The following multi-year National Sea Grant aquaculture extension and technology transfer projects were selected in 2013 (first year of 2-year projects)

Sea Grant College Program	Institutional Affiliation	Sea Grant Director	Project Title	FY 13 Federal Share*	FY 13 Matching Funds*
Alaska Sea Grant	University of Alaska Fairbanks	Paula Cullenberg	Continued Growth of the Alaska Shellfish Farming Industry through Education, Workforce Development, and Extension Services	$80,000	$43,834
Connecticut Sea Grant	University of Connecticut	Sylvain De Guise	Identifying and Addressing Process-related Challenges to the Expansion of Sea Vegetable Aquaculture in Connecticut	$73,596	$30,503
Connecticut Sea Grant	University of Connecticut	Sylvain De Guise	Development of a Northeast Aquaculture Research Farm Network (NARF-Net)	$90,000	$42,513
Delaware Sea Grant	University of Delaware	Nancy Targett	Aquaculture and Fisheries Technologies for Food and Health Educators, Seafood Professionals and Communicators	$80,964	$37,443
Florida Sea Grant	University of Florida	Karl Havens	Revitalizing the Hard Clam Aquaculture Industry in the Southeastern U.S. through Transferring Technology on Sunray Venus Clam,	$90,000	$45,240
Maryland Sea Grant	University of Maryland, Center	Fredrika Moser	Evaluation of Innovative Practices for Sustainable Aquaculture Development in Chesapeake Bay	$83,826	$43,589
Texas Sea Grant	Texas A&M University	Pamela Plotkin	Seed-to-Harvest Operations Manual and Training Program for Indoor BioFloc-Dominated (BFD) Production of L. vannamei, the Pacific White	$90,000	$57,005
Washington Sea Grant	University of Washington	Penelope Dalton	Meeting demands for safe, sustainable shellfish aquaculture in Washington state	$80,000	$38,811
Wisconsin Sea Grant	University of Wisconsin System	Jim Hurley	Workforce Education and Training for Environmentally and Economically Sustainable Great Lakes Aquaculture	$90,000	$54,095
Woods Hole Sea Grant	Woods Hole Oceanographic	Judith McDowell	Increasing Public Awareness of Safe and Healthy Shellfish Consumption	$50,440	$25,659

***Amount shown is FY 2013 federal funding only. Projects are typically 2-year.**

Additional state Sea Grant aquaculture projects can be found via our public search at seagrant.noaa.gov

The following National Sea Grant Aquaculture Research projects were awarded in 2013
(second year of two-year projects from a 2012 competition):

