NRAC
ANNUAL PROGRESS REPORT

For the Period
September 1, 1993 to August 31, 1994

Northeastern Regional Aquaculture Center
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Work summarized in this report was supported in part by Grant Nos. 89-38500-4356, 90-38500-5211, 91-38500-5908 and 92-38500-7142 from the United States Department of Agriculture, sponsored by the Cooperative State Research Extension and Education Service.
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I. INTRODUCTION

The Northeastern Regional Aquaculture Center (NRAC) is one of five Regional Aquaculture Centers which were established and authorized by the U.S. Congress under Title XIV of the Agriculture and Food Act of 1980 and the Food Security Act of 1985. In addition to the Northeastern region, aquaculture centers have been established in the North Central, Southern and Western regions of the continental United States and one in Hawaii.

The Regional Aquaculture Centers are administered by the United States Department of Agriculture (USDA) which was designated Federal leadership in aquaculture by the National Aquaculture Act of 1980. USDA leadership is assigned to the Office of Aquaculture which is located in the Cooperative State Research Education and Extension Service (CSREES) of USDA. The Regional Centers are administrative agencies which encourage and fund cooperative and collaborative aquaculture research and extension educational programs that have regional and/or national application. The Centers are organized to take advantage of the best aquaculture science, education skills, facilities and extension services in the United States; all projects are driven by industry needs and are designed to directly impact commercial development of aquaculture in all states and U.S. territories.

II. ORGANIZATION AND ADMINISTRATION

NRAC encompasses 12 states (Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont and West Virginia) and the District of Columbia. The NRAC administrative office is located on the campus of the University of Massachusetts Dartmouth, in North Dartmouth, MA where it is staffed with a full-time Executive Director and secretary, a part-time accounting clerk, and a part-time clerical assistant. The Center is responsible for coordinating proposals and managing grants, serving as fiscal agent for administering grant monies, arranging for external peer reviews of proposals, maintaining liaison with industry, research and extension participants, coordinating and facilitating interactions among parties in the region, maintaining liaison with other Regional Aquaculture Centers and USDA officials, and for other administrative matters as required in the daily management of the research grants.

A Board of Directors (BOD) representing the region’s aquaculture industries, academic institutions, and government agencies establishes policy and provides overall direction for NRAC. The BOD elects from itself a 7-member Executive Committee which oversees matters of operating procedure for NRAC. A Memorandum of Understanding, enacted in 1988, describes and governs the relationships between member institutions in NRAC. NRAC’s Manual for Cooperative Regional Aquacultural Research, Extension and Demonstration serves as a guide for the development, approval, conduct and review of regional projects sponsored by NRAC.

Research and extension priorities are established by a 24-member Technical/Industry Advisory Council (TIAC) in consultation with the aquaculture industry. The TIAC has a broad regional makeup and represents scientists, extension agents and industry members with varied aquaculture expertise. The TIAC consists of a 12-member Technical Committee (TC) and a 12-member Industry Committee (IC). Nominations for the TIAC are solicited widely throughout the Northeast region.

Dr. Victor J. Mancebo served as Executive Director of NRAC during the report period. In January, 1994, Dr. Robert Miller, Dean of the College of Resource Development at the University of Rhode Island, succeeded Mr. David Morehouse as Chair of the NRAC Board of Directors for a two-year term. Messrs. Joseph Hankins of the Freshwater Institute in Shepherdstown WV and Kenneth Bergstrom of Red-Wing Meadow Farm in Sunderland, MA continued as the technical and industry co-chairs, respectively, of the TIAC.

During the report period, the NRAC Board of Directors approved the implementation of a new Request-for-Proposal (RFP) process as the principal mechanism to develop NRAC’s annual plan of work. This decision, responding to a recommendation of the TIAC reflects a high level of dissatisfaction among industry, university researchers, and NRAC administration with the traditional Work Group Process. The Work Group approach is retained for the development of certain projects (e.g. the Regional Extension Project) and is available for the development of other projects. Use of the RFP process began with development of NRAC’s 7th Plan of Work (FY 1993 institutional award).
III. PROJECT STATUS

The following summarizes the status of NRAC's funded research program during the report period. Information about the financial support levels to active projects is found in Table 1.

A. Completed Projects.

During 1994 nine NRAC funded projects were completed. Completion reports are found in Section IV.

B. Ongoing Projects.

Five multi-year projects continued in 1994. Progress reports are found in Section V.

C. New Projects.

Eleven new projects were started during the report period. Those for which some progress had been achieved by the time of this writing are reported on in Section V.

D. Project Development for 1994 funding.

Five project proposals have been developed and are pending USDA review for funding: 1) "Hard Clam Winter Mortality"; 2) "Monitoring Salmon Cages for Predators"; 3) "Evaluating the Economic Impacts of Piscivorous Predator Damage and Control Methods at Finfish Aquaculture Facilities in the Northeastern States"; 4) "Enhanced Digestibility of Fish Feeds to Reduce Waste Nitrogen, Phosphorus and Solids"; and 5) "Microalgal Starter Culture Service to the Aquaculture Industry".

E. Project Development during 1995.

As described in Section II, a modified Request for Proposals (RFP) process was instituted in 1994 to develop the 1995 NRAC Plan of Work. This process will result in the development of collaborative, regional research projects in the following areas identified as priorities by the aquaculture industry in the Northeast:

Major Areas Of Interest
- Funds to support state Aquaculture Association education initiatives
- Fish health
- Waste management
- INAD's/therapeutants

Also Of Interest
- Non-indigenous species
- Predation
- Assessment of recirculation systems technology
- New technology/equipment assessment and demonstration
- Education - extension
- Wild stock enhancement
- Finfish disease
- Shellfish disease
- Nutrition (finfish)
- Development and/or market research of value added products
- Evaluation of alternative/new species
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<th>Duration</th>
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Northeastern Regional Aquaculture Center
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<td>&quot;A Proposal for the Study of a Protozoan Disease Agent(s) Associated with Mortalities of Hatchery-Reared Juvenile Oysters in the Northeastern United States&quot; (93-9)</td>
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<td>Second Northeast Regional Aquaculture Industry Situation and Outlook Report (94-7)</td>
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IV. PROJECT COMPLETION REPORTS
PROJECT COMPLETION REPORT

Increasing Aquaculture Production in the Northeast through Nutrition

Total Funding: $293,270

Period: May 17, 1990 to November 17, 1993

Participants

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<thead>
<tr>
<th>Name</th>
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<tr>
<td>David Bengtson</td>
<td>University of Rhode Island/E.P.A.</td>
<td>Rhode Island</td>
</tr>
<tr>
<td>Hsiang-tai Cheng</td>
<td>University of Maine-Orono</td>
<td>Maine</td>
</tr>
<tr>
<td>Pavinee Chinchottte</td>
<td>University of Massachusetts-Amherst</td>
<td>Massachusetts</td>
</tr>
<tr>
<td>Radu Giurca</td>
<td>Center for Applied Regional Studies</td>
<td>Massachusetts</td>
</tr>
<tr>
<td>Susan Goldhor (chair)</td>
<td>Center for Applied Regional Studies</td>
<td>Massachusetts</td>
</tr>
<tr>
<td>Tom Handwerker</td>
<td>University of Maryland-Eastern Shore</td>
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<tr>
<td>Reginal Harrell</td>
<td>University of Maryland-Horn Point</td>
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<tr>
<td>Steven Hughes</td>
<td>Monell Chemical Senses Center/USDI</td>
<td>Pennsylvania</td>
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<tr>
<td>Linda Kling</td>
<td>University of Maine-Orono</td>
<td>Maine</td>
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<tr>
<td>Robert Levin</td>
<td>University of Massachusetts-Amherst</td>
<td>Massachusetts</td>
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<tr>
<td>George Nardi</td>
<td>New England Fisheries Dev't Foundation</td>
<td>Massachusetts</td>
</tr>
<tr>
<td>Paul D. Maugle</td>
<td>University of Rhode Island</td>
<td>Rhode Island</td>
</tr>
<tr>
<td>Steven Mulvaney</td>
<td>Cornell University</td>
<td>New York</td>
</tr>
<tr>
<td>Michael Rice</td>
<td>University of Rhode Island</td>
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<tr>
<td>Kenneth Simpson</td>
<td>University of Rhode Island</td>
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Project Objectives

- To estimate the nutrient requirements for striped bass and hybrid striped bass.
- To develop nutritionally complete, cost-effective feeds using alternative protein and energy sources.
- To develop commercially feasible processes for producing aquaculture feeds while maintaining appropriate bioavailability of nutrients.
- To transfer technology and management practices to industry.

Progress And Principal Accomplishments

Objective 1: To estimate the nutrient requirements for striped bass and hybrid striped bass.

(A) Larval requirements:

1. Inland silverside (*Menidia beryllina*), initially used as a surrogate species for larval striped bass, were shown to be not comparable to that species. Histology shows the larval silverside gastrointestinal tract is far more developed, while growth and survival data show that silversides are much better able to digest and absorb nutrients from artificial diets than are striped bass at the same stage.

(2) Ascorbic acid supplementation does not appear necessary in larval striped bass diets, and ascorbic acid-2-sulfate may actually lower survival.

(3) Practical “microbound” diets, in which ingredients are very finely pulverized and bound together into minute balls, gave survival rates and weight gains significantly better than those achieved with microencapsulated diets.

(4) No artificial diet gave survival rates or weight gains comparable to those achieved with live food. However, during the course of this project, incremental improvements brought survival rates and weight gains up from initially negligible to approximately half of those achieved with live food. A series of attractants (sucrose, sucrose + glutamic acid, sucrose + glutamic acid + glycine, glutamic acid, taurine, and betaine) all showed no or very small effects on growth and survival, as did the commercial feed stimulant, Finn-Stim, at all levels of inclusion. Because the striped bass larval intestinal tract is so poorly developed, protease inclusion was tested; this gave negative results which were regarded as inconclusive because protease activity was lost so rapidly from the feed. If protease could be protected, its inclusion could be valuable. A similar rationale governed the inclusion of hydrolysates, which are partially predigested, in the feed. Both herring and dogfish hydrolysates appeared to improve survival, but had a negative effect on growth. Again, more work needs to be done here. Perhaps most interesting was an experiment on inclusion of Vitamins B6
and E (in lecithin), omega-3 HUFA (in algae), and carotenoid (in algae) in larval diets. Although the percent increase in survival was not statistically significant, it was intuitively impressive, with HUFA inclusion raising survival from 33% to 45%.

(B) Adult fatty acid requirements:

(1) Growth and survival of striped bass, white bass, and palmetto bass (striped bass female x white bass male) improved significantly with HUFA supplementation, especially EPA and DHA. These fish do not appear able to elongate shorter chain fatty acids into HUFAs. Although sunshine bass (white bass female x striped bass male) did not respond to HUFA supplementation, body HUFA profiles of unsupplemented fish decreased over the length of the study period, suggesting that the six month study period may have been insufficient to deplete endogenous HUFAs. (Good growth performance may also have been due to hybrid vigor.)

Objective 2: To develop nutritionally complete, cost effective feeds using alternative protein and energy sources.

(1) Vitamin A has been found to be highly toxic to sunshine bass; anecdotal evidence in the literature suggests that this may be true for other bass as well.

(2) Processing wastes were liquefied by enzymatic digestion, followed by pasteurization, screening to remove bone, vacuum evaporation to 50% solids, and preservation either by freezing or acidification. All wastes were treated with antioxidant prior to heating. Both cod (Gadus morhua) and dogfish (Squalus acanthias) wastes were utilized. Dogfish livers were removed prior to processing to keep oil at manageable levels. Since cod is gutted at sea, digestion was carried out by adding papain. Dogfish were autolysed by endogenous enzymes. Hydrolysates were incorporated into moist diets for Atlantic salmon at the 40% level; control moist diets utilized raw herring. (Diets containing cod had herring oil added to make lipid levels comparable.)

Cod hydrolysate preserved by freezing was accepted by Atlantic salmon as well as the control diet. Despite the fact that all feeds incorporating acidified hydrolysates were neutralized up to pH 5.5, feeds containing acidified cod hydrolysate showed reduced palatability. Different acids reduced palatability differentially. Contrarily, dogfish hydrolysates performed best when acidified, matching the control diet in acceptability between pH 5.5 and 6.1. Neutral dogfish hydrolysate showed reduced palatability, presumably caused by the generation of ammonia from urea above pH 6.1.

Human taste panelists judged salmon fed control or dogfish hydrolysate-containing diets superior to salmon fed cod hydrolysate-containing diets. While statistically significant, this result was unexpected and the work should be repeated.

Atlantic salmon dry feed ingredients were made by co-drying dogfish hydrolysate with one of the following: (1) high quality, low temperature-dried fish meal; (2) high quality, low temperature-dried poultry meal; (3) soybean meal. The co-dried ingredients were 50% hydrolysate on a dry weight basis and were included in dry diets at a 60-70% level, replacing three quarters of the diet's fish meal. Although results were statistically insignificant due to using only 14 fish/treatment and a 68-day feeding period, the performance of the co-dried dogfish hydrolysate ingredients was impressive, with both the hydrolysate-fish meal and the hydrolysate-poultry meal equaling (and possibly out-performing) the control diet. (We thank the WRAC nutrition group who alerted us to the possibilities of poultry meal in salmonid diets.)

