ANNUAL PROGRESS REPORT

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EXECUTIVE DIRECTOR

For The Period
July 17, 1987 to November 30, 1989

NRAC
December 1, 1989
TABLE OF CONTENTS

I. Introduction 3
II. Northeastern Regional Aquaculture Center 4
III. Procedures 4
IV. Results 6
   A. Funded Projects 6
      1. Genetic Improvement of the American Oyster for Commercial Culture 6
      2. Hybridization, Genetic Manipulation, and Sex Control in Striped Bass 7
      3. Analysis of the Economics and Marketing of Farmed Finfish in the Northeast 8
      4. Extension Aquaculture Workshop 9
         a. User Conflicts and Social Resistance to Aquaculture 9
         b. Water Quality 10
         c. Government Regulations - Local, State, Federal 11
         d. Economics and Marketing of Aquaculture in the Northeast 12
         e. Health Management of Fish and Shellfish 13
         f. Aquaculture Systems Technology 14
      5. Fish Health Management for Aquaculture Workshop 15
      Position Statements Approved by the Fish Health Workshop Participants 15
   B. Proposed Projects 16
V. Future 18
I. INTRODUCTION

The US Congress, in an effort to promote development of new and vigorous aquaculture industries throughout the country, authorized establishment of up to five regional aquaculture research, development and demonstration centers in the United States in association with colleges and universities, State departments of agriculture, federal facilities, private research institutions and industry.

Five regional aquacultural center have been established as follows:

Western Regional Aquaculture Consortium
University of Washington
Seattle, WA 98195

Center For Tropical and Subtropical Aquaculture
The Oceanic Institute
Makapuu Point
Waimanalo, HA 96795

North Central Regional Aquaculture Center
Michigan State University
East Lansing, MI 48824-1222

Southern Regional Aquaculture Center
Mississippi State University
Delta Branch Experimental Station
Stoneville, MS 38776

Northeastern Regional Aquaculture Center
Southeastern Massachusetts University
North Dartmouth, MA 02747

The mission of the regional centers is to establish aquacultural research, development and demonstration for the enhancement of viable and profitable commercial aquaculture production in the United States for the benefit of producers, consumers and the American economy.
II. NORTHEASTERN REGIONAL AQUACULTURE CENTER

The Northeastern Regional Aquaculture Center was established under Title XV of the Agriculture and Food Act of 1980 and the Food Security Act of 1985 (Subtitle L, Sec. 1475 [d] ) on July 17, 1987 by way of a grant application to the USDA Cooperative State Research Service from Southeastern Massachusetts University.

The NRAC administers a comprehensive research, development and demonstration program designed to enhance commercial aquaculture development in the northeastern region, which includes Connecticut, Delaware, District of Columbia, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont and West Virginia.

Organizational meetings began in early 1987 with the establishment of a 24-member Board of Directors and a 12-member Technical-Industry Advisory Council. The project development process began in late 1987 and the first projects were approved to begin in June 1988.

NRAC made the following grant applications:

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NRAC submitted Annual Plans of Work as follows:

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III. PROCEDURES

A. Administration

The NRAC Administrative Center is located with Southeastern Massachusetts University, North Dartmouth, MA.

The administrative staff consists of the Executive Director and a secretary. Financial accounts are maintained by the University Grants and Contracts Office, Department of Fiscal Affairs.
B. Organization

The Center organization includes a Board of Directors (BOD), Executive Committee of the BOD (EC), and a Technical-Industry Advisory Council (TIAC). The BOD establishes policy, approves an annual budget and sets priorities. It meets once a year. The EC, which consists of 6 directors appointed by the BOD, is responsible for Center operations in conjunction with the Executive Director. The TIAC offers advice and recommendations to the BOD and EC relative to priorities, new projects, renewal of projects and budgets.

C. Proposal Development

The proposal development process is outlined in the NRAC Manual for Cooperative Regional Aquacultural Research, Extension and Demonstration Projects. The first set of proposals followed this process but the northeast aquaculture community felt that the priority and proposal development process was not adequately open for full regional participation. The BOD, in response, decided that a region-wide workshop involving representatives from all aspects of the aquaculture industry should be held to establish a new set of priorities. This was done in October 1988.

