., a highly developed coastline, multiple competing uses of the coast, a redundant regulatory system, legal issues, and a misunderstanding of aquaculture by the public and the fishing industry) our state clearly has the potential to support a thriving aquaculture industry.

The potential for aquaculture to expand in the Commonwealth is dependent on several considerations. This Plan is meant to overcome some of the anthropogenic constraints, such as regulatory framework, business climate, public acceptability, and user conflicts. Other, more environmental constraints, such as tidal range, exposure, biological parameters, flushing rates, and temperature are not easily overcome. On balance, however, Massachusetts has the potential to weigh in as an extremely competitive location for aquacultural activity.

Why Should the State Support this Industry?

Fish, fishing, and fishermen are deeply rooted in Massachusetts' history and traditions. In fact, when the settlers came to Massachusetts, our eastern-most shores were named Cape Cod because of the abundance of fish. Today, however, many of our traditional groundfish stocks have been severely depleted. Aquaculture is a means to continue our fishing traditions in the face of declining wild fish stocks. The harvesting of wild stocks can not be sustained at the levels experienced in recent decades. Aquaculture can be used to augment the wild harvest, which will undoubtedly be fished at lower intensities than in the past.

When sited and managed properly, aquaculture is an environmentally compatible industry that requires consistently high water quality. By encouraging aquaculture, the Commonwealth can enjoy a diversified economy in areas of limited year-round employment while ensuring the protection of a critical resource -- water quality.

The success of aquaculture is, in many ways, dependent on enhanced and sustained water quality. It is essential that local, state and federal resources continue to be mobilized at controlling both point and non-point sources of pollution.

Aquaculture in its many manifestations offers jobs ranging from the highly technical to the basic and supports numerous spin-off and support industries. The aquaculture industry and the jobs it creates are also sustainable, which means that aquaculture activities, if implemented using good husbandry practices, can be carried on indefinitely. Aquaculture products can also assist in diversifying the fresh fish available to consumers, wholesalers and retail markets.

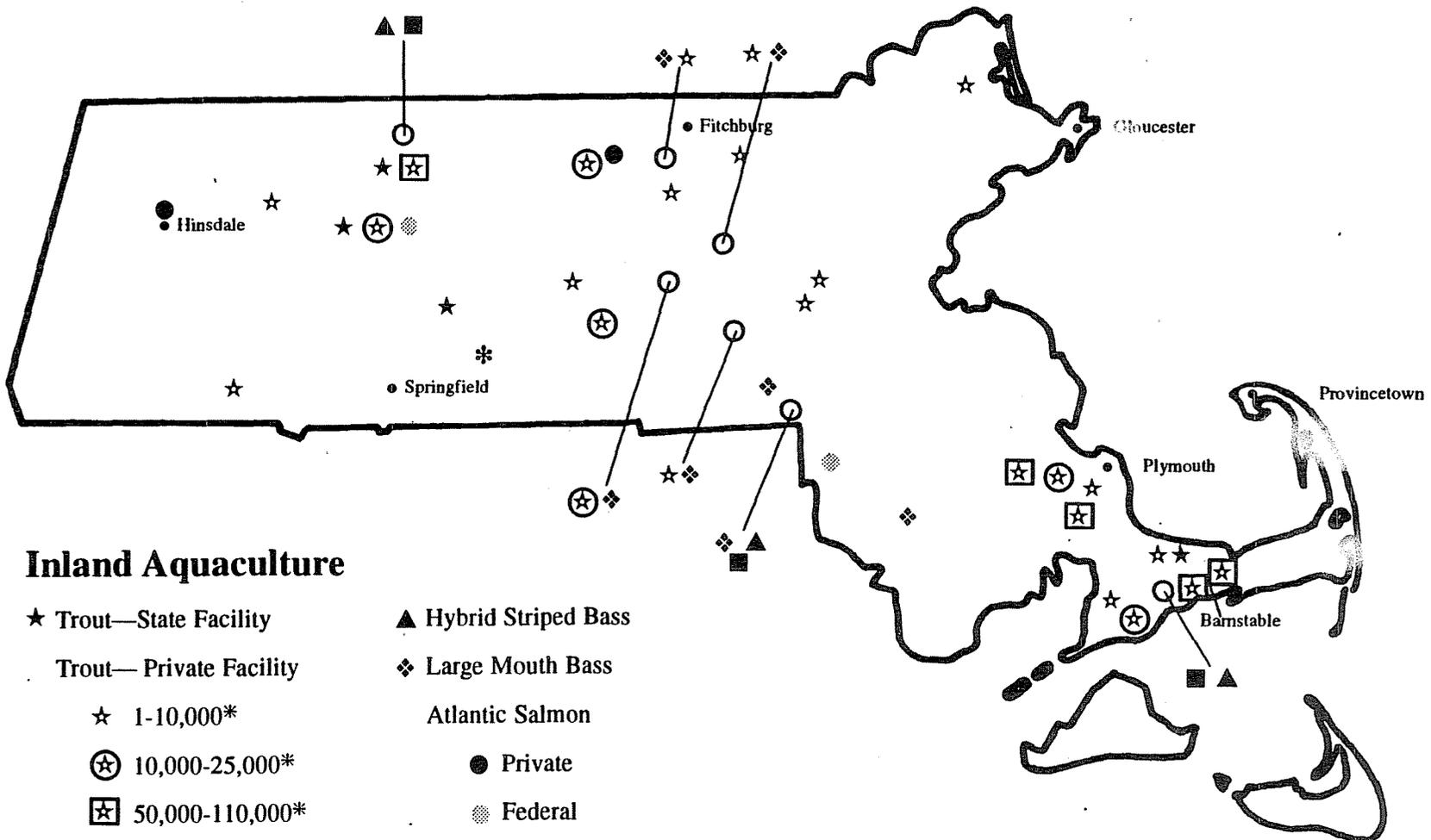
The Need for Balance

The Commonwealth recognizes the need to support aquaculture in a manner that is compatible with the other existing uses of Massachusetts' waters and uplands. Specifically, diverse needs (such as private property rights, public access, the wild fishery, navigation, and recreation) that aquaculture will compete with must be analyzed. Without question, aquaculture must be balanced with other compatible activities. A balance can be struck, however, because all these activities have much in common -- and most importantly, they all require sustained high water quality.

Rather than being a divisive issue, aquaculture in Massachusetts can function as an opportunity to galvanize disparate interests to work toward common goals including: diversified, sustainable economies for isolated rural areas, both inland and marine; remediation of contaminated areas; improved viability of non-productive areas; minimized upland sources of point and nonpoint pollution; and education of our children on the value of a healthy ecosystem that can support renewable natural resource-based food production.

Graphic 1

Inland Aquaculture



Inland Aquaculture

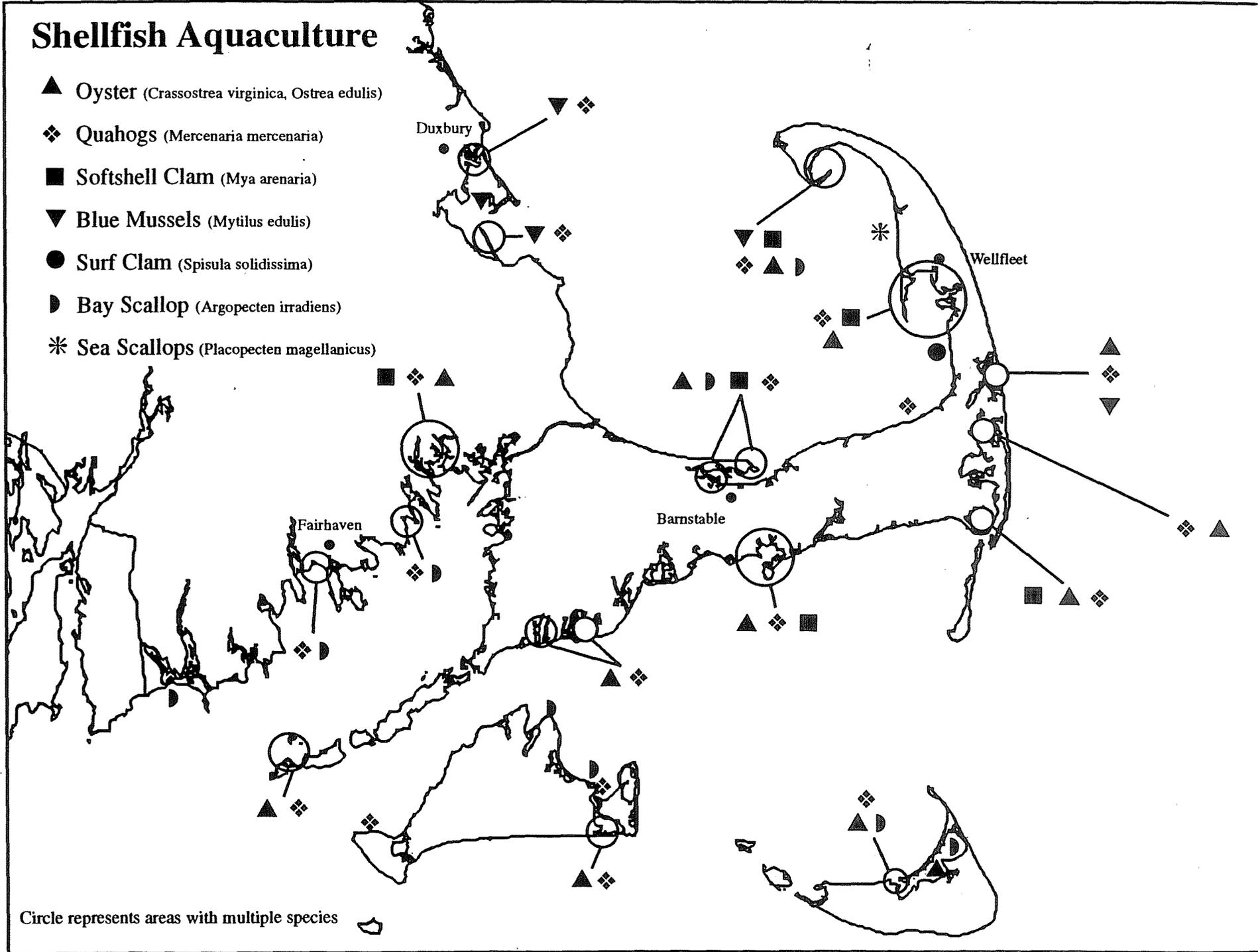
- ★ Trout—State Facility
- Private
- ☆ 1-10,000*
- ⊙ 10,000-25,000*
- ⊠ 50,000-110,000*
- Tilapia
- ▲ Hybrid Striped Bass
- ◆ Large Mouth Bass
- Atlantic Salmon
- ⊙ Federal
- * State Facility—Multiple species

Circle represents multiple species facilities * Number indicates fish under culture

Note: The facilities included on this map represent licensed propagators of the noted fish species. The species presently under cultivation may not include all the species that the operator is licensed to propagate.

Shellfish Aquaculture

- ▲ Oyster (*Crassostrea virginica*, *Ostrea edulis*)
- ❖ Quahogs (*Mercenaria mercenaria*)
- Softshell Clam (*Mya arenaria*)
- ▼ Blue Mussels (*Mytilus edulis*)
- Surf Clam (*Spisula solidissima*)
- ◐ Bay Scallop (*Argopecten irradians*)
- * Sea Scallops (*Placopecten magellanicus*)

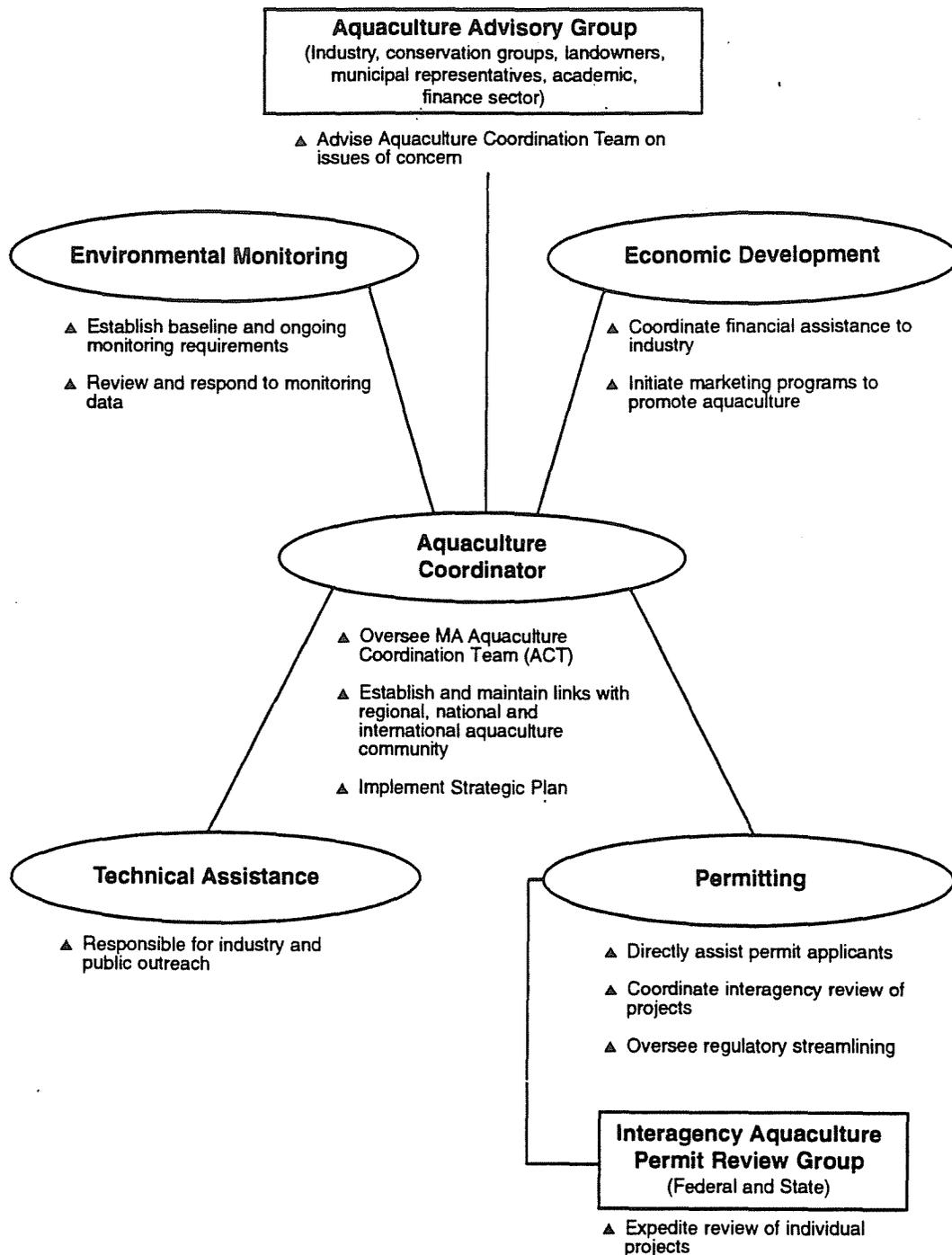


Circle represents areas with multiple species

RECOMMENDED FUNDING LEVELS

Programs (Listed in order of priority)	Five Year Funding Level	Starting Year	Fiscal Year '96	Fiscal Year '97	Fiscal Year '98	Fiscal Year '99	Fiscal Year 2000
Aquaculture Coordinator	\$250,000	FY '96	\$50,000	\$50,000	\$50,000	\$50,000	\$50,000
DMF Aquaculture Specialist	\$250,000	FY '96	\$50,000	\$50,000	\$50,000	\$50,000	\$50,000
Municipal Propagation Grants	\$2,000,000	FY '96	\$400,000	\$400,000	\$400,000	\$400,000	\$400,000
Revolving Loan Fund*	\$1,000,000	FY '96	\$500,000	\$500,000			
Seafood Expo & Other Festivals	\$100,000	FY '96	\$20,000	\$40,000	\$40,000		
High School/Vo-Tech Program	\$150,000	FY '96	\$75,000	\$75,000			
Research and Development	\$2,015,000	FY '96	\$500,000	\$500,000	\$400,000	\$400,000	\$315,000
Extension Agents (2)	\$400,000	FY '97		\$100,000	\$100,000	\$100,000	\$100,000
Research & Innovation Center	\$150,000	FY '96	\$30,000	\$30,000	\$30,000	\$30,000	\$30,000
Consumer P.R. Campaign	\$50,000	FY '98			\$50,000		
Grower Marketing Seminars	\$10,000	FY '98			\$5,000	\$5,000	
Mass Grown Seal**	\$5,000	FY '97		\$5,000			
Buyer's Guide**	\$5,000	FY '97		\$5,000			
Publish New State Policy	\$5,000	FY '96	\$5,000				
Economic Development Seminars	\$10,000	FY '96	\$5,000	\$5,000			
Industry Survey	\$50,000	FY '96	\$10,000	\$10,000	\$10,000	\$10,000	\$10,000
Univ./State College Program	\$1,500,000	FY '97		\$750,000	\$250,000	\$250,000	\$250,000
Public/Private Enhancement Program	\$500,000	FY '97		\$75,000	\$100,000	\$125,000	\$200,000
Public Education	\$500,000	FY '96	\$100,000	\$100,000	\$100,000	\$100,000	\$100,000
Demonstration Centers	\$1,750,000	FY '96	\$50,000	\$950,000	\$250,000	\$250,000	\$250,000
TOTAL	\$10,800,000		\$1,795,000	\$3,645,000	\$1,835,000	\$1,770,000	\$1,755,000
* Revolving loan fund will start with \$1,000,000 in initial investment over two years and will be self sustaining thereafter.							
** Funding could be added into current DFA programs							

Proposed Aquaculture Framework



Chapter II

PRIORITY RECOMMENDATIONS

The following recommendations reinforce recommendations made by several of the Working Groups and reflect the priority actions needed to "jump start" the aquaculture industry in Massachusetts. The first six recommendations should be considered overarching, in that they address issues which are fundamental to coordinated support for aquaculture. The priority recommendations should not take away from the importance of the recommendations found in the individual chapters. In many cases, the implementation of the specific recommendations dealing with regulatory reform, economic development and environmental review hinge on the prior implementation of the recommendations presented below. Recommendation numbers 7 - 13 address the administrative requirements necessary to support an aquaculture industry at the state level.

Note: A (\$) next to a recommendation indicates that a new appropriation is necessary to implement the recommendation. If no (\$) is noted, it can be assumed that the recommendation can be implemented utilizing existing staff and resources. A spreadsheet of all recommendations requiring funding is provided in Graphic 3.

1. *Recommendation:*

Regulatory streamlining recommendations found in Chapter 2 should be implemented immediately. Standardized aquaculture applications which include detailed information needs and standard plan requirements should be coordinated as soon as possible. Regulatory streamlining and coordinated processing are central to the development of aquaculture. Each general type of aquaculture should require only one coordinated application.

2. *Recommendation: (\$)*

In recognition of the multiple benefits of public aquaculture, the Municipal Shellfish Propagation program should be reactivated and improved. Funds should be appropriated to DMF to fund this popular program. Guidance to municipalities must ensure that propagation funds are used effectively and for appropriate purposes. Consideration should be given to incorporating the restoration of contaminated areas into this program. It is recommended that this program be administered as a matching grant program whereby the state would match town propagation budgets.

Justification:

This program had significant local support and is seen as a means for developing local support for aquaculture, both private and public. By enhancing and managing productive public shellfish beds, the recreational and commercial shellfish harvesters may not be so opposed to some privatization.

Other advantages of public aquaculture include the fostering of the public's understanding of aquaculture and the creation of opportunities for experimentation in propagation and harvesting techniques. Additional incentives for the towns to support aquaculture can be created by allowing them to use the proceeds of increased aquaculture license fees to increase the size of state match.

3. *Recommendation: (\$)*

Aquaculture staff within state and municipal government is critical to the growth of aquaculture in Massachusetts. Presently, there is virtually no full time staff in State government responsible for any aspect of aquaculture regulation or economic development. At minimum, an Aquaculture Coordinator at DFA and an Aquaculture Specialist within DFWELE are necessary to meet existing and backlogged needs.

The Aquaculture Coordinator would oversee the ACT, establish and maintain links with the regional, national and international aquaculture communities and would be responsible for implementation of the Strategic Plan. Most importantly, the Coordinator will serve as the single point of contact within the State for all existing and prospective aquaculturists. The Coordinator will actively assist all aquaculturists in identifying and complying with appropriate regulatory requirements. The Aquaculture Specialist within DFWELE is necessary to coordinate the streamlining of the regulatory review process as well as carry out required field survey and monitoring responsibilities.

4. *Recommendation:*

Any State bond monies appropriated for aquaculture purposes should be directed toward priorities identified in this Strategy. Specifically, funding for aquaculture related projects is included in the proposed Open Space Bond Bill (HB no. 5143), Seaport Bond Bill (HB no. 5127) and the Coastal Assessment Bill (SB no. 1834). Aquaculture should be included in the section of the Open Space Bond Bill known as "Linked Investment for Agriculture" which would allow state funds to be invested at lower than market rates in selected financial institutions. The savings to the financial institution could then be passed on the loan recipient.

5. *Recommendation:*

A priority of the aquaculture industry is to improve Shellfish Licensing terms to provide for more predictability and stability of licensing in an effort to improve financing potential. The existing licensing process varies significantly from town to town and leaves room for much discretion. It is recommended that a series of meetings be organized with shellfish aquaculturists, municipal licensing bodies (selectmen), shellfish constables and DMF to discuss potential changes to DMF regulations as well as municipal license administration.

6. *Recommendation:* (\$) The state should produce a user friendly "Aquaculture Regulatory Handbook" which is easily updated. This handbook should detail the permit requirements, review time frames, jurisdictional authorities, application fees, agency contact person, necessary application materials, and review processes for the different types of aquaculture. This handbook should be geared toward prospective aquaculturists, the finance community, and other interested parties. A related longer term recommendation is to provide this regulatory handbook in CD-Rom format.

Agency Responsibilities

7. *Recommendation:* An Aquaculture Coordination Team (ACT) comprised of (existing) State agency staff with expertise and responsibility for technical assistance, environmental monitoring, economic development and permitting should be established. ACT will be responsible for policy development, industry support, oversight of regulatory streamlining, and implementation of the Strategic Plan. An Aquaculture Coordinator, located at DFA should be hired to coordinate the work of ACT. The Strategic Planning process has highlighted the need for sustained inter-agency coordination and ACT would serve that purpose. An Aquaculture Advisory Group would advise ACT. Refer to Graphic 4 depicting the proposed Aquaculture Framework.
8. *Recommendation:* An Aquaculture Advisory Group which includes representation from a broad spectrum of interests including industry, conservation groups, the financial sector, landowners, municipal representatives, and academia should be established. The Aquaculture Advisory Group would advise and guide the ACT on issues of concern. The Aquaculture Coordinator would be the liaison between ACT and the Advisory Group. This group could also establish research grant criteria and review procedures for state aquaculture research and development grant programs.