Objective 3: Develop commercially feasible processes for producing aquaculture feeds while maintaining appropriate bioavailability of nutrients.

Both enzymatic hydrolysis and co-drying are commercially viable processes carried out at multiple industrial sites in the U.S. and other countries. Because companies are somewhat secretive about enzymatic hydrolysis, and because the use of processing wastes which must be collected from multiple sites poses real problems, project researchers, aided by an engineer from a commercial company manufacturing evaporators for fish meal stick water, developed and costed out a process for producing a concentrated hydrolysate. This process starts at outlying cutting plants where wet wastes are stabilized for later collection and transported to a central facility for further processing.

Impacts

(a) Findings on Vitamin A toxicity in sunshine bass, and the fatty acid requirements of striped bass and its hybrids have been communicated to feed manufacturers.

(b) Relevant Northeastern fish processors have been informed of the results of the study on hydrolysates. A computerized spreadsheet is being developed which will allow feed manufacturers,
processors, investors, or entrepreneurs to look at the economics of a hydrolysis plant. Feed manufacturers and aquaculture producers have been informed through multiple information outlets of the results of the hydrolysate trials.

(c) An NRAC extension fact sheet on the nutritional requirements of adult and larval fish has been prepared and includes as many of this project's findings as are relevant.

Suggested Future Work

Given the steady, incremental improvement of survival and growth rates by striped bass larvae on the diets formulated in the course of this project, this work should be continued and its possible extension to endangered marine species explored.

Work on pasteurized hydrolysates to replace raw fish in moist feeds should be carried further and cost/benefit analyses performed. Alternate waste species should be looked at. The possibility of wild-caught fish carrying pollutant loads should be considered.

The use of high quality poultry meal in salmonid diets is extremely promising and deserves further study.

Publications

In print or in press:


In preparation or submitted for publication:


Greenberg, N.J. and R.M. Harrell. Effects of dietary lipid supplements on subadult sunshine bass (Morone chrysops x M. saxatilis). The

Northeastern Regional Aquaculture Center
Progressive Fish-Culturist.  (Submitted for publication)


PROJECT COMPLETION REPORT

91-1 Detection of Fish Pathogens for Fish Health Inspection by Non-lethal Methods

Total Funding: $310,000
Period: March 21, 1991 to March 20, 1993

Participants
Pei W. Chang (chair) University of Rhode Island Rhode Island
Eileen E. Sadasiv University of Rhode Island Rhode Island
Paul R. Bowser Cornell University New York
Joseph K. Buttnner SUNY-Brockport New York
Frank M. Hetrick University of Maryland Maryland
S.K. Samal University of Maryland Maryland
Phillip E. McAllister U.S. Fish and Wildlife Service West Virginia
Bruce Nicholson University of Maine Maine
John T. Singer University of Maine Maine
Paul W. Reno Oregon State University Oregon

Project Objectives

- To develop a non-lethal tissue sampling method (biopsy technique) for obtaining kidneys or other body tissues and to compare the recovery of fish pathogens in fish tissues or body fluid (gonadal fluid, feces, mucus, blood) collected by lethal versus non-lethal sampling methods.

- To develop and compare the rapidity, sensitivity, specificity, and cost of the INPV detection in samples taken by lethal and non-lethal sampling methods.

- To develop and test the efficiency of a time-resolving fluoroimmunoassay for the detection of R. salmoninarum in tissues and body fluids collected by non-lethal sampling methods of fish, using:

- To develop and test the efficiency of monoclonal antibody based indirect ELISA for the detection of A. Salmonicida.

  a) To develop a solid phase ELISA for the detection of INPV-specific antibodies. To compare the sensitivity and specificity of the ELISA with a serum neutralization test.
  b) To correlate the antibody production and virus production of adult Atlantic salmon to INPV following infection at 6°C and 12°C.
  c) To survey fish stocks in hatcheries and in the field for their INPV antibody levels and correlate their immune status with virus isolation and current and past history of INPV outbreaks among them and their progeny.

- To transfer the technology of non-lethal sampling and improved detection methods to workers doing fish inspections by means of workshops and scientific publications. To inform fish producers on the availability and benefits of fish health inspection procedures that include non-lethal sampling.

Progress And Principal Accomplishments

Tissue biopsies can be obtained from adult salmonids using a non-lethal surgical procedure. Adequate quantities of tissue can be obtained and used for disease diagnosis and fish health inspection purposes.

Comparison of methods used for detection of infectious pancreatic necrosis (INPV) virus in tissues and fluids of virus-carrier salmonids were carried out. Specimens of kidney (by lethal sampling) and ovarian fluid pellet (by non-lethal sampling in spawning fish) provide the highest level of sensitivity for assessing the prevalence of INPV. Specimens of surface mucus, feces, and fluids from male and female reproductive products collected by non-lethal sampling can be used to assess the prevalence of INPV in populations of fish.

Stress induced by elevated water temperature and treatment with immunosuppressant enhanced virus titer and virus prevalence in populations of fish.

Nested primers were developed for a polymerase chain reaction (PCR) assay. The PCR assay was sensitive for the detection of virus in clinical samples and, by combining primers, INPV, infectious hematopoietic necrosis virus, and viral
hemorrhagic septicemia virus could be detected and distinguished in a single assay. The PCR assay provides a more rapid and less expensive detection method for INPV than the standard virus isolation assay using cell cultures.

A dot-blot nucleic acid hybridization test was efficient in detecting American strains of INPV in infected cell culture using clones of Ds RNA. The probe was unable to detect viral RNA directly in infected fish but was 100% effective in detecting viral RNA in cells inoculated with infected fish tissues.

*Renibacterium salmoninarium*, the causative agent of bacterial kidney disease, is 3 times and 7 times more frequently found in kidney than in sex products and feces, respectively.

Serum antibodies to INPV were assayed in Atlantic salmon by virus neutralization test. Equal numbers of two age groups (17 and 27 months) were kept at one of three temperatures (6, 10, and 16 degrees Celsius). At various times following INPV infection, the fish were bled by non-lethal methods and their sera tested for anti-INPV antibodies. The majority of the fish developed detectable immune responses at all three temperatures. The final titer after 6 months was similar in all groups.

Eight hatcheries containing brook trout, rainbow trout, and steelhead trout were studied for IPNV virus isolation (from kidneys, spleens, and feces) and serum antibodies. Serum antibodies were detected in 7 hatcheries where the virus was isolated. In one hatchery (the steelhead trout) where virus was not isolated, no antibodies were detected. Screening for INPV antibodies in blood serum from fish populations can be developed as a non-lethal sampling method for fish inspection.

The extension component of this project was to transfer technology of non-lethal sampling and improved detection methods to workers doing fish inspection. These objectives were achieved by two publications and one workshop.

**Suggested Future Work**

A hands-on workshop to demonstrate non-lethal surgical procedures should be held for interested individuals who have a need for such technique.

The comparative intensity of the assay systems for INPV using polymerase chain reaction and cell culture should be definitively established.

The inability of the dot-blot nucleic acid hybridization test to detect viral RNA directly in infected fish tissue was a disappointment. Studies to improve the sensitivity of the cDNA probes should be done by improving the RNA extraction procedure from the infected fish.

The techniques and methods of non-lethal sampling and diagnosis should be collected and identified. Approval to use these techniques in approved fish inspection protocols must be obtained from federal, state, and provincial regulatory agencies. Industry must be made aware of the procedures after they have been accepted as a standard method. Finally, procedures must be made available to industry in a cost-effective manner.

**Publications**


McAllister, P. E., W. B. Schill, W. J. Owens and D. L. Hodge. 1991. Infectious pancreatic necrosis virus: a comparison of methods used to detect and identify virus in fluids and tissues. In the 14th Annual American Fisheries Society/Fish Health Section Meeting and 32nd Annual Western Fish Health Conference,


Unexplained Mortalities of Hatchery-Reared Oysters, *Crassostrea virginica*, In the Northeast: Initiation of a Follow-up Study

**Total Funding:** $10,000

**Period:** March 23, 1992 to March 31, 1993

**Participants**
- Susan Ford (chair)
- Francisco Borreto
- Frank O. Perkins
- David Reylea
- Craig Strong

**Rutgers University**
- New Jersey

**SUNY-Stony Brook**
- New York

**Virginia Inst. Mar. Science**
- Virginia

**Frank M. Flower & Sons, Inc.**
- New York

**Blue Points Oyster Co.**
- New York

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**Project Objectives**

- To determine whether juvenile oyster mortalities are associated with a particular broodstock or grow-out site.
- To determine whether mortalities can be stimulated by experimental temperature elevation.
- To document the association of tissue and shell abnormalities with mortalities.
- To determine whether mortalities are associated with a pathogen.

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**Progress And Principal Accomplishments**

Mortalities were not associated with a particular broodstock. Hatchery-reared offspring of Oyster Bay, NY, native oysters suffered heavy mortalities (up to 90%) in Oyster Bay, on the north shore of Long Island, but showed no mortalities when raised in Great South Bay, on the south shore. The same pattern was documented for hatchery reared offspring of broodstock obtained from the Connecticut shore of Long Island Sound. Native set from the Connecticut shore deployed in Oyster Bay developed a high incidence of abnormal concholin but had low overall mortalities. Cohorts spawned and deployed in Oyster Bay early in the season (by early April) survived well whereas those deployed after late April suffered high mortalities.

There were some site-specific differences in mortality, although they were geographically widespread. High mortalities occurred at several sites, including top and bottom trays, in Oyster Bay, NY, and just offshore of Oyster Bay, in Long Island Sound. No mortalities occurred at the Great South Bay site. Although not part of the study, juvenile Oyster Mortality was also reported from a site on the north shore of eastern Long Island and at a site in Point Judith Pond in Rhode Island.

Mortalities did not occur under elevated temperature in the hatchery. In fact, oysters maintained inside the hatchery at a constant 25°C in a mixture of saline well water and 25um-bag filtered water suffered little or no losses.

Mantle lesions appeared first in affected oysters, followed about two weeks later by the deposition of abnormal concholin on the inner shell and the start of mortality. The prevalence of pre-mortality mantle lesions was, in general, highly correlated with the subsequent prevalence of concholin deposits and mortality in groups that suffered the highest death rates. Some cohorts which had been deployed early developed high levels (50-60%) of abnormal concholin, but suffered relatively little mortality (25-30%), indicating that many individuals had been affected by the etiological agent but had survived.

Nearly 400 individual oysters were examined by tissue section histology without finding any evidence of a protozoan pathogen. As in last year’s study, bacteria and ciliates of various kinds were seen in some oysters, but there was no consistency in their pattern and they may have been secondary invaders.

**Publications**


PROJECT COMPLETION REPORT

93-2 Assesment of the Impact of Stray (Neutral-to-Earth) Voltage on Finfish Aquaculture in the Northeast

Total Funding: $12,000

Period August 12, 1993 to August 11, 1994

Participants
Stephen Greaves
Fern Wilder
Gordon Wilder (chair)
Shawn Wilder

Greaves Dairy Equipment
Hy-On-A Hill Trout Farm
Hy-On-A Hill Trout Farm
Allied Electronics

Vermont
New Hampshire
New Hampshire
New Hampshire

Project Objectives

• To identify finfish aquaculture facilities in the Northeast that have experienced unexplained mortalities that may fit the pattern of stray voltage related stress.

• To determine the presence or absence of stray voltage at facilities identified in Objective #1.

• To document the patterns of behavioral changes in the fish that may indicate the presence of environmental stress.

• To observe patterns in mortalities and review other rearing facility factors (water quality, stocking density, health inspection reports, etc.) to determine whether there is a correlation between stray voltage and finfish mortality.

• To identify possible solutions to eliminate stray voltage problems at aquaculture facilities.

Progress And Principal Accomplishments

Twenty-six letters with questionnaires (Appendix 1) were sent to state aquaculture associations and Fish and Wildlife Agencies within the region. Recipients were asked to distribute the questionnaire among members of their associations Departments to growers that might have experienced unexplained losses of finfish that might be attributed to stray voltage. From fifteen responses, two finfish rearing facilities with potential stray voltage problems were identified: one in New Hampshire and one in Massachusetts.

The grower in New Hampshire had been raising Brook and Rainbow Trout since 1953. For the past eight years he had been pumping water from a dug well. A recirculating pump inside the tank supplemented the natural water flow. He had never experienced any significant losses until the fall of 1991 when the power company replaced a pole in front of his home. During the following 18 months, all trout introduced into his tank on three occasions from two different hatcheries died within 10-12 hours. A fourth introduction comprised of 24 shiners also died within hours.

The Massachusetts grower had experienced devastating losses over a period of several years. During the period just prior to this investigation, the facility had experienced higher than normal losses of larger fish. A pathologist’s examination proved negative for pathogenic agents. Larger fish may be more susceptible to voltage stress than smaller fish as their greater body size exposes them to larger electrical gradients. AC voltage checks between the electrical ground and the water in the tanks following the most recent fish loss revealed voltage differentials varying from 2.5 to 4 volts.

On November 27, 1993 the New Hampshire grower utilized an AC voltmeter to detect the presence of stray voltage at the recirculating pump in the trout tank and at nearby electrical receptacles.