The BOD also decided to combine competitive and work group processes in order to establish new projects. This involved sending out a request for preproposals in the seven priority areas previously determined. Over 200 Request For Preproposals were sent out. Forty-two preproposals were received. The EC reviewed them all and selected two to four in each priority area that would serve as a basis for the establishment of a workgroup in each area to develop a final project proposal. Letters were sent to all regional Experiment Station, Cooperative Extension, Sea Grant, and Marine Advisory directors, NRAC BOD and TIAC members seeking representation at the workgroup meetings. It turned out to be an awkward and prolonged process but six cooperative projects emerged.

D. Proposal Evaluation and Approval

All proposals were reviewed and evaluated by the Industry Committee and Technical Committee of the TIAC and recommendations were prepared for the EC.

The proposals were also sent to two peer reviewers located outside of the region with a peer evaluation form to be returned. These were also presented to the EC for their consideration of project approval.

E. Project Management

A principal investigator is appointed for each project. This person is responsible for total coordination including the preparation of progress, final, and financial reports.

F. Project Evaluation

The TIAC evaluates annual progress reports and recommends continuation, continuation with modification, or termination of all projects annually.
IV. RESULTS

A. FUNDED PROJECTS

NRAC has funded three research projects for three years each, an Extension priority setting workshop and a fish health management workshop to date. The following are brief summaries of each.

Funds Allocated to Projects

1. Genetic Improvement of the American Oyster for Commercial Culture

Rutgers University - lead institution
University of Connecticut
University of Delaware
University of Maine
University of Maryland
Aquaculture Research Corporation
Cotuit Oyster Company

Funding levels are $170,000 for each of three years.

The objectives are: (1) Evaluate survival, growth and meat quality of existing MSX-resistant oyster strains in several northeast coastal areas. (2) Produce new oyster strains by hybridizing fast growing genotypes with MSX-resistant strains. (3) Develop information on the genetic basis for survival against MSX diseases. (4) Make results available to industry extension agents and other investigators.

Accomplishments

Progress has been made in evaluating existing strains in three different environments reviewing disease levels, mortality, shell growth, meat condition and total yield. Evaluation is being made on animals from a four-way cross between a non-selected line and a MSX resistant line in three locations in Maine. Diploid and triploid oysters were developed by mass spawning and subsequent cytochalasin B treatment. Progeny were set and reared. Electrophoretical typing of 120 progeny
has been accomplished. Studies in comparing the effects of MSX infection on physiological functions of selected and unselected strains suggests the difference between strains was genetically based and not because the unselected group was metabolically depressed because of higher MSX levels. Studies comparing changes in hemolymph components of cells and serum give preliminary data showing significant differences between stocks in hemolymph protein, agglutination titers for latex particles, ratios of hemocyte types, and serum acid phosphatase. Members of the project have presented the results at six meetings and have one article published based upon this research.


University of Maryland - lead institution
National Fisheries Center US Fish & Wildlife Service
Nations Fisheries Research Development Laboratory US Fish & Wildlife Service
Walnut Point Farm

Funding levels of $65,000 for each of three years.

Objectives are: (1) Develop technology that will enable production of commercial scale numbers of triploid larvae and conduct relative growth and survival studies comparing them to normal diploid hybrids. (2) Refine techniques for producing tetraploids. (3) Transfer technologies developed in objectives 1 and 2 to culturalists to stimulate further development of a new, major aquaculture industry in the US.

Accomplishments

Progress relative to the respective objectives is as follows:

Objective 1: Diploid and triploid hybrid striped bass were produced with hydrostatic pressure at Florida's Richloam Fish Hatchery in March and April of 1988, then stocked in rearing ponds for culture to Phase I (1.5"-2.0"). Of the larvae treated to induce triploidy, about 90% of the original hybrids and 50% of the reciprocal hybrids reaching Phase I were triploids.