Sea Grant College Program	Investigator	Investigator Affiliation	Project Title	FY13* Federal Share	FY13* matching funds
California Sea Grant	Lester	University of California Santa Barbara	Maximizing the value of offshore aquaculture development in the context of multiple ocean uses	$257,411	$133,863
California Sea Grant	Glazier	Impact Assessment, Inc.	Social Constraints and Solutions for Progressive Development of the Nation's Offshore Aquaculture Industry	$153,026	$80,703
Florida Sea Grant	Benetti	University of Miami	Monitoring, predicting, and managing the environmental impacts of offshore aquaculture in the United States	$46,349	$22,189
Hawaii Sea Grant	Haws	University of Hawaii	Expanding and Diversifying Near-shore Mariculture in Hawaii and the U.S. Affiliated Pacific Islands Through Resolution of Regulatory, Technical and Biological	$91,037	$78,453
Lousiana Sea Grant	Chen	Louisiana State University	Projection of Freshwater Diversion Impacts under Relative Sea Level Rise on Louisiana Oysters Using a Coupled Hydrodynamic-Water Quality Oyster Population Mode	$68,998	$38,787
Maine Sea Grant	Bricknell	University of Maine - ARS	The role of wild and farmed fish in modulating the infectious pressure of the sea louse (*Lepeophtherius salmonis* Kroyer 1837)	$213,835	$118,655
Maine Sea Grant	Brown	University of Maine - CCAR	From capture to culture: Adding value to the sea urchin fishery with aquaculture	$120,534	$47,411
Maine Sea Grant	Johnson	University of Maine	Aquaculture in Shared Waters	$92,017	$54,385
Maryland Sea Grant	Li	University of Maryland	Development and evaluation of eco-enfineered macroalgae and shellfish multi-trophic aquaculture systems in the Chesapeake Bay	$114,471	$73,585
Mississippi-Alabama Sea Grant	Kim	Mississippi State University	Innovative Application of Classic Microbiology for Detecting Vibrio vulnificus in Raw and Post-Harvest Processed Oysters	$45,508	$50,020
Mississippi-Alabama Sea Grant	Saillant	University of Southern Mississippi	A Genomic Approach to the Genetic Management of Aquaculture and Stock Enhancement in Emerging Marine Species	$146,508	$53,142
Mississippi-Alabama Sea Grant	Walton	Auburn University	Quantifying the Economic Value of Ecosystem Services of Oyster Farming as Offsets to Regulatory Fees	$194,755	$97,595
New Hampshire Sea Grant	Jones	University of New Hampshire	Reducing the Extent of Permanently Closed Shellfish Growing Areas through Regulatory Modernization	$110,572	$55,367
South Carolina Sea Grant	Norman	Clemson University	Perceptions of Marine Aquaculture in Tourist Destinations on the Southeastern United States Coast	$79,576	$39,064
Texas Sea Gran	Gold	Texas A&M University – College Station	Use of Next-generation DNA Sequencing to Inform Regulatory Decisions Regarding Spatial Sites for Marine Aquaculture in the Gulf of Mexico	$106,365	$56,058
Virginia Sea Grant	Berman	Virginia Institute of Marine Science	Planning Tools for Aquaculture Expansion and Management within the Chesapeake Bay	$131,597	$65,802
Washington Sea Grant	Cheney	Pacific Shellfish Institute	Planning for sustainable shellfish aquaculture in complex multiple use environments: Determining social and ecological carrying capacity for south Puget Sound	$138,170	$52,000
Washington Sea Grant	Rasmussen	Pacific Shellfish Institute	Identifying Current Activities, Public Perceptions, Conflicts, and Compatibilities for West Coast Shellfish Aquaculture	$35,617	$37,950
Washington Sea Grant	Rensel	System Science Applications, Inc.	Fish Aquaculture Simulation Model and GIS: Validation and Adaptation for Government Management Use	$63,658	$54,730
Washington Sea Grant	Roberts	University of Washington	Sea Grant Aquaculture Research Program 2012: Alleviating Regulatory Impediments to Native Shellfish Aquaculture	$227,518	$89,641

*Amount shown is FY 2013 funding only for multi-year projects

Additional state Sea Grant aquaculture projects can be found via our public search at seagrant.noaa.gov

National Sea Grant Aquaculture Extension and Technology Transfer projects awarded in 2013-14

Continued Growth of the Alaska Shellfish Farming Industry through Education, Workforce Development, and Extension Services
Alaska Sea Grant

Alaska is a challenging location to grow a shellfish aquaculture industry amid the biological, economic, and social constrains that challenges farmers. The Alaska Sea Grant Marine Advisory Program (MAP) in 1991 began assisting the budding industry with an extension program to promote a biologically sustainable, economically viable, and socially acceptable industry through applied research, education, and extension services. Through twenty years of collaborative efforts between MAP, coastal communities, shellfish farmers, supportive agencies, and advocates of economic development, the prospect for success is emerging. The industry is growing and receiving unprecedented support from a diversity of interests, culminating in 2012 with legislative authorization of $6.5 million farmer financing farmer and infrastructure. Now is the opportune time for shellfish aquaculture development in coastal communities to provide employment and economic opportunities. The process is underway with Alaska Native Corporation, Sealaska, investing significantly into farm development, existing shellfish farmers eager to adopt innovative proven practices, and new farmers entering the industry. The next major initiative is to develop an aggressive workforce development program to meet industry needs for skilled labor. Funding from this proposal will develop a comprehensive training program for participants ranging from high school students to experienced farmers, improve technical information delivery, and enhance extension services necessary to meet the workforce needs of this growing industry.