Justification:

State aquaculture development and management activities should be coordinated with members of the various sectors involved to assure that policy decisions and appropriations are efficiently carried out and relevant to industry development.

9. *Recommendation:* (\$) A position should be established at DFA for an Aquaculture Coordinator. The Aquaculture Coordinator should be responsible for coordination of all state aquaculture activities, would oversee the work of the Aquaculture

Coordination Team (ACT) and be responsible for the implementation of the Strategic Plan.

10. *Recommendation:*

DMF should be the lead regulatory agency for marine aquaculture and hatcheries. DMF should be responsible for developing and administering a "one-stop" permit process which incorporates the concerns and timely review of all other relevant agencies, both state and federal.

11. *Recommendation:*

DFW should be the lead regulatory agency for inland aquaculture and hatcheries. DFW should be responsible for developing and administering a "one-stop" permit process which incorporates the concerns and timely review of all other relevant agencies, both state and federal.

12. *Recommendation:*

DFA shall be the lead agency for the promotion and marketing of aquacultured products. To the extent possible, all existing DFA promotion and marketing programs should be extended to include aquaculture.

13. *Recommendation:*

Establish an Interagency Aquaculture Permit Review Group. This group would meet as needed to discuss aquaculture proposals presently under state review. In an ongoing attempt to streamline the regulatory framework for aquaculture, this Review Group would have representation from federal and state agencies. The coordination of this group would be the responsibility of the Permitting representative who sits on the ACT.

Justification:

The value of interagency coordination has become apparent through the Strategic Planning process. Aquaculture, by the nature of the science and industry, does not fit squarely within any existing agency in the state. Not desiring to add another bureaucratic agency, it is recommended that the Interagency Aquaculture Permit Review Group meet on an as needed basis.

Chapter III

REGULATORY REFORM

Introduction

The overriding mission of the Regulatory Reform Working Group (RRWG) was to identify the major regulatory issues which inhibit the development of the aquaculture industry and to propose a streamlined process which protects public and private rights and environmental quality. In order to accomplish this mission, the RRWG reviewed both existing and proposed aquaculture activities in the Commonwealth.

The three major issues identified for review by the committee included regulatory coordination and streamlining, long-term security for capital investments, and state support for the aquaculture industry. These findings, and the associated recommendations, are designed to provide the short-term framework for improving aquaculture permitting. The RRWG contemplates that long-term statutory amendments, consistent with the below recommendations, will also be pursued in order to effectively address the needs of the aquaculture industry.

Based on a review of applicable laws and regulations, the RRWG proposes a series of recommendations which would improve the interagency coordination and management of aquaculture activities in the Commonwealth. As a relatively new industry in Massachusetts, aquaculture activities have rarely been considered in the course of statute or regulation development. As a result, the aquaculture industry faces an uncoordinated, and at times overlapping, regulatory framework for the review and permitting of aquaculture projects. In addition to the uncertain review processes affecting aquaculture, the industry is not afforded an interagency coordinated review processes or a lead state agency with adequate expertise to advise and promote the industry. This lack of a comprehensive and certain review process represents a significant impediment to the development of the aquaculture industry within the Commonwealth.

The recommendations of the RRWG are designed to streamline the regulatory processes for aquaculture activities in Massachusetts. At the outset, a principal recommendation calls for the establishment of a state Aquaculture Coordinator. This position will serve a variety of critical roles. The Aquaculture Coordinator could assist the industry by providing a single point of contact for all aquaculture related issues. The Coordinator should also serve to provide educational material regarding the permit requirements, review time frames, application fees, agency contact person, necessary application materials, and review processes for the different types of aquaculture.

In order to further minimize regulatory bottlenecks in the review and permitting of aquaculture, aquaculture should be jointly coordinated by the Division of Marine Fisheries ("DMF") and the Division of Fisheries and Wildlife ("DFW"). DMF should be the lead regulatory agency for marine aquaculture and hatcheries. DFW should be the lead regulatory agency for inland aquaculture and hatcheries. Each agency should develop one-stop permit process incorporating concerns of all other relevant state and federal agencies. The Department of Food and Agriculture ("DFA") should be the lead agency for the promotion and marketing of aquaculture products.

Finally, state and federal agencies should aggressively pursue the development of general permits for aquaculture activities (inland and marine). Such "general permits" for certain classes of activities could eliminate the need for individual detailed permit processing. A project would automatically qualify for a permit if the conditions of the general permit are complied with. Projects qualifying for a general permit would still be required to apply for a permit, but the processing would be expedited. The use of general permits for aquaculture activities would greatly improve the predictability and efficiency of permitting procedures and significantly reduce permitting time. Concurrent filing will also improve coordination between the various reviewing bodies and public hearings and comment periods should be able to be coordinated.

The second issue of concern to the aquaculture industry is the long-term security of capital investments. Due to the significant capital investments associated with aquaculture, security in the duration of the lease is a major consideration. The lack of such stability in leasing intertidal and Commonwealth tidelands has proven to be a financing obstacle. Lease security is critical to the industry and involves balancing private land use with public interests in tidelands. Several recommendations are provided to clarify ownership of tidelands; terms and transferability of leases; and the role of local, state, and federal agencies in developing lease agreements.

The third principal issue addressed was the development of state support for the aquaculture industry and local shellfish managers. Specific interest was expressed for the reactivation of the Municipal Shellfish Propagation program. Shellfish aquaculture licensing fees should reflect the economic value of public tidelands, be dedicated to municipalities, and be used for public shellfish propagation and/or restoration of shellfish beds. Interest has also been expressed in DMF developing a pilot program of authorizing shellfish nurseries in restricted areas. Finally, a standardized method for reporting aquaculture production should also be developed to provide the Commonwealth and the industry with the ability to monitor the success of the industry.

The final specific recommendations of the RRWG are intended to address the following classes of aquaculture activities:

1. *Shellfish Bottom Culture*: which involves minimal structure and no discharge;

2. *Shellfish/Seaweed Water Column Culture*: consisting of more substantial structures and no discharge;
3. *Recirculating/Flowthrough Culture*: involving structures located on land and having discharges;
4. *Finfish Net Pen Culture*: which involves structures in marine waters and discharges.
5. *Projects in Federal Waters*: involving various culturing techniques and located in part or full in federal waters.

A sixth class of projects, involving pond culture, was not addressed in the present forum because pond culturing is currently being reviewed as part of the legislatively authorized Farmland Advisory Committee.

The regulatory recommendations made in this section are directed at eliminating redundant and unnecessary permit review processes. The intent of this effort was to reduce process, while improving the integrity of vigorous, but relevant environmental review. The need for efficient, but effective environmental oversight of aquaculture activities is critical not only to protect public welfare and resources, but also to ensure the continued viability of aquaculture operations.

In addition to the recommendations presented below, the most valuable outcome from the Working Group process has been an increased understanding of the existing regulatory framework for aquaculture. This improved understanding has been enlightening not only to the regulating agencies, but to the industry as well. By identifying the existing process, the Working Group was able to effectively work toward streamlining and improvement. The existing regulatory framework for the different classes of aquaculture projects is found in Appendix A.

Recommendations

General Regulatory

14. *Recommendation*:
State agencies should work closely with the ACOE and other federal resource agencies in amending the existing Programmatic General Permit (PGP) to directly address aquaculture thresholds. Develop conditions which ensure that only the largest projects and/or those with the greatest potential impacts require review as individual permits under Sections 404 and/or 401.

Justification:

The existing PGP covers aquaculture indirectly, by reference to a previously established Letter of Permission (LOP). The LOP which is not included within the text of the PGP, is oriented toward shellfish culture and does not address other culturing techniques. An updated PGP could incorporate the LOP and update to include other culturing techniques.

Implementation Approach:

Amend the 404 PGP in coordination with the development of General NPDES permits for aquaculture (see Recommendation 28). Have MCZM then issue consistency on the PGP and DEP certify the PGP. It is estimated that this process would take between 6-9 months to finalize.

15. *Recommendation:*

State agencies should make test lease or pilot projects viable by reducing regulatory requirements and facilitating joint monitoring for predetermined periods.

Justification:

The permit process for aquaculture is cumbersome. By allowing pilot projects, the state can encourage experimentation with new technology, develop project specific monitoring protocols and coordinate with industry while jointly monitoring baseline data and project impacts. Knowledge gained from pilot projects will benefit regulatory agencies, the public and industry.

Implementation Approach:

ACT should develop an expedited permit process for pilot projects.

16. *Recommendation:*

MCZM should adopt a policy stating that aquaculture projects do not need to apply for Consistency Review unless 1.) They require an Individual permit as determined by the ACOE and/or 2.) They are sited in whole or in part in federal waters. MCZM should also draft a Program Policy which directly addresses and supports aquaculture.

Justification:

This will clarify and simplify MCZM's review authority over aquaculture projects. An Aquaculture Policy will provide policy guidance for Consistency Review.

Implementation Approach:

MCZM should develop policy in coordination with the ACOE, notice in the Environmental Monitor and publicize.

17. *Recommendation:*

Amend DMF Chapter 130, Section 17 B to authorize the Director of Marine Fisheries to promulgate regulations concerning the siting, operation and monitoring of finfish aquaculture projects in the marine environment. DMF should be the lead agency in regulating ocean based aquaculture facilities and should develop a coordinated permit process for ocean based finfish projects which incorporates the concerns of all other relevant state and federal agencies.

Justification:

DMF regulations do not provide adequate guidance for the administration of finfish aquaculture licensing. There is strong desire both from industry and other regulating agencies to develop a "one-stop" permit process particularly for finfish culture.

Implementation Approach:

DMF should work with ACT to develop one-stop permit process.

18. *Recommendation:*

The state should maintain and assert its position that the boundary between private tidelands and state-owned subtidal land is mean low water.

Justification:

Private/public ownership of tidelands in Massachusetts has a complex history and there is a need to clarify the legal boundary of state ownership. The recent Pazolt decision held that because aquaculture is more like farming than fishing, the landowners permission must be received before aquaculture is practiced on private tidelands. The precise delineation between private and public lands (i.e. mean low water or extreme low water) remains uncertain.

Implementation Approach:

The Executive Office of Environmental Affairs Legal Counsel and possibly the Attorney Generals' Office should coordinate with DMF, MCZM, DEM and DEP staff attorneys in searching for a case in which the delineation between public and private tidelands is the central issue, and put it before the Supreme Judicial Court of Massachusetts. In addition, counsel should review the issue of municipal propagation on private property.

19. *Recommendation:*

The existing fee structure for the Waterways Program (Chapter 91) should be reevaluated and revised for all aquaculture operations. The fee structure should reflect the nature of the facility and some of the benefits which aquaculture provides to the public (e.g. supplementing the wild stock, cleansing the water). Fees should adequately reflect the economic value and productivity of the operation.

Justification:

Existing Waterways licensing regulations do not address aquaculture specifically and the existing fee structure (based on displacement) is both illogical and prohibitive for aquaculture activities. The fees charged by the state for private use of public land should reflect both the economic value of the activity and the loss of land to the public.

Implementation Approach:

DEP, in the course of revising Chapter 91 regulations should develop specific appraisal techniques for aquaculture activities. MCZM will assist DEP by analyzing other state aquatic land leasing processes and fee structures. See Appendix B for state leasing survey.

20. *Recommendation:*

The MEPA unit should review the adequacy of existing thresholds as they apply to aquaculture facilities. When considering these thresholds, MEPA should focus its limited resources on projects that will benefit from coordinated review and comment by both private and public interests. Additionally, this review should consider limiting MEPA jurisdiction through "limited project" general permit provisions, utilizing the categorical inclusion threshold, Memoranda of Understanding and/or developing a Generic Environmental Impact Report for aquaculture.

21. *Recommendation:*

EOEA (DEM and MCZM) should review the existing Coastal Areas of Critical Environmental Concern (ACEC's) and existing state regulations to evaluate how the ACEC designation will affect new aquaculture facilities. If it is determined that the higher regulatory standards that accompany ACEC designation will adversely affect aquaculture operations that are compatible with the ACEC, then consideration should be given to amending the relevant state regulation.

Justification:

Any aquaculture activity proposed within an ACEC may be required to file an Environmental Notification Form (ENF). The more stringent review standards that are triggered within an ACEC should be balanced against the benefits of aquaculture projects within the coastal zone.

Implementation Approach:

The relationship between the ACEC designation process, MEPA and DEP regulations and other regulations should be evaluated. DEM and MCZM should review existing coastal ACEC's and work with ACEC communities, preferably in the context of preparing ACEC resource management plans to develop recommendations for the Secretary of EOEA as to the compatibility of aquaculture projects to existing ACEC's. Longer Term - Future ACEC designations and ACEC resource management plans should specifically

reference aquaculture projects and their relationship with the ACEC and, when appropriate, include language to allow or encourage aquaculture projects.

22. *Recommendation:*

DEM should issue a policy stating that the interests of Ocean Sanctuaries regulations are presumed to be met provided that DMF, Chapter 91 and MCZM have approved or signed off on the project proposal. A longer term recommendation is for DEM to amend the existing regulations to build on the other programs as outlined above.

Justification:

The Ocean Sanctuaries Act and regulations specifically permit "the harvesting and propagation of fish and shellfish in all forms," so long as DEM and DMF "are satisfied that such activities are carried on in accordance with sound conservation practices" (defined as "practices designed to maintain, increase or restore existing finfish or shellfish stocks by the management of resources).

Implementation Approach:

DEM, in addition to writing a policy stating that their regulations are presumed to be satisfied, should be actively involved in the Interagency Aquaculture Permit Review Group.

23. *Recommendation:*

Aquaculture licenses should be subject to performance criteria set by individual towns. Such criteria or license conditions shall be valid for the term of the license. It is recommended that initial license terms should be a minimum of five years with 15 year renewals. Renewal of the license shall be authorized by the licensing authority provided that the license holder meets the performance criteria. Renewals shall also be contingent upon a determination that there have been no unacceptable adverse impacts from the initial license period.

Justification:

Currently, potential lenders are reluctant to finance aquaculture ventures as they have no assurance that licenses will continue beyond the initial period. The uncertainty surrounding aquaculture leases translates into risk and lack of collateral. The Steering Committee recognizes this issue to be one of the most critical to the industry as well as potentially the most controversial to local municipalities and the citizenry of the state. The issue of balancing private use with public interests will continue to need additional study and input from a variety of public and private stakeholders for both the short and long term.

Implementation Approach:

The Steering Committee should assist legislators in public outreach on this issue prior to any proposed resolution or change to lease terms. The duration and terms of leases or licenses of other states should be investigated to evaluate

how other states have balanced the issue of public rights with private use. Refer to state leasing survey found in Appendix B.

24. *Recommendation:*

Shellfish aquaculture licenses should be transferable during the license period with the approval of the licensing authority. Denial of transfer shall only be authorized if the performance criteria set by the town was not met.

Justification:

same as 23

Implementation Approach:

same as 23

25. *Recommendation:*

Municipalities should be given the option to preapprove areas (with DMF, DEP, Conservation Commissions, MCZM and ACOE) of its jurisdiction for aquacultural uses.

Justification:

Ad hoc or site by site decision-making on aquaculture licensing is time consuming and not advantageous to good management. By affording municipalities the option to pre-approve large areas of town waters for aquaculture, the municipality could have better control over long term planning. Additionally, by preapproving large areas, administrative costs and delays of individual reviews could be minimized.

Implementation Approach:

At the request of a municipality, DMF could survey a large section of town waters and identify areas which are non-productive and have no overarching natural resource constraints. DMF would establish criteria for pre-approving areas. Once these areas are identified, the municipality could apply to DEP and the ACOE for authorization of aquacultural activities under the jurisdiction of Chapter 91 and Section 10 respectively. The municipality would then know which area could be used for aquaculture, hold the proper authorizations and make siting decisions accordingly. Applicants would then apply to municipality only. Conservation Commissions and licensing authorities could also become involved in pre-approval utilizing resource conservation plans.

26. *Recommendation:*

The state should provide written guidance to towns regarding the legal requirements relating to the administration of shellfish licenses. This guidance should include the appropriate scope of review, relevant issues and criteria and public hearing formats.

Justification:

A need has been identified to establish criteria for the appropriate scope of review for shellfish licenses both for the benefit of aquaculturist and licensing bodies. This guidance is also intended to standardize administration of shellfish licensing from town to town, without compromising ultimate home rule authority.

Implementation Approach:

Review all municipal aquaculture licensing bylaws and statutes and develop a generic model for towns to review.

27. *Recommendation:*

WPA application should be filed concurrently with 404 Army Corps of Engineers permit applications, Section 10 (Rivers and Harbors) applications and Section 57 permit application, if required.

Justification:

Concurrent filing will improve coordination between the various reviewing bodies and public hearings and comment periods should be able to be coordinated. While there is currently a joint ACOE and WPA application for aquaculture projects it is still necessary for applicants to send copies separately to the ACOE and the Conservation Commission.

Implementation Approach:

Long Range - Consider amending the WPA regulations (310 CMR 10.00) to eliminate the need for individual permit review by creating a presumption that interests under the WPA are met provided that conditions imposed by DMF are adhered to. This will require additional coordination and conditioning between DEP, Conservation Commissions and DMF to ensure adequate protection, particularly in cases where upland access is a consideration. Coordination with municipal by-laws regulating aquaculture is also necessary.

28. *Recommendation:*

Shellfish aquaculture licensing fees paid by aquaculturists to towns should be increased to reflect their economic value and productivity. DMF should also evaluate the necessity to charge a (one time) application fee which covers the costs of surveying an area. License fees paid to municipalities should be directed to Shellfish programs for use in public shellfish propagation and/or restoration. Municipalities should provide an option to culturists to pay fees and/or provide seed for public propagation.

Justification:

DMF's statute (Chapter 130, section 64) currently caps shellfish aquaculture fees at \$25/acre/ per year. However, the fee varies from town to town. There is concern that there may be an imbalance between the fee paid for private use of

public land for aquaculture and the potential loss of public access to this land. The fees should be evaluated to reflect an appropriate balance. Once in place, the revenues generated should be directed to public shellfish enhancement. With enhancement of public resources, it is hoped that municipalities will likewise be encouraged to permit some level of private aquaculture.

Implementation Approach:

DMF should review license fees and consider adjustments. Statute should be amended to direct license revenues to Shellfish Department budgets. Refer to Appendix B for state leasing review.

29. *Recommendation:*

DMF requirements for reporting shellfish production should be improved. All reporting requirements (town and state) should be coordinated. Productivity thresholds (for keeping license) should be evaluated and increased. All reports to towns and state involving production and/or financial disclosure should be made confidential. (Amend Ch. 130, section 65)

Justification:

Existing reporting procedures are redundant and do not result in an accurate representation of the aquaculture industry.

Implementation Approach:

DMF, Massachusetts Aquaculture Association, and the Massachusetts Shellfish Officers Association should cooperatively develop a standardized reporting process and amend DMF regulations accordingly.

30. *Recommendation*

DMF should develop a pilot program of authorizing towns to lease restricted areas for use as shellfish nursery areas. Pilot projects would only be initiated at the request of and with the cooperation of, individual municipalities.

Justification:

Many contaminated areas are either naturally productive or have the capacity to be productive. By not allowing aquaculture for seed production, a resource is forfeited.

Implementation Approach:

Short term - Policy change. DMF should work with Municipal Shellfish Officers to develop procedures to allow a limited amount of leases within restricted areas. The implementation of this program should be closely tracked to evaluate the viability of expansion. Longer term - After evaluation of pilots, DMF should consider making regulatory changes to authorize this activity.

31. *Recommendation:*

DEP and EOEA, in conjunction with the EPA, should aggressively pursue the development of NPDES general permits for aquacultural activities (inland and marine). An initial estimate of 6 - 9 months has been suggested as the time period needed to draft, public notice and publish these two permits. In order to accomplish this goal considerable effort and coordination with EOEA, EPA, Mass Aquaculture Association and interested environmental groups must be dedicated in order to complete the project.

Justification:

Creating "general permits" for certain classes of activities would essentially eliminate the need for individual projects to go through a detailed and individual permitting process. A project would automatically qualify for a permit if the conditions of the general permit are complied with. The overall goal is to establish a general permit that would provide adequate protection while reducing individual project review and application processing delays. A screening provision, similar to the PGP, may be an effective way to allow timely review of individual projects. A recommended approach to a screening provision is to have a reporting requirement that automatically approves the project if the state does not require an individual permit review within 21 days of receipt of the project notice.

The establishment of general NPDES permits for aquaculture activities will greatly improve the predictability and efficiency of the regulatory process and will reduce permitting time significantly.

32. *Recommendation:*

DEP's Office of Watershed Management should issue a policy outlining the procedures for water withdrawals in brackish or saline waters from either surface or groundwater. The policy should also indicate that no individual permit is needed for salt water withdrawals from surface or groundwater.

Justification:

There is significant confusion among both regulators and the regulated community regarding the necessity of authorization for water withdrawals.

Implementation Approach:

DEP should simply issue a written policy on what types of projects require water withdrawal permits and which do not. DEP should further outline the process and requirements for projects which do require such authorization.

33. *Recommendation:*

The state should work with the New England Fisheries Management Council (NEFMC) and other federal agencies to develop a clear and coordinated administrative process for authorizing aquaculture activities in the Exclusive Economic Zone (EEZ). MCZM Consistency Review will be linked to this

process. The state should ensure that federal regulatory processes and actions are compatible with state interests.

Justification:

The NEFMC has the authority to designate special management areas in the EEZ for activities such as aquaculture. There is not presently an established process for authorizing such uses despite industry interest in siting in federal waters. At least two bills are being proposed in Congress to delineate federal aquaculture responsibilities.

Implementation Approach:

The state should become involved in the NEFMC Aquaculture Subcommittee as well as review proposed congressional aquaculture legislation.

Chapter IV

ECONOMIC DEVELOPMENT AND MARKETING

Aquaculture: Why the Commonwealth of Massachusetts Should Support the Development of Its Aquaculture Industry

Worldwide aquaculture is forecast to be a major growth industry into the 21st century. In response to increasingly constrained global supplies of wild finfish and shellfish and growing consumption of seafood products, aquaculture production has expanded in many regions of the United States and indeed the world. World aquaculture production (including seaweeds, finfish, mollusks and crustaceans) increased 85 percent over a nine year period from 10.4 million metric tons in 1984 to 19.3 million metric tons in 1992, at a value of \$32.5 billion (FAO 1995). Indeed, aquaculture accounted for 14 percent of global fish production in 1992, up from 8.3 percent in 1984. In the period 1984-1992, aquaculture production of finfish, mollusks and crustaceans grew at an average annual compound rate of nine percent in volume and 14 percent in value.

Based on population growth projections and a projected continued growth in seafood consumption, global seafood demand is expected to increase over 60 percent in the next 30 years (Parker 1995). Given that harvest from wild fish stocks are approaching or have exceeded maximum sustainable yields, aquaculture production will have to increase approximately 500 percent to meet global seafood demand in the year 2025 (Parker 1995).