Approximately 55,000 diploids and 17,000 triploids were transferred to Leetown, Pennsylvania where growth and survival were examined to Phase II (4"-8"). Overall survival rates ranged from 96.5% to 99.5%. Original hybrid triploids grew faster than original hybrid diploids, but reciprocal triploids grew slower than reciprocal diploids.

Gonad tissue from year-old triploids will be examined histologically during the fall to evaluate gonadal development. Expected completion: December 31, 1989.

Diploid and triploid striped bass and hybrid striped bass were produced with hydrostatic pressure at Richloam Fish Hatchery in April of 1989. Unfavorable weather caused low fertilization rates and numerous abnormal embryos. Less than 50,000 triploidy-induced larvae were stocked, and after harvesting about 1,000 putative triploid hybrids and 200 putative triploid striped bass were transported to the University of Maryland for growout.

For FY'90, Florida personnel expect a large, high quality white bass brood stock (reciprocal hybrids), and Maryland personnel will attempt to duplicate the efforts made in Florida.

Objective 2: The 1989 study focused on two objectives: (1) to compare the effects of two sex reversal hormones (methyl testosterone [MT] and mibolerone [MB]) at three different concentrations in a flow-through system, and (2) to compare the efficiency of MT introduced to fish in four ways: through skin and gills using a flow-through system, through skin and gills using high concentration
Last May, about 100,000 two-day-old striped bass larvae were transported from Virginia's Brookneal Hatchery to the National Fisheries Research and Development Laboratory at Wellsboro, Pennsylvania. The following information has been gained from the various treatments these bass underwent.

- Daily MT treatments of 5.0 and 10.0 parts/million (ppm) and MB treatments of 0.5 and 1.0 ppm, all using a flow through method, caused 100% mortality in all replicates by the seventh week.
- Daily MT treatments of 1.0 ppm and MB treatments of 0.1 ppm, both in flow-through systems, had survival rates similar to controls after 13 weeks.
- Initial MT dip treatments of 200 ppm for 30 minutes produced no noticeable mortality on Day 1. However, when the second treatment was applied ten days later (Day 11), two of nine tanks were lost after 24 hours, and five of nine by the 13th week.
- The 27.5 gallon glass aquarium used in the study can support 30 striped bass through the three-inch stage.
- The first effort to culture striped bass resulted in 298 fish at the 13 week stage produced form 59,000 day old larvae, a survival rate of 0.5%.

Because fish are still being reared and gonad analysis has not started, information on the effectiveness of test treatments to induce sex reversal remains undetermined. This information should be available by the end of the year.

Objective 3: Technology transfer of current striped and hybrid striped bass culture has been fostered by:

- holding a workshop on striped bass and hybrid culture this past spring at the University of Maryland;
- producing a video and fact sheets on cage culture of striped bass and hybrids, which includes segments on cage construction, stocking, feeding, growth evaluations, and harvesting techniques (the video should be ready for distribution in the Northeast by January, 1990);
- providing Rutgers University Cooperative Extension Service with 1000 juvenile hybrid striped bass for use in an aquaculture demonstration project;
- holding presentations in Maryland and Virginia on producing and culturing striped bass;
- answering phone calls asking about striped bass and hybrids from many Northeastern states and also from Canada.
- assisting NRAC's Extension work group whenever possible.

Videos and facts sheets on pond culture techniques and the project's findings are planned for the future.

Harrell also announced a week-long, hands-on workshop on striped and hybrid striped bass aquaculture will be held the third week of April 1990.


University of Rhode Island - lead institution
Cornell University
University of Maryland

Funding levels of $58,406, $85,690 and $86,380 for each of three years respectively.

Objectives are: (1) Characterize status and trends of the aquaculture industry in the northeast. (2) Determine production costs for striped bass, hybrid striped bass and ocean pen-reared salmon in the northeast. (3) Conduct market analyses for farmed salmonoids, striped and hybrid striped bass and prepare marketing strategies to maximize profits. (4) Publicize and disseminate results.
Accomplishments

- University of Maryland researchers identified 30 growers or prospective growers of hybrid striped bass and surveyed half of that group.
- Cornell University investigators surveyed 187 trout growers by mail, but only 85 were active in the industry. Of that 85, 35 were completed and returned, and the draft report will be based on those preliminary responses. More completed surveys are expected.
- University of Rhode Island researchers interviewed 17 salmon growers in person, and also contacted one Canadian firm and two federal hatcheries.