Technology Transfer of Self Cleaning Larval Rearing Tanks to the United States to Improve Microbial Control and Larval Survival
USC Sea Grant

The goals of this project are to increase public awareness of aquaculture and significantly advance sustainable marine aquaculture in the U.S. by improving larval rearing success and efficiency through enhanced microbial control, and extend information on enhanced larval husbandry techniques to other federal, state and private hatcheries in the U.S. Objective 1: To pilot-test a single production-scale, self cleaning culture tank at Hubbs-Sea World Research Institute's laboratory in San Diego. The main question being addressed in this objective "is this self-cleaning tank design mechanically and functionally robust". Objective 2: To rigorously test the functionality and efficiency of self-cleaning culture tanks against traditional tank designs using two different species of marine fish. Each of the two species of fish – white seabass and California yellowtail – has unique behaviors and associated culture requirements, which cover a spectrum applicable to other aquaculture species in the United States. Objective 3 : Ongoing throughout the pilot demonstrations to disseminate the results of this project widely through industry and agencies and to expand the Seabass in the Classroom Program into additional schools and enhance curricula used to increase awareness of the need for increased aquaculture production to supply future needs and how this can be sustainably accomplished.

Identifying and Addressing Process-related Challenges to the Expansion of Sea Vegetable Aquaculture in Connecticut
Connecticut Sea Grant

Interest in sea vegetable aquaculture in Southern New England is increasing, however, lack of federal guidelines regulating domestically cultivated sea vegetables and associated processing techniques poses a challenge to the expansion of this potentially new industry. Identifying and addressing potential hazards associated with the aquaculture and processing of sea vegetables will lead to established guidelines allowing for the sale of sea vegetables for human consumption. Objectives of this project include the development of a hazards guidance document to address any potential biological, chemical, or physical hazards identified with the production and processing of sea vegetables in Connecticut. A variety of processing techniques for sea vegetables will be conducted and the products tested to help in the hazard assessment. Investigations into processing facilities for sea vegetables in Connecticut will be undertaken as well as an economic viability assessment comparing various types of process facilities. Recommendations will be summarized in a report for the lead aquaculture regulatory agency in Connecticut.

Development of a Northeast Aquaculture Research Farm Network (NARF-Net)
Connecticut Sea Grant

Extension aquaculture specialists will work with industry partners to test and modify prototype shellfish aquaculture gear. In this project, team members will conduct evaluations of two new gear technologies on farms in six coastal states in New England. The participants will demonstrate the gear use and present the results of their field trials at farm field days and at industry technology transfer workshops in their respective states.

Aquaculture and Fisheries Technologies for Food and Health Educators, Seafood Professionals and Communicators
Delaware Sea Grant

Aquaculture creates important new opportunities to meet the increasing local and international demand for seafood, but a number of questions need to be addressed for its full potential to be realized. The quality and safety of wild-caught and farm-raised products is a growing concern with increased consumption and international trade. Sea Grant has a key role to play in advancing public understanding of the nature of these problems. Consumers are confused about many issues related to including seafood in their diet. There is a need to increase the level of training for food and health educators, seafood professionals and others so that they may better inform their local audiences and help to achieve Sea Grant National strategic goals for a safe, secure and sustainable seafood supply and informed consumers who understand how to evaluate the health benefits, the safety and sustainability of the seafood they buy. This project will focus on conducting in-service training programs on the East, West and Gulf Coasts to provide information covering current issues, developments and trends for fishery and aquaculture industries and products, including proper selection, preparation and handling.

Revitalizing the Hard Clam Aquaculture Industry in the Southeastern U.S. through Transferring Technology on Sunray Venus Clam Production
Florida Sea Grant

This project aims to provide the impetus needed for the shellfish aquaculture industry to advance the production and distribution of a promising new aquaculture species, the sunray venus clam *Macrocallista nimbosa*. Revitalization of an industry that is currently based exclusively on one bivalve species will be achieved by facilitating technology transfer to the various industry sectors (seed suppliers, growers, wholesalers) of the established hard clam industry in Florida, geographically diversifying culture areas within the southeastern United States, and promulgating market development. This project will provide the necessary infrastructure via a public-private partnership with Sea Grant specialists and industry to commercialize the sunray venus clam through large-scale demonstration, education, and "hands-on" training. Development of alternative culture species and farming technology represents an important gain over the present reliance of a single clam species crop.