In the U.S., due to the decline of native fish stocks and the need to diversify the economic base of many rural coastal and agricultural communities, aquaculture has expanded in many regions of the country. Aquaculture is one of the fastest growing agricultural sectors in the U.S. In fact, U.S. aquaculture production more than doubled from 308 million pounds in 1983 to nearly 716 million pounds in 1993 at a value of \$810 million (NMFS 1995). Nationwide, catfish, crawfish, and trout account for the largest share of aquaculture production, followed by baitfish, salmon, and oysters. Other domestically cultured species include mussels, shrimp, abalone, hard and soft shelled clams, ornamental fish, tilapia, sturgeon, hybrid striped bass, aquatic plants and others.

Nationwide, estimated employment and economic activity generated by the domestic aquaculture industry is substantial. According to a USDA funded study now being completed by Dr. Michael Dicks of the Department of Agricultural Economics at Oklahoma State University, estimated U.S. Employment in aquaculture production and processing is over 180,000 jobs including those associated with the transport, storage, processing, manufacturing, distribution and sales of aquaculture products (Dicks *et. al.*, forthcoming). This figure also includes employment associated with purchases of equipment, supplies, feed, seed, labor and

financing. This study also estimates that aquaculture contributes approximately \$5.6 billion to the U.S. gross domestic product (Dicks *et. al.*, forthcoming). An earlier study by the National Fisheries Education and Research Foundation (1989) found that the U. S. aquaculture industry generated approximately 230,000 full-time equivalent jobs in 1988 with associated direct and indirect economic activities of \$6.43 billion (National Fisheries Education and Research Foundation (1989).

While the aquaculture industry continues its strong growth both nationally and internationally, Massachusetts continues to lag behind in the development of its industry. The total estimated 1992 farm gate value of aquacultured products in the northeastern U.S. (West Virginia to Maine) is estimated at \$146.4 million dollars (Bush and Anderson 1993). Connecticut leads with a \$61.8 million industry in 1992 based mainly on the strength of its oyster industry. Maine is the second largest aquaculture-producing state in the region with a \$42.9 million production in 1992, primarily due to its pen-reared salmon industry. In contrast, Massachusetts produced a mere \$8 million of aquacultured products in 1992, comprising mainly hard shelled clams, oysters, trout, and hybrid striped bass. This is surprising if one considers the vast, rich, and varied coastline of the Commonwealth.

Much of the sluggishness in the growth of the aquaculture industry in Massachusetts compared to that of other states can be attributed to the myriad of regulatory barriers, a lack of government coordination in the management of aquaculture, and simply a lack of clear vision and policy regarding both marine and freshwater aquaculture. Given the uncertainty surrounding aquaculture regulations, particularly grant leasing policies, and the inherent risks in aquaculture, financing of new aquaculture ventures in Massachusetts has been difficult if not impossible to access.

The Commonwealth's interest in aquaculture development has intensified in the past year, mainly due to the declines of New England's mainstay groundfish stocks and the continuing economic hardship faced by the Massachusetts commercial fishing industry. While aquaculture development can provide some jobs for displaced fishermen and broaden the economic base of many coastal communities, aquaculture is certainly not the solution to the New England fisheries crisis. Nonetheless, aquaculture offers excellent opportunities for community economic development, jobs creation, technology development and seafood production.

Massachusetts is particularly well situated to take advantage of the opportunities in aquaculture, including seafood production as well as technology development. The state has a wealth of diverse marine and freshwater resources well suited to offshore, inshore, and land-based aquaculture. The state is also home to many world class research institutions which specialize in marine and aquatic technology and science and give Massachusetts a unique advantage in this expanding industry. The state also has a concentration of marine technology firms which are poised to profit from the growth of the aquaculture industry worldwide. Massachusetts is also strategically located to service one of the largest seafood markets in the world - the

Eastern seaboard of the United States. The state also has an immensely talented and diverse work force and an established seafood processing and distribution network ready to deliver aquaculture products to domestic and world markets.

Clearly the state of Massachusetts must seize the opportunity to foster this growth industry. The state can not continue to sit mired in a sea of regulations and policy inaction which restrict opportunities for economic development and diversification. The Task Force on Aquaculture Economic Development and Marketing believes that Massachusetts stands at a true crossroads. Stand behind and actively promote the development of a strong, diversified and environmentally sensitive aquaculture industry, or miss the boat and watch development dollars and markets go to our neighboring states and other countries.

To encourage vigorous growth and development of the aquaculture industry in Massachusetts there must first be strong leadership and commitment from the Governor of the Commonwealth, affirming that growth of the aquaculture industry is in the best interest of the state and will play a significant role in its economic future.

Furthermore, the state needs to develop a coordinated approach to aquaculture development and regulation. Central to this effort must be the creation of an aquaculture coordinator position to promote aquaculture in the state and coordinate the various state agencies and other entities involved in regulation and support. Currently aquaculture regulation is scattered across a myriad of state agencies and individual towns. The need for coordination is not only clear, it is absolutely critical. Review of the successful aquaculture programs in other states is testimony to the key role of aquaculture coordination.

Equally important to the Governor's leadership and aquaculture coordination is the dire need for regulatory reform. The current aquaculture permitting process is lengthy, costly, and complicated and discourages financial investment. In order for any growth in the industry to take place, overhauling and streamlining of the regulatory process must be the top priority. Until the regulatory process is improved, little industry development is likely. The State should also push for the development of federal policies permitting aquaculture in offshore waters, an area of significant economic opportunity as offshore technologies come on line. Massachusetts has a distinct advantage in the field of offshore aquaculture technology given the concentration of marine science and technology research institutions and firms in the state.

The state must also act to provide this fledgling industry with opportunities for start-up capital, research and development funds, marketing and promotion support, and education and training. These efforts must take an industry-up approach rather than a government-down approach, whereby the state uses industry expertise and experience to help it identify germane areas of applied research that will actively promote the development of the state's aquaculture industry.

Likewise, the industry can help guide and develop useful financing programs, appropriate education programs, and effective marketing and promotion efforts.

The state, by working cooperatively with the industry, can have an enormously positive impact on the development of aquaculture in Massachusetts. The passage of comprehensive aquaculture legislation - addressing the concerns raised by the Task Force, including state coordination of aquaculture development and management, access to capital for aquaculture entrepreneurs, dedication of research and development funds, reform of the regulatory environment, creation of education and training programs at the secondary, vocational and university levels, and adequate marketing and promotion support - is the top priority. Aquaculture offers significant opportunities in community economic development, job creation, technology development, and food production. The Commonwealth, through swift and decisive action outlined in the following recommendations, can capitalize upon these opportunities.

Constraints to Growth

Aquaculture Coordination

The development and regulation of aquaculture in Massachusetts is currently spread over a myriad of agencies with little coordination among them. This has resulted in not only a complicated regulatory environment, but one that has been generally unsupportive of aquaculture development in the state. The state is clearly in need of a coordinated approach to aquaculture development and we see the creation of an aquaculture coordinator position along with the Aquaculture Advisory Group as the cornerstones of coordinated industry development. This approach has been used very successfully in most other states, as exemplified by the National Association of State Aquaculture Coordinators.

Obstacles to Financing

The rapidly growing domestic and international aquaculture industry offers great benefits to the Commonwealth of Massachusetts through increased employment opportunities and job creation in the industrial sector including new and traditional spin-off industries that support aquaculture and seafood manufacturing. Spin-off opportunities include feed production, transportation, equipment manufacturing (pumps, cages, veterinarian services, nets, boats, etc.), processing, packaging, electronic monitoring and others.

A chief force propelling the growth of the aquaculture industry has been the declining supplies of many of our principal wild fish stocks. Other factors have been the demand for year round supplies and consistent quality and appearance. In spite of many industry growth indicators, the finance community has been reluctant to support its development. The reluctance is based on a daunting regulatory environment and a lack of information concerning what factors contribute to a successful aquaculture operation. Consequently, start-up capital is difficult to access,

and there has been little investment in technology that would reduce capital equipment costs.

The availability of information for the finance community on technology, market conditions and production costs would allow a more accurate assessment of risk and the securing of financial support for aquaculture development. Economic models for successful aquaculture operations would further contribute to improved perceptions of aquaculture among the finance community.

Lack of Marketing and Promotion Support

Product marketing and promotion are key to the success of any business, and aquaculture is no exception. As aquaculture of many species is relatively new to the state and the region, consumers are not familiar with the business nor its products. Local opposition to aquaculture development often stems from a misunderstanding of aquaculture operations. Aquaculture products, having been farmed under controlled conditions, possess unique product characteristics that can be used in their promotion. Expansion of the aquaculture industry in Massachusetts will not proceed smoothly unless the public understands the nature of aquaculture and is aware of the many benefits of aquaculture to their local communities and the state. There is a clear need for state public education programs regarding aquaculture - how it works and what its benefits are. The state can also capitalize upon the favorable image of New England seafood and the promotion of its aquaculture products can stimulate demand in the state, region, nation and around the world.

Regulatory Barriers to Marketing and Product Development

Currently there are many state regulations which hamper not only the development of aquaculture but also the marketing of aquaculture products. Some of these regulations set size restrictions based on those that pertain to the wild fisheries. One of the key advantages of aquaculture is the ability to harvest at a size which is most economically efficient and most profitable in the marketplace. Inappropriate size restriction placed on cultured products results in loss of revenue and an increased risk on the part of the aquaculturist who must hold live product longer than is desirable. Other regulations restrict the availability of fish and shellfish for stocking, broodstock and research. All of these restrictions result in higher costs to the aquaculturists, fewer marketing options and in certain cases, higher production risks. The state should actively review and revise some of their current fisheries regulations to allow for flexible aquaculture development and marketing while assuring the protection of its wild fish stocks.

Aquaculture Technology

The aquaculture industry is not limited solely to companies that produce finfish, shellfish and aquatic plants. When the industry is considered in a broader sense, it can include individuals and firms involved in research and development (R&D) and the marketing of technologies such as sensory instruments, growout system (pens, tanks, etc.) disease identification and control methods, feeding and breeding methods and environmental controls.

Massachusetts marine technology firms, universities and marine research institutions possess world class capabilities, and Massachusetts is indeed poised to capitalize on this in-house source of expertise. These capabilities can be coordinated to focus on technological problems in aquaculture to reduce the investment risks and improve the efficiency of production. State investment in technology research and development will also foster the development of the marine technology industry in Massachusetts, a sector with excellent growth potential to service the expanding aquaculture industry worldwide.

Currently, there are several bills before the Legislature that would authorize significant levels of funding to enhance aquaculture R&D. However, the proposed legislation appears to allocate funds in advance for specific R&D projects. Although identification of general categories of technological problems seems appropriate, a policy of "picking winners" through legislation is not. General research areas must be carefully identified according to state needs, and grants must be awarded on a competitive, peer-reviewed basis.

Aquaculture Education in Massachusetts: Current Situation and Opportunities
Education and training are necessary for the growth of aquaculture in Massachusetts. The state must take the initiative in the formation of these programs. Foreign countries and U.S. states leading in aquaculture have implemented comprehensive education programs including university degree programs, vocational training, extension services, and public/private education, research, and development activities. Hawaii, Florida, Maine and other leading states have integrated public university systems with industry directed research, extension services and degree aquaculture programs.

There are presently very few opportunities for aquaculture training and education in Massachusetts (see attached survey). Existing private aquaculturists generally rely on other aquaculturists and limited assistance from UMASS cooperative extension service and regional organizations such as the Northeast Regional Aquaculture Center, Sea Grant, and out of state universities.

Technical education will increase the success rate of start-up aquaculture ventures. Successful start-ups are critical for financial support to the industry. Extension service can provide necessary technical assistance to aquaculture operations, reducing the failure rate of start-ups, increasing production and mitigating losses from disease, predators, and other risk factors.

There are presently no degree granting institutions with aquaculture programs in the state, and there is very limited application of aquaculture education at other levels. Formal education programs combined with industry driven research have proven beneficial to aquaculture development in other states. Aquaculture education programs in secondary schools and vocational-technical schools can easily be integrated into the state's cross curriculum initiative. Biology, chemistry,

engineering, business and writing skills are all necessary components to the multi-disciplinary field of aquaculture. Regional training centers specific to aquaculture could provide training to prospective aquaculture teachers.

Public education programs can generate the public support necessary for aquaculture to develop in the state. The public is generally uninformed regarding aquaculture operations and benefits. This lack of knowledge results in a negative attitude and a public perception of aquaculture as detrimental. With home rule in Massachusetts, local communities control coastal aquaculture. Positive public support is needed for expansion of all (inland, coastal & offshore) aquaculture. Public/private aquaculture projects can be very effective in the development of the private and public (enhancement) aquaculture industry in Massachusetts. Private involvement insures cost efficient and industry relative projects. Public involvement ensures public benefit, consistency with other projects, and a broad overview. (i.e., water quality monitoring & remediation, habitat restoration, population stability. Information transfer is critical to the success of all aquaculture.)

Recommendations

The following recommendations represent the economic initiatives necessary to make Massachusetts competitive in the regional, national and international aquaculture market. Recommendations requiring funding have a (\$) next to them. Funding levels for each recommendation can be found on Graphic 3. Graphic 3 also indicates the prioritization of the recommendations requiring funding.

34. *Recommendation:* (\$)

The state should establish an Aquaculture Revolving Loan Fund providing up to \$25,000 for aquaculture start-up capital and requiring a 50/50 match. If the loan is for bricks and mortar, with no operating expenses, provide an 80/20 match for up to 70 percent of costs.

Justification:

The private finance community looks upon private aquaculture with interested skepticism. State funding of a revolving loan fund could serve to leverage private capital. There is a direct correlation between states with growing aquaculture industries and direct state funded support.

Implementation Approach:

Create lending criteria and an oversight committee or board of directors to advise with expertise from industry, academia, finance and other government entities. Legislative appropriation may be necessary. Note that this fund could be included as part of a comprehensive natural resource financing legislation that is presently being considered.

35. *Recommendation:*
DFA should expand its existing agriculture marketing and distribution programs to include aquaculture. Specifically, DFA should develop/expand the following programs: work with area restaurants, chefs and supermarkets to showcase Mass. aquaculture products; track information on domestic seafood markets and international trade opportunities (see Appendix C for an excellent example from the Maryland Aquaculture office.); coordinate with the Governor's Seafood Task Force in their development of fishery product promotion; and incorporate Massachusetts aquaculture products into the DFA Fresh Connection promotion program.

Justification:

Many of these programs are already established and would require minimal effort to expand to include aquaculture products.

36. *Recommendation:* (\$) Provide funding to subsidize participation in the Boston Seafood Show, currently the premier seafood trade show in the U.S.. The Massachusetts seafood industry could have a "Massachusetts Ave." block of booths similar to Maine's successful "Maine Street" promotion of Maine seafood companies. Also provide funding for promotion of MA aquaculture products at local seafood festivals such as those in Gloucester and New Bedford, as well as the Harvest Festival in Cambridge.

Justification:

A display at the Boston Seafood Show would promote not only MA aquaculture products but other MA seafood products and an overall positive image of Massachusetts seafood.

37. *Recommendation:* (\$) Establish a grants program or incentive program for secondary schools to implement aquaculture curriculum and small scale aquaculture facilities. Emphasize aquaculture in the state's cross curriculum goals for secondary schools.

Justification:

Curriculum is available from other states and can easily be transferred to Massachusetts schools. Small scale, hands-on facilities are vital to the education effort. Freshwater recirculating systems are the most cost efficient for this type of basic training. Vocational schools should be given priority in this program. For those schools unable to establish a hands on program assistance should be provided for some cooperation with local vocational school and/or exposure to other aquaculture operations and regional demonstration centers.

38. *Recommendation:* (\$)

The Commonwealth should sponsor a seminar for the finance community to acquaint them with the various forms of aquaculture possible in Massachusetts. In addition, the aquaculture coordinator should work to inform the public/private finance community about industry developments and successful models in order to encourage lending. The coordinator should also work with local communities to encourage aquaculture as an element of community economic development planning.

Justification:

Many key and interested bankers and investors in the Northeast have been or would like to be involved in investing in or lending to the aquaculture industry, whether inshore, offshore or land-based. One obstacle that the finance community must overcome is a general lack of information about the nature of the aquaculture industry.

Implementation Approach:

Regularly scheduled seminars, distribution of printed materials and video production to focus on economic benefits to state and local communities.

39. *Recommendation:* (\$)

Develop a public relations campaign designed to enlighten citizens about what aquaculture is, how it works and the importance and benefits of the industry. This may involve the development of videos, print material and posters. Point-of-purchase materials should be distributed to retail outlets.

Justification:

There is a need to educate the general public regarding all aspects of aquaculture in order to generate public support for the aquaculture industry and market demand for its products.

40. *Recommendation:*

Allow finfish growers to sell their products at below the minimum size set by regulations governing the wild fisheries.

Justification:

There are significant markets for these products, particularly in the market for live fish, and proper documentation such as tracking numbers and duplicate invoices should assure the protection of the wild fish stocks.

41. *Recommendation:*

Consider developing a limited access, quota controlled fishery for elvers (juvenile eels) to provide stock for Massachusetts aquaculture operations. Elvers would be allowed to be harvested and sold only in the state of Massachusetts for aquaculture in Massachusetts only.

Justification:

Techniques for hatching elvers from adult eel eggs is not yet known; hence the aquaculture industry must rely on wild caught elvers for their stock. Currently elvers sell approximately \$200-450 per pound in Maine. If aquaculturists held the elvers for growout to adults, assuming normal growout and typical mortality, the value of one pound of elvers grown to adult size would amount to an estimated \$30,000.

42. *Recommendation:*

Allow a limited number of special permits for collection of highly regulated species such as striped bass, white perch, yellow perch, sturgeon, largemouth bass and others for aquaculture broodstock and research.

Justification:

There may be significant opportunities in the aquaculture of many alternative species. However, aquaculturists and other researchers need a limited number of wild fish in order to research the possibilities.

43. *Recommendation:*

Reassess the current restrictions on the culture of non-native species to Massachusetts. Develop a set of protocols that would allow the culture of non-native species in alternative growing systems. Industry should prioritize species of interest and a risk assessment should be performed on high priority species.

Justification:

There are significant opportunities in the culture of many species that are not native to the state. The state, before closing the door to these opportunities, should at least analyze the risks. If the risks are found to be acceptable, aquaculture of those species should be allowed.

44. *Recommendation:*

The MA Division of Marine Fisheries should develop a written policy concerning acceptable sources for shellfish seed for aquacultural purposes, including the importation of seed from other states. The protocol of the Atlantic States Marine Fishery Commission regarding interstate shipment of seed should be used as guidance.

Justification:

Currently DMF does not allow the importation of shellfish seed from hatcheries outside of the region, and there is some confusion concerning the certification process a hatchery must follow to become certified by DMF. Since the Massachusetts shellfish aquaculture industry is presently limited by seed availability, this recommendation should result in improved access to hatchery seed sources.

45. *Recommendation:* (\$)

Fund a non-government organization to conduct an annual survey of the Massachusetts aquaculture industry. Information to be gathered in the survey would include annual production and value figures, employment, future expectations, current constraints to the industry, etc.

Justification:

This information is critical to the tracking of industry development, the marketing of products and the documentation of the value of the industry to the state of Massachusetts.

46. *Recommendation:* (\$)

Establish a competitive grant program to foster research and development. Funds should be allocated to aquaculture R&D projects through a peer-reviewed, competitive process and on the basis of Commonwealth and industry needs. Identification of R&D grant criteria will be set by the Aquaculture Advisory Group and funds will be administered by an appropriate state agency.

Justification:

Basic and applied research is needed to identify appropriate species for culture in Massachusetts and to develop efficient and economic technologies. There will be ongoing research needed in these areas as well as areas such as disease prevention, feed efficiency, hatchery techniques, environmental impacts, etc. Few private firms have the expertise or funds to conduct this typically costly research and thus rely upon publicly funded research.

47. *Recommendation:* (\$)

Fund on a competitive basis an industry based and driven research and innovation center such as the newly established Massachusetts Aquaculture Innovation Center (MAIC). Modeled after the successful Maine Aquaculture Innovation Center, the MAIC should be a state assisted, but industry-driven research and development center. (The MAIC is presently an organization with a board of directors. There is no physical "center" at this time.)

Justification:

Organizations such as the MAIC will facilitate and expand cooperative efforts between industry and the research community while acting as an information transfer source. This approach has proven itself to be very responsive to industry needs while maintaining a balanced representation from government, academia and industry.

48. *Recommendation:*
Earmark existing state programs and funding that can be redirected towards aquaculture training, education, and extension at secondary, vocational, and college levels.

Justification:

There are likely to be several existing state education programs and funding sources which could be directed to include aquaculture training and education. Prior the implementation of this recommendation, consideration must be given to the availability of aquaculture jobs.

49. *Recommendation:*
Recommend that the Governor appoint a member to the Fish and Wildlife Advisory Board who has experience in the aquaculture field the next time a position on the board is open.

50. *Recommendation:* (\$)
The state should provide aquaculture extension services. Through the state university/college system, establish two extension agents, one specializing in freshwater aquaculture and one in marine aquaculture.

Justification:

Extension agents, using university and regional demonstration center resources, can provide training and assistance to the industry.

51. *Recommendation:* (\$)
Develop a Massachusetts-Grown Seal to be put on packaging to promote MA aquaculture products.

Justification:

A Massachusetts-Grown seal will promote Massachusetts aquaculture products and the Massachusetts seafood image.

52. *Recommendation:* (\$)
Establish an internet bulletin board or homepage which would post MA aquaculture products availability and prices. This could be partially funded by fees to businesses using the service.

Justification:

An internet bulletin board is a potentially efficient and highly effective means of promoting the awareness and availability of Massachusetts aquaculture products to a wide variety of domestic and international buyers.

53. *Recommendation*
Initiate study of agriculture cooperatives and how they could be applied to aquaculture in MA. Currently there is not a critical mass of businesses nor a marketing logjam to warrant the establishment of a cooperative.

Justification:

As the aquaculture industry expands in the state, the industry may benefit from management, marketing, and other support services that a cooperative can offer at a lower cost than if left to an individual firm.

54. *Recommendation:* (\$) Develop a buyers guide to MA aquaculture products to be distributed locally, regionally, and nationally.

Justification:

There is a need to attract and educate buyers about MA aquaculture products.

55. *Recommendation:*
Provide marketing seminars to growers to inform them of alternative marketing options for their products.

Justification:

Growers can capitalize on the unique characteristics of aquaculture products if they are better informed about marketing options.

56. *Recommendation* (\$) Appropriate funds for aquaculture degree programs at universities and colleges. Massachusetts universities/colleges should develop coordinated programs with each institution specializing in one or two particular areas. The curriculum exists in other university systems both in the U.S. and abroad. Suggested areas of focus include: shellfish, marine finfish, crustaceans, aquatic plants, freshwater finfish, disease and veterinary studies, engineering, and technology. All programs should include business, sales and marketing, and technology. The universities could also act as regional training centers to offer teacher training in aquaculture.

Justification:

Critical to the successful implementation of any aquaculture program is education and training.

57. *Recommendation:* (\$) Establish a grants program available to community organizations to design and implement public aquaculture education programs.