4. Extension Aquaculture Workshop

Rutgers University - lead institution
University of Maine

Funding level of $25,000

Objectives: (1) Identify constraints affecting the development of a strong aquaculture industry in the northeast. (2) Obtain a broad spectrum of input from all groups in the northeast interested in the development of an aquaculture industry. (3) Seek input for establishing regional priorities for NRAC programming.

Accomplishments

The workshop was held on October 17-18, 1988 at the Tara Hyannis Hotel, Hyannis, MA. There were 97 attendees with 37 from industry, 3 from county and town governments, 6 from state governments, 8 from the federal government and 42 from academia. Dr. Nick C. Parker, Scientific Director, SE Cultural Fish Laboratory, US Fish and Wildlife Service was the keynote speaker discussing "Future of the Aquaculture Industry in the Northeast: Issues, Opportunities and Problems."

General and workgroup sessions were held during which the following priority areas were identified. These priority areas constitute the regional aquaculture priorities for the NRAC 1989 - 90

a. User Conflicts and Social Resistance to Aquaculture

Description:
Social resistance to aquaculture continues to hinder the development and expansion of the industry. Although both real and perceived user conflicts exist, the situation is complicated by inaccurate and insufficient information available to the public, not to mention community leaders and legislators. At the same time, aquaculturists often ignore social, political, biological and economic factors that have no immediate bearing on their operations. There is a need for improved public-private communications, as well as a broad based understanding of aquaculture definitions and policies.

Objectives:
To develop educational and outreach programs which would provide the information, data, and awareness necessary to minimize conflicts and to dispel the resistance against aquaculture.

- Dissemination of the appropriate information using proven Extension techniques, focusing on those groups that have an impact on aquaculture (i.e. general public, legislators, fishermen, government, academia, industry). These include forums, conferences, written materials, demonstration projects, curricula for schools, public participation, and networking within the industry, for example.

- States must tailor this towards their own problems and needs. Encourage the development of a mechanism for interstate information exchange (such as how to develop a trade association,
contents of aquaculture plans, model legislation).

- To establish a system for providing more industry input to the research community. It is hoped that researchers would better listen to the industry when determining industry needs. Enhanced communications with academia would give more credibility to both academia and industry.

b. Water Quality

Description

Marine resources are affected by a wide range of human (anthropogenic) perturbations, including pollutants from point and nonpoint sources. Most of the impacts attributed to these sources have been observed in estuaries and coastal waters, often the most productive marine environments. Since the inception of the federal Clean Water Act in the early 1970's point sources, such as sewage treatment plants and industrial discharges have, for the most part, come into compliance with established federal and state pollution control permits. However, nonpoint sources of pollution, particularly those associated with over-development of the coastal zone, have received relatively little attention. These diffuse sources, often difficult to quantify and control, include stormwater runoff from urban, suburban and marina development. Pollutants from these sources include bacteria and pathogenic organisms, pesticides, herbicides, lawn fertilizers, heavy metals, petroleum hydrocarbons, roadway de-icing salts and sediment. They are commonly conveyed by stormdrains, over-land runoff, or direct discharge. In addition to their impact on fish and shellfish resources, nonpoint source pollutants can also contribute to dissolved oxygen depletion, toxic algal blooms, and consumer health risks associated with the ingestion of contaminated seafood products.

Working groups for the National Oceanic and Atmospheric Administration, the EPA and international environmental organizations responsible for categorizing the effect of substances and activities on the water quality of coastal and estuarine habitats have ranked coastal development as causing the most degradation. The pressures to expand development in the coastal zone are intense. As construction continues the cumulative stresses on the coastal waters, bays, and estuaries increase. largely from poorly controlled land development. Each disturbance adds to the total pollutant loading into the system.