From January 6, 1994 through February 17, 1994, a Rustrack Ranger II Data Logger with accessories was used to measure the neutral-to-earth voltage at the Massachusetts location. Differentials were monitored at three locations; (1) between the outside fish tanks and the secondary neutral, (2) a separate reference rod and the secondary neutral, and (3) the fish tanks and the reference rod.

In early November 1993, the New Hampshire trout grower reported unexplained Rainbow Trout losses with rapid and extensive (100%) mortalities. Prior to the mortality, he had observed severe stress evidenced by erratic swimming, obvious discomfort, surfacing as if to get air, running the surface of the water, and poor feeding. All trout (between one and two years old) died within a 24-hour period.
Water testing at the New Hampshire facility revealed normal levels for trout propagation. Stocking density was heavy. Tiger stripes were present across the backs of some moribund specimens.

The Massachusetts trout grower noticed that, in addition to gill hyperplasia, the dying fish seemed to orient themselves facing the walls of the tanks and stayed on the bottom.

At the Massachusetts station, the overall husbandry and layout appeared to be adequate to support trout. Nevertheless, gills seemed to be very irritated, and the skin of all species showed a darkened, striped effect. Internally, there appeared to be no unusual characteristics. The fish had been checked annually since 1991 by a certified fish biologist, and appeared to be disease-free. Since the water supply, water chemistry and fish pathology did not appear to explain the observed mortalities, the electrical sources supplying the fisheries were suspect.

Possible solutions for stray voltage include; voltage reduction, a four-wire system, new construction, isolation from primary and secondary neutrals, identification and removal or repair of faulty wiring or motors.

**Impacts**

A correlation between stray voltage and fish mortalities has been determined. This information will be useful to all fish growers, making them aware of a problem that can easily be overlooked. Massive losses of fish can be prevented by simple electrical monitoring and modification of the electrical grounds in the vicinity of fish ponds, pools, or raceways, which has the potential to be a significant breakthrough for the entire fish rearing industry.

**Recommended Follow-up Activities**

Further scientific study about the effects of voltage on fish behavior and physiology are recommended. Tolerance levels of different species and sizes of fish to stray voltage and identification of measures that may be taken to prevent environmentally stressful situations at fish rearing facilities should be explored. Building fish tanks or raceways to reduce or eliminate the problem of stray voltage on a non-conductive surface, developing methods for monitoring stray voltage at hatcheries, identifying stray voltage experts as sources of information are suggested follow-up activities.
PROJECT COMPLETION REPORT

93-6 The Role of Bacteria and Microalgae in Unexplained Juvenile Oyster Mortalities

Total Funding: $71,491
Period: May 1, 1993 to June 30, 1994

Participants
Susan Ford (chair) Rutgers University New Jersey
Gordon Taylor SUNY, Stony Brook New York
Monica Bricelj SUNY, Stony Brook New York
David Relyea Frank M. Flower & Sons Co. New York
Joseph Grochowski Nantucket Marine Laboratory Massachusetts
Robert Garrison Nantucket Aquafarm Massachusetts

Project Objectives

- To monitor survival, growth, and pathology of juvenile eastern oysters grown under commercial conditions at the Frank M. Flower, Co. nursery, in Oyster Bay, NY.
- To compare survival, growth, and pathology of juveniles grown on 1/4" and 1 mm screens.
- To compare survival, growth, and pathology of juveniles grown in various combinations of well salt water, 25-um filtered bay water, and raw bay water.
- To attempt transmission of juvenile oyster disease from affected nursery animals to unaffected oysters in the hatchery.
- To sample water, sediment, and culture container contents (including oysters) for presence of *Vibrio* spp. at the FMF Co. site and at a control site in Oyster Bay.
- To perform challenge experiments with suspected pathogenic *Vibrio* spp. collected at the nursery site.
- To sample water in the vicinity of the FMF Co. nursery for the presence and abundance of potentially noxious phytoplankton, and isolate and produce unialgal, non-axenic cultures.
- To perform challenge experiments with suspected noxious microalgae, if candidate species are associated with Juvenile Oyster Disease.
- To perform challenge experiments with potentially damaging chain- and colony-forming microalgae collected on Nantucket Island, MA.

Anticipated Benefits

Mortalities of juvenile oysters are a major impediment to the development of oyster aquaculture in the Northeast. Identification of a cause should permit the design and implementation of measures to reduce or eliminate the losses.

Progress And Principal Accomplishments

From the 1993 SUNY survey of the Frank M. Flower Co. nursery floats, 1,749 individual bacterial isolates from oyster tissue, hatchery waters, algal cultures, bay waters, and sediments were archived. These isolates were grouped on the basis of source, time of collection, and growth characteristics. Those from oyster tissue (as well as shell liquor and inner shell scrapings) that preceded and coincided with the onset of mortality have been given the highest priority for identification. Presently, 200 of these have been subjected to a stringent series of identification procedures, including sensitivity to Vibriostat and oxytetracycline, BIOLOG GN micro plate ID system, API 20E test strips, and other supplementary confirming tests, e.g., haemolysis, growth at 0% NaCl, etc. Most of the isolates associated with diseased oysters are closely aligned phenotypically to just a few species of *Vibrio*: *V. angillarum*; *V. papahaemoliticus*; *V. vulnificus*; *V. alginolyticus*; and *V. metchnikovii*.

In two separate challenge experiments, seven *Vibrio* isolates were injected into the mantle cavity of separate lots of non-diseased oysters (total n= 1200 oysters). All lots were replicated and held in separate containers at the SUNY Flax Pond facility. Two *Vibrio* isolates produced significantly higher mortality than controls (*E. coli* inoculated or uninoculated).
Mortalities produced by other isolates were similar to controls. At present, we do not know if the pathogenic isolates are unique strains of known bacterial species or unique species altogether. Further taxonomic characterization is required. We are currently analyzing bacteria re-isolated from oysters in high-mortality groups in order to fulfill Koch's postulates.

About 2,000 juvenile oysters required for the investigation of chain- and colony-forming phytoplankton in juvenile oyster mortality were produced at the Nantucket Marine Lab in the Spring, 1994. Three laboratory incubation systems, each receiving filtered sea water, were constructed to reproduce summertime temperature regimes present on Nantucket Island during the 1989 juvenile oyster mortality episode.

Two hundred and fifty 10-mm seed were placed in each system and incubated at 20, 25, and 30°C for three weeks and fed unicellular cultures of *Tsochrysis* and *Skeletonema* at rate of 100,000 to 200,000 cell per ml per day. Survival was 100% and growth was 60% in all systems, demonstrating that during the study period under the experimental conditions, survival was independent of temperature.

Attempts by the Nantucket Marine Lab to culture long-chained or large colonial populations of algae collected from the field have failed. In all cases, when pure cultures have been initiated from the field collections, unicells resulted. No colonial forms or chains could be maintained in the laboratory.

**Suggested Future Work**

Final identification of *Vibrio* isolates and histopathological examination of experimentally inoculated oysters will be conducted at SUNY and Rutgers, respectively. On Nantucket, juvenile oysters have been placed in the field where chain-forming or colonial algae occur. They will be monitored over the remainder of the summer.

**Impacts**

One finding of the summer of 1993 field study was a reduction in mortality of juvenile oysters held in 1/4" mesh trays at the Frank M. Flower Co. Consequently, that company has begun to use larger mesh trays in its nursery operation. Although juvenile oyster mortalities have not occurred at that site in 1994, oysters in the larger mesh are growing somewhat faster than those in the smaller mesh.

**Publications**


PROJECT COMPLETION REPORT

Possible Cytotoxic Effects of the Dinoflagellate, *Gyrodinium aureolum*, on Juvenile Bivalve Molluscs

**Total Funding:** $2,489

**Period** July 1, 1993 to June 30, 1994

**Participants**
- Sandra E. Shumway (chair)
- Roxanna Smolowitz

**Southampton College**
- Univ. of PA/Laboratory of Marine Animal Health

**New York**
- Massachusetts

**Project Objectives**

- To determine the possible cytotoxic effects of exposure to *Gyrodinium aureolum* on juvenile, commercially important shellfish from the Gulf of Maine (surf clam, *Spisula solidissima*; blue mussel, *Mytilus edulis*; sea scallop, *Placopecten magellanicus*; softshell clam, *Mya arenaria*; eastern oyster, *Crassostrea virginica*; and European oyster, *Ostrea edulis*).

- To assess possible reversibility of any cellular damage.

**Progress And Principal Accomplishments**

Delineated the effects of a commonly occurring dinoflagellate, *Gyrodinium aureolum*, on juveniles of commercially important bivalve molluscs. The species were chosen because they are either cultured or fished commercially in Gulf of Maine waters. Only juveniles were used in the experiments as they were expected to be the most susceptible to any toxins present.

Confirmed lethal effect of this dinoflagellate on juvenile bay scallops, *Argopecten irradians*, and noted cytotoxic effects on digestive gland tissues. While the most devastating effects were noted in bay scallops, mortalities were also noted in surf clams, quahogs, and possible cellular damage was noted in mussels, sea scallops, and European oysters.

**Impacts**

Aquaculturists should monitor for the presence of *Gyrodinium aureolum*. Given the large size of this dinoflagellate (approximately 25-30mm), it could be easily be filtered out of the incoming water to hatcheries. No data are currently available on the effects of any toxins that might be present in the water during blooms of this dinoflagellate.

**Publications**


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*Northeastern Regional Aquaculture Center*
PROJECT COMPLETION REPORT

93-8  Analysis of Genetic Purity of Captive and Wild Striped Bass

Total Funding:  $15,955

Period  July 1, 1993 to June 30, 1994

Participants
Reginal M. Harrell (chair)  University of Maryland, Horn Point Environ. Lab  Maryland
L. Curry Woods, III  University of Maryland, Crane Aqua. Facilities  Maryland

Project Objectives
• To complete the purity screening of CAF broodstock

• To screen the 1993 broodstock fish associated with the NRAC Domestication of Striped Bass for Aquaculture project (92-2).

Progress And Principal Accomplishments
Genomic DNA was isolated from all family representatives or their parents of the Crane Domesticated Stocks, and a series of three single locus nDNA species diagnostic probes using Southern hybridization methodologies and four PCR-based assays. The molecular markers used in this study revealed, through agarose gel electrophoresis, different banding patterns for striped bass and white bass. Depending on the marker, one to five alleles were diagnostic for striped bass while white bass controls displayed one or two alleles. Based on the analyses of the molecular data, we found no evidence of introgressive hybridization present in the CAF founder stock or wild fish tested. Since we have not observed genetic linkage among any of the seven loci tested, results indicate that these white bass alleles are extremely rare, if present at all.

Suggested Future Work
Given the information that the Crane Domesticated Stocks and the fish collected from wild populations and used in the Domestication of Striped Bass project are genetically pure, the next phase of these studies would be to initiate selective breeding studies and continue domestication efforts with the progeny.

No further purity evaluation with these progeny or parents is recommended at this time. However, any stocks taken from the wild should be evaluated for purity if the fish are to be used in a domestication and selective breeding effort.

Publications

PROJECT COMPLETION REPORT

93-9
A Proposal for the Study of a Protozoan Disease Agent(s) Associated with Mortalities of Hatchery-reared Juvenile Oysters in the Northeastern United States

Total Funding: $10,000
Period: July 1, 1993 to June 30, 1994

Participants
Frederick G. Kern (chair) USDA/NOAA/NMFS Maryland
C. Austin Farley USDA/NOAA/NMFS Maryland
Earl J. Lewis, Jr. USDA/NOAA/NMFS Maryland
Dorothy Howard USDA/NOAA/NMFS Maryland
Dr. Harry Danforth USDA Maryland
Dr. Eugene Small University of Maryland Maryland
Dr. Ana Baya Maryland Department of Agriculture Maryland
Phillip Rudledge University of Maryland Maryland
Don Meritt University of Maryland Horn Point Lab Maryland
David Relyea F.M. Flower & Sons, Inc. New York
Joseph Zahitila F.M. Flower & Sons, Inc. New York
Gregg Rivara Cornell University New York
Stan Czyzycz Bluepoints Co. New York

Project Objectives

• To provide a continuous source of infectious disease agent for future identification.

• To study the role of salinity in the disease process to determine if salinity may be a barrier to the disease agent.

• To explore potential therapeutic and continue pathological studies of juvenile oyster mortalities concentrating on epizootiology, pathology, and parasitology.

• To continue the identification of the suspected protistan pathogen by use of electron microscopy to discern parasite-specific ultrastructural characteristics.

• To demonstrate etiologic relationships with known features of the disease - age, size, conchoelin deposition.

• To continue transmission studies to prophylactic use of selected ciliate and bacterial medications to eliminate the disease.

Progress And Principal Accomplishments

Six sequential weekly samples of F.M. Flower and Sons Co. cultured juvenile oysters were examined for juvenile oyster disease (JOD) from June 15 - July 29, 1993. Progression of parasite prevalence and intensity, and gross and microscopic pathology were documented and correlated with subsequent mortalities. No significant presence of JOD was seen in naturally set oysters. Indications of JOD were not found in Flower's cultured clams, *Mya arenaria* or *Mercenaria mercenaria*. Data suggest that resistance to JOD may be developing in Flower's oysters. Some samples provided evidence that 1-mm seed may spread JOD to new growing areas once introduced.

