2010-2012 Summary of Funded Projects

The Regional Aquaculture Centers are funded through the USDA National Institute of Food and Agriculture with a history over 25 consecutive years. The combined five regional centers represent a national program that covers and reaches all states and territories in the US. The program is unique with the participation of aquaculture industry representatives appointed to an Industry Advisory Council who identify regional research and extension education priorities for project development and monitor progress and outcomes. Other project development and oversight bodies include a Technical Advisory Committee and Board of Directors.

This material updates past project summaries that covered the period 2005-2010. For more information about the listed projects as well as past projects, please visit the home page for each of the five Regional Aquaculture Centers that is referenced below.

Northeastern Regional Aquaculture Center

Director: Reginal Harrell, University of Maryland
Home page: http://nrac.umd.edu/

Genetic Marker-assisted Selection of Northeastern Hard Clams for QPX Resistance

Funding level: $199,998
Project start date: TBD
Project duration: 36 Months
Participants: Stonybrook University, Rutgers University, Roger Williams University, Cornell University, Cape Cod Cooperative Extension, University Of Paris 6, NY Sea Grant

The hard clam, or northern quahog, *Mercenaria mercenaria,* is one of the most valuable seafood products for numerous states in the Northeast. Since the 1990s, several states have suffered severe losses in cultured hard clam stocks due to a fatal disease caused by a single-celled, protistan parasite called Quahog Parasite Unknown (QPX). The extensive scale of these mortality events resulted in the loss of several millions of cultured, market-size clams and significant economic impact on clam aquaculture operations. The overall objective of this project is to employ molecular genetic tools that will provide the commercial aquaculture industry with improved clam stocks. Previous work demonstrated that clam susceptibility to QPX depends upon the geographic origin of the broodstock suggesting a genetic basis for clam resistance. It is hoped that clam resistance to QPX is genetically dictated and can be predicted using selected genetic markers. Marker-assisted selection will be combined with traditional selection methods in conjunction with field and laboratory disease transmission studies to identify clam stocks that are resistant to QPX disease. The selection for QPX-resistant clam strains would allow the development and expansion of the hard clam aquaculture industry. Information on genetic variation in clam broodstocks, as related to disease resistance and growth,

will be widely diffused through the robust extension and outreach plan providing direct benefits to shellfish breeders and farmers. Improved germplasm is expected to substantially reduce losses to QPX disease and enhance yields.

Development of More Efficient Methods of *Vibrio* sp. Detection and Identification of *Vibrio* sp. Abundance in Cultured Oysters from Northeast U.S. Farms and from Retail Sites Post-harvest

Funding level: $190,360
Project start date: March 2012
Project duration: 24 Months
Participants: Woods Hole Sea Grant, Roger Williams University, University of Rhode Island, Chenoweth Laboratory, Rutgers University, Maine Sea Grant, Cornell University, University of Maryland

The project intends to develop a multiplex, quantitative, real-time Polymerase Chain Reaction (mqrtPCR) method for the detection of *Vibrio vulnificus* (Vv) and *Vibrio parahemolyticus* (Vp) which are both human pathogens, using an oyster DNAse (enzyme) inhibitor and compare sensitivity and specificity with the FDA methods. Two additional multiplex methods will be developed for evaluation of samples for both Vp and Vv pathogenic genes using previously published methods with the oyster DNAse inhibitor. Cultured oysters, water, and sediment from two locations (one in RI and one in MA) will be intensively monitored over a year using the MPN/mqrtPCR and FDA methods side by side in order to understand the Vv and Vp cycle and the occurrence of pathogenic Vv and Vp in the northeast environment. The data will be used to compare sensitivity of both tests. The project will also identify the occurrence of pathogenic and non-pathogenic strains of *Vibrio sp*. in oysters at two time periods after collection of oysters from culturists who reside in 5 northeastern states and from 10 retail stores and restaurants. The source of oysters and post-harvest handling (time between harvest and chilling and length of time chilled before sampling) will be identified as selection criteria. Findings will be provided (via presentations, websites and brochure/white paper) to culturists, extension agents, and diagnostic laboratories at regional and national meetings and at local meetings for culturists and extension agents as well as representatives of the FDA.