Objectives

1. Management of Nonpoint Source Pollution

Successful management of nonpoint source pollutant loadings prior to their entry into the marine environment will require assessment of several interrelated processes. These include:

- Use and/or development and enforcement of planning and zoning ordinances to limit growth in the coastal zone and to control stormwater runoff when new growth is permitted. These "limits to growth" can be based on scientific estimates of the amount of development an ecosystem can withstand and still support diverse assemblages of marine resources.

- Development of a Geographic Information System (GIS/ARC INFO) database on the existing water quality, fish and shellfish resources, land use/land cover and pollution sources (point and nonpoint) and their magnitude in the watershed. A strong database should be the foundation for problem assessment, watershed management plan development, political and legislative support and future funding requests.
• Development of a watershed management plan identifying: pollution sources, structural and nonstructural management practices to control pollution from existing and proposed development, and federal, state and local responsibilities in implementing the plan.

• Coordination of overall watershed management activities, to ensure continued project momentum, inter-agency communications, problem resolution and tracking of progress.

• Public education and information program focusing on nonpoint pollution control.

• Ecological risk assessment and communication program focusing on pollutant effects on fish and shellfish populations.

Several attendant issues are also relevant when considering the sustained use of available marine resources in areas where water quality is already deteriorated:

• Development of systems or programs which can assist in mitigating the adverse effects of inferior water quality on fish and shellfish harvesting and marketing (e.g., depuration, relay, microbial disinfection).

• Retrofitting existing technology, or developing new designs for stormwater pollution control devices which can subsequently be installed at key locations within the coastal zone (e.g., upstream of fish and shellfish production areas).

2. Water Quality, Conservation, and Reuse

Limited quantity of water coupled with high costs of pumping are intensifying use; therefore, increased attention must be placed on methods and efficiency of aeration and recirculation to allow intensive production while minimizing diseases and off-flavor; as use intensifies, discharge must be controlled quantitatively and qualitatively.

Work needed under this category will include but not be limited to the following:

• Design of aeration systems which maximize efficiency.

• Design of recirculation systems for ponds and raceways.

• Inventory regional water resources and conservation needs.

• Develop methods for discharge minimization and effluent treatment.

• Development of management procedures for prevention of off-flavors.

• Improve algae and aquatic plant management techniques.

• Other

C. Government Regulations - Local, State, Federal

Description

There is little doubt that most companies and individuals involved in aquaculture enterprises in the Northeast region, view problems associated with regulatory procedures and protocols as one of the major constraints, costs, or "headaches" in allowing profitable aquaculture endeavors to reach their full potential in the immediate future.

Lack of coordination between federal, state, and local regulatory agencies, is the most commonly cited complaint among aquaculture industry representatives in this regard. In many instances, regulations are not uniform from state to state, between the state and federal agencies, may not exist or be inadequate on the state and federal level, or be inappropriate altogether given the nature of the regulation and what it proports to regulate. Matters may be further complicated when there is more than one (often several) agencies at any
given level of government (local, state, federal) with responsibility or jurisdiction in similar areas (i.e., fresh water/salt water/anadromous fishes - NMFS, USFW, USDA, EPA). The permitting process for site location and/or equipment placement may involve a maze of local, state, and federal agencies that has been likened to a "bureaucratic crossfire." This confusing, and often frustrating lack of coordination among and between agencies is at the very least, costly and time consuming for those in industry, or those contemplating entrance into aquaculture business.

Industry leaders often refer to the absence of a "lead agency" for aquaculture, especially at the state and federal levels, as fueling the confusion and lack of coordination by regulators. At the same time, however, the industry recognizes its own shortcomings in educating, in some concerted fashion, regulators and elected officials as to the problems, opportunities, and benefits of aquaculture. Such an effort is needed in overcoming real or perceived reluctance on the part of state and federal agencies in leading, promoting, and coordinating regulatory initiatives on behalf of the industry.

Objectives

1. Compilation, impact assessment and documentation of local, and regional laws and regulations that affect the aquaculture industry.

2. Workshops, site visits, and seminars for regulators, public officials, or the interested public on:
   • the potential benefits of aquaculture.
   • how to streamline regulatory permitting and certification processes.
   • joint processing of aquaculture related applications.
   • "one stop" permitting.
   • lead agency identification.