Justification:

Aquaculture development in Massachusetts requires community level programs. Raising the public's awareness of the benefits of aquaculture is critical to success. Community organizations can tailor specific public education programs to their particular conditions. Model programs include Nantucket where private aquaculture is being developed in conjunction with public fisheries enhancement programs. The program includes water quality monitoring through educational programs for local students and the general public. In Westport, students and other local organizations collect scallop spat for enhancement. Involvement of the local community generates support for aquaculture development.

58. *Recommendation:* (\$)

Establish regional aquaculture information/training demonstration centers which are state/private partnerships and locally operated.

Justification:

These demonstration centers will provide the infrastructure necessary for aquaculture development. The centers should be based upon a commercial level aquaculture operation to provide funding for operations. This will promote relevant training, practical research and development opportunities, and offer facilities to commercial operators for research and development activities. As demonstration centers, these facilities will play the important role of introducing the public to physical aquaculture operations. They will provide training to prospective aquaculturists, teachers, and students.

59. *Recommendation:* (\$)

Establish a grants program to design and implement public/private programs which combine public enhancement and private aquaculture development. For example, on Nantucket, the Nantucket Research and Education Foundation and future private aquaculturists (aquaculturists in training) provide labor and expertise to the town for Nantucket's public enhancement program. In return, the town allows use of areas normally closed to private aquaculture for nursery operations.

Justification:

This cooperation increased benefits to both public and private operations. The private sector is much more efficient at operating aquaculture programs whether for profit or enhancement. The program has also increased water quality monitoring activities for the entire island. This same model can be used for freshwater resources.

Chapter V

ENVIRONMENTAL REVIEW

Introduction

Aquaculture is a relatively new and promising industry in Massachusetts, therefore it stands to reason that communities as well as individuals are concerned about proposals for its promotion. Water quality is frequently a prominent concern when aquaculture facility siting options are discussed. The problems posed by competing uses such as marine and coastal environments, as well as social considerations, such as private ownership, can be addressed in a thoughtful deliberative fashion, by incorporating good siting and environmental data into the initial stages of the decision-making process.

To assist proper siting, support aquaculture-related management and policy decisions, and ensure the long-term sustainability of this fledgling industry, the state needs to develop sound data and reliable information. The effective utilization of data will be the cornerstone for deciding fundamental issues such as, land-use patterns, and how water-based activities affect water quality and aquatic habitats in marine and coastal environments. In addition, this information is necessary to enhance the development of a balanced, comprehensive, and effective policy that will promote aquacultural enterprise.

This chapter contains the following subsections: Siting and Monitoring. While these two topics are related, siting and monitoring present different perspectives and concerns and therefore, require separate attention. The information required for siting is both site and species-specific. Conversely, monitoring is broad-based and must be consistent with a range of current and future uses and needs.

Monitoring data required to describe ambient environmental conditions of a specific fishery, at a specific site proposed for aquaculture is, different on both spatial and temporal scales from physical, chemical, and biological parameters needed to document the presence/absence of change. Several regulatory programs also govern site-selection and the on-going operations of established facilities. Siting decisions must take into account issues such as: the natural productivity of the area under consideration; proximity of wild fisheries; migratory stocks; competing uses; navigational constraints; questions of coastal access; and upstream uses. In addition, an up-and-running aquaculture facility will have to satisfy National Pollutant Discharge Elimination System (NPDES) permitting conditions according to monitoring parameters required by this well-established program. NPDES permitting, however, may not necessarily be relevant to the siting process itself.

Siting

General Considerations

If Massachusetts is to successfully site aquaculture facilities and promote the growth of the aquaculture industry, economic investment required for its success must incorporate sound management decisions while also protecting environmental quality. A wide array of environmental, political, economic, and social considerations affect proper siting of aquaculture projects. These practical considerations are often site, and species specific, however, general features of the state of Massachusetts, both political and geographic, must also be considered when making siting decisions.

Within the borders of Massachusetts exist two distinctly different hydrogeographic and biogeographic provinces. North of Cape Cod, water temperatures are consistently colder, especially during winter. These colder temperatures can cause problems with icing, which is a major impediment to the use of cages and other aquaculture structures. Moreover, cold water temperatures, even south of Cape Cod, can often be lethal to a wide variety aquaculture species. Conversely, summer temperatures in the Massachusetts and Cape Cod Bays, especially near-shore, are often too warm for most salmonids, the species most commonly used for finfish aquaculture in the northeast. However, south of Cape Cod, warm summer temperatures actually promote growth of certain shellfish and finfish, where cold winter waters can greatly increase culture time and consequently, costs.

In both of these areas of Massachusetts, many of the species traditionally associated with aquaculture are difficult, if not impossible, to culture profitably. Thus, the first step for any siting venture in Massachusetts coastal waters must be the generation of a detailed annual temperature profile. Any siting decision must use temperature profile information to determine the optimal temperature range for the species and systems under consideration. The responsibility of generating this profile, and incorporating the information it contains into the siting decision, needs to be clearly specified.

Equally important to the temperature profile is a description of prevailing hydrographic conditions. This information will determine the usefulness of the site for particular categories of aquacultural enterprise. Current direction and velocity, affect the delivery of plankton to filter-feeding shellfish and the elimination of wastes from systems where feeding and/or medication are required. Structural adequacy of moorings and other project deployments must be demonstrated with regard to sea-state conditions at the site.

Good water quality is a fundamental concern for siting aquaculture facilities. The water quality of most Massachusetts coastal environments is generally acceptable and capable of supporting most of the kinds of aquaculture ventures that are likely to be introduced within the state. Water quality in Massachusetts is poorest in urban estuaries and inner harbor areas. Aquaculture may be precluded in these

areas, not only because of water quality, but also because of the presence of other well established conflicting uses such as commerce and navigation.

For most, if not all, potential sites there is limited or no environmental/water quality data upon which siting and operational decisions can be made. Consequently, for all siting decisions critical information must first be generated regarding water temperature, dissolved oxygen, and pathogen and toxic contaminant concentrations. The responsibility for gathering this information also needs to be determined.

Siting for shellfish aquaculture facilities is further constrained by the fact that shellfish projects can be located only in beds classified as "approved" under the National Shellfish Sanitation Program (NSSP). This restriction limits the availability of potential shellfish aquaculture sites in near-shore environments within Massachusetts.

The experience of other states and countries which have successfully addressed problems concerning siting protocols for aquaculture facilities has been utilized in developing systems within the state. Combining the best of these collective solutions and adapting them to the state's needs, should aid the development of siting and operational monitoring systems to encourage aquaculture development.

Many aquaculture projects require a near-shore location where water and sediment quality are often most degraded by upland activities. This situation limits the potential availability of many sites in Massachusetts for successful aquaculture development. Nevertheless, there are several areas in Massachusetts which support relatively pristine conditions suitable for aquaculture. Long-term suitability, however, may be jeopardized by future pressure for development and by changing land uses. This existing and potential conflict between land and water uses is an important policy and management question. To balance the competing demands on coastal areas, successful planning for aquaculture must integrate long range land and water-use planning.

Specific Siting Considerations

Siting an aquaculture facility requires evaluation of diverse kinds of information ranging from ambient water quality, to state and local regulatory concerns. The following reviews existing regulatory authority, siting criteria, and mapping as a siting tool for regulators, policy decision makers, and entrepreneurs.

The current Massachusetts regulatory scheme assigns control to local governments for the issuance of aquaculture licenses in waters and flats up to the three-mile limit. This authority however, only applies to licenses for shellfish aquaculture. To date, no comparable regulations/licenses exist for finfish aquaculture.

The succeeding siting considerations and the monitoring criteria are each discussed in accordance with the following four categories of aquacultural enterprise described in Chapter III.

1. No Structures/No Additions/No Discharges:
Prototype, Shellfish Bottom Culture
2. Structures (Water-Based)/No Additions/No Discharges:
Prototype, Shellfish/Seaweed Water Column Culture
3. Structures (Land-Based)/Additions/Discharges:
Prototype, Recirculating/Flowthrough Culture
4. Structures (Water-Based)/Additions/Discharges:
Prototype, Net-Pen Culture of Finfish

Category 5 projects, Projects in Federal Waters, can involve any of the four categories referenced above. Siting and monitoring criteria for category 5 projects, are not discussed in this section.

Category 1.

No Structures/No Additions/No Discharges: Prototype, Shellfish Bottom Culture

Aquaculture facilities in this category typically involve intertidal and subtidal bottom culture of shellfish. Authority granted under Massachusetts General Laws Chapter 130 (MGL Ch. 130), section 57, requires DMF to review applications to ensure site-specific shellfish culture activities, approved in via a town-issued license, will not have an undue adverse affect upon area natural resources. DMF's review begins by assessing the water quality using a sanitary survey which establishes a classification for the area such as approved, restricted, or prohibited. The primary basis for classifying shellfish growing areas is the concentration of fecal coliform bacteria counted in water samples collected from the site. If a site is classified as either prohibited or restricted, the municipality can not issue a shellfish aquaculture license.

Under (MGL Ch. 130) section 57, and as part of the current siting process, DMF is required to review the public hearing record to identify other potential problems including the presence of other productive fisheries or competing uses. A grid survey is used to assess the density of shellfish population per square foot as well as the presence of other resources at the site. DMF must also consider the presence of threatened or endangered species, such as the piping plover, their critical habitats, and seek advice on these issues from other appropriate agencies. Finally, DMF must also consider the effect of the proposed activity on current public access to shoreline habitats, as well as effects on sea grasses and other vegetative systems.

For the purpose of aquaculture facilities siting, the Army Corps of Engineer (ACOE) is concerned with environmental impacts and obstructions to navigation. To facilitate the aquaculture permitting process, the ACOE has developed thresholds regarding size and type of facility. Facilities under 10 acres, which covers most bottom shellfish operations, are subject to the ACOE Programmatic General Permit (PGP) program. Facilities over 10 acres would require submission of an individual permit application. DMF often collaborates in providing site-specific information to the ACOE regarding both of these type of permits.

Under the Wetlands Protection Act, local Conservation Commissions are authorized to review aquaculture projects proposals in tidal flats, saltmarshes and submerged lands. Conservation Commissions are required to ensure that proposed activities will not adversely affect drinking water supplies, wildlife habitat, or interfere with stormwater runoff.

Category 2.

Structures (Water-Based)/No Additions/No Discharges: Prototype, Shellfish/Seaweed Water Column Culture.

These operations involve using gear suspended in the water column from buoys that can be moved vertically for ease of maintenance and harvesting. This category also covers production of algae and other nonshellfish species, where feeding is not required. An Individual Permit from the ACOE is required for most subtidal, suspended, or transient facilities. Some suspended or floating shellfish culture activities are allowed under the PGP. Municipalities do not have licensing authority over these nonshellfish aquaculture operations, however Conservation Commissions do have oversight authority under the WPA.

Criteria for siting subtidal, suspended, or transient shellfish cages, are essentially the same as siting intertidal shellfish operations. These operations, however, receive a higher level of review, due to potential navigational and engineering limitations, and the potential effects aquaculture structures may have on the ambient environment and endangered species.

Category 3.

Structures (Land-Based)/Additions/Discharges: Prototype, Recirculating/Flowthrough Culture (Addressed elsewhere)

Category 4.

Structures (Water-Based)/Additions/Discharges: Prototype, Net-Pen Culture of Finfish.

At present, no process exists within Massachusetts government to assess siting proposals for finfish aquaculture. Municipalities have no "home rule" regulatory authority with respect to finfish aquaculture as they do for shellfish aquaculture, except under the WPA.

The following basic elements are for incorporation into a aquaculture siting procedures check list:

- a. Endangered species habitats must be identified within a given distance from the proposed culture site. Gear modification or alternative site selection may be required to reduce potential adverse effects to protected species and their habitats.
- b. Issuance of a water quality certification from the Massachusetts Department of Environmental Protection must be obtained, and criteria set forth in the Clean Water Act and the Rivers and Harbors Act must be met.
- c. Applicants must provide accurate plans for pen facilities, existing resources, and current and proposed uses in the site, and in adjacent areas. These plans must, at a minimum, also include: the number, size and location of pens; a mooring plan; and, the maximum area to be utilized by pen systems.
- d. A baseline survey will be required that includes video diver survey, sediment and infauna analysis, water quality sampling, and hydrographic data collection such as current and water depth information. As part of this baseline survey, benthos must be characterized in terms of sediment structure, community structure, and basic hydrography.
- e. Water depth must be sufficient at all times to allow circulation beneath pen systems.
- f. The engineering specifications of any proposed system must be sufficient to withstand the worst expected sea state and other hydrographic parameters at the selected site. The ACOE will determine if engineering design is sufficient in its permit review process.

Mapping for Aquaculture in Massachusetts

Maps are the traditional tools used to visually display information and locate and monitor the physical environment. The recent explosion in information technology now offers many more mapping formats than previously available. Maps can be customized to show the user the exact information needed for any particular use. In addition, maps can easily be revised to reflect changes to the physical and natural environment.

Use of information technology for mapping is rapidly becoming a significant management tool for ocean and coastal planning. Several marine oriented items

now under review in the Massachusetts legislature, require mapping using modern mapping tools. The Open Space and Seaport Bond bills are examples of such items, which if passed, present opportunities for funding coastal mapping initiatives. Mapping based on information technology could greatly benefit the business community, regulatory agencies involved with aquaculture, and state and municipal planners. In addition, maps and data produced could significantly enhance private support by aquaculture entrepreneurs. These maps, once developed, can guide applicants for aquaculture licenses to appropriate sites and help simplify the license application process. Regulatory officials reviewing license applications rely on standardized maps, which facilitates the recording of baseline and operational monitoring data. Planners developing and modifying zoning and land use designations in harbor areas will also benefit from the development of these maps and the accompanying coastal and marine resource data sources.

On the down side, base map preparation is costly and time consuming. Identifying users and the appropriate use specific scale is a crucial component for developing useful maps. It is important to note, that inaccuracies inherent in mapping exercises necessitate the continuance of site and field investigations, as well as long-term monitoring efforts. Field investigations that verify current baseline information and establish precise locations of crucial data and information will continue to be essential.

In Massachusetts, various agencies and organizations are engaged in the mapping of geographic data using information technology. MassGIS coordinates many of these activities among the agencies and with the state's Management Information System (MIS) efforts. Since its inception in 1985, MassGIS data base has developed in close cooperation with federal agencies, local communities, and special interest groups. MassGIS base maps have been derived from 1:25,000-scale USGS topographic maps. This scale, while efficient in terms of cost for state-wide needs, does not provide the precision, detail, or up-to-date qualities necessary for coastal and marine mapping requirements.

To promote, regulate and assist the aquaculture community, maps on a scale of plus or minus 1 m, rather than the plus or minus 10-15 m, are needed. To date, MassGIS has operated in a cost-for-services mode. An agency or outside user, orders and pays for data layers to be digitized, and then purchases customized maps. Because custom map production is time consuming, efforts using CDROM technology are currently underway at EOEA. This conversion will make the MassGIS data base more cost effective and increase accessibility to outside users, allowing the private sector to assume more of the custom map generation function for non-agency users.

Assuming passage of the Open Space Bond bill, MassGIS will begin an aggressive multi-year mapping effort to enhance the precision of the state's base map through the generation of black and white orthophoto maps. Orthophoto maps provide precise positional information which future agency mapping efforts could share. Orthophotos provide a pictorial representation over which interpretive data can be

superimposed. Stored in the existing MassGIS archives, are a number of useful layers of coastal marine data, developed by MassGIS, DFW, ELF, and MCZM. The utility of these data varies depending on their origin and their intended use.

In October 1994, the United States Department of Commerce's NOS began a multi-year shoreline mapping project to update the state's nautical charts. Results of the NOS mission will include precise delineations of the shoreline at Mean High Water (MHW) and Mean Low Water (MLW). Additionally, information about docks and piers, and other features commonly seen on a nautical chart, will be included, and incorporated into MassGIS.

MCZM is working closely with both MassGIS and NOS to unify these efforts and to develop a comprehensive and long term 1:10,000 scale coastal map series that will better meet the requirements of coastal and marine users. Phase I of this project, to be completed by September 1995, will produce rectified color aerial photographs using the NOS source data currently available. Phase II will add and refine marine jurisdictional designations to the MassGIS by Spring 1996. Phase III will produce color orthophotographs for the entire coast.

MCZM has received funding under a federal grant to establish a Marine Resources Information System. This integrated with MRGIS will collate, standardize and manipulate existing geographic information relating to ocean resources. New information layers will also be added as compatible information is gathered. MCZM is working with DMF, MassGIS and other agencies to initiate this system.

Considerable amounts of basic physical and interpreted coastal marine information still need to be acquired and/or synthesized. Data on bathymetry, navigation channels, circulation, fisheries assessments, and many other categories of essential information are needed for planning, regulating, monitoring and promoting aquaculture interests. Some of these data are already available within the scientific community. The USGS Atlantic Marine Geology Division, Woods Hole Oceanographic, the National Marine Fisheries Service, and Salem State College are merely some of the regional information sources which can be tapped. These, and other data, need to be collected, organized, and integrated into the MassGIS to improve accessibility for broader categories of coastal users.

In discussing mapping as an appropriate tool for aquacultural siting and monitoring initiatives, it is important to address the development of siting maps that would indicate favorable aquaculture conditions. Unfortunately, there are a number of drawbacks to this approach. First, there are many different species which are the subject of aquaculture, each requires different habitats, structures, etc. The volume of data that would have to be collected and digitized to display these species specific requirements would be prohibitively expensive. Second, previous siting experience suggests that maps of potential aquaculture sites can be used to prevent, rather than promote, the development of aquaculture facilities in otherwise ideal locations.

Lastly, sites can change, either subtly or drastically, over time as a result of natural or man made disasters.

Having considered these deterrents, the Working Group recommends that aquaculture-relevant maps be produced which identify areas where aquaculture would be constrained or prohibited using the following parameters:

1. Physical Characteristics

- temperature
- wind direction
- direction and velocity of currents
- maximum wave height/wave direction
- velocity overwash zones
- bathymetry
- surface water designations, such as outstanding resource waters (ORWs)
- Mean Low Water and Mean High Water (MLW, MHW)
- barrier beaches
- shoreline changes

2. Areas with Biological Management Designations

- ACECs
- endangered species and critical habitats
- identifiable nursery areas
- location of eelgrass (DEP)
- plankton density
- shellfish management areas

3. Cultural Features

- access issues
- competing uses, adjacent or at location, (land use and land cover data are available from 1972 and 1985; 1990 data completed for the Cape, and 1995, for Buzzards Bay)
- upland ownership (public vs. private)
- location of NPDES point sources (water pollution)
- navigation channels
- navigational markers with a 100' to 200' contraindication buffer (all markers in N.E.) soon to be available on disc
- dredge and disposal sites (ACOE digital data)
- shipwrecks

Note: Many of the parameters listed above have already been or are in the process of being digitized, however, scales frequently vary.

Monitoring

Good water quality is an important prerequisite for successful aquaculture. Maintaining a healthy coastal environment is not only important to the organisms to be cultured at a site, but also for flora and fauna that are indigenous to the site, and to the migratory species that circulate through and around the site. Maintaining good water quality ensures a healthy valuable product will be marketed, and helps to ensure the prolonged productiveness of the area, reducing the need to develop other sites.

Maintaining good water quality, particularly in intensively developed coastal environments such as Massachusetts, requires frequent monitoring. Effective monitoring can detect changes in environmental quality that result from aquaculture operations, as well as other impacts to coastal areas. In addition, monitoring can quantify the scope and duration of environmental impacts.

Early identification of environmental degradation through a routine monitoring program permits the aquaculturist to institute minor operational changes, for example altering feeding frequency of net-pen reared finfish in order to correct an identified problem before it reaches an extreme condition. Early identification of environmental problems prevents cumulative environmental degradation and can save the grower money. When degradation reaches an extreme level, cultured organisms experience depressed growth rates, disease, and even death. A situation all growers want to avoid.

Monitoring also permits comparison of baseline values of flora and fauna already existing in the area prior to siting an aquaculture facility. This data provides useful information on the extent of impact from a single operation and possible cumulative impacts from many operations located within a single water body. In general, successful monitoring can aid growers in raising organisms at a site for long periods of time while minimizing impacts to the environment.

Healthy coastal ecosystems are characterized by a diversity of species. Change in species diversity at a particular site is commonly used as an index of environmental quality. Some aquaculture practices, such as feeding of net-pen finfish, may attract new, wild species, hence resulting in a transient increase in biodiversity. Evidence indicates, however, that over time continued inputs of food, essential nutrients, and other "contaminants", typically results in a net loss of biodiversity near an aquaculture site. Opportunistic species, such as Capitellid worms, often dominate affected sites. Changes in the abundance of sensitive indicator species may reflect initial impacts, while the total absence of indigenous benthic fauna reflects more severe degradation. Some effects on the benthic community must be expected at an *in situ* aquaculture site. However, the level and duration of such impacts need to be monitored at regular intervals to determine if the degradation is persistent, worsening, or extend beyond the immediate confines of the permitted facility. If conditions become critical, steps need to be taken to reduce impacts to the area. Such

steps could be as simple as modifying feeding frequency or the volume of feed offered to prevent unconsumed food from accumulating in benthos. Although more drastic action may sometimes be required, such as moving the entire culture system, temporarily, or perhaps permanently, to allow the area to recover.

Process for Defining Monitoring Protocols for Proposed Aquaculture Projects in Massachusetts

Current aquaculture in Massachusetts is largely limited to shellfish culture in the southeastern coast, with some land-based aquaculture occurring in the western part of the state. However, when considering a process to define monitoring guidelines, the Working Group reviewed the complete spectrum of aquacultural enterprise.

The Working Group surveyed aquaculture monitoring protocols from outside the United States, in Canada, Italy, Japan, Norway, Scotland, Chile, GESAMP, and also domestically in the states of Washington, New Jersey, Connecticut, Rhode Island, and Maine. Although all were instructive, none provided a truly successful "fit" with the environmental, political, and cultural features that define marine aquaculture in Massachusetts. Particularly, the state's physical location on the boundary between two biogeographic provinces, its highly developed, intensively used coastal environment, and its long tradition of home-rule make Massachusetts truly unique.

Maine has, by northeast standards, a relatively well established aquaculture industry. The majority of Massachusetts waters are part of the Gulf of Maine system, therefore the Monitoring Subgroup relied heavily on Maine's experience. From this information a three step process to generate the data and information will need to be developed to monitor the environmental impact of aquaculture projects. This proposal, and the process it defines, must be seen as iterative, subject to continuing revision. The following is an adaptation of the Maine three-step model.

Step One - Categorize the project

Define the project using one of four possible categories (see Appendix F) to describe a continuum of potential impact on Massachusetts marine/coastal waters. These four categories are consistent with the kinds of aquaculture facilities discussed in the Regulatory Chapter and in the siting section of this chapter.