Ultrastructural studies revealed rare intracellular bodies, resembling protists, in mantle epithelia of JOD-infected oysters. These presumed protists had mitochondria with tubular cristae, small dense bodies, and vesicals. One organism showed evidence of a pellicle and endogenous budding.

Attempts to isolate candidate ciliate organisms from infected oysters resulted in the isolation of over 25 species, many identified to genus by Dr. Eugene Small. An unidentified spirochaete has been repeatedly isolated from JOD-infected juveniles, but not from uninfected oysters.

Clear correlations between intracellular inclusions (which we consider to be a protist), mantle lesions, conchoelin, mortality, and shell checks in survivors have been noted. Mortality correlates with both size and age in populations affected by the disease. Evidence was found of healed conchoelin lesions in larger, dead oysters (80-110 mm).

Due to the lack of available uninfected juvenile oysters for transmission studies, only one
transmission study was accomplished. Alternative methods using naturally infected seed from the Flower's hatchery were used for substitute experimental salinity studies.

Uninfected, cultured juveniles from the University of Maryland Horn Point Laboratory were exposed to survivors of the 1992 JOD epizootic for 6 weeks at salinities of 10-26 ppt. Disease onset was delayed and subsequent mortalities were reduced at salinities below 20 ppt. JOD-infected oysters were also subjected to 6-week salinity exposures of 10-30 ppt salinity. Mortalities likewise were reduced in salinities below 18 ppt.

Of 5 therapeutic agents tested, only erythromycin was effective in reducing mortality in infected animals. Minocycline, recommended by the manufacturer for treatment of gram-negative bacterial infections such as Vibrio, had no effect. Four species of Vibrio were isolated from 8 of 18 JOD-infected animals. No evidence of an etiological relation was apparent.

Anticipated Benefits

- Possible identification and clarification of the role the suspected causative agent plays in the mortalities of hatchery-reared juvenile oysters.

- Association of the above organism with the disease syndrome.

- The identification of management approaches based on acquired knowledge of the pathogen and its requirements.

Impacts

Reduction in JOD-associated mortalities of 1993 hatchery-reared seed has resulted from applying management techniques at the Flowers hatchery that were developed from field and laboratory studies [e.g. suggestions to spawn earlier to reach 30mm or larger size before the onset of the disease; use survivors of the previous years' epizootic (ones with severe growth checks) as brood stocks.]

Publications


PROJECT COMPLETION REPORT

93-12 Aquaculture and the Marine Environment: The Shaping of Public Policy

Total Funding: $10,000

Period: August 12, 1993 to March 12, 1994

Participants

- Dr. Harlyn O. Halvorson (chair) Policy Center for Marine Biosciences & Tech. Massachusetts
- Dr. Hans Kornberg Christ College Cambridge, England
- Dr. Alex Keynan Hebrew University Jerusalem, Israel
- Mr. Eric Anderson University of Massachusetts Dartmouth Massachusetts

Project Objectives

- To conduct a workshop to address relevant issues in waste management and release of cultured organisms.
- To prepare proceedings of the workshop for different audiences.
- To carry out an educational and implementation program that reaches the appropriate people as an extension component of the workshop.
- To recommend policy changes.

Progress And Principal Accomplishments

The main objectives of the initial proposal have been met. PCMBT has been formed, a broadly-based Steering Committee selected, and with their help the mission of PCMBT was defined. A brochure describing the goals and activities of the Center has been prepared by Eric Anderson. The workshop on “Aquaculture and the Marine Environment: the Shaping of Public Policy” was held last August/September and a final report prepared and distributed.

The differences we have encountered since the original proposal have been to more sharply define the nature of the next workshop. Identifying the primary causes of failure of aquaculture in the U.S. has helped to focus more clearly areas in which PCMBT can play a more active role. For example, state and local regulations and permitting requirements are disincentives to aquaculture. Ways are being sought in which PCMBT can be a mediator in discussions between all the interested parties.

Mr. Eric Anderson prepared a report from the notes, documents, and tapes of the workshop. After review by staff of PCMBT, the early drafts were reviewed by the Steering Committee on September 21, 1993 and the final draft on November 9, 1993. Final approval was received at two Steering Committee meetings (November 17, 1993 in Washington, DC and November 19, 1993 at Kennedy School of Government, Harvard University. This report has been widely distributed, including to members and staff of the House of Representatives Committee on Merchant Marine and Fisheries who are considering legislation, to OTA, and to relevant Federal and State Agencies.

Numerous discussions have been made with individual members of the Steering Committee to focus planning for the next workshop.

Dr. Halvorson attended the World Aquaculture Meeting in New Orleans in January and the Coastal Science Session at the Cape Cod Community College “Aquaculture on Cape Cod: Economic Opportunities and Legal Constraints” on March 4th where there were opportunities to discuss the recommendations of the workshop. He attended a preplanning meeting for the International Marine Biotechnology Conference in Naples, Italy in February, 1994 for which PCMBT is a sponsor. This meeting took place in Tromsø, Norway in August, 1994. PCMBT organized a second version of “Aquaculture and the Marine Environment: the Shaping of Public Policy” at this meeting.

Dr. Halvorson served on the OTA “Offshore Aquaculture Committee” and reviewed the OTA draft report, “Aquaculture Food and Renewable Resources from U.S. Waters - International Examples of Success and Failure and their lessons for the U.S.”. PCMBT received a grant from OTA for a study on Aquaculture to be conducted by Dr. Rollin Johnson.

Anticipated Benefits

As noted in the final report, the conference Aquaculture and the Marine Environment: The
Shaping of Public Policy was sponsored by a number of organizations knowledgeable about and interested in marine aquaculture. Participants represented government, academia, industry, research institutes, and public interest organizations.

This conference was designed to explore public perceptions about marine aquaculture, assemble relevant facts and realities surrounding these perceptions, and explore the economic impacts being achieved or lost as a result of these perceptions and regulations. Two major themes of the workshop were considered to be of public concern. The first was waste management (including water quality) and the second were interactions of aquatic stocks with native populations, which included risks as well as the impacts of released animals. These topics were examined from various perspectives in order to create a comprehensive overview that will aid lawmakers in formulating fair regulations that are sensitive to environmental, economic, and social issues. It was made clear that current regulations are a severe hindrance to further aquaculture development, and that this issue must be addressed if the United States is going to reap the benefits of a strong, internationally competitive aquaculture industry. The topic is timely since Congress will be considering new legislation regarding aquaculture this year and in the next decade.

The Policy Center for Marine Biosciences and Technology (PCMBT) has developed numerous contacts with people in the aquaculture industry and with organizations representing the industry. Their newsletters have covered our workshop and we are now getting requests for help and inquiries from members of the aquaculture industry community. I expect this trend to continue.

One unexpected bonus, in part due to analysis of the causes of failures in aquaculture, was the planning for a short course to help corporate executives in the biotechnology industry enhance their knowledge and the skill base for decision making in biotechnology. This plan has grown out of cooperative planning with faculty and administration members at the University of Massachusetts Dartmouth, the Biotechnology Center for Excellence Corporation, the Southeastern Massachusetts Partnership and PCMBT. This course illustrates the ability of PCMBT to leverage support from other organizations.

Suggested Future Work

Two main problems were identified from the workshop of the previous year:

1. Economic—the inability of aquaculturists to prepare a business plan and to analyze market possibilities. Aquaculture should be treated as part of biotechnology; as such it should emphasize job-creating possibilities or else downstream processing of products from it.

2. Regulations at both the state and local levels. Federal and state regulators are very poorly informed about aquaculture. A New England Aquaculture Authority is needed as this industry transcends state boundaries. Aquaculture needs to be placed on the agenda of the governors meetings. An education program is needed for regulators.

As a result of this activity, we recommend that another workshop be convened. The focus of this workshop should be: How can sustainable non-polluting aquaculture ventures be achieved in the New England region?

This workshop should:
• define the information needed.
• identify the available sources
• discuss how such information could be assembled in the most useful form.

An agenda for this workshop has been proposed. This agenda is based on interviews with various persons who are trying to promote aquaculture in this region who have been in contact with potential entrepreneurs. There is a general consensus that the technical questions, which have to be considered by potential applicants of aquaculture, are only part of the problem. Critical to the initiation of a project and its successful outcome are detailed considerations of:

• its economic feasibility
• the requirements of the various regulatory agencies, which differ between and within states.

A list of potential participants in such a workshop who could help define the outline of an information book, has been developed as well as experts who could supply the necessary information and advice on the best approach to reach the desired audience.

The information book should be about 100-200 pages, and written in easily understandable language. It must be emphasized that this is not a text book to teach people about aquaculture. It is intended to be a means of directing interested people.
to the information necessary to initiate a marine Aquaculture project. The sources of information may be publications, data bases, reports, and academic consulting institutions. This book should inform the reader on the problems they may have to confront and where the information can be found to address them.
V. PROJECT PROGRESS REPORTS
PROJECT PROGRESS REPORT

90-6 Commercial Field Trials of MSX-Resistant Strains of the American Oyster (Crassostrea virginica)

Total Funding: $194,941
Period: March 21, 1990 to March 20, 1995

Participants

<table>
<thead>
<tr>
<th>Name</th>
<th>Company/Institution</th>
<th>Location</th>
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<tbody>
<tr>
<td>William Barnish</td>
<td>William Barnish Shellfish</td>
<td>New Jersey</td>
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<tr>
<td>Richard Drew</td>
<td>Yarmouth Oyster Farms</td>
<td>Massachusetts</td>
</tr>
<tr>
<td>Gef Flimlin</td>
<td>Rutgers University</td>
<td>New Jersey</td>
</tr>
<tr>
<td>Susan E. Ford (chair)</td>
<td>Rutgers University</td>
<td>New Jersey</td>
</tr>
<tr>
<td>Joel Fox</td>
<td>Joel Fox Shellfish</td>
<td>Massachusetts</td>
</tr>
<tr>
<td>Harold H. Haskin</td>
<td>Rutgers University</td>
<td>New Jersey</td>
</tr>
<tr>
<td>Richard Kraus</td>
<td>Aquacultural Research Corporation</td>
<td>Massachusetts</td>
</tr>
<tr>
<td>Mark Luckenbach</td>
<td>Virginia Institute of Marine Science</td>
<td>Virginia</td>
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<tr>
<td>George Mathis</td>
<td>Mathis and Mathis, Ltd.</td>
<td>New Jersey</td>
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<tr>
<td>Don Merritt</td>
<td>University of Maryland</td>
<td>Maryland</td>
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<tr>
<td>William Mook</td>
<td>Mook SeaFarms</td>
<td>Maine</td>
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<tr>
<td>Michael Naughton</td>
<td>Yarmouth Oyster Farms</td>
<td>Massachusetts</td>
</tr>
<tr>
<td>Richard Nelson</td>
<td>Cotuit Oyster Company</td>
<td>Virginia</td>
</tr>
<tr>
<td>Chip Petre</td>
<td>Intertidal Marine Aquaculture</td>
<td>Massachusetts</td>
</tr>
<tr>
<td>Irving Puffer</td>
<td>Wellfleet Oyster and Clam Co.</td>
<td>New York</td>
</tr>
<tr>
<td>H. Karl Rask</td>
<td>University of Massachusetts</td>
<td>New York</td>
</tr>
<tr>
<td>David Relyea</td>
<td>F.M. Flower and Sons, Oysters</td>
<td>Maryland</td>
</tr>
<tr>
<td>Gregg Rivara</td>
<td>Cornell University</td>
<td>Massachusetts</td>
</tr>
<tr>
<td>Sam Shriver</td>
<td>World’s End Aquaculture</td>
<td>Massachusetts</td>
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<tr>
<td>Robert Wallace</td>
<td>Billingsgate Shellfish</td>
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Project Objectives

• To compare survival, growth, market value, and MSX incidence in MSX-resistant strains and local controls, using commercial quantities and commercial methods.

• To evaluate performance of the MSX-resistant strains in different parts of the region, under different growing conditions.

• To make results available to industry, Extension Agents, and other investigators.

Progress And Principal Accomplishments

This project was designed to produce and test three consecutive year-classes of MSX-disease resistant and control oysters, each over three years. In the first year (1990), juvenile oysters were produced in commercial hatcheries in Massachusetts and New York. In the spring, nine growers in Massachusetts, New York, and New Jersey each received and deployed at least 50,000 MSX-resistant (Rutgers University selected strain) and 50,000 control seed (Wellfleet Harbor, MA or Oyster Bay, NY stocks). Later in the summer, a grower in Maryland and one in Virginia each received and deployed a similar number of seed, which had been spawned later but from the same broodstocks. The later deployment in Maryland and Virginia was intended to avoid a major early summer infection period of another oyster disease agent, Perkinsus marinus, the cause of Dermo disease.

In Massachusetts, New York, and New Jersey, survival and growth were poor, especially in the MSX-resistant stocks. Shortly after they were placed in the field, the young oysters displayed many of the symptoms of Juvenile Oyster Disease - shell cupping and anomalous concholin rings deposited on the inner sides of shells. Juvenile Oyster Disease, first described in 1988, had begun to adversely affect growers in many Northeastern locations. Because overall performance of the 1990 year class was so poor, continued maintenance of the stocks was deemed commercially impractical and monitoring was terminated in 1991. Histological analysis during the trial indicated that
MSX-disease pressure was almost completely absent during this period.