Increasing Public Awareness of Safe and Healthy Shellfish Consumption
Woods Hole Sea Grant (single-year study)

Recent press regarding potential human pathogens tied to consumption of raw shellfish has been identified as an emerging concern to the reputation and value of the growing Massachusetts shellfish aquaculture industry. There is a need to educate consumers about the potential risk of raw seafood products while also reaffirming the health value and safeguards in place to provide quality shellfish from local waters. In addition, there is a need amongst the shellfish grower and harvester communities to understand how to manage the shellfish product to be harvested to ensure the best quality product. This project is a cooperative effort of Woods Hole Sea Grant, the Massachusetts Division of Marine Fisheries, the Massachusetts Department of Agriculture, and the Massachusetts Aquaculture Association to provide educational materials to inform the public on safe and healthy shellfish consumption.

Evaluation of Innovative Practices for Sustainable Aquaculture Development in Chesapeake Bay
Maryland Sea Grant

The Maryland Sea Grant Program will maintain an Aquaculture Business Specialist as part of its Extension Aquaculture Team. The Aquaculture Business Specialist will provide one-on-one business counseling services to current and prospective Maryland aquaculturists. Assistance will be provided for developing business plans, financial projections, and determining farm sizes to meet individual financial goals. The Aquaculture Specialist to provide additional extension programming on aquaculture business management via online tools, workshops, and one on one client meetings. Additionally the Aquaculture Specialist will play a critical role in advancing the concept of compensation for ecosystem services provided by oyster aquaculture. The Chesapeake Bay Total Maximum Daily Load (TMDL) has created an environment where the role of oysters in nutrient cycling can be monetized via a nutrient trading or offset program.

Seed-to-Harvest Operations Manual and Training Program for Indoor BioFloc-Dominated (BFD) Production of L. *vannamei*, the Pacific White Shrimp
Texas Sea Grant

Traditional shrimp farming discharges nutrients, organic waste, and disease vectors that threaten coastal environments. The indoor Biofloc-Dominated system developed over the past 20 years at the Texas A&M AgriLife Research Mariculture Lab at Flour Bluff, Corpus Christi, Texas promotes sustainability through limited water exchange with harvest densities up to 7 times those of traditional systems. This work will summarize recent developments in a manual accessible to producers, technicians, and entrepreneurs. It will describe BFD design and operation, the economics of the Texas A&M AgriLife system, and water-quality concepts that generally are poorly understood in the commercial sector. The latter will use proprietary graphical software to explain technical aspects of water-quality management without invoking chemical and mathematical calculations. The focus will be on L. *vannamei*, but content will be relevant to live bait shrimp, and Tilapia. The manual will contribute to revitalizing US shrimp farming by providing commercial interests with practical training on sustainable BFD technology.

Meeting demands for safe, sustainable shellfish aquaculture in Washington state
Washington Sea Grant

The shellfish aquaculture industry in Washington state is large, diverse, and faces numerous challenges to long-term sustainability. These include evolving culture techniques, controlling disease, maintaining product quality and genetic diversity, and minimizing ecological impacts of their operations. In addition, threats such as climate change, ocean acidification, harmful algal blooms, pathogenic bacteria, aquatic invasive species and hypoxia threaten the health of shellfish resources. There is also a growing friction between the industry and shoreline residents with respect to long-term coastal development priorities. Finally seafood consumers are confused and concerned about the safety and ecological sustainability of aquaculture and its products. This project facilitates interaction of WSG aquaculture outreach and research activities to engage and inform shellfish farmers, state and regional agencies, tribes, stakeholder groups and the public. Using our previously completed needs assessment, WSG, is conducting an integrated program of outreach events such as conferences, workshops, and documentary screenings; expanded citizen engagement and monitoring; and technical assistance, curricula, and publications on topics like shellfish culture and seafood safety.