Shellfish STEM-GIS Development for Improved Siting and Farm Management

Funding level: $85,000
Project start date: March 2012
Project duration: 24 months
Participants: Maine Aquaculture Innovation Center, Pemaquid Oyster Company, Inc., Blue Hill Hydraulics, Discovery Software, Ltd., Plymouth Marine Laboratory, University of Connecticut

This work is focused on improving and expanding upon shellfish Global Information System (GIS) software developed in 2010-2011 with NRAC funding. Great progress was achieved in developing a high-resolution GIS with hydrodynamics and oyster growth simulation. During

focus group presentations to industry and resource managers in Maine and Connecticut, a number of recommendations were made to make it more user-friendly and address certain industry needs through added functions. The final product will be a shellfish STEM-GIS software (Shell-GIS) which can be used to improve shellfish yield and profitability for both suspension and bottom culture of the Eastern oyster *Crassostrea virginica*, taking into account both local- and system-scale effects of site selection, seeding time, seeding size and density, and potential inter-annual variations in natural environmental conditions, as well as other users of the water body. Bioenergetics simulations by the ShellSIM component of ShellGIS are already calibrated for 12 more species that are commonly cultured worldwide. The product will have potential benefits for other species both in the US (i.e. northern quahogs) and beyond.

Optimization of Hatchery and Culture Technology for Razor Clams

Funding level: $93,616
Project start date: October 2011
Project duration: 1 year
Participants: University of Maine, Roger Williams University, Woods Hole Sea Grant, Maine Sea Grant College

The overarching goal of the proposed work is to develop technology for the increased production of alternative species to support the expansion and diversification of the northeastern shellfish culture industry. Efforts will focus on improved hatchery and grow-out methodologies for the culture of the Atlantic jackknife or razor clam (*Ensis directus*). Specific objectives seek to improve hatchery protocols to establish consistent, reliable sources of razor clam seed from commercial hatcheries, to identify improvements for existing grow-out technologies, to work directly with shellfish growers to increase acceptance and understanding of the culture of razor clams, and to further document the market receptivity to razor clams. Through the simultaneous consideration of these objectives, there is increased opportunity for faster acceptance of razor clam culture and more-rapid diversification of a key aquaculture sector in the Northeast.

Developing Improved Management Practices for Mussel Farming in Southern New England

Funding Level: $199,779
Project start date: October 2011
Project duration: 2 years
Participants: Woods Hole Marine Biological Laboratory, Martha's Vineyard Shellfish Group, University of New Hampshire, Zephyr Marine Education Foundation, American Mussel Harvesters, Inc.

Approximately 93% of mussels consumed in the U.S. are imported, primarily from Canada and New Zealand. The Prince Edward Island mussel farming industry alone provides both direct and indirect employment for at least 1,500 people. The development of domestic offshore mussel farms offers promising options for fishermen and for shellfish farmers to diversify. Results can

reverse the flow of US dollars out of the country, employ displaced fishermen, and enrich depressed coastal economies with support/service jobs. The waters of Southern New England (SNE) appear to be especially well-suited for the development of a vibrant domestic mussel industry. Research on the first pilot commercial-scale farms demonstrated the feasibility of growing mussels from seed to market size in less than 12 months; faster than other eastern North American competitors. Several issues need to be addressed to make this regional mussel industry a reality. They include: 1) selecting optimum materials, sites, and times for collection of mussel seed; 2) comparing methods of tunicate eradication without compromising the survival of mussel seed; 3) comparing different types of socks and stocking densities to optimize growth and yield to market for improving management of mussel operations in SNE; and 4) developing effective hands-on workshops and extension materials to train a workforce capable of managing offshore mussel longlines. The Woods Hole Marine Biological Laboratory will lead this project to address these constraints with comprehensive field investigations conducted by a diversified team of scientists, resource managers, fishermen, businessmen, and extension agents.