In Maryland and Virginia, growth and survival of both 1990-year class MSX-resistant and control groups was equal and good for the first year. By the second year, *Perkinsus marinus* infections had become prevalent and intense in most oysters in both stocks and heavy mortalities ensued. The tests were terminated in 1992 and it was decided to eliminate these two locations from future tests because of the high *P. marinus* levels.

In the second year (1991), heavy mortalities in the Massachusetts hatchery affected both stocks; consequently, no seed was available for distribution. This mortality episode was not caused by MSX or Dermo diseases, but may have been related to Juvenile Oyster Disease. The New York hatchery, which produced seed for its own growout only, was also experiencing high losses due to Juvenile Oyster Disease and decided to withdraw from the project.

Because of the Massachusetts hatchery problems in 1991, it was decided to utilize two New England hatcheries in the third year (1992) and to produce a double quantity of seed. This strategy was successful; high losses occurred again in Massachusetts, but a hatchery in Maine was able to provide commercial quantities of resistant (Rutgers University selected strain) and control (Wellfleet, MA wild stock) seed to growers in Massachusetts and New Jersey. The 1992 year class has been monitored at several sites in these two states for three growing seasons.

MSX-disease pressure has been almost non-existent in the study areas and test results have been mixed. At some locations, the resistant stock has outperformed the control; at others, the reverse has been true. However, differences have been relatively small and on average, survival and growth of both groups has been commercially acceptable.

A small-scale comparison of the two 1992 groups, with rigorous sampling, has been conducted in Delaware Bay, NJ, at the Rutgers University Cape Shore Laboratory. During the study period, MSX-disease was rare at this location but Dermo disease was heavy. Although the MSX-resistant stocks grew more slowly and had higher early mortalities than the control stock, they showed much better survival than the control oysters during the second two growing seasons, after Dermo disease had become a factor. Pathology revealed that prevalence and intensity of Dermo disease was much lower in the MSX-resistant stocks.

Dissemination of the results has been on a casual basis. All sampling has been done by extension agents working with the growers themselves. Information has been circulated by agents and growers in direct one-to-one contacts or by talking among themselves at state aquaculture meetings and at regional meetings such as the annual Milford Aquaculture Seminar.

**Anticipated Benefits**

MSX-disease, caused by a protozoan, *Haplosporidium nelsoni*, has been a recurrent problem for oyster growers in the northeastern U.S. Documentation of the performance of MSX-resistant seed under a variety of commercial-scale culture conditions and in different environments will permit growers to make rational decisions about its value relative to unselected seed.

**Work Planned**

The fall sampling in 1994, when most groups should be near marketing size, is anticipated to be the last one. Final sample workup and data analysis will be done in late 1994 and early 1995.

**Impacts**

Results of the study have enabled oyster growers in the Northeast to see first-hand and under their own growing conditions, how seed from a selected strain compares to that from wild parents. Of at least equal importance, the study has demonstrated that a number of problems, including hatchery and growout operations, and Juvenile Oyster Disease, need to be solved before oyster strains selected for adult performance (e.g., MSX-disease resistance) become commercially attractive.
PROJECT PROGRESS REPORT

92-1 Alternative Marketing Options to Improve Profitability of the Northeast Aquaculture Industry

Total Funding: $200,000

Period: May 1, 1992 to August 31, 1994

Participants

James Anderson
Hsia-Lai Cheng
Ken Gail
Robert Gempesaw
Catherine Halbrecht
Gregory Hanson (chair)
Nona Henderson
Robert Hermann
Bruce Lindsay
Alberto Manalo
Linda O'Diemo
Brad Powers
Cathy Wesells
James Wilson

University of Rhode Island
University of Maine
New York Sea Grant
University of Delaware
University of Delaware
Pennsylvania State University
Rutgers University
Pennsylvania State University
University of New Hampshire
University of New Hampshire
New Jersey Department of Agriculture
Maryland Department of Agriculture
University of Rhode Island
University of Maine

Rhode Island
Maine
New York
Delaware
Delaware
Pennsylvania
New Jersey
Pennsylvania
New Hampshire
New Hampshire
New Jersey
Maryland
Rhode Island
Maine

Project Objectives

• To identify consumer seafood buyer preferences on product attributes, value-added products and seafood safety concerns affecting purchase decisions of Northeastern aquaculture products.

• To reduce institutional marketing constraints and to promote niche and value-added marketing opportunities for Northeast aquaculture products.

Progress And Principal Accomplishments

Cooperators at Pennsylvania State analyzed marketing data provided by the Southern Regional Aquaculture Center (SRAC) for the northeast and other regions. Cluster analysis focused on consumer profiles categorized as Totally Favorable, Favorable but Expensive, Favorable but Dislike Odor or Boniness, Moderately Favorable, and Not Favorable. The two most favorable profiles were uniquely differentiated by their view of the expensiveness of fish. Four of the five profiles found fish to be relatively expensive compared to other meats. A second study analyzed frequency of purchases for at-home and restaurant consumption. Results suggested that value-added seafood products that are easy to prepare, without bones, flavorful and nutritious could be highly successful in segments of the northeastern U.S. market. A third study indicated that efforts to increase aquaculture and seafood purchases in restaurants could target high income, white, well-educated consumers in families with few children present.

A market analysis of aquacultured products in the Greater New York/New Jersey marketplace and an assessment of the opportunities for value-added products was conducted by researchers at the New Jersey Department of Agriculture and the New York Sea Grant Extension Program. Quantitative and qualitative market data were developed to provide a profile of major aquaculture market segments including food service operators, restaurateurs, retailers, and consumers. These profiles will facilitate development of effective marketing and merchandising strategies to better position aquacultured products in the marketplace. Another focus was to identify value-added products which generate greater returns to the individual aquaculturist. An added benefit of further processing is the development of new products such as fish cakes and chowders from by-products of the primary processing operation. Three separate surveys were conducted: consumers; retail operators; and food service operators. Several focus groups were also convened to aid the process of understanding the survey results. The final report will be available in early November, 1994.

A multivariate market research technique that sorts out the relative importance of a product’s individual attributes was used by researchers at the University of Delaware, the University of New Hampshire, and the University of Maine to analyze the purchase preferences of mid-Atlantic seafood buyers when purchasing tilapia, catfish, salmon, rainbow trout, and hybrid striped bass. The results from the analysis will provide information to producers to
aid them in the design of products that match purchase preferences of seafood buyers. A survey was developed to elicit preference ratings for each of the key attributes for each type of fish. A 65% response rate was received on surveys sent out to 86 finfish retailers. Personal interviews were used to collect data from retailers in Maryland, Delaware, Pennsylvania, New Jersey, and New York. The highest rating for salmon was for a product profile consisting of $2.99 per lb., 8 lb. size and 1-day delivery; the lowest rating was for $4.75 per lb. and 3-day delivery. For tilapia, the highest rating was for product profile consisting of $2.99 per lb., 2 lb. size, and 1-day delivery. Results of the study indicate that freshness of the fish is essential to acceptance by retailers. This fact gives the producers in the Mid-Atlantic region an advantage since most producers are near to the consumer markets they serve. Fish buyer perceptions of farm-raised versus harvested wild catch will be evaluated with respect to hybrid striped bass.

Consumer preferences for consumption of Northeastern aquaculture seafood products was analyzed by researchers at the University of Rhode Island, the University of Delaware, and the University of New Hampshire. Surveys were conducted separately for finfish and shellfish. The finfish survey contains questions for salmon, trout, tilapia, and hybrid striped bass. The shellfish survey addressed consumer perceptions and purchasing behavior for mussels, clams, and oysters. Fresh product targeted in the questions including breaded, canned, and product otherwise used for home preparation. Mail questionnaires were sent to 5000 households for each survey. Mailings were based on each state’s share of the total population for the Northeast region. Each survey generated a 30% response rate, with 1,533 returned shellfish surveys and 1,529 returned finfish surveys. Fully 97% of the respondents consume seafood as often as every week. The primary reasons to purchase seafood were taste and adding variety to their diets.

Particular note is given to the high numbers of seafood consumers who purchase fresh seafood for home consumption but who are not familiar with several of the species indicated in the surveys. While salmon and clams are frequently consumed at home, trout, tilapia, hybrid striped bass, and mussel producers could benefit from increased visibility of their products in supermarkets and seafood markets. Sixty percent of the respondents are unaware of aquacultured products. However, half of those surveyed consider farm-raised products to be safer than wild-harvested products. Half of the respondents also think that aquacultured products are of higher quality, are grown in cleaner water, and handled better than wild-caught seafood products. These factors signify a distinct opportunity for aquaculture producers to build upon these favorable perceptions to enhance market growth. The need to address safety concerns of consumers was found to be more urgent in the case of shellfish. In fact, relative to all other types of food, shellfish is considered by survey respondents to have the highest potential to cause illness. Both traditional and aquaculture fishing industries can attempt to reverse this situation by producing high quality shellfish and communicating that quality to the consumers. The best method of communicating quality is unclear. Positive stories in the media regarding seafood safety impacted only 2% of the respondents. However, “farm-raised” was found to have a positive influence on respondents’ preferences for the product, as did information regarding product inspections. Overall, the data gathered in these surveys is the most thorough analysis of seafood consumption behavior in the Northeast.

Anticipated Benefits

The results of this project will assist the aquaculture industry in the Northeast to develop marketing and processing strategies to better enable regional seafood and aquaculture firms to remain competitive in the U.S. seafood industry. The research will provide insights into consumer purchase decisions, assess consumer perceptions of seafood safety and quality, and provide critical insights into the marketing process that fosters growth of industry sales in the Northeast.

Work Planned

Analysis of data from several consumer and retailer surveys will be completed during the remainder of the project and reports and articles prepared for publication.

Publications


PROJECT PROGRESS REPORT

92-2 Domestication of Striped Bass for Aquaculture

Total Funding: $87,859

Period May 8, 1992 to August 31, 1994

Participants
Bernard Petrosky (chair) Delaware State College Delaware
William. Bason Delmarva Aquatics Delaware
Joseph Buttner SUNY Brockport New York
John Foltz Aquafarm Products, Inc. Delaware
Reginal M. Harrell University of Maryland Maryland
Scott Lindell Aquafuture, Inc. Massachusetts
Steven VanGorder Fresh Culture Systems Inc. Pennsylvania
Donald Webster University of Maryland Maryland
L. Curry Woods University of Maryland Maryland
Yonathan Zohar University of Maryland Maryland

Project Objectives

- To develop techniques to effectively capture, hold, and spawn wild striped bass and raise their progeny and existing captive stocks to reproductive maturity under various commercial production scenarios.

- To develop reliable techniques, including the use of critical temperature and photoperiod cycles, for inducing spawning of striped bass and hybrids on a year round basis.

- To transfer information and technology to the striped bass cultivation industry.

Anticipated Benefits

This project will benefit the industry by aiding in the development of captive striped bass brood stocks, which are a desirable facet of any aquaculture industry. In addition, the results of this project will provide further information regarding handling, maintaining, and spawning these fish, much of it acquired in a commercial aquaculture milieu. The ability to manipulate spawning has obvious benefits for year-round fry production. In addition to the formal technology transfer, the participants will also become a resource through their training and hands-on experience during this project.

Progress And Principal Accomplishments

Within Objective 1, nine progeny groups from nine spawns with different parentage were produced. Several groups came from each of three spawning facilities (Crane Aquaculture Facility (CAF) (4), Horn Point Environmental Lab (HPEL) (2), and Delmarva Aquatics (DA) (3)). Thirty-day larval proofing was conducted at CAF and HPEL. Larvae were also stocked in ponds at Delaware State University (DSU) and HPEL. Excess fish were transported to Aquafuture, Inc., (AFI) where fish from last year’s production are also being held. Additional fish may be moved to other locations for growout, ultimately to broodstock size.

Work on Objective 2, at the Center of Marine Biotechnology (COMB), has demonstrated that after one year of exposure to manipulated photoperiod and temperature regimes, development of striped bass gonads was phase-shifted by approximately two months in each group, producing fish ready to spawn at two month intervals, from January through May. It is estimated that another year of exposure to the manipulated environmental regimes will be necessary to obtain a complete phase-shifting of gametogenesis and the establishment of spawning groups at 4-month intervals throughout the year. Even though, in all groups, females treated with GnRH implants responded by undergoing final oocyte maturation and ovulation, very few fertilized eggs were collected. Since egg collection was equally unsuccessful in the control and the delayed groups, we attribute it to either inefficient egg collection through our egg collectors or to low salinity that resulted in excess hydration and a collapse of the spawned eggs.

In Objective 3, the striped bass producer survey of desired traits has been initiated through the Striped Bass Growers Association and should be ready by Fall, 1994.
Work Planned

This project is in its final year. The participants will be continuing activities to which they are committed during the project extension period into Fall 1994. Specifically, in Objective 1, growout will continue; in Objective 2, monitoring of gametogenesis will continue and salinity and egg collection techniques will be modified; and in Objective 3, results of the grower survey and any other information developed by the project will be prepared and disseminated.