Category 1 Aquaculture

Applies to low-impact, bottom-culture systems where there are no structures suspended within the water column. These systems do not inhibit other individuals from using the overlying water and do not contribute extraneous additions of food or other inputs to the system. Category 1 aquaculture requires minimal baseline evaluation of the site. For example, information on traditional usage, level of productivity, and so forth are generally sufficient. Operational monitoring, (referring to long-term, continuous monitoring activities in contrast to baseline monitoring) of a category 1 projects, should not be extensive.

Operational monitoring for these types of projects can consist of an annual inspection of the site by local regulators to ensure the use of site is consistent with permit conditions. In addition, an annual report submitted to DMF should be required for each category 1 site. This report should include, at a minimum the number of seed deployed and amount of crop harvested. (Note: This information should be handled by reporting officials as proprietary information. Since reports such as these were recently ruled to be public information, confidentiality will require new legislation.)

Category 2 Aquaculture

These projects will involve a more intensive use of the physical space, with structures suspended within the water column or intertidal zone, thereby impeding access to other individuals who might otherwise use the overlying water. No additional inputs of feed or other agents are permitted in Category 2 aquaculture sites. Baseline information required for Category 2 aquaculture efforts will include all the information required for Category 1 projects, plus an evaluation of the potential impact of the suspended structures. This evaluation shall include:

- a. A detailed design plan for the facility including concise drawings of the equipment to be deployed into the environment;
- b. A description of the proposed site including: measurements of depth; tidal current velocities, benthic habitat (including video diver survey); sediment type; submerged vegetation; and resident fauna; and
- c. Information on known uses of the proposed site by endangered species and a discussion of the potential for impacts on endangered species.

Operational monitoring at category 2 sites shall include an annual site visit and a biannual evaluation of the benthic environment within the site which includes a video diver survey. Any entanglements of protected species shall be reported within 24 hours to DMF and NMFS. In addition, an annual report of production at the aquaculture site (confidentiality maintained) shall be required. Documented in this report will be all animal entanglements and user conflicts that have occurred within the previous year.

Category 3 Aquaculture

These operations are land-based and intensively managed facilities such as shellfish or finfish hatcheries or recirculating culture systems. Facility discharges are concentrated and remotely deployed into the environment. In considering a Category 3 culture system, regulations addressing point-source discharges are currently well established and guidelines/regulations are clearly outlined as part of the NPDES permitting process. Therefore, the Working Group felt it unnecessary to address environmental monitoring of a category 3 culture system as the system is already in place. It will be necessary, however, to ensure that the effluent from

an intensive Category 3 aquaculture system is classified as "agricultural effluent" and to apply those regulations required for the discharge of such waste effluent to all category 3 aquaculture facilities.

Category 4 Aquaculture

These operations represent the most intensive level of field-deployed *in situ* aquaculture and consequently demands the most intensive environmental monitoring. This category involves both structures within the water column and added inputs of organic and inorganic materials. All of the information required for the previous 3 categories of aquaculture development will be needed for a successful category 4 project. In addition, the Maine model, with appropriate adaptation to reflect unique features of Massachusetts, offers a reasonable framework for environmental monitoring of finfish aquaculture operations. (See Appendix F, Categories of Aquaculture Projects in the Commonwealth of Massachusetts.)

Step Two - Develop Baseline Monitoring Guidelines

Baseline monitoring guidelines must be developed that are consistent with the aquaculture categories established in step one. These guidelines are "time-zero" data, and are the foundation needed to assess the impacts projects may have on the ecosystem effects over time.

The baseline data established in this phase will serve as the parameters for step 3 which will detail operational monitoring guidelines. The baseline data is of critical importance, and how they are defined needs to be an integral part of the aquaculture facility permitting process. The following are questions which need to be addressed in order to develop an aquaculture permit application:

- What category of environmental impact will the proposed aquaculture site fit into?
- Given the level of intensity of culture (Categories 1 through 4) what are the potential and likely environmental impacts?
- What biological, chemical, and physical measurements are required to quantify the potential impacts?
- What are appropriate thresholds of environmental degradation?
- What are appropriate sampling frequencies?
- What laboratories (private, public or both) are needed and are available to process samples in a timely, cost-effective fashion?
- Should a private contractor, capable of doing all assessment and able to verify methods, be utilized?

- Which State agency will collect and review the data? (If DMF is designated, additional staff support with collection, diving, and photographic capabilities will be required.)
- Can start-up projects afford the baseline monitoring which must be conducted?
- How can the state fund monitoring costs? Who will pay for baseline and operational monitoring?

Step Three - Develop Operational Monitoring Guidelines

Operational monitoring requirements the necessary tools for the continuing evaluation of the project's impact. Operational, or on-going monitoring requirements, must also be coordinated with the other marine monitoring programs, particularly the Massachusetts Marine Monitoring Program now being developed.

Upon completion of the three activities identified above, an initial evaluation (baseline) procedure as well as a continuing monitoring program will have been designed to accommodate any aquaculture effort proposed for the Commonwealth.

Recommendations

60. *Recommendation:*

Encourage municipalities to develop land use, harbor plans, shellfish bed management plans, resource management plans and other coastal resource related managements plans, which incorporate opportunities for public and private aquaculture as well as development of commercial and recreational fisheries.

Justification:

Such resource management plans will allow municipalities or cities to decide, in advance, the kinds of activities and development they wish to foster and support. Resource planning will alleviate last-minute, haphazard planning that does not allow a municipality to fully utilize its waterfront areas and resources. Natural resource planning maximizes the types of uses an area or region can support and sustain.

In general, municipalities do not have the resources required to develop these plans, although good planning can be cost effective over the long term. Therefore, any assistance, even small grants and technical assistance, provides important incentives for municipalities to proceed with the harbor planning process.

Implementation Approach:

This is a long-term implementation project which can be initiated immediately. Promote existing incentives for communities to develop natural resource plans for resource allocation. This outreach should be initiated when municipalities approach DMF for aquaculture surveys and should be done with assistance from DMF, MCZM and the Mass. Bays Shellfish Bed Restoration Program. Harbor planning activities can be funded, in part, through the pending Seaport Bond bill.

61. *Recommendation:*

The state should encourage the development of several (initially, small scale) aquaculture pilot projects to assist in establishing realistic siting and monitoring protocols.

Justification:

Experience with pilot projects will allow the recommended siting and monitoring procedures to be tried before full-scale implementation of these strategies is required. Changes will likely need to be made to the procedures based on actual field experience. Pilot projects will allow protocols to be tailored to the specific environmental conditions in Massachusetts.

Implementation Approach:

The Interagency Aquaculture Permit Review Group should work with all appropriate applicants in designing and assisting in the implementation of environmental monitoring plans.

62. *Recommendation:*

MASSGIS should produce a hard-copy, base map incorporating all relevant coastal features for which data are available at the most practicable scale. Maps should be available to users at field stations throughout the Commonwealth.

Justification:

Adequate mapping can greatly facilitate the siting of aquaculture facilities for municipalities and the state alike.

Implementation Approach:

MCZM has received funding and is initiating this project with the assistance of DMF, MassGIS and DEP.

63. *Recommendation:*

Adopt a three-step monitoring definition process which (1) evaluates each proposed aquaculture project in terms of its potential environmental impact and labels it accordingly (see Appendix F, Categories of Aquaculture Projects in Mass.), (2) defines, in conjunction with the permitting process, baseline data acquisition to be implemented and (3) delineates operational (long-term)

monitoring criteria, together with a regimen for their implementation, to be incorporated in the permit "order of conditions".

Justification:

Reliable environmental quality data are needed to adequately assess both the potential suitability of a site for an aquaculture operation and the baseline conditions against which future changes can be measured. This information is essential for agencies responsible for environmental protection and management. Aquaculturists also need these data since, in many instances, they will be investing large sums of money into operations and need to know the suitability of the site for sustained production.

Implementation Approach:

Requirements for generating baseline data on proposed sites should be included in the application process. It should be stated that monitoring is the responsibility of the applicant. Data, when collected, should be integrated into the Mass. Marine Monitoring Program data base.

64. *Recommendation:*

Support the Open Space Bond Bill and other dedicated sources of funding for long-term marine environmental monitoring activities.

Justification:

Given that environmental monitoring is a very high priority for both siting aquaculture operations and to ensure that environmental quality is adequately protected once an project is underway, a dedicated effort should be made to secure funding for marine monitoring efforts.

65. *Recommendation:*

Secure new resources for DMF (funds for new personnel, computer mapping capabilities, etc.) dedicated to support (technical assistance, regulatory responsibilities) for aquacultural enterprises.

Justification:

Resources of DMF staff are presently fully allocated with existing mandatory responsibilities.

66. *Recommendation*

An aquaculture application packet should be developed which includes: 1) basic background information on aquaculture in the Commonwealth, including regulations, licensing, siting requirements, operational monitoring requirements, etc., 2) a standardized application form which integrates reviews by DMF, ACOE, MDEP, local Conservation Commissions, and the Harbor Master, 3) a format for public comment at the local level, and 4) a Standard Field Survey Matrix for use by DMF field biologists during Aquaculture Surveys.

Justification:

A standardized form would streamline the application and permitting process and make it easier for both applicants to file for a permit and for agencies to review the application. The Field Survey Matrix will provide guidance to local Conservation Commissions during their reviews, thereby allowing a thorough and more expeditious review.

Implementation Approach:

The Aquaculture Coordinator should work with ACT to develop this standardized application packet as soon as possible.

67. *Recommendation:*

All siting and monitoring data collected shall use approved, performance-based methodologies and shall be consistent with and integrated into the Massachusetts Marine Monitoring Program (MMMP) currently being developed by the MCZM.

Justification:

The Executive Office of Environmental Affairs (EOEA) and the University of Massachusetts are collaborating in the development of a Massachusetts Marine Monitoring Program (MMMP) that is integrated with state agency monitoring activities. An integrated approach to monitoring and data management should eliminate duplicative monitoring efforts, allow for consistency in data collection and data quality and increase the utility of any data collected.

Implementation Approach:

Coordination should begin immediately with DMF taking the lead role.

68. *Recommendation:*

An environmental monitoring focus group should be established to provide the oversight of environmental monitoring efforts associated with aquaculture.

Justification:

The process of establishing and maintaining a monitoring protocol for aquaculture should be iterative with the state learning from each project.

Implementation Approach:

DMF and DFW should identify appropriate expertise to fulfill this recommendation.

Chapter VI

SUMMARY

Conclusion

The lack of a cohesive aquaculture strategy, the absence of aquaculture staffing in State government and a daunting array of regulatory requirements have effectively stymied the potential for the aquaculture industry in Massachusetts to flourish. While there are other constraints to the industry, the administrative issues mentioned above are central to the success of aquaculture in this state. Without focussed, consistent State support for the industry, the aquaculture sector of our economy will continue to be small, representing a fraction of its potential.

This Strategic Plan is a critical first step toward establishing an effective and responsive administrative and regulatory framework which supports aquaculture in its many forms. The recommendations below represent the general consensus of the Working Groups and address the larger administrative needs of the industry. These recommendations, in concert with the specific regulatory, economic development and environmental review recommendations provide the underpinnings of the Strategic Plan.

Complete Listing of Recommendations

1. Implement regulatory streamlining. (pg. 13)
2. Reactivation of the Municipal Shellfish Propagation Program. (pg. 13)
3. Establish aquaculture positions at DFA and DFWELE. (pg. 14)
4. Bond monies should be directed to Strategic Plan priorities. (pg. 14)
5. Improve shellfish licensing terms and conditions. (pg. 14)
6. Produce "Aquaculture Regulatory Handbook". (pg. 15)
7. Establish an Aquaculture Coordination Team. (pg. 15)
8. Establish an Aquaculture Advisory Group. (pg. 15)
9. Hire an Aquaculture Coordinator at DFA. (pg. 15)
10. DMF is lead regulatory agency for marine aquaculture. (pg. 16)
11. DFW is lead regulatory agency for inland aquaculture. (pg. 16)
12. DFA is lead agency for promotion and marketing. (pg. 16)
13. Establish an Interagency Aquaculture Permit Review Group. (pg. 16)
14. Amend ACOE Programmatic General Permit. (pg. 19)
15. Encourage pilot projects. (pg. 20)
16. MCZM should clarify Consistency Review. (pg. 20)
17. DMF should promulgate regulations for finfish aquaculture. (pg. 21)
18. Maintain and assert position that the boundary between private tidelands and state-owned subtidal land in MLW. (pg. 21)

19. Chapter 91 fee structure should be reevaluated. (pg. 21)
20. MEPA should review the adequacy of existing thresholds as they apply to aquaculture. (pg. 22)
21. DEM should review ACEC program as it relates to aquaculture. (pg. 22)
22. Establish presumption that the interests of the Ocean Sanctuary Act are met if DMF, DEP and MCZM approve a project. (pg. 23)
23. Shellfish aquaculture licenses should be renewable. (pg. 23)
24. Shellfish aquaculture licenses should be transferable. (pg. 24)
25. Municipalities should be given the option to preapprove areas. (pg. 24)
26. State should provide written guidance to municipalities. (pg. 24)
27. Concurrent filing of applications is encouraged. (pg. 25)
28. Increase shellfish licensing fees. (pg. 25)
29. Improve shellfish reporting requirements. (pg. 26)
30. DMF should develop pilot leasing program for restricted areas. (pg. 26)
31. Develop NPDES general permits for aquaculture discharges. (pg. 27)
32. Develop policy on water withdrawals. (pg. 27)
33. Ensure federal-state coordination. (pg. 27)
34. Establish revolving loan fund. (pg. 35)
35. Expand existing DFA programs to include aquaculture. (pg. 36)
36. Subsidize participation in Boston Seafood Show. (pg. 36)
37. Establish curriculum grants program for secondary schools. (pg. 36)
38. State sponsorship of seminars for finance community. (pg. 37)
39. Develop a public relations campaign for aquaculture. (pg. 37)
40. Allow finfish growers to sell their products at below minimum size restrictions. (pg. 37)
41. Consider developing a limited access elver fishery. (pg. 37)
42. Allow limited number of special collection permits for broodstock. (pg. 38)
43. Reassess current restrictions of culture of non-native species. (pg. 38)
44. DMF should publish its policy concerning shellfish seed certification. (pg. 38)
45. Conduct an annual survey of Mass. aquaculture industry. (pg. 39)
46. Establish a competitive grant program to foster research and development. (pg. 39)
47. Fund a research and innovation center. (pg. 39)
48. Earmark existing funds for aquaculture training. (pg. 40)
49. Consider adding an aquaculture member to the Fish and Wildlife Advisory Board. (pg. 40)
50. The state should provide aquaculture extension services. (pg. 40)
51. Develop a Mass.- grown seal. (pg. 40)
52. Establish internet bulletin board. (pg. 40)
53. Initiate study of agriculture cooperatives. (pg. 41)
54. Develop a buyers guide to aquaculture products. (pg. 41)
55. Provide marketing seminars for growers. (pg. 41)
56. Appropriate funds for degree programs in aquaculture. (pg. 41)
57. Establish grant program for public aquaculture programs. (pg. 41)
58. Establish regional aquaculture demonstration centers. (pg. 42)
59. Establish a grants program for private/public programs. (pg. 42)

60. Encourage municipalities to include aquaculture within the context of local planning efforts. (pg. 56)
61. The state should encourage pilot projects. (pg. 57)
62. A base-map of coastal/ocean features should be developed. (pg. 57)
63. Adopt a three step environmental monitoring process. (pg. 57)
64. Support funding for long-term marine monitoring. (pg. 58)
65. Secure new resources for DMF. (pg. 58)
66. Develop an aquaculture application packet. (pg. 58)
67. All data collection should be consistent with Mass. Marine Monitoring Program. (pg. 59)
68. Establish an environmental monitoring focus group. (pg. 59)

GLOSSARY

ACEC - Area of Critical Environmental Concern

ACOE - Army Corps of Engineers (U.S.)

aquaculture - The manipulation of marine or freshwater organisms and/or their environment before eventual release, harvest, or capture; the controlled cultivation and harvest of aquatic animals and plants (USDA, 1983).

broodstock - Individual fish/shellfish used for breeding purposes.

culch - Hard material (usually broken oyster/clam/scallop shells) laid down in intertidal area to attract spat.

DFWELE - Department of Fisheries, Wildlife and Environmental Law Enforcement

DEM - Department of Environmental Management

DEP - Department of Environmental Protection

DFA - Department of Food and Agriculture

DFW - Division of Fish and Wildlife

DMF - Division of Marine Fisheries

DO - dissolve oxygen

EEZ - Exclusive Economic Zone. Marine areas under the jurisdiction of the federal government. Generally, the area between the three mile state jurisdiction and 200 miles.

ENF - Environmental Notification Form

EPA - Environmental Protection Agency

EOEA - Executive Office of Environmental Affairs

EOEcA - Executive Office of Economic Affairs

FTE - full time employee

inland aquaculture - Facilities on land, including wetlands, ponds, tanks, and enclosures used to culture marine species. Species cultured in inland facilities are

dependent upon the culturist for maintenance of water quality, food supply and waste removal.

LOP - Letter of Permission (ACOE)

MCZM - Coastal Zone Management Office

NREF - Nantucket Research and Education Foundation

NMFS - National Marine Fisheries Service

NOAA - National Oceanic and Atmospheric Administration

NOS - National Ocean Service

NPDES - National Pollutant Discharge Elimination System. Authorization to discharge into surface waters of the U.S. issued by the Environmental Protection Agency.

NSSP - National Shellfish Sanitation Program

neretic - near shore

NEFMC - New England Fisheries Management Council

marine aquaculture - Structures (trays, pens, enclosures, nets, ect.) which are located in or on unaltered marine waters.

MAA - Massachusetts Aquaculture Association

MAIC - Massachusetts Aquaculture Innovation Center

MEPA - Massachusetts Environmental Policy Act Unit

MGL - Massachusetts General Laws

MHW - Mean High Water

MLW - Mean Low Water

MMMP - Massachusetts Marine Monitoring Program

MOBD - Massachusetts Office of Business Development

PGP - Programmatic General Permit (ACOE)

therapeutants - Substances used for the remedial treatment of disease

TOC - Total Organic Carbon

WG - Working Group(s)

WPA - Wetlands Protection Act

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V. Zupo Stazione Zoologica, Naples, Italy Tel 081 583 3309

APPENDICES

Appendix A: Existing Regulatory Framework

Below is a brief summary of the regulatory processes for different types of aquaculture in Massachusetts. Project specifics, including location, may result in a variation of the identified process.

Shellfish Bottom Culture/No Discharge

This class of projects, used exclusively to grow shellfish, is characterized by low profile structures positioned directly on the substrate and includes netting, culch, nursery boxes, and rebar. This type of culture does not generally impede navigation or other uses of the area. The structures are only visible during low tide.

NOTE: The below order is recommended to pursue permits.

1. Apply for shellfish aquaculture license (Ch. 130, section 57) from municipality (selectmen or city council). Plans which describe the project and proposed area shall accompany application. The governing body gives public notice and holds a hearing concerning license. License is approved or denied within 60 days of receipt of application. After local approval, DMF surveys the project area to determine that there is no adverse impact to the shellfish or other natural resources of the town. Upon DMF certification, license may be issued by the governing body.
2. A Notice of Intent is generally filed with the local Conservation Commission in compliance with the Wetlands Protection Act (WPA). After a comment period and public hearing, an Order of Conditions is issued or denied. A denial by the Conservation Commission can be appealed to the Department of Environmental Protection.
3. If the project area is privately owned tidelands, permission from the landowner is required.
4. Under the Programmatic General Permit (PGP) an application for a Section 10 permit is required from the Army Corps of Engineers (ACOE).

Structure/No Discharge (shellfish/seaweed water column culture)

This category is the same as Shellfish Bottom Culture/No discharge and the regulatory process only differs if license is on state owned subtidal lands. This type of culture utilizes more of the water column than does bottom culture and therefore, often excludes and conflicts with more uses.

A Chapter 91 Section 10 A permit from the harbormaster is required for use of state-owned subtidal lands.

Discharge/Structure

RECIRCULATING/FLOWTHROUGH/HATCHERIES

This category of projects is characterized by landbased facilities having water withdrawal (from any source) and discharge (to any type of water body). The precise regulatory requirements will differ depending on location and types of water bodies from which project is withdrawing and discharging water. Discharges generally consist of uneaten food inputs and feces and occasionally drug treatments and fish mortalities.

NOTE: The permits listed below are not in a recommended order.

1. Existing operations are exempt from further review under the WPA (normal maintenance and improvement activities of the operation). New or expansions of existing operations that are proposed within areas subject to jurisdiction (e.g. 100 year floodplain, buffer zone to BVW or river) need a permit under the WPA and should be coordinated with Waterways (DEP). Work in the waters of the United States (including wetlands and intertidal areas) may require an ACOE authorization.
2. If the project involves pipes or headwalls located in navigable waters or below mean high water, a Waterways permit (Chapter 91) and Section 10 permit (ACOE) may be necessary. Review by DEM under the Ocean Sanctuaries Act will automatically occur as part of Waterways review.
3. Different aquaculture licenses and permits are required from both DFW and DMF depending on location, species cultured and marketing approaches.
4. A permit for withdrawal of fresh water (greater than 100,000 gallons/day average) is required from the Office of Watershed Management. No water withdrawal permit is needed from DEP Office of Watershed Management provided the withdrawal is from ocean or harbor.
5. An individual National Pollution Discharge Elimination System (NPDES) permit is required by the Environmental Protection Agency (EPA) for any discharge into fresh or salt water. This permit program is jointly administered by DEP and EPA. No NPDES is needed for discharges to municipal wastewater treatment facilities, although a sewer extension permit from DEP would be required.

This category of projects, used primarily to raise finfish, is located in marine waters and utilizes the entire water column and surface area. Concentrated discharges from this type of culture include unconsumed food, feces, and on occasion, excess drugs and fish mortalities.

Below is the existing process for marine finfish culture in state waters.

1. Applicants apply directly to DMF as towns have no direct authority over leasing for finfish. DMF has limited authority, it can allow culturing but not exclusive use of site.
2. Under the authority of Chapter 91, there are two options available to aquaculturists interested in leasing state owned land. An aquaculturist can either apply yearly under Section 10 A permit (obtained through harbormaster) or under Chapter 91 for a longer term lease.
3. Conservation Commissions in each municipality have review authority under the Wetlands Protection Act.
4. An individual permit (Section 10 of Rivers and Harbors Act) from the ACOE is required.
5. 401 Water quality certification and NPDES permits are currently required.
6. MCZM has the authority to exercise federal Consistency review, but because no major finfish projects have been approved, no project has undergone formal Consistency Review to date.

Project located within Federal Waters

This class of projects are characterized by their location in federal waters which are by their nature, generally exposed and in the open ocean. Most of these projects are expected to be highly technical.

1. The New England Fisheries Management Council has jurisdiction over fishery activities (including aquaculture) sited within the Exclusive Economic Zone (EEZ). A clear administrative process for authorizing private use of the EEZ is not yet developed.
2. Through Federal Consistency Review, the Coastal Zone Management Office can review any direct federal activity, federally funded project or federally authorized project located in the EEZ for consistency with MCZM policies.
3. Authorization from the ACOE is required.