Workforce Education and Training for Environmentally and Economically Sustainable Great Lakes Aquaculture
Wisconsin Sea Grant

Great Lakes region aquaculture represents an array of production systems with flow-through, pond, and recirculating aquaculture systems. While nationally the aquaculture industry continues to expand, growth of the Great Lakes region's aquaculture industry has slowed. Many new and existing fish farmers cite a need for technical training and dissemination of current production knowledge, especially in the area of sustainable recirculating systems and associated business operations. This project will increase aquaculture workforce education and training opportunities and provide skilled workers for a continuously developing aquaculture industry. Objectives are: 1) develop a series of nine, three to five-day teaching modules based on topics the Great Lakes aquaculture industry has identified as deficient in current education offerings, and 2) deliver these teaching modules through a 3-tiered system of progressive advancement using online lectures and in-person workshops for direct technology transfer.

National Sea Grant aquaculture research projects awarded in 2012

(Second year of two-year projects):

Maximizing the Value of Offshore Aquaculture Development in the Context of Multiple Ocean Uses

University of California Santa Barbara

Offshore and open ocean aquaculture are potentially sustainable options for meeting growing seafood demand. However, it is critical to proactively manage offshore aquaculture's future development to minimize conflicts with existing uses and maximize the value of our ocean resources. This project will develop a new dynamic spatial tradeoff analysis framework to quantitatively model and evaluate the economic and environmental tradeoffs between offshore aquaculture development and other existing and planned marine uses in order to in order to identify promising spatial plans for aquaculture siting. This goal will be achieved by: 1) assessing the full suite of potential conflicts and environmental impacts associated with offshore aquaculture, 2) developing a spatial bioeconomic model for the Southern California Bight as a case region, 3) applying our model to aquaculture planning and regulation development in California to maximize sustainable production across multiple uses, and 4) generalizing the modeling framework so that it can be adapted to aquaculture siting across the US, and presenting this framework in a series of outreach events in key regions. Ultimately, this project aims to move the dialogue in the US about offshore aquaculture development to a place of greater regulatory certainty and environmental sustainability.

Social Constraints & Solutions for Progressive Development of the Nation's Offshore Aquaculture Industry

Impact Assessment, Inc.

It is widely recognized that future levels of production in our nation’s capture fisheries are not likely to increase substantially and that offshore aquaculture has the potential to enhance domestic food security. The overarching goal of this project is to identify valid options for mitigating social and social-environmental limitations on the development of a viable aquaculture industry in the Exclusive Economic Zone (EEZ) of the United States. This will be achieved through implementation of a systematic social science research approach designed to: (1) thoroughly document the range of social, economic, environmental, cultural, and ocean space-use challenges now confronting the industry; and (2) elicit, analyze, and compare expert perspectives on how such limitations could be effectively diminished. The project will generate data and analysis of utility for formal policy deliberations regarding the future of the industry, and should a policy framework be developed to enable aquaculture firms to undertake operations in the EEZ, such information will be of value to agency representatives charged with moving the industry forward under new and existing policies and mandates.

Monitoring, predicting, and managing the environmental impacts of offshore aquaculture in the United States

University of Miami

Offshore aquaculture avoids many of the problems of traditional fish farming. Most importantly, these systems do not discharge waste into coastal ecosystems. Nonetheless, even in the open ocean, at a large enough scale, waste from these systems may increase local primary productivity, alter benthic environments, and affect food webs. Unfortunately, the scale of operation at which these impacts would become significant is unknown. This knowledge gap makes it difficult to plan for aquaculture development because questions about siting, scale, and ecosystem effect cannot be answered. In this project, we intend to address this knowledge gap by applying novel techniques for monitoring, predicting, and managing the ecosystem impacts of offshore aquaculture. To do this we propose to: 1) use Lagrangian platforms to monitor nutrient discharges and associated plankton, and benthic, community dynamics at a commercial offshore aquaculture facility; 2) model the ecosystem effects of a hypothetical offshore aquaculture industry in the Gulf of Mexico; and 3) analyze ecosystem-based management policy schemes in light of the data and insights gathered via the monitoring/modeling portions of this project.