Impacts

The primary impact at this stage of the work is the development of stocks of potential brood fish in captivity and the demonstrated success of shifting gonadal development. By the time the project terminates and work under way is completed, there should be additional information relating to the anticipated benefits of this project.
PROJECT PROGRESS REPORT


Total Funding: $198,698

Period April 6, 1992 to August 31, 1994

Participants
Carter Newell (chair) Great Eastern Mussel Farms, Inc. Maine
Kennedy T. Paynter University of Maryland Maryland
Roxanna M. Smolowitz Woods Hole Oceanographic Institute Massachusetts
Donald W. Merit University of Maryland Maryland
Scott M. Gallager Woods Hole Oceanographic Institute Massachusetts
Dennis T. Walsh Aquacultural Research Corp. Massachusetts
Gary H. Wikfors National Marine Fisheries Service Connecticut

Project Objectives

- To characterize the normal microscopic anatomy of Crassostrea virginica from fertilization through metamorphosis to early juvenile (about 30 days post-set).

- To document normal larval development and feeding activity through metamorphosis with non-invasive, time-lapse video technology.

- To characterize physiological rate processes in normal and stressed organisms using both real-time and post-sampling techniques.

- To document changes in major catabolic energy substrates (protein, lipid, and carbohydrate) throughout development and under conditions of nutritional stress.

Progress And Principal Accomplishments

It has long been known that metamorphosis is an especially stressful stage of the bivalve life cycle. This fact is exemplified by the large mortalities which typically occur in most bivalve hatcheries. Commercial hatcheries that are considered most successful in oyster production, for instance, claim only one-third to one-half of the eyed larvae they produce survive through metamorphosis. Other, less successful hatcheries state that fewer than 5% typically survive. At the time this research project was proposed, the reasons for the disparity in survival between hatcheries was unclear.

The work group process generated a proposal to examine larval development at a hatchery scale on several different levels. Our original suspicion was that the failure of larvae to survive through metamorphosis was caused by nutritional problems. However, we could not rule out site specific bacterial and viral problems. Therefore, a three-pronged research effort was proposed which would investigate feeding behavior, nutritional status, and histological/pathological condition of oyster larvae raised at two different hatcheries: The Aquacultural Research Corporation hatchery which typically experienced 30 to 40% survival of eyed larvae through metamorphosis and the University of Maryland Horn Point hatchery which typically experienced less than 5% survival of eyed larvae. Furthermore, in order to differentiate among the various possible influences between the hatcheries, broodstock and larvae were transferred between the two hatcheries to create a balanced, nested experimental design which would separate the influences of broodstock, spawning site, culture site, and metamorphic site on oyster larvae.

Larvae were generated from broodstocks at both hatcheries which were representative of each hatchery, producing northern (N) and southern (S) strains. Subsets representing these strains were transferred between hatcheries four days after fertilization and in late pediveliger stage. Metamorphic survival was determined as the percent of eyed larvae that were counted as spat 40 days post-fertilization.

The nutritional studies showed that metamorphic survival was most closely associated with culture site and secondarily associated with broodstock origin. Total protein, lipid, or carbohydrate composition was not correlated with metamorphic survival; however, triglyceride content of eyed larvae was positively associated with metamorphic success. Histopathological examination of larvae showed gross morphological differences between groups with higher metamorphic survival and groups that experienced little or no survival through metamorphosis. Organ development in the
high mortality groups was poor, epithelial and connective tissues were underdeveloped, and the general appearance of those groups was consistent with starvation or malnourishment. Feeding studies have shown that fed and starved larvae behave differently with respect to their digestive physiological. Well-fed larvae retain pigment in their gut much longer than starved animals. Starvation stress may have longer term effects than previously thought. The feeding studies also indicated that transportation may have a significant effect on larval development.

The most important finding was that nutritional stress has significant and severe consequences on larvae that may not be reflected in larval growth rates or noticeable in casual, low-power inspection of the larvae. Larvae of similar size exhibited significantly different mortality rates at metamorphosis and the mortality appeared to be positively correlated with the triglyceride content of the larval groups.

**Anticipated Benefits**

The findings produced by this study will be valuable in a variety of ways. First and foremost, commercial hatcheries involved in *C. virginica* production will have valuable information regarding the quality of their larvae and will hopefully be able to improve production by increasing the quality of their feeding regimens. This study shows what many commercial establishments have already determined - that feed quality is very important to seed production - but quantifies certain requirements in such a way that larval failure may be predictable based on their triglyceride contents. This knowledge may allow hatchery mangers to "rescue" nutritionally depaupered larvae and turn a poor set into a good one.

**Work Planned**

1) Conduct additional measurements on larvae collected from various hatcheries in NE to determine whether or not the triglyceride/setting efficiency relationship is supported across larval groups from several hatchery sources and whether it can be used as a predictor of poor larval survival during metamorphosis.

2) Publish a technical report for industry application of knowledge.

**Publications**

PROJECT PROGRESS REPORT

93-3 Development of a Northeast Regional Aquaculture Extension Network

Total Funding: $150,000

Period: July 15, 1993 to August 31, 1994

Participants

- John Ewart (chair)
- Chris Bartlett
- Gef Filmin
- Michael Opitz
- Karl Rask
- Michael Timmons
- Donald Webster
- Nancy Balcom
- Roland Barnaby
- Roy Bergstrom
- Richard Bohn
- Max Chambers
- Regional Harrell
- Thomas Handwerker
- Michael Hastings
- William Lussier
- Michael Rice
- Greg Rivara
- Daniel Teruzzi
- Agnes Vanderpool Spicer

Each of these participants is associated with a university or cooperative extension program in their respective state:
- University of Delaware Sea Grant Advisory (Delaware)
- Maine Aquaculture Innovation Center (Maine)
- Rutgers University Sea Grant Advisory (New Jersey)
- University of Maine Cooperative Ext. (Maine)
- University of Massachusetts Cooperative Ext. (Massachusetts)
- Cornell University Cooperative Ext. (New York)
- University of Maryland Cooperative Ext. (Maryland)
- University of Connecticut Sea Grant Advisory (Connecticut)
- University of New Hampshire (New Hampshire)
- University of Rhode Island (Rhode Island)
- University of Maryland Cooperative Ext. (Maryland)
- Maryland Aquaculture Association (Maryland)
- University of Maryland Cooperative Ext. (Maryland)
- University of Maryland Eastern Shore (Maryland)
- Maine Aquaculture Innovation Center (Maine)
- University of Delaware (Delaware)
- University of Rhode Island (Rhode Island)
- Cornell University Cooperative Extension (New York)
- University of Maryland Cooperative Ext. (Maryland)
- West Virginia University (West Virginia)

Project Objectives

- To develop educational programs on priority topics identified by industry.
- To improve the technical expertise and function of the regional extension network.

Progress and Principal Accomplishments

Industry Summit

REP participants assisted Ken Bergstrom, Industry Chair of the Technical/Industry Advisory Committee (TIAC), to organize the agenda and site arrangements for a biennial NRAC Industry Summit held at the Sheraton Airport Hotel in Providence, Rhode Island on February 5-6, 1994. The summit agenda addressed various topics, including review and revision of research priorities, communication/interaction among state associations, the desired role and current status of extension programs in the region, discussion of other state association concerns, and fish health regulations (see below). Minutes of the meeting were distributed to all state aquaculture associations, and research priorities established by industry at the summit were used by the TIAC to develop NRAC's 1994 Request for Proposals.

Fish Health Regulations Conference

The Fish Health Regulations Workshop originally scheduled for January 28, 1994 at the Sheraton Airport Hotel in Providence, Rhode Island was postponed due to a winter storm. Since representatives from the state aquaculture associations were scheduled to attend the industry summit, a discussion of regional fish health regulatory policies was added to the summit agenda. The current status and activities of state programs and the New England Salmonid Health Commission were reviewed. A draft resolution on industry fish health policy recommendations that were completed by a national ad-hoc committee at the Fish Farming Expo/WAS meeting in New Orleans, January 12-17th was introduced and discussed for endorsement and use by the northeastern state aquaculture associations to effect revisions to current policies.

Fish Health/Stress Management Workshop

The second New England Fish Health Workshop, organized by REP participants and industry representatives, was held on April 22, 1994 in Eastport, Maine. The workshop was attended by 71 persons associated with trout and salmon farming, primarily from New England and the Canadian...
The main theme of the workshop was criteria for reevaluating fish health regulations. Risk assessment methods were presented and specific examples of risk assessment and disease control were presented from speakers from veterinary colleges in Canada, the northeastern industry, USDA, FDA, the biologics industry, and the University of Maine. The workshop was well received. A limited number of copies of a proceedings containing abstracts of meeting presentations were prepared and a second, larger printing is being considered for regional distribution.

Other Conferences, Workshops and Regional Industry Meetings

The Milford Aquaculture Seminar solicited the REP for partial support for its 14th annual meeting. A request for full funding by NRAC as a special project was not supported by the TIAC because cooperative funding support from the National Marine Fisheries Service (NMFS) was not included in the proposal and some of the requested budget items were considered inappropriate. Following a NMFS commitment to provide funding for 1994 and full support for the next annual meeting, a proposal of partial funds for meeting programs and related items was submitted to the REP for consideration. Because the revised proposal addressed the original TIAC objections, the REP Review Committee responsible for allocating ad hoc funds for conferences, workshops and regional industry meetings provided partial support of $1,500.00. The Milford meeting has served as the primary venue for the region for members of the shellfish industry to meet and exchange information with researchers and extension agents.

Mobile Educational Programs

A letter was sent to presidents of all state aquaculture associations in the region offering REP assistance in developing and providing educational seminars and workshops in their states. The purpose is to provide information on subjects or issues of importance that is otherwise unavailable for lack of local expertise, funding, or other reasons. Subjects identified by industry in the regional extension survey are also being used to develop program topics. Follow-up phone calls are being made to association presidents to answer questions and discuss potential programs and dates. Background information on the educational programs and their availability for state association meetings was also provided at the industry summit. In response to a request from the Ocean State Aquaculture Association (Rhode Island), arrangements have been made to send extension specialists from Maryland to Rhode Island early this summer to put on a workshop and hands-on demonstration on remote setting of oysters. Other requests from state associations are anticipated.

Biosecurity Video for Aquaculture

Production of the biosecurity video continues in schedule with an anticipated completion date of all filming by July, 1994. The video, tentatively titled "Biosecurity in Aquaculture", is expected to be edited and ready for review, approval, and distribution by mid-August.

Regional Extension Survey Situation and Outlook Report

A questionnaire was developed to compile information on the current status and needs of state aquaculture extension programs in the region. Eighty-nine questionnaires were distributed to extension personnel, administrators, state industry associations and aquaculture coordinators. Fifty-nine (66%) questionnaires were returned. Preliminary results were summarized and presented at the industry summit and a draft situation and outlook report for northeastern state extension programs is in preparation. The report will be distributed regionally. Preliminary survey results show that approximately 80% of the extension personnel responding worked part-time on aquaculture with 68% supported at a level of .25 Full Time Equivalents (FTE) or less. General aquaculture, fish and water quality were most often cited as areas of expertise. More than two thirds (68%) of those surveyed from extension, 64% from industry, and 73% of state aquaculture coordinators were dissatisfied with the level of information and technical assistance available in their states. There was good agreement among all groups on the need for additional educational programming and the subjects to be addressed. Legal/regulatory, system design, feeds/feeding, husbandry/management, therapeutants, water quality, and effluents were highly rated for future seminars and workshops. Fish and shellfish health, hands on experience, water quality, information organization and retrieval, closed systems, system design and therapeutants were requested by extension for future in-service training. The survey also compiled information on computer use among extension programs and industry. Regional and national contacts, legislation, question and answer forum, e-mail, access to other databases, and meetings/announcements were identified as preferred categories of information to be included a regional electronic bulletin board system.
Introductory and Technical In-Service Programs

REP participants gave individual presentations on NRAC program activities, national/regional information resources, and water quality management during two introductory workshops on aquaculture at the annual meeting of the National Association of County Agricultural Agents (NACAA) held in Baltimore, Maryland, August 22-26, 1993. Letters were sent to the directors of extension programs in the northeast offering REP assistance in developing and/or providing in-service seminars and workshops in their states on issues of concern to them or on subjects identified in the regional extension survey. Follow-up phone calls are being made to extension directors to answer questions and discuss potential topics and dates. The New Hampshire Sea Grant Marine Advisory Service has expressed interest to include REP assistance and introductory seminars on aquaculture as a part of an annual state extension conference to be held during fall or winter 1994. A REP Program Committee is developing an in-service workshop program on fish and shellfish health, therapeutants, water quality, system design and information organization and retrieval to be offered in conjunction with an annual work group meeting of the REP tentatively scheduled for fall 1994.

Aquaculture Industry Training (Internship) Program

A package of information outlining the goals and objectives of the internship program was produced and mailed out to all extension contacts in the northeastern states. The package contained information on policies and procedures in effect for the program as well as approximately how much money had been budgeted for each state and how applications would be prioritized and reviewed. To date, eight inquiries have been received about the program from agents and specialists with aquaculture responsibilities in the region. One commercial business wanted to know whether it could recruit someone to work with it and one formal application from an extension specialist in Maryland has been received and is under review. Plans call for another letter or announcement to go out throughout the region, as well as a notice to be placed in a national newsletter in order to ensure that the information is reaching the agents and specialists that the program is designed to assist.