Appendix B: State Submerged Land Leasing Survey

ALABAMA

Contact: Walter Tatum, Chief Biologist, Marine Resources Division
Alabama Department of Conservation and Natural Resources
P.O. Drawer 458
Gulf Shores, AL 36547

Phone: (334) 968-7576
Fax: (334) 968-7307

State leases of submerged lands for aquaculture: are only allowed for oyster culture. There is currently a leasing law, but no leases are in effect.

Submerged lands leasing process: Individuals must file an application with the Department of Conservation and Natural Resources. If the individuals requesting the lease does not own the property which they hope to use, they must secure permission of the property owner before applying for lease. Alabama Marine Resources Division would evaluate the site in terms of natural habitat and potential for aquaculture and use both factors to determine the lease fee.

Fee structure: Lease fee/acre Dependent on predicted value of product and impact on site (site specific), but the lease fee is not determined as percentage of production value. Lease fee consistent for different marine techniques, while MRD would consider the applicant's projected startup/development costs in determining appropriate lease fee. Startup fee and annual fee (renegotiated annually), independent of lease duration.

Terms of lease: No set duration or overall cap, each lease is dependent on perceived development requirements and other factors. All leases are renegotiated annually according to changes in site and other factors. Renewable, but no guaranteed renewal. Non-salable, non-transferable, non-heritable.

CALIFORNIA

Contact: Bob Hulbrock, Aquaculture Coordinator
Department of Fish and Game
Ninth St., Rm. 1251
Sacramento, CA 95814-2090

Tel: (916) 653-9583
Fax: (916) 653-8256

State leases submerged lands for aquaculture.

Process for leasing submerged lands: If site is advertised by the state, it is awarded to the most qualified bidder according to his/her ability to develop, produce. If the site is identified by the applicant, which occurs more often, he/she will pay a minimum tax for the site if granted the lease. The lease fee is established with a consistent, state-wide fee.

Fee structure: Less than 10 acres....\$10/acre/year.
10 acres or more.....\$2/acre/year.
Startup fee paid as an application processing fee of \$500.
Individual only pays startup fee after being assured by the state that his/her application will most likely be approved.

Terms of lease: 30 years lease with minimum development expectations. Lessee needs to show development during the first 5 years of lease. The next 25 years of the lease proceed on a less regulated basis.

Lease is renewable after 30 years if minimum production levels are maintained. Lease is not salable or transferable, but if the company is sold the lease is usually transferred by state with approval of sale, with this transferal is subject to the commission's approval. Lease is heritable.

CONNECTICUT

Contact: John H. Volk, Director, Aquaculture Division
Department of Agriculture
P.O. Box 97
Milford, CT 06460

Phone: (203) 874-2855

Fax: (203) 783-4217

State leases submerged lands for aquaculture.

Responsible Agencies: The Department of Agriculture is responsible for all bottom culture leases. The Connecticut Department of Environmental Protection is responsible for issuing and overseeing leases which permit the lease holder to construct various structures in the intertidal water.

Process for leasing submerged lands: Applicants select their own sites which they propose in an application to the Department of Agriculture. The Department of Agriculture conducts a survey of the site and advertises the site (in legal notice form) in a local newspaper. The application procedure continues on a competitive bid basis. If the Department of Agriculture deems the site acceptable and the applicant able to maintain the site, it grants the lease.

Fee structure: The applicant pays a \$65 application fee, \$63 of which covers the cost of advertising the legal notice. The Department keeps the remaining \$2 as an application processing fee. The applicant also pays a survey fee of \$35/corner of the proposed site. The minimum bid for a site is \$2/acre/year.

Terms of lease: The applicant can apply for a lease with a minimum duration of 3 years and a maximum duration of 10 years. The applicant must submit annual reports of planting activity and production. If these reports meet the Department's production standards, the lease holder can choose to renew the lease. The lease holder can sell or transfer the lease, while he/she must pay a \$3 legal fee for the completion of this transaction.

DELAWARE

Contact: Richard Cole, Program Manager, Division of Fisheries and Wildlife
Department of Natural Resources and Environmental Control
Box 1401
Dover, DE 11901

Phone: (302)739-4782

Fax: (302)739-6780

Delaware leases submerged lands for aquaculture.

Process for leasing submerged lands: Between January 1 and March 15, an individual can propose a site or apply in response to the DFW's advertisement for shellfish grounds. If more than one individual applies for the same site, the applicant who offers the highest bid continues through the application process. The applicant pays a fee for the survey of the site, which the DFW conducts. If the results of the survey are acceptable, the DFW grants the lease.

Fee structure: The state designates plots ranging in size from 50-100 acres as available for leasing. There is no application fee, but there is a site survey fee of \$17.50/corner. The minimum annual fee for Delaware residents is \$.90/acre/year and for non-Delaware residents is \$11.50/acre/year.

Terms of lease: The lease is granted and renewed on a yearly basis. The lease holder is guaranteed renewal of the lease each year so long as he/she pays the required lease fee and submits the required annual report. This annual report offers a summary of the previous year's production levels and physical changes on the site. The lease is salable and transferable.

FLORIDA

Contact: Wanda Prentis, Bureau of Marine Resources, Regulation and Development
Department of Environmental Protection
Marjory Stoneman Douglas Building
3900 Commonwealth Boulevard MS #205
Tallahassee, FL 32399-3000

Phone: (904) 488-5471
Fax: (904) 922-6398

Florida leases submerged lands for aquaculture.

Process for leasing submerged lands: DEP issues a public notice about site being offered by the state or proposed by a prospective aquaculturist. The highest bidder applies to the DEP and pays a survey fee. The survey and application are evaluated and the lease is granted or denied depending on the evaluations.

Fee structure: Startup fees: Application fee= \$200. Survey fee= \$100/acre for shellfish and \$500/acre for live rock culture, reduced to \$10/acre and \$50/acre, respectively, if site is state owned.

Annual fees: of \$50/acre for shellfish and \$100/acre for live rock culture, increased to \$100/acre and \$200/acre, respectively, beyond the fifth year of the lease. If the lease fee is determined on a competitive bid basis, the annual fee will equal the highest bid for each of the first five years, beyond which the annual fee will double.

Terms of lease: Generally, there is a 5 acre maximum for clam leases and a 10 acre maximum for oyster leases, although applicants can receive exemptions from these limits if they prove themselves capable of managing a larger site than the maximum allowed. The original lease is granted for a period of time not to exceed 10 years. Leases are renewable and transferable with the permission of the Division of Marine Resources.

GEORGIA

Contact: Brad Williams, Environmental Health Program Manager
Georgia Department of Natural Resources
1 Conservation Way
Brunswick, GA 31523

Phone: (912) 264-7218
Fax: (912) 262-3143

Georgia lease submerged lands for aquaculture.

Process for leasing submerged lands: (1) Individual applies for the lease by writing a letter to the DNR, (2) the DNR advertises the proposed lease site for 2 weeks, (3) the application procedure continues on a sealed bid basis, (4) the DNR considers the various bids and the bidders' management plans/abilities in order to determine who would be most able to cultivate shellfish on the site.

Fee structure: The lease fee is a function of the lease holder's on-site production of shellfish. The lease holder pays to the DNR a set amount of money for each bushel harvested. The share of production which goes towards the DNR varies between different sites.

Terms of lease: The original lease is granted for a 5 year period. At the end of the first 5 year period, the lease holder has the option of renewing his/her lease at ten year increments as long as his/her monthly production reports satisfy the DNR's expectations. Leases are transferable with the DNR's authorization.

LOUISIANA

Contact: Ron Dugas, Oyster Program Manager
Louisiana Department of Wildlife and Fisheries
1600 Canal St.
New Orleans, LA 70130

Phone: (504) 568-5678
Fax: (504) 568-2048

Louisiana leases submerged lands for aquaculture.

Process for leasing submerged lands: Individual proposes site in an application to the DFW. The individual must pay a survey fee to the DFW. If the DFW deems the results of the survey to be acceptable, the Secretary of the DFW signs the lease and it is granted to the applicant.

Fee structure: The individual pays a survey fee to the DFW as part of his/her application. The survey fee varies according to the size of the proposed site and its number of corners. If the applicant chooses to hire a private surveyor rather than rely upon the DFW to conduct the survey, he/she is refunded 80% of the survey fee. The individual pays an annual fee of \$2/acre.

Terms of lease: The DFW grants leases for a period of 15 years. Leases are renewable as long as the lease holder pays the annual lease fee and reports annually on his/her aquaculture activities.

MAINE

Contact: Ken Honey, Aquaculture Administrator
Department of Marine Resources
McKnown Point Rd.
West Booth Bay Harbor, ME 04575

Phone: (207) 633-9500
Fax: (207) 633-7109

Maine leases submerged lands for aquaculture.

Process for leasing submerged lands: Individual files application with the DMR who does an environmental impact study on site. After DMR receives this report there is a public hearing. The application is either denied or the lease is granted to the applicant. The original application filed with DMR is actually a multi-agency application (to be reviewed by agencies including ACOE), while these other agencies tend to go along with DMR's approval/denial of the lease.

Fee structure: Startup fees include application fees: \$100 for less than 1 acre, \$250 for 1-10 acres, \$500 for 11-50 acres, and \$1000 for 51-100 acres. There is also a site insurance fee of \$500-1000 in case of harm to the site by the aquaculturist. The actual lease fee is \$50/acre/year.

Terms of lease: Leases are available for up to 10 years and are renewable, alienable and transferable. The renewal process includes public notification of renewal in case there are any objections to continuing aquaculture at the given site. Since the vast majority of leases are held by corporations and companies rather than individuals, leases heritability is not a real issue.

MARYLAND

Contact: Ben Florence, Director of Hatcheries and Aquaculture
Fisheries Division
Maryland Department of Natural Resources
5580 Taylor Ave.
Annapolis, MD 21401

Phone: (410) 974-3733
Fax: (410) 974-2600

Maryland leases submerged lands for aquaculture.

Process for leasing submerged lands: (1) Individual advertises site, (2) DNR evaluates site, (3) interested parties apply.

Fee structure: Startup fee is \$300 survey fee as part of application process.
Bottom aquaculture is \$3.50/acre/year. Water column is \$80/acre/year.

Terms of lease: 15-20 year lease, annual fee. Renewable depending on evidence of development. Heritable, but not salable or transferable. No corporate ownership allowed.

NEW HAMPSHIRE

Contact: Nancy Gerard, Counsel
New Hampshire Fish and Game
2 Hazen Dr.
Concord, NH 03301

Phone: (603) 271-3511
Fax: (603) 271-1438

New Hampshire leases submerged lands for aquaculture: and has new regulations regarding this, but does not have any active leases.

Process for leasing submerged lands: Rather complex: divided between applying to the Governor's Council for a land lease (written into state constitution) and applying the NHFG for an aquaculture permit.

Fee structure: Bottom culture: \$200/acre/year, suspended culture: \$500/acre/year, pen culture: \$750/acre/year.

Terms of lease: Leases are granted on a 1 year basis, while individuals who plan to renew are required to submit a 5 year schedule for development, production. Permits are renewable, but not salable. Permits are transferable and heritable but the lease is only effective for the remainder of the year-long period.

NEW YORK

Contact: Dick Fox, Aquaculture Specialist
Department of Environmental Conservation

Phone: (516) 444-0438

Fax: (516) 444-0434

New York leases submerged lands for aquaculture, legally speaking, but there haven't been any new leases of state lands in decades, and last lease of municipal land was revoked eight years ago. Aquaculture has met very strong resistance from the fishing community.

Process for leasing submerged lands: (1) Lease application, (2) Request for DEC analysis of site, (3) Notice of bid posted, (4) lease awarded to highest bidder.

Fee structure: Applicant pays a fee designed to cover the state's survey of the site. Lessee required to post bond equal to the projected lease fee for the duration of the lease, which will be withheld and the lease revoked if the lessee fails to make the annual payment. Lease minimum of \$1/acre, otherwise determined by the highest bid offered at public auction.

Terms of lease: 10 year lease period with a 50 acre minimum, which renewable within 90 days after expiration, and transferable after the first 5 years of lease. Dick Fox and others have tried to have reduced the minimum acreage requirement with near success in recent years, but motions have been defeated by the very vocal, anti-aquaculture segments of the fishing community.

NORTH CAROLINA

Contact: P.A. Wojciechowski, Submerged Land Director
Public Trust
Division of Marine Fisheries
P.O. Box 769
Morehead City, NC 28557-0769

Phone: (919) 726-7021

Fax: (919) 726-6062 or 726-0254

North Carolina leases submerged lands for aquaculture.

Process for leasing submerged lands: Individual proposes a site in an application to the DMF. He/she next hires a private surveyor to fix corner markers, calculate acreage, and describe the site location in terms of competing uses, ecology, etc. The DMF's surveyors analyze the site's suitability and check the private surveyor's report. The applicant provides a written shellfish production plan. The Marine Fisheries Commission, with the DMF, reviews the application and survey results and either grants or denies the lease.

Fee structure: Application fee is \$100.
Annual fee for bottom culture techniques is \$5/year.
Annual fee for water column techniques is \$505/year.

Terms of lease: The lease has a duration of 10 years. The lease holder must submit annual reports describing his/her activities and production levels. If the lease holder has met the DMF's requirements (which include a minimum 25 bushels/acre production level, barring extraordinary barriers to production), he/she may apply for a renewal of the lease. The leases can be renewed at 10 year increments. The lease holder must pay a small legal fee if he/she chooses to either renew or transfer the lease. The DMF processes the sale of a lease by the lease holder to another party as it would a lease transfer. The lease holder must arrange to have the lease continue as part of his/her estate through a process similar to that designed for renewals.

OREGON

Contact: John Faudskar, Extension Seagrant Agent
Oregon State University, Extension Office
2204 Fourth St.
Tillamook, OR 97141

Phone: (503) 842-3433
Fax: (503) 842-7741

Oregon leases submerged lands for aquaculture.

Responsible Agency: The Department of Agriculture is responsible for oyster aquaculture.

Process for leasing submerged lands: The prospective oyster culturist proposes site and receives an application from the Department of Agriculture. The individual applies for the lease and the application is reviewed by the Department of Agriculture and various other (14-22 in all) local, state, and federal agencies. After considering the other agencies' responses, the Department of Agriculture has the final ruling on whether the lease will be granted or denied.

Fee structure: The prospective lessee must pay an application fee of \$25. The annual lease fee is \$2/acre in addition to \$.05/bushel of harvested product. The latter fee is calculated according to the amounts of production reported in the lease holder's required quarterly reports.

Terms of lease: The Department of Agriculture grants the lease for an indefinite period of time. The Department can withdraw the lease if the lease holder fails to pay the annual fee, file the quarterly report, or improve the minimum percentage of the lease site as stated in the lease. Leases are salable, transferable, and heritable.

RHODE ISLAND

Contact: Arthur Ganz, Marine Biologist	Jim Boyd, Environmental Scientist
Coastal Fisheries Laboratory	Coastal Res. Mgmt. Council
1231 Succotash Rd.	Oliver Stedman Govt. Center
Wakefield, RI 02879	4808 Tower Hill Rd.
	Wakefield, RI 02879

Phone: (401) 783-2304	(401) 277-2476
Fax: (401) 783-2760	(401) 277-3922

Rhode Island leases submerged lands for aquaculture, but the majority of leases are currently small-scale operations designed to supplement other sources of income. A few lease holders/applicants are showing interest in advancing aquaculture to a more sophisticated level.

Responsible Agency: Rhode Island Coastal Resources Management Council.

Process for leasing submerged lands: Individual needs to apply to the CRMC for a leasing permit and to the Division of Fish and Wildlife for an aquaculture permit...Upon receiving the lease permit application, the CRMC puts out a public notice and the CFL analyzes the site for potential impact on preexisting free and common fisheries...If any objections are raised in response to the public notice, the CRMC brings the application to a public hearing.

Fee structure: Startup fee consists of an application fee which varies according to estimated project cost for developing the site: \$50 for less than 1,000 acres, and \$100 for 1,000-2,500 acres, \$150 for 2,500-5,000 acres.

Terms of lease: Lease period maximum of 5 years. Renewable, based on annual report analysis (pretty lenient) and annual site visit...Neither salable nor heritable.

SOUTH CAROLINA

Contact: Willis Keith, Marine Resources Division
Department of Natural Resources
P.O. Box 12559
Charleston, SC 29427

Phone: (803) 795-6350

Fax: (803) 762-5412

South Carolina leases submerged lands for aquaculture, intertidal lands more often than fully submerged lands.

Process for leasing submerged lands: Individual proposes site and defines his intended activity; shellfish culture on grounds on which shellfish naturally reproduce or shellfish mariculture on grounds on which shellfish do not naturally reproduce. If the individual does not intend to build any structures as part of the proposed aquaculture-related activities, s/he needs only apply for a permit from the DNR. If, however, s/he intends to build a structure on the proposed site, he/she must apply separately for a permit from the Coastal Resources Management division of the South Carolina Department of Health and Environmental Control. The applicant must advertise the proposed site in a local newspaper once a week for three weeks. If s/he hopes to obtain a construction permit, s/he must also advertise his/her development plans in a local newspaper, while only on one D. The shellfish permitting committee within the DNR addresses any concerns which the public expresses in response to these advertisements. The DNR surveys the proposed site to determine its acreage. The DNR decides to grant or deny the lease after reviewing the survey results, the one-page application, and the applicant's attached management plan.

Fee structure: The applicant must pay a \$25 application fee and an annual fee of \$5/acre/year. South Carolina currently has no legislation regarding forms of aquaculture other than bottom culture (i.e. water column aquaculture). The state is currently considering legislation regarding alternative forms of aquaculture and may design separate fee structures as part of this process.

Terms of lease: The state does not issue leases for sites greater than 500 active acres. The state might lease a site greater than 500 acres only if the lessee does not cultivate the extra acreage and treats it as

a buffer zone surrounding his/her active site. In such a situation, the DNR only charges the lessee for the 500 active acres.

Leases are renewable each year. The applicant can extend the duration of the lease to 5 years by submitting to the DNR an extended management plan. When a lease approved under an extended management plan approaches the end of its 5th year, the lease holder has the option of renewing the lease for another 5 years. After 10 years, the DNR conducts a thorough review of the lease holder's management record before granting him/her another renewal. The DNR monitors the lease site by conducting annual site visits.

Leases are not salable, transferable, or heritable.

VIRGINIA

Contact: Wilford Kale
Virginia Marine Resources Commission
P.O. Box 756
Newport News, VA 23607-0756

Phone: (804) 247-2269

Fax: (804) 247-8062

Virginia leases submerged lands for aquaculture.

Process for leasing submerged lands: (1) Individual files an application, (2) VMRC acknowledges receipt of application, (3) the site being petitioned for is advertised, at the applicant's expense, in a local newspaper once a week for four weeks, (4) the highest bidder pays a fee to the VMRC in return for its survey of the site (5) the results of the survey are posted for 30 days and if no one objects at this time, the lease is awarded.

Fee structure: Startup fee amounts to an application fee of \$25 and a site-survey fee of \$470. \$1.50/acre/year, fee rounded up to the nearest full acre.

Terms of lease: 10 year lease...3 months before expiration date, VMRC will contact lease holder and ask him to submit a form explaining annual production levels and development efforts....DMRV conducts no site inspections with renewal request....Yes, the lease is transferable, which requires the lease holder to fill out a transfer form and the transfer recipient to pay \$17 for leases of 10 acres or less and \$22 for leases of more than 10 acres....The leases are recognized as part of the deceased lease holder's estate for a period of 18 months, during which time the lease can be transferred to a Virginia resident...all leases are available only to Virginia residents.

WASHINGTON

Contact: Fred Hirsch, Aquaculture Specialist, Aquatic Resources Division
Department of Natural Resources
1111 Washington St. S.E.
P.O. Box 47027
Olympia, WA 98504-7027

Phone: (360) 902-1067

Fax: (360) 902-1786

Washington leases submerged lands for aquaculture.

Process for leasing submerged lands: Individual proposes site in an application to the DNR. The individual must fill out 2 application forms (1 for the land lease and 1 for an aquaculture permit). The individual must also present any local, state, and federal permits which might relate to the specific activity and site which he/she has proposed (eg. county permits for the use of shoreline). The individual must hire a private surveyor to determine the acreage and assess the ecological status of the proposed site. The applicant must also present proof of insurance and put forward a security bond equal to twice the annual rent for the leased site. Based on the information listed above, the DNR decides whether to approve or deny the lease.

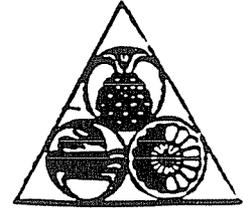
Fee structure: The applicant pays a \$25 application fee. The lease holder also pays a \$25 fee whenever the lease changes hands (by transfer or sale). For bottom culture in the tidelands, the annual lease fee is approximately \$110/acre. For water column aquaculture, the DNR demands 3.5% of the aquaculturist's annual revenue. The DNR determines this annual revenue at the beginning of each year by estimating the annual production/acre and multiplying that production level by the local market price for the shellfish being produced.

Terms of lease: Leases are approved for periods of 10-25 years, depending on the aquaculturist's development plans and the DNR's confidence in the lease holder's ability to develop the lease site. Leases are renewable, transferable, salable, and heritable. The DNR contacts lease holders 6 months prior to the lease's expiration date and explains the procedure for renewing, transferring, or selling the lease. If the lease holder hopes to renew or pass the lease on to someone else, he/she must notify the DNR within 30 days of the lease's expiration date.



MARYLAND AQUACULTURE OFFICE

Department of Agriculture
 50 Harry S. Truman Parkway
 Annapolis, Maryland 21401
 (410) 841-5724



Maryland Food Center Authority

WHOLESALE MARKET REPORT

Week Ending 1-20-95

MDA 143

Vol. 4 No. 1

H I G H L I G H T S

This report is for the week ending January 19, 1995. In general, the reported finfish prices were higher with no price change for Arctic Char. The higher prices were led by red meat salmon trout fillets at 60 cents per pound more followed by boned/ dressed rainbow trout at 5 cents, tilapia fillets at 4 cents and whole Atlantic salmon and whole hybrid striped bass at 1 cent per pound more. Price decreases were led by catfish fillets and Atlantic salmon fillets at 4 cents per pound less and rainbow trout fillets at 3 cent per pound less. Volume increase were reported for catfish fillets, boned/dressed rainbow trout and rainbow trout fillets. Volume decreases were reported for whole Atlantic salmon, Atlantic salmon fillets, red meat salmon trout fillets, tilapia fillets and whole hybrid striped bass. New or reappearing items include dressed catfish, cajun - lemon pepper catfish fillets, boned red meat salmon trout, boned coho salmon and steelhead trout fillets. No turbot was reported.

Shucked oysters increased 58 cents per gallon in price and no change in volume. Shell oysters reported no change in price and a volume decrease of 1440 oysters. Hard clams reported no change in price or volume. Mussel prices increased 10 cents per pound in price and 25 pounds in volume. Black tiger shrimp increased 8 cents per pound in price and 420 pounds in volume. No scallops were reported.