Aquaculture Health Hazards – Developing Outreach Services to the Region's Farmers via Extension and Aquatic Animal Health

Funding level: $196,312
Project start date: January 2011
Project duration: 2 years
Participants: University of Connecticut, University of Maine, Professor, Salem State College, University of Delaware, The Pennsylvania State University, Rutgers University, University of Massachusetts, University of Maryland, Roger Williams University , Cornell Cooperative Extension, University of New Hampshire, Cape Cod Cooperative Extension,Woods Hole Sea Grant, and University of Rhode Island

This project intends to identify, organize, and compile science-based information and educational resources about aquaculture health hazards including major diseases of aquatic organisms, pests of aquaculture species, and organisms that cause human illness. The object is to develop HACCP-style guidelines for monitoring, recording, evaluating, and sampling of stocks at the farm level, and to assemble and publish technical information and guidelines as individualized protocols and responses for shellfish and finfish farmers. Training workshops will be conducted for extension and outreach practitioners on how to apply the HACCP-type guidelines for the development of a health-risk management plan for individual farms. Local industry outreach programs will be implemented to assist farmers develop their own HACCP health risk plans. An economic assessment will be completed on the impact of implementing a HACCP plan on individual farms in the Northeast region.

Examination of Finfish Pathogen Physiology and Predictive Ecology in Bivalve Integrated Multi-trophic Aquaculture

Funding level: $200,000
Project start date: February 2010
Project duration: 2 years

Participants: University of Maine, University of Connecticut

Fish farmers applying Integrated Multi-trophic Aquaculture systems **(**IMTA) at their farms need a clear understanding of how the culturing of filter-feeding organisms in close proximity to finfish cages will impact disease transmission at their farms. The project involves disease research that will beneficially impact regional aquaculture production by providing vital research answers on the potential benefits (possible disease management strategies) and/or risks (reservoirs for disease) of co-culturing mussels (*Mytilus edulis*) with Atlantic salmon or Atlantic cod. Results of this project will also provide essential health and economic perspectives to further increase the implementation of the more economically profitable and environmentally sustainable IMTA husbandry techniques. This project will build on results from a previous NRAC project "Investigations into the potential health and economic benefits of bivalve/finfish co-culture", which investigated the interactions of two pathogens: infectious salmon anemia virus (ISAV) and *Vibrio anguillarum* 02β, with mussels and finfish. With tremendous progress with the first project, work will be expanded to investigate the interaction of two additional pathogens, *Francisella* sp. (an intracellular bacterium) and IPNV (a non-enveloped virus) with mussels and finfish and to determine the economic cost/benefit based upon disease risk. The overall goal of this project is to examine the effect of many different pathogen types to avoid increasing the risk of spreading a different type of pathogen when IMTA is implemented.

Assessment of Environmental Impacts of Oyster Aquaculture in New England Waters

Funding level: $199,994
Project start date: January 2010
Project duration: 2 years
Participants: Maine Aquaculture Innovation Center, Pemaquid Oyster Company, Inc., Blue Hill Hydraulics, Pacific Shellfish Institute, Plymouth Marine Laboratory, University of Connecticut

The project focuses on shellfish (oyster) aquaculture in New England; specifically ecosystem research on the interactions of aquatic shellfish farms with phytoplankton, marine invertebrates, and fish, and leading to the development of guidelines for farm-siting issues and carrying capacity. The project utilizes an aquaculture GIS format (STEM-GIS) to disseminate results that include contrasting Maine and Connecticut sites' bathymetry, water velocities and directions, phytoplankton depletion by the shellfish, ecological information about the farms, aquaculture activities, BMP recommendations, and an oyster growth module which may be used to optimize shellfish production. The project will be conducted by a team of experts from the U.S. east coast (oyster farmers, shellfish ecophysiologists, and hydraulic engineers), the U.S. west coast (participant in two Sea Grant National Marine Aquaculture Initiative projects), and experts from the United Kingdom.