3. Production of an "Aquaculture Regulations Handbook".


5. Organization of a regional industry task force to pursue the initiatives of "responsible regulation."

d. Economics and Marketing of Aquaculture in the Northeast

Description

There is considerable economic risk and uncertainty associated with aquaculture ventures. This risk and uncertainty is the result of technological uncertainties, market uncertainties, input supply uncertainties, regulatory uncertainties, capital constraints and management skill levels. There has been little work done to evaluate the profitability and economic risks associated with Northeast regional aquaculture ventures. This lack of specific baseline information makes it difficult for the emerging aquaculture industry to obtain capital resources and insurance. In addition to the lack of regional financial and economic information, many aquaculturists are unfamiliar with the sources of capital and marketing options available. Aquaculturists also often do not have the background to develop effective business plans and marketing plans necessary to attract investors and other sources of support.

Objectives:

1. Develop Educational Material

The project should develop educational materials which specifically address how to develop business plans, marketing plans and feasibility studies for aquaculture operations. Types of capital and means of acquiring capital
need particular attention. Publications (especially guidebooks which include examples and baseline information), videos, and workshops are all possible communication mechanisms for disseminating this information. Agent training sessions should be developed to encourage specialists to incorporate components of financial and economic analysis in their extension activity.

2. Conduct Market Research

The project should conduct market research which documents sources of data and evaluates species-specific market opportunities. Studies should identify and utilize currently available market information in conjunction with primary data. Trends in supermarkets, restaurants and institutions and the implications of these trends for the emerging aquaculture industry need evaluation. Particular attention should be given to specialty markets, ethnic markets and other niche markets both domestic and abroad. The potential markets for aquatic plants, live animals, fresh/frozen and smoked products and other valued-added products on a species-specific basis should be addressed. Also, the implication of feed additives, toxins and other substances such as antibiotics which may influence the marketability of aquaculture products should be considered.

3. Evaluate Market Structure

The project should evaluate the likely market structure which will develop for the aquaculture industry in the Northeast and to suggest and analyze possible alternatives which may enhance firm profitability and minimize marketing risks. The possibilities of cooperative marketing and marketing orders for the emerging aquaculture industry should receive attention. Documentation on how cooperatives and marketing orders are developed should be included.

4. Analyze the Economic Risks and Uncertainties Associated with Aquaculture Enterprises

The project should determine the economics of production and the associated economic risks for specific regional aquaculture systems. Risk assessment should document sources of risk (such as production, environmental, regulation and market risks) and the known history of aquaculture projects in Northeast and other regions. Suggestions should be made for risk-minimizing production, distribution and marketing systems.

Models of aquaculture systems should be developed to determine particularly risk sensitive aspects of aquaculture enterprises.

c. Health Management of Fish and Shellfish

A coordinated effort in the health management of fish and shellfish aquaculture would greatly benefit the development of commercial culture of aquatic animals in the Northeastern United States. Presently, a number of government agencies and other groups have developed various regulations or guidelines regarding fish health and the transport of live fish across certain boundaries. The ideal would have one coordinated effort that would provide assurance to all interested parties that their concerns for limiting the spread of aquatic animal diseases would be met. This may take extensive negotiation to reach. An initial step would be inform all interested parties of what regulations and guidelines do currently exist.

The next step in this coordinated effort would be to contribute to an environment facilitating the meeting of the regulations or guidelines. Aquaculturists face a serious problem in meeting the health inspection requirements prior to transport of live
aquatic animals across state boundaries. The cost of the inspection is extremely high and the producer must provide a number of fish (usually 60 fish per lot) that will be sacrificed during the inspection process. Research is needed to develop testing techniques that are sensitive, rapid and economical to perform. Sampling techniques that are non-destructive of the animal would also be highly desirable, especially when dealing with a limited number of broodstock any test must be evaluated so that they will be accepted into what is known as the Fish Health Blue Book (PROCEDURES FOR THE DETECTION AND IDENTIFICATION OF CERTAIN FISH PATHOGENS, K. A. Amos, Editor, 1985. Fish Health Section, American Fisheries Society, Bethesda, Maryland). This manual lists procedures that are currently accepted for fish health inspections.