Anticipated Benefits

The current (1993/95) project for regional extension network development builds on the efforts successfully initiated by the first regional project "Northeast Regional Aquaculture Extension Program for a More Viable, Profitable Industry". The aim of this follow-up regional extension project (REP) is to continue working toward education, the promotion of information exchange, and cooperation among industry, public and sector groups.

Work Planned

Activities planned for Year 2 (1994/95) include: continuation of work with industry to revise regional fish health regulations; development of regional workshops on recirculating systems and effluent/waste management; continuation of work with industry associations to identify and deliver instate educational programs on priority subjects; completion and distribution of the extension situation and outlook report and biosecurity video; continuation of work with state extension programs to identify and provide assistance with introductory and technical in-service programs; and a continuation of efforts to encourage and increase participation in the aquaculture industry training (internship) program.

Impacts

Although the majority of project activities are still in progress, there have been some measurable impacts. REP participation in the industry summit was well received by all industry association representatives in attendance and was cited by many as an example of how extension can assist regional industry. Both fish health workshops have helped industry focus on regional regulations from a technical and policy standpoint, with revised, reasonable regulations as a final goal. Support provided by the REP to co-sponsor the 14th Milford Aquaculture Seminar helped maintain a major venue used by the shellfish industry for information exchange. Extension survey results document current time allocation and regional expertise available for aquaculture and identify subjects and activities for in-service training and further network development. Organizational efforts to solicit and deliver seminars and workshops (industry and extension) and extension training opportunities throughout the region have taken more time than anticipated. Regional implementation of objectives will be a high priority for the second year of the project.
PROJECT PROGRESS REPORT

Alternatives to Lessen the Economic Impact of Aquaculture Regulations

Total Funding: $86,260

Period: July 1, 1993 to August 31, 1994

Participants
Richard E. Bohn (chair) University of Maryland Maryland
James W. Dunn Pennsylvania State University Pennsylvania
Conrado M. Gempesaw University of Delaware Delaware
Gregory D. Hanson Pennsylvania State University Pennsylvania
Eric B. May Department of Natural Resources Maryland
Joseph P. McCraken U.S. Trout Farmer's Association West Virginia
Mary E. Mueller U.S. Fish and Wildlife Service Washington, DC
Eileen C. Sadasiv University of Rhode Island Rhode Island
Alex W. Wypyszynski Rutgers University New Jersey

Project Objectives

Fish Policy Subcommittee:

• To compile information on the distribution of diseases and pathogens from both cultured and wild sources, and on existing fish health regulations in the Northeast region.

• To prepare a white paper outlining the history and evolution of fish health policy within the Northeast region, identifying issues of fish health significance in need of resolution, and addressing an alternate approach to policy development and implementation recognizing the missions of industry, agricultural agencies and natural resource agencies.

Economics Subcommittee:

• To determine the types of costs of regulation and the parties that bear them as a result of fish health policies, and develop a mechanism for evaluating the economic impact of these regulations on the aquaculture industry.

• To use this mechanism to estimate the economic impact of selected fish health regulations on the aquaculture industry.

Progress And Principal Accomplishments

Fish Policy Subcommittee:

Nearly 3,000 literature citations have been obtained and reviewed, with several hundred additional citations currently under review. To date, the following databases have been searched: Fish and Wildlife Reference Service, Fish and Fisheries Worldwide, CRIS/USDA, CAB and Biosis. Additional gray literature has also been gathered where encountered. The review focused on certifiable diseases listed in the New England Fish Health Guidelines. These diseases are of primary importance to fish health regulators and are assumed to have the greatest potential impact to natural resources. All information relative to diseases impacting the northeastern region of the United States and occurring elsewhere were retained. Any information concerning diseases and their impact on wild stocks, regardless of origin, was also retained. To seek information in addition to cited research, a questionnaire was developed in cooperation with the U.S. Fish and Wildlife Service and state regulatory personnel. Questions were developed to gain information about the incidence and movement of fish pathogens which may have been experienced throughout the United States. 178 questionnaires were mailed in September 1993, primarily to state regulatory and wildlife personnel. Answers to the original questions indicated that a follow-up questionnaire would be required for clarification, and to gain more complete coverage by the survey. A telephone questionnaire is being developed under Industry Advisor Richard Colantuono for this purpose. Information from previous NRAC projects compiling Northeast state regulations has been received by the subcommittee. Additional, updated information is also being sought from federal and state regulators. The data will be summarized in the white paper on fish health regulations.

The subcommittee formed a working group for the white paper and met in July 1993 in Annapolis, Maryland. Assignments were given for assisting the economics subcommittee, state and federal...
regulations and economic involvement, database searches, development and collation of the questionnaire, and drafting the white paper. The outline for the white paper has been completed and the draft is in progress. The subcommittee met on June 1, 1994 to review work on the draft. Depending on the results of the review and time requirements to update the regulation, database, and questionnaire results, publication is planned for summer 1994. Comments from additional Federal, state and private resource and animal management representatives will be sought during the final drafts of the white paper.

Economics Subcommittee:

Members of the economics subcommittee met with growers in November 1993 to determine cost factors associated with regulations. Factors have been identified which are determined by fish health policies, but are specifically affected by receiving state regulations and individual state certification requirements. These costs will vary by circumstances, and will be clarified using the regulatory compilation from previous NRAC projects and the fish health subcommittee. An overall measurement of the costs of reduced trade due to existing fish health policies in the region is also being produced.

The mechanism for evaluating the economic impact of fish health regulations has been established and will be applied to the region. A paper describing this mechanism is in the draft stages. The model used for the evaluation is a standard for interregional trade and includes costs as part of transportation expenditures separate from production costs. This is necessary due to the specific nature of receiving state regulations and variation in certification costs from state to state. Further development of this model is scheduled for the second year of the project.

Application of the mechanism to fish health regulations and the production of case histories are planned for the second year of the project. Applying this mechanism to proposed regulations will also require an assessment of the benefits of limiting the spread of a specific pathogen to wild stocks, and is dependent upon factors specific to the ecology of the pathogen and value of the protected stocks considered. Additional factors, such as enforcement costs, are also being considered in the assessment of the economic impact to both industry and consumers.

Anticipated Benefits

For over a century, fish health regulations have been promulgated by resource agencies in the interest of protecting resident fish stocks. The regulations have developed into trade barriers to private aquaculture. Fish health certification became the legal and technical basis for eliminating or reducing fish health problems, but the technology and information which have developed since do not appear to support this approach.

While most fish health studies have focused on hatchery problems, private industry has encouraged review of the assumed impact of pathogens on the resource. Regulators have agreed that this is a worthwhile avenue of research, considering the original intent of regulations. It is also generally agreed that better information is needed on pathogen distributions. Combined with more standard assessment of the economic burdens placed upon private industry, this project provides far-ranging changes in the way both regulators and industry view fish health regulation.

All regulations require periodic review; those affecting fish health are no exception. There will always be some form of regulation. It is the intent of this project to lead to regulations that are realistic, scientifically based, and less costly to all concerned. Private industry will have played a leadership role in the process.

Work Planned

Completion of the state survey, database search, and regulatory compilation is in progress. Drafting, review, and publication of the white paper is scheduled in the next few months. No supplemental funding is required or requested for this subcommittee in the following year.

Completion of the mechanism for evaluating the economic impact of fish health regulations is in progress. A draft paper is also being completed. Applying this mechanism, determining additional costs, and the development of case histories is planned for the following year, as described in the original proposal.

Impacts

The information being generated has been requested by a number of policy-making bodies, reflecting the timely nature and need for this study. Both state and federal (U.S. Fish and Wildlife Service, USDA/APHIS) regulatory institutions are requesting information, are state and regional groups. Dissatisfaction with proposed policies and
decreasing federal assistance for implementation and enforcement of current policies shows the willingness of regulators and industry to examine alternatives.

Publications


Two publications (the Fish Health Regulations white paper and the Economic Measurement of Fish Health Regulation Impact) are in draft form.
PROJECT PROGRESS REPORT

93-5  
Computer Network Communication System

Total Funding:  $25,000
Period:  July 15, 1993 to August 31, 1994

Participants:
Thomas Handwerker (chair)  
Karl Rask  
University of Maryland Eastern Shore  
University of Massachusetts  
Maryland  
Massachusetts

Project Objectives

• To survey the telecommunication resources within the NRAC community and formulate the basic BBS (bulletin board system) protocol and services.

• To install a PC-based BBS.

• To create appropriate packages of information that can be used by commercial growers, associations, extension and research specialists with variable computer or commercial expertise. This includes: a) developing a methodology to support the acquiring information; b) developing a working prototype for assimilating the data from several diverse cooperators; and c) selecting a hypertext architecture that enhances the information flow, retrieval, and navigation form critical decision making in commercial aquaculture.

• To enhance the telecommunication skills of growers and specialists to include access to additional databases, regional centers, and interest groups.

• To evaluate the protocol for submission of documents, reports, or announcements for utilization in aquaculture association newsletters, the NRAC newsletter, the National Association of State Aquaculture Coordinators, and for general electronic distribution.

Progress And Principal Accomplishments

A telephone survey was performed to identify the perceived need, computer resources, acceptability, sensitivity, relevance, and enthusiasm for an aquaculture computer network communication system by members of the NRAC community. Additional questions were also prepared and included in the recent mail survey by the Extension Project. It quickly became apparent that Internet access was limited to specialists and researchers while growers were limited to modem or on-line services with batch file capabilities. Grower participation would only be enhanced with quick and immediate access to these specialists through the BBS.

A review of the existing commercial BBS computer systems included RBBS, Searchlight, Wildcat, numerous shareware systems, and Galacticom. These systems were reviewed by the UMEES computer services. Major BBS (a product of Galacticom) was suggested as being compatible with the new university fiber optic network technology, linked to the NOVELL network with INTERNET address allocated for the service.

In the review of BBS systems during the first year, the linkage with the INTERNET and the BBS software that would allow full access (real-time) by researchers and specialists and users with phone modem access did not exist. This would mean that communications between researchers and specialists would be limited to batch-file communications. This was viewed as untenable for the success of the project. Therefore, time was spent to identify an appropriate technology group that could develop and link the BBS to the INTERNET under real-time conditions.

The NRAC NETWORK can be accomplished by TELNET command across the INTERNET to NRAC.UMD.EDU. At the prompt, decline ASCII graphics and login. Growers without INTERNET access must use a telecommunication protocol such as PROCOMM or KERMIT and utilize a modem call to (410) 651-7731. Modem connections can take advantage of ASCII graphics and even use RIPTERM. The NETWORK software is auto-sensing for establishing communications protocol, speed, and presentation.

Decisions have been made that basic information (subject matter categories) will follow the existing archival database of AQUANIC. However, the basic function of the NRAC NETWORK is to provide real-time communications of events, policies, announcements, and networking interest groups in our aquaculture community.
Anticipated Benefits

A product is anticipated that will provide the NRAC community a vehicle to access information, materials, and agencies as a communications network, operating 24 hours per day, for increasing the transfer of information, technology, and services. The network will provide experience for decisions about future directions of telecommunication products within NRAC.

The network will encourage inter-regional discussions to identify research priorities or focus resources on commercial issues.

Work Planned

The Major BBS software installed on the system will be able to handle multiple joint conferences in an almost unlimited selection of subjects. Interested individuals are suggesting “forum topics” based on need and interest. Specific forum groups under development include: EXPO planning, juvenile oyster disease, newsletters, etc.

Several excellent suggestions by initial users are being incorporated at the present time: 1) the selection of options are being simplified for first time users; 2) the on-line help documentation is going to be for more inexperienced users; 3) the initial users will be defaulted to a simple set of commands that can be expanded upon request; and 4) a utility file of programs will be provided on the system for users who may not have access to graphical viewers.

Document translation of existing NRAC publication will have first priority. It is suggested that all future publications be provided in electronic format for availibility on the system. Documentation currently available in AQUANIC will not be duplicated unless NRAC information. Users will be “pointed” to AQUANIC if appropriate.

Publications

An on-line NRAC network help manual is available for new users that can be downloaded for printing or review. A NRAC fact sheet on accessing the NRAC NETWORK is under development.
PROJECT PROGRESS REPORT

94-1 Market Research for Nori Production

Total Funding: $9,500
Period: January 1, 1994 to August 31, 1994

Participants
I. Levine (chair)
J. Eldredge
Coastal Plantations International (CPI)
Commonwealth Marketing
Maine
Maine

Project Objectives

• To evaluate the market potential for nori within the North American supermarket distribution channel.

• To determine the number, location, and identity of supermarket chains carrying nori and sushi products.

• To determine the identity, source, and retail price points of current nori products.

• To review current packaging and merchandising of competitive products.

• To identify nori brokers and distribution channels.

• To develop a demographic and psychographic profile of the supermarket consumer of nori and sushi products.

Anticipated Benefits

Nori and sushi product information identifies the potential for market penetration of the supermarket distribution channels by American-produced nori.

Research results will be incorporated into future product line configurations, packaging design, pricing strategy, in-store merchandising strategy, and the selection of specific geographical markets.

Increase the potential for the success of American-produced nori in the U.S. marketplace.

Marketplace success will stimulate additional nori cultivation sites along the Atlantic coast of the Northeast and Mid-Atlantic states.