Expanding and Diversifying Near-Shore Aquaculture in Hawaii and the U.S. Affiliated Pacific Islands through Resolving Regulatory, Technical and Biological Impediments

University of Hawaii

This research is intended to overcome key obstacles that impede small- and medium-scale forms of sustainable aquaculture in Hawaii and U.S. Affiliated Pacific Islands. The focus is on overcoming permitting and management issues for traditional Hawaiian fishponds, primary sites for small-scale aquaculture. Also, developing approaches and methods to support the fledgling bivalve culture industry is important now that legal impediments to bivalve culture have been surmounted, thus allowing clam and oyster culture to proceed. Outcomes expected from this initiative are: 1) support to streamline permitting related to aquaculture for traditional Hawaiian fishponds; 2) data base and GIS model of parameters related to water quality and aquaculture for the same ponds; 3) development of methods and plans for small-scale bivalve culture in Hawaii and the Marshall Islands. For the latter component, a nursery system will be developed for open coastal waters, a state bivalve development plan will be drafted, an oyster breeding program designed and implemented, and oyster growout trials will be conducted in the Marshall Islands.

Projection of Freshwater Diversion Impacts under Relative Sea-Level Rise on Louisiana Oysters Using a Coupled Hydrodynamic-Water Quality-Oyster Population Model

Louisiana State University

In a rapidly changing coastal environment, knowing when and where appropriate conditions will exist for productive oyster aquaculture is critical for proper management of the industry. The objectives of the study are to: 1) develop a coupled hydrodynamic, water quality and oyster population model; and 2) examine the effects of Mississippi River diversions and Relative Sea Level Rise (RSLR) on spatial and temporal variability of eastern oyster population dynamics in coastal Louisiana using an integrated spatial modeling approach. The computer model will be

integrated with field measurements to assess the impacts of river diversion projects on oyster population size, growth rates and total production, and to project those impacts on oyster production under different scenarios of RSLR in the Breton Sound Estuary, an important oyster production area in Louisiana. Findings will be disseminated at conferences, meetings and workshops to allow oyster producers to best plan and adapt to RSLR and wetland restoration. Through the Louisiana Sea Grant, results will be extended to stakeholders involved in oyster production and managers of wetland restoration in coastal Louisiana.

The role of wild and farmed fish in modulating the infectious pressure of the sea louse (*Lepeophtheirus salmonis* Krøyer 1837)

University of Maine

The project is a collaboration between the Aquaculture Research Institute, University of Maine and an industry partner, Cooke Aquaculture. The overall goal of the proposal is to establish and model where and when sea lice, whether shed from wild or farmed fish, infect migrating or farmed salmonids in a near-shore ecosystem and to identify potential wild reservoirs of sea lice. The impact a fish farm has on the infective pressure of sea lice in the coastal zone will also be investigated. This project will provide vital information to understand the infectious pressure of sea lice, the role of wild fish as hosts for sea lice, and sea lice infection dynamics over an aquaculture production cycle, enabling the evaluation and refinement of collaborative integrated pest management efforts and providing a scientific framework to inform lease-granting bodies and marine resource users of the actual risk factors associated with wild fish populations to salmon farms (or vice versa). Measurement of infectious pressure of sea lice will be achieved via the placement of Atlantic salmon sentinels at four fixed locations within Cobscook Bay, ME (an active area of salmon aquaculture), quantifying the effects of location, seasonality and environmental factors on the infectious pressure of sea lice. Wild fish will be monitored for sea lice infections at the site. This will help establish whether or not a peripatetic or reservoir wild host species exists within the bay system.