The following disease organisms/diseases are commonly included in an "inspection list":

**Bacteria:**
- Aeromonas salmonicida (Furunculosis)
- Yersinia ruckeri (Enteric Redmouth Disease)
- Renibacterium salmoninarum (Bacterial Kidney Disease)
- Aeroccocus viridans (Gaffkemia in Lobsters)

**Viruses:**
- Infectious Pancreatic Necrosis (IPN)
- Infectious Hematopoietic Necrosis (IHN)
- Viral Hemorrhagic Septicemia (VHS)

**Parasites:**
- Myxobolus cerebralis (formerly Myxosoma cerebralis)
- Ceratomyxa shasta
- Proliferative Kidney Disease organism
- Haplosporidium (MS)
- Perkinsus

**Misc.**
Neoplasia of molluscs

**Objectives**

1. Develop a database of the existing regulations and guidelines that impact on fish health management in the Northeastern United States, with a listing of the individuals charged with the administration of such programs, and a listing of all individuals with skills in the discipline of fish and shellfish health.

2. Conduct a symposium of the identified individuals above for the purpose of discussing the feasibility of a more coordinated effort to the end result of a sound fish health management program for the region.

3. Develop the sensitive, rapid, economical testing procedures for the above named pathogens. Make the testing technologies available to parties who will be providing the testing service. (It is not seen as an appropriate expenditure of NRAC funds to provide the operating budget for testing or diagnostic laboratories.)

4. Develop a strategy for establishing a unified code between government agencies and producers to enhance interstate transport of aquatic animals and products.

**f. Aquaculture Systems Technology**

**Description**

Aquaculture in the Northeast can flourish only if aquaculture technology appropriate to the region is developed. Appropriate technology is that which takes into account the regional climate, political realities, orientation and characteristics of people interested in legal constraints and other important factors. NRAC should be a catalyst in developing needed technology for the region.
Development of regionally adapted technology is envisioned as including the definition of the present state-of-the-art and making this information available to the commercial sector and the public, developing basic criteria on which practical component and system designs can be based, and testing improved designs to at least the prototype stage.

Objectives

1. Defining State-of-the-Art

Although defining the present state-of-the-art will require input from industry and the research community, the major effort will be carried by extension people. The current state-of-the-art must be determined by careful literature review; visiting existing aquaculture enterprises; discussions with researchers, industry representatives, governmental agencies, association representatives, and other interested parties; and by considering the industry's interests and environmental, political, social constraints.

The information gathered must then be collated, condensed and presented in a form appropriate to the specific audience addressed. The information must be presented in public meetings, conferences, through publications, video tapes, one-on-one consultations and other appropriate methods to users of the information.

5. Fish Health Management for Aquaculture Workshop

NRAC lead institution
University of Rhode Island
University of Maine
University of Massachusetts
Division of Marine Resources, State of Maine

Funding level of $8,000

Objectives: (1) Present an overview of the current fish health regulations of each state and related research efforts in agencies and university laboratories. (2) Provide a forum for industry, regulatory agencies, and academia to address regional fish health issues and regulations. Included would be uniformity of regulations, education and coordination. (3) Identify areas of research needed to provide a better scientific base for fish health inspection and management, particularly in the area of rapid, cost-effective diagnostic methods and non-lethal sampling. (4) Identify possibilities for certification training that are acknowledged nationally. (5) Assess opportunities for interregional collaboration.

The workshop was held in Windsor Locks, CT on August 28, 1989. Nineteen people attended with 9 from industry, 5 from academia, 4 from state regulatory agencies.

Accomplishments

The following statements emerged from the meeting:

Position Statements Approved by the Fish Health Workshop Participants:

I. Aquaculture/Agriculture

Given that aquaculture entails the rearing of a product within some confined area and all the accessory functions involved, we suggest that AQUACULTURE be classified as AGRICULTURE to enhance and encourage this activity within the United States. The Regional Aquaculture Centers are critical for the attainment of this goal.