Regions in US: NE (Northeast), MA (Mid-Atlantic), S (Southern), MW (Mid-Western), W (Western), IM (Import)

MARYLAND MARKETS

SPECIES	FORM	SIZE(lb)	\$/lb	Volume(lb)	Point of Origin	
Catfish	Fillets	5 - 7 oz.	2.92	800	S	
		7 - 9 oz.	3.06	8,500	S	
		9 - 11 oz.	2.89	400	S	
Catfish	Dressed	12 - 16 oz.	1.87	1,965	S	
Cajun - Lemon P.	Fillets	7 - 9 oz.	3.50	4,095	S	
Hybrid Striped Bass	Whole	3/4 - 1 1/4	2.34	6,200	S/MA	
		1.5 - 2	2.40	3,300	S/MA	
Tilapia	Fillets	4 - 7 oz.	3.45	940	IM	
		8 - 16 oz.	3.25	240	IM	
Rainbow Trout	Fillets	6 - 8 oz.	3.81	790	W	
	Boned	8 - 10 oz.	2.71	4,730	W/MA	
	Dressed	1 - 2	2.17	50	W	
Red Meat Salmon Trout	Fillets	8 - 10 oz.	3.10	210	S/W	
Atlantic Salmon	Fillets	1 - 2	3.05	1,700	IM	
		2 - 4	3.70	5,380	IM	
		Whole	2 - 4	2.35	300	IM
		4 - 6	2.34	2,000	IM	
		6 - 8	2.64	8,000	IM/NE	
		8 - 10	2.73	8,150	IM/NE	
Coho Salmon	Boned	10+	2.91	7,420	IM/NE	
		10 oz	3.25	200	W	
Arctic Char	Whole	2 - 4	3.65	50	IM	
Steelhead Trout	Fillets	1 - 2	3.00	1,000	IM	
Oysters	Shucked	6.5 lb./gal.	35.31/ gal.	337 gal	W/S/NE	
	Shell		0.35 ea.	50,600 pcs.	NE	
Clams (Hard)	Shell		0.17/ea.	19,840 pcs.	S/MA	
Mussels	Pound		0.69	7,525	NE/IM	
Shrimp (Black Tiger)		16 - 20 ct.	7.10	1,760	IM	

Shrimp (Black Tiger)	21 - 25 ct.	6.15	480	IM
	26 - 30 ct.	6.25	320	IM
	31 - 40 ct.	5.15	2,160	IM

WASHINGTON, D.C. - VIRGINIA MARKETS

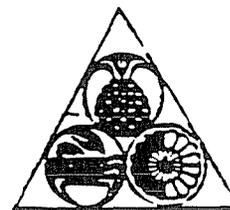
SPECIES	FORM	SIZE (lb)	\$/lb	VOLUME (lb)	POINT OF ORIGIN
Catfish	Filletts	5 - 7 oz.	3.10	800	S
		7 - 10 oz.	2.95	1,050	S
Hybrid Striped Bass	Whole	1.5 - 2	2.70	250	W
		2 - 3+	2.81	250	W/S
Alapia	Filletts	4 - 6 oz.	3.43	360	IM
		7 - 9 oz.	3.75	200	IM
Rainbow Trout	Boned	8 - 10 oz.	2.79	1,980	W/MA
Red Meat Salmon Trout	Filletts	8 - 10 oz.	3.25	500	IM/MA
		Boned	8 - 10 oz.	2.40	3,000
Atlantic Salmon	Filletts	2 - 3	5.00	200	IM
		4 - 6	2.30	400	IM
		6 - 8	2.57	3,500	IM/NE
		8 - 10	2.68	2,750	IM/NE
		10 - 13	2.73	2,250	IM/NE
Oysters	Shucked	6.5 lb/gal.	36.95/gal.	38 gal.	NE
	Shell		0.26 ea.	8,720 pcs.	NE/IM
Clams (Hard)	Shell		0.16 ea.	17,250 pcs.	MA
Mussels	Pound		1.06	2,600	IM
Callops			5.00	200	NE

Parris N. Glendening, Governor
 Lewis Riley, Secretary
 Henry Virts, Deputy Secretary



MARYLAND AQUACULTURE OFFICE

Department of Agriculture
50 Harry S. Truman Parkway
Annapolis, Maryland 21401
(410) 841-5724



Maryland Food Center Authority

WHOLESALE MARKET REPORT

Week Ending 2-03-95

MDA 143

Vol. 4 No.

HIGHLIGHTS

This report is for the week ending February 3, 1995. In general, the reported prices were mixed with no price change for Cajun-lemon catfish fillets, red meat salmon trout fillets and whole turbot. Price increase were led by dressed white sturgeon at 30 cents per pound followed by catfish fillets at 8 cents, boned golden trout at 7 cents, boned red meat salmon trout at 6 cents, boned/dressed rainbow trout at 2 cents and rainbow trout fillets at 1 cent per pound more. Price decreases were led by whole Arctic char at 32 cents per pound less followed by whole hybrid striped bass and whole Atlantic Salmon at 11 cents, Atlantic salmon fillets at 10 cents and tilapia fillets at 9 cents per pound less. Volume increases were led by Atlantic salmon fillets and whole hybrid striped bass at 500 pounds followed by catfish fillets at 300 pounds, boned red meat salmon trout at 150 pounds whole turbot at 100 pounds and boned golden trout at 70 pounds more. Volume decreases were led by whole Atlantic salmon at 9,400 pounds followed by Cajun-lemon catfish fillets at 250 pounds, tilapia fillets at 190 pounds, Arctic char at 150 pounds, red meat salmon trout fillets and dressed white sturgeon at 100 pounds and boned/dressed rainbow trout at 60 pounds less. There was no change in volume for rainbow trout fillets. New and reappearing products are dress catfish, whole tilapia and boned coho salmon. Products missing are steelhead trout and live eels.

Shucked oysters reported no price change with a volume decrease of 14 gallons. No change in price or volume for shell oysters. Hard clams were 1 cent each lower and 43,100 clams lower in volume. No change in price or volume for imported clams. Mussels had no price change with a volume increase of 2090 pounds. Black tiger shrimp were 2 cents lower in price and 93,220 pounds less in volume. Escargo reported no price change with a volume increase of 2200 meals.

The northeast live markets reported a 100 pound increase in catfish, and 11,000 pounds increase in bighead carp. Tilapia volume decreased by 1,000 pounds. Tilapia prices increased 1 cent per pound and big head carp decreased by 10 cents per pound. No change was reported for catfish price, hybrid striped bass price and volume and price for oysters and Manila clams.

Regions in US: NE (Northeast), MA (Mid-Atlantic), S (Southern), MW (Mid-Western), W (Western),

PENNSYLVANIA MARKETS

SPECIES	FORM	SIZE (lb)	\$/lb	VOLUME (lb)	POINT OF ORIGIN
Catfish	Fillets	5 - 7 oz.	2.95	100	S
		7 - 10 oz.	3.03	4,400	S
Hybrid Striped Bass	Dressed	12 - 16 oz.	1.96	400	S
	Whole	1 - 1½	2.40	240	MA
Tilapia	Fillets	2 - 4	2.95	100	MA
		4 - 6 oz.	3.37	600	W/IM
Rainbow Trout	Whole	1 - 1½	1.00	1,700	S
		5 - 5 oz.	3.25	300	W
Golden Trout	Boned	8 - 12 oz.	2.70	1,260	W
		8 - 24 oz.	1.90	450	W
Atlantic Salmon	Boned	8 - 10 oz.	3.17	150	W
		4 - 6	2.40	1,500	NE
Arctic Char	Whole	6 - 9	2.65	4,400	NE/IM
		9 - 13	2.55	1,500	NE
Oysters	Shucked	2 - 4	4.50	100	I
		6.5 lb/gal	\$ 50/gal	7/gal	MA
Oysters	Shell		.28/ea	5,200	MA
			.14/ea	138,100 pcs	MA/S
Clams	Shell	Pound	.33	5,550	NE
		16 - 20 ct.	7.00	150	IM
Mussels	Shell	26 - 30 ct.	6.50	150	IM

NORTHEAST LIVE MARKETS					
SPECIES	FORM	SIZE (lb)	\$/lb	VOLUME (lb)	POINT OF ORIGIN
Catfish		1 - 8	0.90	2,500	MA
Hybrid Striped Bass		1 - 3	3.05	500	MA
Tilapia		1 - 2	2.10	30,000	MA
Big Head Carp		2 - 4	0.60	36,000	S
Oysters		Shell	0.25	600	W
Manila Clams		Pound	2.20	200	W

NEW YORK - MASSACHUSETTS MARKETS					
SPECIES	FORM	SIZE (lb)	\$/lb	VOLUME (lb)	POINT OF ORIGIN
Catfish	Fillets	7 - 10 oz.	3.02	2,210	S
Cajun - Lemon	Fillets	7 - 9 oz.	3.55	350	S
Hybrid Striped Bass	Whole	1	2.25	750	S
		1.5 - 2	2.60	1,550	MA/S
Tilapia	Fillets	3 - 5 oz.	3.50	1,500	IW
		5 - 7 oz.	3.55	240	IW
Rainbow Trout	Fillets	8 oz.	4.05	100	W
	Boned	10 - 12 oz.	2.43	710	W
	Dressed	8 - 16 oz.	1.95	3,000	W
Red Meat Salmon Trout	Fillets	8 - 10 oz.	3.75	50	S
	Boned	7 - 10 oz.	2.41	700	W/S
Atlantic Salmon	Fillets	2 - 3	3.55	3,000	IM
	Whole	6 - 9	2.40	3,000	IM
		6 - 12	2.40	2,500	IM/NE
		12+	2.39	1,650	IM/NE
Coho Salmon	Boned	11 - 13 oz.	2.75	150	NE
Arctic Char	Whole	2 - 4	3.50	50	IM
		3 - 4	3.95	250	IM
Turbot	Whole	10	4.50	300	IM
White Sturgeon	Dressed		5.75	100	W
Escargo	Meats		0.23/ea	3,000 pcs	W

NEW JERSEY MARKETS					
SPECIES	FORM	SIZE (lb)	\$/lb	VOLUME (lb)	POINT OF ORIGIN
Hybrid Striped Bass	Whole	2	2.50	700	NE
Atlantic Salmon	Whole	6 - 8	2.30	3,000	IM
		8 - 12	2.40	9,000	IM
Clams	Pound		1.70	40,000	IM
Shrimp Black Tiger		13 - 15 ct.	8.75	2,500	IM
		16 - 20 ct.	6.95	2,500	IM
		21 - 25 ct.	6.35	30,000	IM
		26 - 30 ct.	5.80	15,000	IM
		31 - 40 ct.	5.10	12,500	IM
		41 - 50 ct.	4.85	5,000	IM

Parris N. Glendening, Governor
Lewis Riley, Secretary
Henry Virtz, Deputy Secretary

Appendix D: MA Educational Programs

APRIL 11, 1995

UPDATE ECONOMIC DEVELOPMENT AND MARKETING SUB GROUP; EDUCATION

The following is an outline of current education initiatives related to the Commonwealth of Massachusetts. To facilitate analysis the topic, Aquaculture Education has been divided into three categories; Elementary through Secondary/Vocational Education; Collegiate/Formal Course Studies; Applied Education through Workshops, Seminars and Short Courses. Accordingly, it does not reflect all of the proposed aquaculture education initiatives.

Further analysis is underway to to develop a strategy for training and education with Rob Garrison of the Nantucket Research and Education Foundation. Additionally, communications with Hank Parker, USDA and area elementary and secondary schools have indicated there is great interest in dissemination of available aquaculture education materials.

Any questions suggestions or comments should be directed to Scott Soares at SRPEDD 508-824-1367, fax 508-880-7869.

AQUACULTURE EDUCATION IN MASSACHUSETTS
Draft/Outline
Scott J. Soares
SRPEDD, phn. 508-824-1367 fax. 508-880-7869

- I. Elementary/Secondary/Vocational-Agricultural
 - A. The National Council for Agriculture Education
 - 1. 1992 core curriculum for aquaculture ed. at the secondary level developed per USDA office of Higher Education
 - 2. MARS (Model Aquaculture Recirculating System)
 - a. Developed through North Carolina State University
 - b. Utilized as a education tool, research and production unit
 - c. Currently application of the curriculum in Massachusetts is questionable
 - B. Massachusetts Department of Education
 - 1. Massachusetts Curriculum Library
 - a. Some curriculum does exist. Listing will be sent to office.
 - b. Contact Virginia Day @ 617-863-1863
 - 2. Current Curriculum Applications
 - a. Voc-Agricultural Settings
 - (1) Norfolk County Agricultural School
 - (a) Via Animal Science and Marine Science
 - (b) Contact Kerrie Cavallaro, Principal @ 508-668-0268

- (2) Essex County Agricultural Tech.
 - (a) Animal Science ?
 - (b) Contact Edward White, Director @
508-774-0050

- b. Traditional Secondary (High School) Setting
 - (1) West Roxbury High School
 - (a) Small component in Animal Science
 - (b) Contact Sprissler @ 617-635-8917
 - (2) Programs under development
 - (a) Water Works Group, Westport Ma
 - i) Westport Public Schools
 - ii) Dartmouth High School
 - iii) Utilize shellfish culture as
an education tool
 - iv) Contact Wayne Turner @ 508-
636-5444
 - (b) Nantucket Research and Education
Foundation
 - i) Nantucket Public Schools
 - ii) Utilize shellfish culture as
an education tool
 - iii) Contact Rob Garrison @ 508-
228-2649

II. Collegiate/Formal Courses

A. Massachusetts Colleges and Universities (according to AFS, Fisheries Programs and Related Courses at North American Colleges and Universities, 1990)

1. University of Massachusetts-Dartmouth

- a. Possibility of expanding course studies to include aquaculture. degree option ?
- b. currently 1 undergraduate level, introductory aquaculture course. (no lab)
- c. Contact Dr. Victor Mancebo, Director NRAC @ 508-999-8157

2. University of Massachusetts-Amherst

- a. Due to illness, series of aquaculture courses no longer offered as part of interdisciplinary studies.
- b. Budgetary restraints leave continued lab operation in Gloucester questionable.
- c. Contact Buryl Bouchard, @ U-Mass Amherst, Chief Advisor, Environmental Science Program.

B. Marine Biological Laboratory, Woods Hole, Ma

1. Aquatic disease program via Univ. of Penn
2. Contact Dr. Don Abt @ 508-289-7513

III. Workshop/Short Course

- A. Massachusetts Maritime Academy; Fisheries Program
 - 1. "Aquaculture Seawater Systems" Workshop Scheduled for 5/6/95.
 - 2. Informal "Aquaculture Seminar" Scheduled for 11/5/95.
- B. Martha's Vineyard Shellfish Group Inc.
 - 1. Northeast Fishing Industry Grant Funded
 - a. Re-train "fishermen interested in making occupational transition to aquaculture"
 - b. Provide assistance in securing appropriate permits
 - c. Develop self sustaining industry
 - 2. Contact Rick Karney @ 508-693-0391
- C. Nantucket Research and Education Foundation
 - 1. Nantucket Aquaculture Project
 - a. "trains fishermen and other local individuals in shellfish aquaculture".
 - b. Presently 20 participants involved in the town/organization cooperative effort.
 - c. Nantucket Marine Lab provides the platform for the organizations various activities.
 - 2. Contact Rob Garrison @ 508-228-2649

Appendix E: Monitoring Survey

Table 1
Existing or Proposed Monitoring Requirements for US Aquaculture

<u>State</u>	<u>Requirements</u>
California (Kent et al., 1995) (For white Sea Bass only)	
Baseline	Environmental impact report may be required. NPDES not for annual prod. below 9,090 Kg/yr.
Monitoring	Periodic monitoring must be undertaken at both hatchery discharge and storm water run-off.
New Hampshire (Falcon)	
Proposed requirements	
Baseline	
Biological:	Not permitted in natural populations of fish. Must assess natural flora & fauna.
Physical:	Benthic substrate evaluation. Tidal Information. Presence of other aquaculture sites within 1 mile radius.
Chemical:	Provide list of proposed biocides, algaecides, antibiotics, or other methods of control.
Monitoring	Shall conduct experimental monitoring to determine degradation and report once per year. Must report all unusual events within 48 hours. Provide list of all biocides, algaecides, etc. used during the year.
Exotics	Importation laws (Fis 803 & Fis 805) already on the books.
Disease	Not granted if risk is identifies
Species	Identified competition with indigenous species as potential risk
Other	Funding and responsibilities by the lease holder.
New Jersey (State of New Jersey)	
Existing requirements	
Baseline	No water column regulations. Environmental Impact Statement may be required for waterfront development.
Exotics	Under jurisdiction of the Lacy Act. No Carp (State law).
Disease	Oyster import banned.
Proposed requirements	
Baseline	NPDES application if large enough.
Monitoring	Set discharge regulations using EPA Guidelines to start "BMP" to be developed. Must differentiate "aquaculture discharge" from "industrial discharge".
Exotics	Assure habitat protection and integrity of wild stocks.
Other	Responsibility lies with NJ Dept. of Agriculture. MOAs with DEP, Commerce, and Health.

**Table 1 (continued)
Existing or Proposed Monitoring Requirements for US Aquaculture**

<u>State</u>	<u>Requirements</u>
Maine (State of Maine, 1994)	
Baseline	
Diver survey:	a) Video film of bottom under proposed pen location moving along axis of current and through center of lease, b) document sediment type, c) erosion or depositional areas, d) flora and fauna relative abundance, e) can use still photos every 10 meters.
Hydrography:	a) Measure current speed and direction at 3 depths (surface, pen floor, 1 cm off bottom), b) 15 min. samples every hour through 12 average tidal cycles.
Water Quality:	a) DO profile at 10 equally spaced intervals through the water column, b) at center of site, c) temp. and salinity measurements, d) sample within 1 hour of slack low in early morning.
Benthic Analysis:	a) sediment samples for grain size analysis b) chemical: TOC, c) biological infauna on 0.5 mm sieve and ID critters.
Area resources:	a) shellfish beds, b) fish migration area, c) submerged vegetation, d) endangered species/ critical habitat.
Surrounding area:	a) riparian uses, b) existing uses.
Monitoring	
Diver survey:	Semi-annual. a) video taped, b) within footprint and 60m beyond each end, c) same as baseline.
Water quality:	a) DO, salinity, temperature: every 2 weeks through summer, b) 3 samples at mid-pen depth (100m up current, 100m down current, 5m down current), c) detailed DO, salinity, temperature once in August: 10 equally spaced stations over depth.
Benthic:	a) during first period of peak feeding and then biannual, b) single core samples (discontinuity layer depth, depth of flocculent layer, grain size analysis, TOC of surface sediments), c) infauna (4 inch core, sieve to 0.5 mm, ID to species or lowest practical taxonomic level).
Reporting by December:	a) Spring and Fall diver survey, b) water quality monitoring data 1 July through 30 Sept., c) benthic survey report for year.

**Table 1 (continued)
Existing or Proposed Monitoring Requirements for US Aquaculture**

<u>State</u>	<u>Requirements</u>
Washington (Washington Dept of Ecology, 1986) (Salmon only)	
	Based upon production capacity: (A) <20,000 lbs/yr. (B) 20-100K lbs/yr. (C) >100K lbs/yr.
Baseline	I.D. habitats of special significance which are given additional protection (see critical habitats / species. Recommend maximum intensities of culture in specific areas based on frequency of O2 depletion and N2 limitation. Characterization survey: Consult with state and local authorities. Bathymetric Survey. Hydrographic Survey, Current velocity and direction (2 depths, 1 tidal cycle), Drough tracking (2 depths), and vertical profiling (S, T & DO) - 1, 10, 20, 30' at 30' intervals to 3' above bottom.
	Baseline survey: (for C only). Sediment Chemistry and Benthic infauna. Sampling in transect stations from under pen, down current at distance of 20, 50, 100, and 200'. Triplicate cores or grabs Total C, Kjeldahl N, Grain size distribution, Visual ID RPD, Species level ID, Infauna of 0.5 mm mesh sieve.
Monitoring	
Chemical:	(C only) Annual water quality sampling in summer at slack tide. 3 Stations: 100' in current, 20' down current, 100' down current. Measure DO, T, S, pH, NH3, NO3/NO2. From these parameters and current velocity. calculate loading estimates (g/Kg fish/day) for NH and NO3/NO2. Also use cross section area of net pen and weight of fish in pen.
Physical:	(C only) Annual current velocity and direction Single measurement at time of water quality monitoring.
Biological:	(B) Annual diver benthic survey. Main object to I. D. depth and lateral extent of solids removed (C) Annual Benthic and infauna survey (See baseline survey above).
Other	Funding of monitoring and Responsibility lies with operator

Table 2
Federal Waters: EPA NPDES Monitoring Plan for Finfish Aquaculture (US EPA, 1994)

<u>Area</u>	<u>Regulations</u>
Gulf of Mexico (off Alabama)	
Baseline	
Physical:	The site cannot be located within 1,000 meters of areas containing live bottom, including man-made habitat. Current direction and velocity will be collected from a permanent current meter station.
Chemical:	a) Water column: D.O., chlorophyll A, TKN, NH ₃ , NO ₂ , NO ₃ , soluble P, total P, TOC, TSS and Turbidity. b) Sediment: Sediment texture (grain size), TOC, total N, total sulfides, total P, sediment oxygen demand.
Biological:	a) Benthic infaunal communities: Sieve analysis (0.5 mm mesh), species composition, number of individuals per species, species density and dominance. b) Epibenthic survey: Two video transects, after construction and prior to operation.
Monitoring	See above
Operational	
Start-up:	(First 6 months of operation). Notify EPA of initial stocking event: Date of stocking, species, biomass, feeding rate. Water column sampling and analysis as described above. Sediment sampling: Texture analysis, measure change caused by variable stock densities prior to full production. Take benthic videos along 2 transects. Samples should be taken 2 and 4 months following commencement of production. Measure current direction and velocity.
Post start-up:	Six months after start up water column samples will be collected at 3 stations plus reference site. Sediment samples for chemical and benthic infauna analysis will be collected at 10 stations plus the reference site. Video epibenthic survey will be conducted.
Analysis	Pre-operational data will be compared with post-operational data. The sampling procedures may then be modified. A Quality Assurance/Quality Control Plan must then be submitted for all monitoring activities.

Table 3
Existing or Proposed Monitoring Requirements for Canadian Aquaculture.

Provinces

Regulations

British Columbia (Hall, 1995)

From 1988-1995

Baseline None

Monitoring Based upon volume of feed for finfish. No requirements for < 120 ton;
 120 - 630 (A), > 630 (B).

Chemical: (A) T/DO profiles. Monitor 2 sites during summer (upstream &
 downstream).

(B). Monthly profiles of NH₃, NO₂, NO₃

Physical: (A) T/S Monitor for 1 year. Current speed and direction. (B) Same.
 Also repeat in late afternoon.

Biological: (A, B) Annual diver survey of site and control; areas (Sediments &
 Benthos).

Other Funding for monitoring and responsibility lie with the operator.

Present requirements

All requirements were dropped but materials accounting because of lack of utility and completeness of most of the data. They are redesigning their program to focus on benthic impacts.