Work Planned

All original project objective have been met and no additional work on this project is required.

Impacts

This project identified the specifics of one segment of the U.S. nori market - supermarket chains. As a result of the research, marketing strategies were modified and opportunities were identified. The ability of American produced Nori to penetrate this market segment was enhanced, increasing the potential for a successful entry into the distribution channels.

Suggested Future Work

Subsequent research on the development of an American nori industry is multiphasic. Additional funds are needed to:
1) Improve nori cultivars through genetic enhancement;

Northeastern Regional Aquaculture Center 45
1) Continue Japanese-American nori farmer exchange program;
2) Improve cultivation engineering and farming technologies;
3) Market research and development;
4) Consumer education.

Publications

No additional publication of this material is anticipated by CPI. Currently CPI is funding additional market surveys and focus group research. Additionally, CPI has funded the creation of informational video on the development of American based Nori farming.
PROJECT PROGRESS REPORT

Development of a Model Quality Assurance Program for the Aquaculture Industry in the Northeast

Total Funding: $60,000
Period: April 1, 1994 to August 31, 1994

Participants
Joseph McCraren (chair)
Keith R. Carlson
National Aquaculture Association
Agri-Education, Inc.
West Virginia
Iowa

Project Objectives

• To develop two introductory quality assurance programs designed to provide growers with a series of best management practices for continued production of safe, quality product; one program for finfish, the other for shellfish producers. These programs are viewed as providing industry with models or guidelines upon which future programs may be developed.

• To advise producers in the Northeast and elsewhere of the program’s availability through the use of the extension network, trade journals, media, association newsletters, and the Regional Aquaculture Center system.

• To develop a brochure for producer use to promote public awareness of the quality assurance programs. Ensure that a half-dozen sets of printer-ready copy are available for reprinting by producers who wish to do so.

Progress and Principal Accomplishments

The project was approved and funds for implementation became available in March, 1994. Work to date has been directed toward the first objective -- development of separate introductory quality assurance programs for finfish and shellfish. Work on the other objectives is dependent upon completion of these two programs.

The first task was to respond to a 1993 TIAC motion directing the project’s principal investigator to work with TIAC advisors on the final composition of the project’s Technical Review Committee. This was satisfied during May-June of 1994 by forwarding copies of the proposed committee’s membership to the TIAC for review.

Following the review process, plans were immediately implemented for a committee meeting in Providence, RI in July 1994. Prior to the meeting, committee members were familiarized with the project’s objectives and advised of what we intended to accomplish in Providence.

In addition to the two principal investigators, the following individuals were in attendance at the committee meeting: Dr. Hugh Mitchell; Greg Rivara; Wec Terry; Dr. Marty Brunson; Dr. John Kraeutler; Dr. Michael Castagna; and Scott Lindell. Four committee members were not able to attend.

The principal focus of the meeting was to determine not only what should be referenced in the manuals, but how and in what context. Examples of discussion points include reference to development of guidelines that industry can live and work with. In the introductions, reference to teamwork, responsibility, commitment, and how growers can participate. A definition of Quality Assurance should be included. Each manual should contain ten critical production points (BMP’s). The manuals should be written in an upbeat positive vein. They should include reference to current drug/Therapeutant regulations. A table of approved compounds should be included. Crawfish and shrimp will be referenced in the shellfish manual. Photos must reflect the diversity of the industry. Numbers of copies to print were arbitrarily set at 10,000 for finfish and 5,000 for shellfish.

Examples of suggested critical production points for both finfish and shellfish include: site; water; waste management; by-products; feeding practices; health management; record keeping; and harvesting.

In addition to suggestions from the committee, Mr. Carlson has been provided copies of all available industry Quality Assurance materials (catfish, trout, oysters) to assist him in draft development.

Current planned activities include manual drafts for review prior to the holidays. Input will be obtained from producers and others external to the committee, when the drafts become available.
A committee conference call will be conducted following an appropriate review period. Publication of the manuals is scheduled for January, 1995.

**Anticipated Benefits**

The aquaculture industry’s continuing responsibility to the consumer, coupled with increased interest in seafood safety by FDA and Congress, provides the industry with a unique opportunity to promote the quality and wholesomeness of farmed product through implementation of quality assurance programs. Quality assurance programs, both producer- and processor-based, have been developed and are being utilized by several large catfish and trout companies. The vast majority of aquaculture producers, however, have only recently become acquainted with such programs. These programs have a relatively long and successful history in traditional aquaculture. Due to inherent control over production afforded aquaculturists, quality assurance programs will serve to document and promote that aspect more fully.

In the past year, the catfish and trout industries have each developed and published producer-based QA programs. Quality assurance is becoming a reality in the aquaculture industry. Continued development and implementation of these programs will assist the industry in the following manner:

- Enhance consumer understanding of aquacultural production practices, thereby improving product image and marketability.
- Participants will receive timely information on current issues and developments impacting their businesses.
- QA participants can maximize their economic return through application of sound management practices set forth in such a program.
- Employee confidence and pride of accomplishment tend to improve when QA is implemented.
- Industry is in an improved position to deal with increased regulatory requirements when producers are enrolled in a QA program.

**Work Planned:**

As noted, the project will be completed in early 1995. No changes in the work plan or schedule are anticipated. Our goal is to have the manuals available for introduction at the February, San Diego meeting during a special session hosted by NAA on the subject of seafood safety.
PROJECT PROGRESS REPORT

94-3 A Proposal to Study Potential Ciliate Pathogens of Hatchery Reared Oysters in the Northeastern United States

Total Funding: $10,000

Period February 21, 1994 to August 31, 1994

Participants
Eugene B. Small University of Maryland Maryland

Project Objectives

- To collect and fix appropriate protists from oysters either suspected of dying of Juvenile Oyster Disease in infected experimental tanks or from the oyster containments.

- To stain these protists with appropriate diagnostic silver stains (Protargol methods).

- To identify the ciliates and designation if applicable to potentially causal disease organisms.

- To communicate results to the NMFS Cooperative Oxford Laboratory, Oxford, Maryland.

Anticipated Benefits

The anticipated benefits are to: (1) determine whether or not a ciliated protist is the causal organism of the Juvenile Oyster Disease as the disease has been encountered at the Frank M. Flowers and (2) identify the ciliated protists associated with Juvenile Oyster Disease.

Progress and Principal Accomplishments

Protists have been successfully stained and identified to the level of genus (for ciliates encountered) for collections made from two sites (the particles passed through a 47 micrometer filter but were retained by a 5 micrometer filter):

- the Frank M. Flowers Oyster Hatchery Facility seed rack containers;

- the particulate residue in the experimental tanks at the Oxford Laboratory where JOD killed more than 80% of the oysters by six weeks and about 75% of the juvenile oysters by six weeks at salinities of 26 ppt and 20 ppt, respectively.

In these experimental tanks only a small, 9-11 micrometers diameter suctorian ciliate, Endosphaera sp., was recovered and successfully stained via the Protargol staining technique. Also found in these samples was a small unknown (new to science) stichotrich ciliate containing similar suctorians within its cytoplasm. The size of the internally encountered suctorians was 5-8 micrometers, about the same size as the eukaryotic endoparasites earlier encountered in the separate studies of Farley and Lewis as seen in histological feulgen stained tissues in which suspect macro- and micronuclei were seen in addition to healthy host nuclei in sectioned mantle epithelium. A similar small (about 11 micrometers) suctorian has most recently been found in the same particulate fraction of filtered particulates from which Farley and Lewis have successfully infected juvenile oysters this past summer 1994.

From the mantle cavity fluids of JOD infected oysters, new species of Mesanophrys and Paranophrys have been discovered. Both of these genera contain ciliate species known to be parasites of other invertebrate hosts (e.g., Mesanophrys pugettensis in dungeness crabs on the northwest Pacific Coast, and Mesanophrys sp. in Chesapeake Bay blue crabs and the gonads of the hydrozoan Tubularia sp. from Woods Hole, MA). However, these apparent histophagous, ciliated protists of various invertebrates are too large to be directly related to the intracellular mantle tissue parasites first observed by Farley and Lewis. The known intracellular suctorian, Endosphaera sp., is however the prime suspect.

Work Planned

Work continues on the staining of other appropriately fixed samples from Frank M. Flowers & Sons and from experimental tanks set up during this past year at the Oxford Laboratories.

Impacts

Clearly, a suctorian ciliated protist is implicated in oysters infected with Juvenile Oyster Disease.
PROJECT PROGRESS REPORT

94-9 National Coordination for Aquaculture Investigational New Animal Drug (INAD) Applications

Total Funding: $35,180 (NRAC support $2,000)
Period September 1, 1992 to August 31, 1994

PARTICIPANTS:
Robert K. Ringer Michigan State University Michigan
Ted R. Batterson (chair) Michigan State University Michigan
Henry S. Parker USDA/CSREES Washington, DC

Project Objectives

• To ensure effective communication among groups involved with INAD applications, including liaison with Canada.

• To serve as an information conduit between INAD applicants and the U. S. Food and Drug Administration’s Center for Veterinary Medicine (FDA/CVM).

• To champion preparation and submission of INAD applicants by affected groups

• To seek opportunities for and encourage grouping of applicants.

• To function as an information source for INAD applications.

• To coordinate educational efforts as appropriate.

• To identify potential funding sources for INAD activities.

Progress And Principal Accomplishments

In September 1992, Dr. Robert K. Ringer, Professor Emeritus of Michigan State University, was hired on a part-time basis as a National Coordinator for Aquaculture INAD Applications. Dr. Ringer served in that capacity through August 31, 1994. He also serves as the National Coordinator for the USDA’s National Research Support Project No. 7 (NSRP-7) for Minor Use Animal Drugs.

As National Coordinator for Aquaculture INADs, Dr. Ringer has participated with FDA/CVM in educational workshops on INAD procedures and requirements. These workshops were conducted throughout the United States and attended by several hundred within the aquaculture community. This included workshops held in conjunction with the U.S. Trout Farmers Association, Boston Seafood Show, and Aquaculture Expo V in New Orleans. The workshop at the Boston Seafood Show was videotaped and is now available on cassette from the Northeastern Regional Aquaculture Center. In addition to the workshops, talks were presented on aquaculture drugs at the request of several organizations, including the World Aquaculture Society.

Dr. Ringer also helped in the preparation of a letter that FDA/CVM used in requesting disclosure information from those holding aquaculture INADs. By law, FDA/CVM cannot release any information about an INAD without such permission. As of September 1994, 70 disclosure permissions had been granted. A table containing information about these disclosures was recently made available to the general public. This included the names and addresses of the INAD holders as well as the drug and species of fish intended for the use of the drug. It is intended that this table will be periodically updated after additional disclosures have been made.

Every effort was made by the National Coordinator to encourage applicant grouping. The Coordinator also provided specific instructions to INAD applicants on proper procedures and requirements for submitting applications to FDA.

It was repeatedly stressed to the aquaculture community that aquaculture INADs are merely a stop-gap measure and efforts must be undertaken to support approval of new animal drugs.

Anticipated Benefits

Investigation and approval of the use of safe therapeutic drugs is one of the highest priorities currently facing the aquaculture industry. At present, only a few approved compounds are available to the industry and further development of the aquaculture industry is severely constrained by lack of approved drugs essential for treating over 50 known aquaculture diseases. The FDA/CVM has afforded the aquaculture industry throughout the

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U.S. with a “window of opportunity” to seek approval of legal drugs to be used in their production practices. The need for additional drugs is great, but securing data necessary to satisfy the requirement of FDA/CVM for drug approval is time consuming, costly, and procedures are rigorous. Obtaining drugs for legal use through the INAD process is one method by which the industry can provide FDA/CVM with data on efficiency and also aid the producer in their production practices.

Educating potential INAD applicants will save time for both the industry and FDA/CVM. A National Coordinator for Aquaculture INADs would serve as a conduit between an INAD applicant and the FDA/CVM. The Coordinator would help to alleviate demands on FDA staff, allowing more time to process a greater number of applications as well as increasing the breadth of research endeavors within the industry. The grouping of INAD applicants should help to alleviate redundancy, amalgamate efforts, and increase the amount of efficacy data, all of which should result in greater progress toward developing therapeutic drugs.

Work Planned

Depending upon adequate financial resources, efforts during the next year will focus on New Animal Drug Approvals (NADAs) for aquaculture. A National NADA Coordinator will be hired if the position can be supported at a minimum half-time level.

Impacts

Establishment of the National Coordinator for Aquaculture INAD applications has broadened awareness not only of INAD procedures and requirements but also of the need to carry investigations beyond the INAD to gain approval of New Animal Drug Approvals.

As a result of this broadened awareness, the National Research Support Program-7 and FDA sponsored a two-day national workshop “Drugs in Aquaculture: Current Status-Future Goals.” This workshop was held in Bethesda, Maryland, September 29-30, 1994. Published proceedings of the workshop are forthcoming.

Because of limited funds, this position was only supported on a part-time basis. Therefore, not all intended aspects of coordination were accomplished. The Joint Subcommittee on Aquaculture, Working Group on Quality Assurance in Aquaculture Production, which established the position, has realized the benefits of a National Coordinator for aquaculture drugs. That group is making every effort to establish the position on a full-time basis in the future.

Publications