II. National Meeting

It is proposed that a national meeting be assembled to develop a set of rational, acceptable model guidelines for fish health management and regulatory policies. The attendees should be
composed of representatives from industry, regulatory agencies, and researchers. Joint sponsorship by all five regional aquaculture centers is essential. It is also suggested that a database be developed from the proceeding of this meeting.

III. New England Salmonid Health Guidelines

In light of the proposed national meeting and the lack of adequate industry input it is recommended that the New England Salmonid Health Guidelines be further evaluated prior to implementation.

IV. Research Priorities

It is suggested that the number one research priority be the development of novel non-lethal sampling techniques and to assess the feasibility of these techniques for use in fish diagnostics. Ideally this research would result in the development of cost-effective and (more) rapid health assessment tools. Methodologies which might be investigated include serology, serochemistry, and biopsies.

The workshop participants also approved the following topics for research/extension education:
• production of vaccines
• development of a national clearinghouse for fish health management topics
• control measures for sea-lice
• testing and clearance of new therapeutic agents through the IR4 program
• drug resistance
• training course and videos (extensions)

B. PROPOSED PROJECTS

The following projects were developed by the NRAC workgroups.

**PROPOSED PROJECTS**
(Suggested Funding Levels)

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\begin{align*}
\text{Gov. Reg.} & \quad 50000 \\
\text{Genetic Man.} & \quad 100000 \\
\text{Ext. Prog.} & \quad 150000 \\
\text{Larval Comp.} & \quad 100000 \\
\text{Water Quality} & \quad 250000 \\
\text{Nutrition} & \quad 300000
\end{align*}
\]
1. **Governmental Regulation of Growth and Development: Improving the Legal Framework for Aquaculture in the Northeastern United States**

Institutions involved are:
- University of Connecticut
- University of Delaware
- University of Maine School of Law
- Rutgers University
- University of New Hampshire

Requested funding level is $88,780 over three years.

2. **Genetic Manipulation of Oysters Through Hybridization and Polyploidy**

Institutions involved are:
- University of Delaware
- Rutgers University
- University of Maryland

Requested funding level is $66,145 first year, $56,114 second year, total $122,259.

3. **Northeast Regional Aquaculture Extension Program for a More Viable, Profitable Industry**

Institutions involved are:
- State University of New York at Brockport
- University of New Hampshire
- University of Massachusetts
- University of Maine
- Rutgers University
- University of Maryland

Requested funding level is $131,380 for two years.

4. **Studies of Larval Competence, Juvenile Growth, and Juvenile Survival in Selected Bivalve Species**

Institutions involved are:
- Tufts University
- University of Rhode Island
- University of Maryland

Requested funding level is $72,227 for the first year.

5. **Volunteer Citizen Water Quality Monitoring and Assessment of Nonpoint Impacts**

Institutions involved are:
- University of Massachusetts
- University of Connecticut
- Cornell University
- Rutgers University
- University of Rhode Island
- University of Maine
- University of New Hampshire
- University of Maryland

Requested funding level is $124,857 for the first year, $72,952 for the second year, $56,452 for the third year, total $254,261.

6. **Increasing Aquaculture Production in the Northeast through Nutrition**

Institutions involved are:
- Cornell University
- University of Maine
- University of Maryland
- University of Massachusetts
- University of Rhode Island

Requested funding level is $97,770 for the first year, total 292,270.
V. FUTURE

This first annual report of NRAC covers about a two year period from early 1987 when the organizational meetings were held until the present. The start was slow and rather rocky. Yet, the BOD and the Executive Director have tried to be responsive to the concerns of the northeast aquaculture community and make changes in operational procedures accordingly.

Communications has been a major concern. Consequently, a newsletter has been established and is published every three months. Furthermore, the Executive Director has attended every NRAC workgroup and committee meeting plus written and distributed extensive reports on each.

The establishment of the Executive Committee of the BOD has greatly facilitated the operations of the Center.

There is a great potential for aquaculture in the northeast and NRAC plans to be a major asset in this development.