New Brunswick (Zupo)

Baseline

Chemical: Sediment redox potential at site center

Physical: Depth of cage site at MLW, current velocity and direction, fetch.

Biological: Quantify area extent of Beggiatoa sp., total # of Capitella sp. present
 observe change in fish and macroinverts. 3 -30 m transects across site
 at ends and center. At each measure depth, core for composition and
 grain size. Fauna, flora, redox. Take video along each transect.

Monitoring

Chemical: Sediment core: organic carbon (2 sites), grain size, CPD depth.

Biological: Video diver, transects (3), 50 meters downstream, 50 meters
 upstream, under cages.

Physical: Quantitative assessment of benthic habitat at each site.. These include
 sediment color, consistency, odor, outgassing, bacterial mat coverage,
 macrofauna abundance, feed and feces distribution.

Table 3 (continued)
Existing or Proposed Monitoring Requirements for Canadian Aquaculture.

<u>Provinces</u>	<u>Regulations</u>
Newfoundland (Snow)	
Baseline	Fecal coliforms in the water column.
Monitoring	Larval monitoring.
Species	Atlantic Salmon, rainbow trout, Arctic char, cod, blue mussel, giant scallop.
Nova Scotia (Chandler)	
Baseline	Video transects (Maine Protocol); Ranges of water depth, sediment thickness, current speed. Sediment cores (minimum of 5/site) (Maine Protocol): grain size, water content, redox potential, total sulfide and organic carbon.
Monitoring	
Biological:	Study to look at effects of aquaculture operations on lobster immigrations into the area, to see lobsters use of area under the pens; video transects; Proposing to look at effects on clam and scallop perturbations, recruitment, growth rates, population structure, fecundatory.
Chemical:	In sediments: redox potential, total sulfides, determine carbon content.
Physical:	In sediments: Grain size distribution; (or profiles of selected Physical/Chemical /biological productions).
Species	Atlantic Salmon, rainbow trout, blue muscles, lobster, clam mussels.
Prince Edward's Island (Raymond)	
Baseline	No requirements
Monitoring	No requirements.
Species	Blue Mussels, Oysters.

Table 4
Proposed or Existing Requirements for Aquaculture in Other Countries

<u>Country</u>	<u>Requirements</u>
GEASAMP (Proposed) (Rosenthal)	
Baseline	
Physical:	Topography, surface brackish layer, depth of summer eutropic zone, current speed and direction, renewal rate retention time.
Chemical:	Sedimentary redox potential, carbon, nitrogen, selected heavy metals.
Biological:	Community structure of macrofauna.
Monitoring	
Physical:	Sediment accumulation and sediment rate, grain size evolution. Use video or SPI.
Chemical:	For suspended and bottom aquaculture measure organic (C & N) during the winter, H ₂ S, and redox potential (4 cm deep in sediment).
Biological:	In summer benthic macrofauna and community structure for finfish pens. For suspend or bottom aquaculture also measure Phytoplankton biomass for shellfish.
Italy (Sweeney)	
Baseline	
Inland	
Freshwater:	Law on waters, R.D. 11.12 of 1993 nr. 1775: all waters are public. A State authorization must be requested prior to the use of it. The concession for use has a duration of 10 years. Some regions apply local rules.
Inland	
Saltwater:	From underground water see law nr. 1775. From sea channels, state permission must be requested from local Region Authority. In some regions (e.g. Venice) a local regulation is applied.
Depuration:	Law nr. 147/79. All edible bivalve molluscs, to be commercialized, must come from controlled areas and depuration plants authorized by the State and local USL. Water must come from an allowed area, according the National map of approved coastal waters, compiled by regional governments.
Marine:	Law 30.12.1992 nr. 531. On preparation and commercialization of fish products. The area of production must be well separated by public areas. An impact study must be performed on the chosen area. It must precede the request of authorization, submitted to the State Authority, for use of area for aquaculture purposes. The study must consider all the physical, chemical and biological impacts on the resident population.

Table 4 (continued)
Proposed or Existing Requirements for Aquaculture in Other Countries

<u>Country</u>	<u>Requirements</u>
Italy (continued)	
Monitoring	
Inland	
Freshwater:	The amount of water taken is monitored by the local Compartment of the National Hydrographic Mareographic Service. Art. 26 T.U.R.D.27.7.3 nr. 1265. The local regional authority monitors, according to the local sanitary office (USL), the health state of waters and plants, from the physical, chemical and biological point of view.
Inland	
Saltwater:	The situation is unclear. The water must be "Merli". Cu, Zn, Cl, GH, pH, O ₂ , BOD, NH ₄ , NO ₂ , Pi, and microbiology must be yearly monitored and the results communicated to the local U.S.L.
Depuration:	Physical and chemical characteristics must be checked daily. Oxygen concentration and the presence of bacteria are the main parameters to be considered. Cu, Zn and Fe must be absent. An addition of Cl is allowed.
Species:	Mainly trout, Anguilla, Seabass, etc. Depuration - Mytilis, Tapes, Venerupis etc.
Norway (Ervik)	
Existing	None, Exotics not permitted. Costs will be incurred by industry.
Proposed	
Baseline Max	volume 12,000 cubic meters, depth 5 meters, density 25 kg/cubic meter, biomass 3,000 lbs.
Monitoring	Core samples to measure redox, pH, sediment: color, smell, water content. sieved for infauna.

Appendix F: Categories of Aquaculture Projects in the Commonwealth of Massachusetts

In developing a process for monitoring the environmental impact of aquaculture projects in Massachusetts' marine and coastal waters, the Monitoring Subgroup relied heavily upon the previous experience of the State of Maine, which in turn adapted its protocols from initiatives already underway in the State of Washington.

The model proposed for Massachusetts would assign a proposed aquaculture project to one of four categories:

Category 1 aquaculture projects are low-impact, bottom-culture systems with no structures suspended within the water column that could inhibit other uses of overlying waters and with no addition of food or other inputs to the ecosystem. A prominent example of Category 1 aquaculture is the bottom culture of bivalve mollusks. Category 1 aquaculture should require minimal baseline evaluation of the site over and above that required to evaluate whether the site is appropriate in the context of traditional uses, levels of productivity anticipated, and so forth. Operational monitoring once a Category 1 system is in place should require little effort beyond annual inspection by local [and/or state?] regulators to ensure that the level of use is as described in the permit "Order of Conditions". An annual report on productivity at a Category 1 site would be required, with submission to the appropriate state [permitting? regulatory?] agency. This annual report should include, but not be limited to, information on the number of seed deployed and the amount of crop harvested. These data would be maintained as proprietary and confidential.

Category 2 projects involve more intensive use of the physical space, with structures suspended, e.g., within cages or on ropes, within the water column or in the intertidal zone, thereby limiting access to the overlying waters. Hanging (suspended) culture of bivalves is an example of Category 2 aquaculture. No additional inputs (feeds or other therapeutic agents) are permitted at a Category 2 site. Baseline monitoring information required for a Category 2 aquaculture initiative consists of all the information required for Category 1 projects, plus data to evaluate the potential impact of the suspended structures. These additional data include:

1. A detailed design plan, including engineering specifications, if appropriate, for the facility, including concise drawings of equipment to be deployed temporarily and/or permanently into the environment.
2. A description of the proposed site, including measurements of depth, tidal current velocities, and of benthic habitat (including video diver survey), specifically identifying sediment type, submerged vegetation, and in-fauna.

3. Information on known uses of the proposed site by endangered species and discussion of potential impact of the proposed aquaculture project on endangered species.

Monitoring requirements for a Category 2 site include an annual site visit and a biannual evaluation of the benthic environment under the site (including video diver survey). Entanglements of protected species will be reported within 24 hours to the Division of Marine Fisheries. In addition, an annual report on site productivity, plus documentation of all animal entanglements and user conflicts throughout the reporting period, shall be required. These data will be maintained as proprietary and confidential.

One issue not addressed by the Maine model, which may warrant consideration in Massachusetts' waters, concerns placement of suspended structures in shallow waters overlying submerged vegetation, where shading of sunlight may be a problem.

Category 3 aquaculture operations are land-based and intensively managed facilities such as shellfish or finfish hatcheries or recirculating culture systems. Facility discharges are contained, concentrated and remotely deployed into the environment. In considering monitoring programs for Category 3 culture systems, the Working Group noted that regulations addressing point-source discharges are currently well established and that guidelines/regulations are clearly outlined as part of the National Pollutant Discharge Elimination System (NPDES) permitting process administered through the Army Corps of Engineers. The tools for environmental monitoring of Category 3 culture systems are thus already in place, although it will be necessary in Massachusetts to classify the effluent from these systems as "agricultural effluent" and to apply those regulations which are required for the discharge of such waste effluent to all Category 3 aquaculture facilities.

Category 4 aquaculture is defined by the addition of structures to the water column as well as inputs of organic and inorganic materials. The prototypical Category 4 aquaculture enterprise involves floating netpen culture of finfish. Because Category 4 aquaculture is the most intensive level of field-deployed, *in situ* aquaculture, the most stringent environmental monitoring is associated with this level of aquaculture development.

Category 4 aquacultural enterprises affect the environment primarily on account of the addition of organic and inorganic products (feed, medications) to the water. Addition of feed and the subsequent production of feces contribute to overall nutrient loading in the water column as soluble products leach from food and feces and as fine particulate material persists in suspension in the water column. Although nutrient enrichment of the receiving water may present a problem, particularly on a cumulative basis, within a confined water body, the overwhelming impact from category 4 aquaculture activities usually derives from

hypertrophication of the benthos. Settling solids (both feed and feces) can result in unacceptable impacts such as azoic areas adjacent to or under pens primarily due to benthic anoxia, outgassing events which liberate toxic gases such as methane and hydrogen sulfide, establishment of fungal mats (*Beggiatoa* sp.) within the netpen impact area, and hyperdominance of infauna extending beyond the footprint of the netpen system.

The State of Maine has developed a comprehensive site evaluation protocol for category 4 aquaculture facilities. Environmental assessment begins with a baseline evaluation at the beginning of the site permit application process and continues with yearly site inspections performed by agents from the State, coupled with production and distribution of an annual environmental report by the aquaculturists.

The following baseline and operational monitoring guidelines, derived directly from the Maine model, are suggested for Category 4 aquaculture projects in Massachusetts:

Baseline Field Survey/Monitoring: All permitted proposals will require on-site field studies to characterize existing environmental conditions as reference data for future comparisons after operation start-up. Elements of the baseline field monitoring program for Category 4 projects include video-recorded observations collected by divers, hydrographic information, water quality measurements and benthic data on sediment quality as well as macrobiological community structure).

Aquaculture lease regulations shall specify that applicants may do more than one site evaluation, but at least one evaluation must be conducted and completed between May 1st and September 30th before a lease is granted

1. Diver survey. A diver shall survey the proposed site to determine the relative abundance of the macrofauna/flora, sediment types, and other unique features of the substrate including the presence of *Beggiatoa* or like species, epibenthic algal layers, prominent ledges, depressions, etc., prior to operation start-up. This survey shall be documented with a video camera. The dive shall be conducted along the axis of the current and through the center of the proposed lease area. The diver shall document sediment types and features, noting erosional or depositional areas. Relative abundance of flora/fauna shall be documented in accordance with the following very general categories: abundant (seen occasionally within the diver's view), common (seen occasionally throughout the dive, maybe patchy), rare (only seen once or in a few places throughout the dive).

One copy of the video tape on standard VHS tape format shall accompany the application. Although video format is preferred, photographs taken at 10-m intervals may be submitted, if video is not available. A brief narrative describing

appropriate reference points shall accompany the tape or photos. All visual documentation shall include the dates on which data were collected.

2. Hydrography. Hydrographic data shall be collected, including measurements of current speed and direction, in order to predict the fate of fecal material and/or unconsumed feed. The current shall be measured at three depths: surface, suspended structure bottom, and 1 m off the ocean floor. A 15-minute sample shall be collected at each of these 3 depths every hour for 12 consecutive hours, representing one complete tidal cycle. An average tide should be selected; spring or neap tides should be avoided. Subsurface current meters are preferred. However, flow meters may be used with concurrent surface direction estimated. The data (hard copy as well as disc) shall be delivered in tabular format and shall include the date and tide predictions for that day.
3. Water quality. Water quality samples shall be collected, including dissolved oxygen profiles during peak stratification periods (usually August or September). A detailed dissolved oxygen profile, consisting of 10 equally spaced samples over the entire vertical depth, shall be measured at the center of the site. This is the same location where hydrographic data shall be collected. Water samples may be collected or an electronic membrane probe may be used to measure concentrations. Temperature and salinity profiles are also required from the same samples and depths. These data will determine percent saturation and evidence of stratification. Samples shall be taken within one hour of slack low water (preferably in the early morning).

Water column dissolved oxygen acceptable methodology and quality assurance procedures, required to substantiate compliance with water quality standards, are discussed in the following paragraph.

Although the preferred method for quantifying dissolved oxygen is the "Winkler Titration" (azide modification), of Standard Methods, the use of the membrane electrode method is acceptable, considering the multiple depths required for the profile. The zero and standard calibration methods described in the most current edition of Standard Methods and the instrument manufacturer's instructions shall be followed. Air calibration readings shall be recorded at the beginning and end of each interval when the meter is on. One duplicate reading per profile shall be taken and reported to verify that the meter is reading consistently. Furthermore, at the beginning and end of each sample season, calibration curves comparing the probe to Winkler readings for at least four dissolved oxygen concentrations ranging from less than 20% to 100% saturation shall be constructed. If more than one meter is used, curves shall be developed for each meter. These curves shall be submitted with all data.

4. Benthos. Benthic monitoring shall involve two components: sediments and infauna.

- a. Sediments. The applicant shall prepare a sediment loading plan which includes the number and location of sediment samples to be collected for geological, chemical, and biological analyses. Single sediment cores shall be collected for a set of samples which are representative of bottom characteristics of the proposed site. The precise design, number and location are not specified here because of the variety of potential structure configuration and sizes. However, a systematic sampling design (sampling at equidistant intervals) which covers the entire area of proposed site, plus 60 m in each tidal direction (ebb and flood) is required.

The sampling grid design and protocol shall be coordinated with the appropriate state agencies (DEP and DMF) to ensure that the data collected are acceptable and consistent. Sediment cores will identify sediment grain size (percent gravel, sand, silt, clay), the depth of the redox discontinuity layer, the depth of the unconsolidated organic layer, and total organic carbon (TOC). Single cores collected using a Plexiglas type corer according to the proposed sampling plan shall be inserted to resistance or to 15 cm, whichever is less. The depth of the discontinuity layer shall be measured from the surface. The depth of the unconsolidated organic layer can also be measured visually with a Plexiglas corer. Grain size analysis shall be performed using the wet sieving method described in Buchanon, or according to a similar procedure. Standard sieve sizes for gravel, sand, silt and clay shall be used. Full analysis of the silt clay fractions may be calculated as the difference in the dry weight between the original sample and the sum of the sieve fractions down to the 0.062 mm sieve (very fine sand). The fraction in each sieve shall be reported in grams (dry weight) and percent of total (dry weight), including the total dry weight of the initial sample.

The unconsolidated material and the top 2 cm of inorganic sediments shall be collected for TOC analysis. The applicant shall ensure that a minimum of 30 g is collected for analysis. Multiple cores (which include the top 2 cm of inorganic material), if warranted, shall be required. TOC shall be analyzed using methods described in the Puget Sound Estuary Program, Hedges and Stearn or Verardo et al.

- b. Infauna. Infaunal samples shall be sieved through a 0.5 mm sieve (collection techniques are presented with metric measurements) and organisms identified to species or the lowest practical taxonomic level. Single cores shall be collected according to the proposed sampling plan along the axis of the current. Cores must be inserted to resistance or to 15 cm, whichever is less, and the depth of the core shall be reported.

Individual benthic infaunal cores collected by a diver shall have an area of at least 81 sq. cm (a 4-inch diameter PVC pipe will suffice). Alternatively, cores may be collected from a grab or box-type corer having an area of at least 0.1 sq. m. If subsamples are taken from a grab or box-type corer for the sediment

analysis and the remaining sample used for biological analyses, no more than 1/4 of the surface of each sample can have been removed for the sediment analysis.

Operational (Long-Term) Monitoring: After an aquaculture permit has been issued, the following operational monitoring program shall be required. The objective of these monitoring requirements is to identify effects of aquatic farms on sediments and water quality. It will also provide data with which to review current environmental requirements for possible future modifications.

1. **Diver survey.** A diver survey shall be conducted twice a year, once between April and May and once between October and November. Except as provided below, diver surveys shall be documented with continuous video footage within the footprint of the aquaculture structures and shall extend 60 m beyond the ends of the system along the axis of the primary current. The diver shall document sediment types and features, noting erosional or depositional areas, as well as macroflora/fauna observed, including their relative abundance. Relative abundance shall be characterized approximately as follows: abundant (seen occasionally within the diver's view); common (seen occasionally throughout the dive, maybe patchy); rare (only seen once or in a few places throughout the dive). Video format is preferred, but photographs taken at 10 m intervals may be submitted if video is not available. A brief narrative describing reference points shall accompany the tape or photos. Diver surveys conducted by the DMF (done once per year to corroborate videos presented by the permit holder) may be used to satisfy this monitoring requirement, if they are available. All visual documentation shall include the dates on which data were collected.
2. **Water quality.** Three water quality samples shall be collected and analyzed for dissolved oxygen, temperature, and salinity every two weeks from June 1 through October 30. Sampling stations shall be placed such that down-current samples will represent water that has passed through the greatest concentration of suspended structures. Water quality samples shall be taken at mid-depth, i.e., if the structure is 6 m deep, the sample shall be collected 3 m from the surface. The three stations to be sampled shall be located 100 m up-current of the operation, 100 m down-current of the operation, and within 5 m down-current from the structures. Also, during the month of August, a once annually, detailed dissolved oxygen, temperature, and salinity profile, consisting of ten equally spaced samples over the entire vertical depth, shall be measured at each of the three stations listed above.

Water samples may be collected, or an electronic membrane probe may be used to measure the concentrations. Temperature and salinity measurements are also required from the same samples and depths. These data will determine percent saturation and evidence of stratification. Samples shall be taken within one hour of slack low water (preferably in the early morning). Methodologies to be

used are as described above in the discussion of baseline monitoring, water quality.

3. Benthos. Analysis of the benthos shall be required during the first period of peak inputs. This generally coincides with the first harvest at the end of the growing season, when multiple age classes are in the water. After this initial survey, monitoring will be required every other year. As with the protocol for baseline monitoring, there are two components to the operational benthic monitoring protocol: sediments and infauna. Procedures and methodologies are as described previously under baseline monitoring/benthos.

Additional operational monitoring requirements may be necessary as the Commonwealth's aquaculture initiative develops and especially to ensure coordination with the Massachusetts Marine Monitoring Program.

Reporting requirements, operational monitoring: By December 15th of each year the leaseholder shall submit the following information to DMF:

1. Spring and fall diver survey reports and videos.
2. Water quality monitoring data from June 1 through October 30.
3. Benthic survey report for the year.
4. Summary data of total feeds fed, stocking density of organisms, and total production of culture system for the year in question (confidentiality maintained).
5. Data (substance, quantity, date(s) added, and location) of all substances introduced into the culture system other than animal feed.

To corroborate the data reported above for a Category 4 aquaculture system, an annual site visit, including a diver survey, shall be conducted by the Massachusetts DMF during the summer.

Appendix G: Steering Committee and Working Group Participants

(Chairs are noted in italics)

STEERING COMMITTEE MEMBERS

Leo Pierre Roy (Undersecretary, EOEA)
Trudy Coxe (Secretary, EOEA)
Gloria Cordes Larson (Secretary, EOEcA)
Peg Brady (Director, MCZM)
Cliff Rotenberg (Governor's Office)
David Struhs (Commissioner of DEP)
Jay Healy (Commissioner of DFA)
Wayne MacCallum (Director, DFW)
Phil Coates (Director, DMF)
The Honorable Bruce Tarr
The Honorable Henri Rauschnenbach
Mark Forrest - Rep. Gerry Studd's Office
Jennifer Miller - Sen. John Kerry's Office
Chancellor Peter Cressy (U-Mass Dartmouth)
Dr. Mark Tisa (DFW)
Karl Rask (Cape Cod Resource, Mass. Aquaculture Association)
John Richards (Chatham Shellfish Co.)
Roger Berkowitz (Legal Seafoods)
Joseph Milano (Union Oyster House)
John Reid (Bioshelters)
Joshua Goldman (Aquafutures)
Rob Garrison (Nantucket Research and Education Foundation)
Lisa Standish (Mass. Office of Business Development)
Dr. Priscilla Brooks (CLF)
Dr. Harlyn Halverson (U-Mass/Dartmouth)
Jim Fair (DMF)
Susan Snow-Cotter (MCZM)
Bob Golledge (DEP)

WORKING GROUPS

Economic Development:

Priscilla Brooks (Conservation Law Foundation)
Jay Healy (Department of Food and Agriculture)
Lisa Standish (Mass. Office of Business Development)
Ken Bergstrom (Fair Acres Farm)
Alice Boyd (Cape Cod Resource)
Bill Blanchard (DFA)
William Burt (Barnstable County Cooperative Extension)
Micheal Collins (Cape Cod Economic Development Council)

Pat Eldridge (Senator Raushenbauch's office)
Jill Fallon (Kaye, Fialkow, Richmond and Rothstein)
Rob Garrison (Nantucket Research and Education Foundation)
Gary Glenn (Ma. Foundation for Excellence in Marine and Polymer Sciences, Inc.)
Alexander Gryska (NE Fisheries Development Association)
Porter Hoagland (Woods Hole Policy Center)
Buell Hollister (DMF)
Kent Lage, (MOBD)
Karl Rask (Cape Cod Resource, Mass. Aquaculture Association)
Paul Sisson (MOBD)
Scott Soares (SERPED)
Richard Taylor (F/V My Marie, prospective aquaculturist)

Thanks also to Tim Clark, Josh Goldman, Hauke Kite-Powell, Fernando Quezada, and Terri Thompson.

Environmental Review

Siting:

Jim Fair (DMF)
Amanda Dickerson (EOEA)
Marie Studer (MCZM-Bays Program)

Monitoring:

Harlyn Halverson (U-Mass Dartmouth)
William Clark (MCZM-Bays Program)
Michael Hutcheson (DEP)
Dale Leavitt (Woods Hole Sea Grant)
Eric Nelson (NMFS)

Regulatory Reform

Bob Golledge (DEP)
Susan Snow-Cotter (MCZM)
Jim Fair (DMF)
Bill Blanchard (DFA)
Dave Shepardson (MEPA)
Debbie Graham (DEM)
Michael Stroman (DEP)
Deerin Babb-Brott (MCZM)
Mark Tisa (DFW)
Grant Kelley (ACOE)
Eric Nelson (NMFS)
Mike Marsh (EPA)
Terri Thompson (Sen. Raushenbach's Office)
John Richards (aquaculturist)
Karl Rask (Cape Cod Resource)