Breeding Resistance to Sea Lice and ISAV in Atlantic Salmon

Funding level: $199,614
Project start date: August 2010

Project duration: 2 years
Participants: University of Maine, National Cold Water Marine Aquaculture Center, Stony Brook University, Cooke Aquaculture

Sea lice, in particular *Lepeophtheirus salmonis,* is an important parasite of farmed and wild salmonids, causing direct losses due to the damage caused by the parasite directly to the fish and indirect losses due to the requirement for therapeutic treatments. It has also been implicated in the spread of serious infectious aquaculture diseases such as Infectious Salmon Anemia virus (ISAV), *Vibrio anguillarum,* and *Aeromonas salmonicida*. However, its role in the spread of these diseases is only suspected …not confirmed. Suspicions were based upon the detection of these pathogens by traditional and molecular methods on parasites removed from infected fish and not by studies that demonstrated reproducible transmission. One method of reducing the impact of sea lice and the diseases they spread is the development of disease-resistant strains of salmon. In European stocks (which cannot be farmed in the US due to the risk of an accidental introduction of non-native strains), breeding programs have already selected fast-growing, late-maturing fish with good resistance to Infectious Pancreatic Necrosis virus, giving salmon farmers in the European Union and Chile an economic advantage over US-produced animals. This project will investigate three important areas concerning the interactions of sea lice with Atlantic salmon. Firstly it will investigate if the families that are being developed at the ARS National Cold Water Marine Aquaculture Center (NCWMAC) at Franklin, Maine have inheritable resistance to sea lice infestation. This consortium has already established that NCWMAC has families resistant to ISAV within their native, American populations. These fish families will be evaluated to assess if they also possess a natural resistance to sea lice. This will be carried out by challenging healthy and ISAV-infected Atlantic salmon (containing both ISAV resistant and susceptible families) with sea lice and observing the prevalence and intensity of the parasite in the two populations. This data will identify sea lice resistant families and confirm if the ISAV-resistant trait is already carried by some of the ISAV-resistant families. During these trials, material will be collected from the ISAV- and sea lice- infected groups to determine if sea lice infection predisposes fish to infection with ISAV or, conversely, if early ISAV is a risk factor for sea lice infestation. The immune status of the ISAV- and sea lice-infected fish will be established by molecular and biochemical analysis of immune function. The role sea lice play as vectors of ISAV will also be established by investigating where the pathogen is located on/in the parasite after it has fed on infected fish, how long ISAV survives, both on the surface of the parasite and in its digestive system, as well as establishing if sea lice are a major vector transmitting the disease between wild and farmed fish and within and between farms.

Novel Methodologies to Overwinter Cultured Hard Clams in the Northeast U.S.

Funding level: $200,402
Project start date: January 2010
Project duration: 2 years
Participants: Rutgers University, University of Maine, Haskins Shellfish Research Laboratory, Baruch College

This project will examine new overwintering technologies for cultured hard clam juveniles in ME, NY, and NJ. The new methodology is based on 12 years of successful overwintering of cultured juveniles of *Mya arenaria* in Maine. An initial overwintering trial with hard clam seed (2.5-11.5 mm) during the winter of 2006-2007 in Maine resulted in > 99% survival over 177 days. Subsequent monitoring of seed in protected field plots in eastern Maine indicated >80% survival for four months. Similar results have been found during the winters of 2007-2008 and 2008-2009, thereby substantiating these preliminary results and warranting large, regional tests of this methodology. Two experimental field trials were done from Nov 2009 to April 2010, and Nov 2010 to April 2011 in the three states to examine spatial and temporal variation in the new overwintering techniques. Commercial quantities of local hard clam seed (3 sizes: 4-5.9 mm; 6-7.9 mm; 8-9.9 mm) were overwintered in each state for a 5-month period. To determine if success is related to seed source, a reciprocal study will be done by taking seed originating/reared in each state, and overwintering seed in the other states. In each state survival of overwintered seed using the new technique will be compared to survival of seed overwintered in protected field plots, as is the current, standard practice. In addition, the fate of local seed that survive the new overwintering methods in protected field plots will be monitored in each state for six months. Biochemical assays will be conducted on clams from all size classes and origins at each field site overwintered using the new methodology to measure energy use through the overwintering period and to determine if the ME genetic strain is better-adapted to temperature stress by using less energy stores. Simultaneously measuring biochemical composition and environmental parameters should also provide an understanding of how the various clam strains respond physiologically to local conditions and culture methods.