From capture to culture: Adding value to the sea urchin fishery with aquaculture

University of Maine

This project evaluates an intensive, land-based culture system for wild caught and cultured green sea urchins (*Strongylocentrotus droebachiensis*). Such a system allows them to be held at high densities (>50 kg/m2) while being fed seaweed to improve gonad yields and quality. This can add significant economic value to sea urchins marketed to Japan. Methods to hold and market sea urchins beyond the fishing season will also be tested. Gonad analysis and a taste panel will evaluate sea urchin market quality from this system and the project will also include a market study and cost/benefit analysis of these methods. Including sea urchin aquaculture within a Fisheries Management Plan will be discussed with fishery regulators and sea urchin industry members. The project has implications for other regions in the US where sea urchin and seaweed fisheries co-exist with aquaculture.

Aquaculture in Shared Waters

University of Maine

This project aims to assess commercial fishermen's perceptions of potential barriers to and opportunities for exploring aquaculture production; to develop and implement a comprehensive aquaculture career training program; and to assess attitudinal changes resulting from outreach and education. This project combines social science research with community outreach and an applied education plan to gather information on perceptions and understanding by commercial fishermen on the inclusion of aquaculture production into their livelihoods as seafood producers. Investigators from the University of Maine and Maine Sea Grant will identify two groups of commercial fishermen along the coast of Maine to engage in a comprehensive education program in shellfish and seaweed aquaculture. Project partners include the Maine Aquaculture Association, Maine Aquaculture Innovation Center, Coastal Enterprises, Inc. and Island Institute. The educational program will be designed to maximally prepare participants to file a lease application with the state, and to begin production operations.

Development and Evaluation of Eco-engineered Macroalgae and Shellfish Multi-trophic Aquaculture Systems in the Chesapeake Bay

University of Maryland

The goal of this project is to develop integrated multi-trophic aquaculture (IMTA) systems for Chesapeake Bay seaweeds and oysters, and evaluate the ecological impacts. Detailed objectives include: 1) identify suitable seaweed species for culture in the Chesapeake Bay; 2) design a seaweed culture system compatible with shellfish culturing systems; 3) obtain nutrient uptake data, growth rate and yield data for selected seaweed species, and estimate the nutrient remove efficiency; 4) modify current ecosystem models for the seaweed-shellfish IMTA systems to estimate carrying capacity, prediction of production and evaluate environmental impact of the systems; and 5) give an economic assessment of the economic impact of seaweed aquaculture. Seaweeds act as biofilters to remove the extra nutrients. By harvesting the seaweed, nutrients are directly removed from the water. This project will enhance economic and the environmental sustainability of Chesapeake Bay oyster aquaculture. High value seaweed production will also increase local income and job opportunities.

Innovative Application of Classic Microbiology for Detecting *Vibrio vulnificus* in Raw and Post-Harvest Processed Oysters

Mississippi State University

The primary goals of this project are: (1) to develop a rapid, simple, and reliable *Vibrio vulnificus* detection/quantification kit as an alternative to procedures currently accepted by ISSC; (2) to validate the test kit for the detection of V. *vulnificus* in raw oysters (live and processed) using procedures currently accepted by ISSC as the reference method; (3) to introduce the innovative key technologies and their detection/quantification concepts to educate extension personnel and undergraduate and graduate students; and (4) to transfer technology to the oyster industry and institutions that conduct post-harvest process (PHP) validation and verification testing. The research project objectives 1 and 2 will benefit the U.S. Gulf oyster industry, and state and federal agencies by having a rapid in-house V. *vulnificus* detection kit in PHP facilities. Objectives 3 and 4 will be useful for multiple partners (oyster industry, academia and state and federal agencies) because the features of the test kit provide easy use even for individuals with minimal training, such as education/extension/inspection services personnel.

A genomic approach to the genetic management of aquaculture and stock enhancement in emerging marine species

University of Southern Mississippi

Sustainable management of aquaculture and stock enhancement projects requires reliable information on spatial genetic structure in particular on the genetic adaptation of local wild populations. Investigating natural selection and local adaptation has been especially challenging in emerging non-model species, but is now greatly enhanced thanks to the advent of high throughput genomic technologies. In this project, the potential of the recently developed RAD-tag sequencing methodology will be illustrated by surveying a large panel of single nucleotide polymorphism (SNP) loci in geographic populations of the red snapper, a species with high potential for marine aquaculture in the United States. The dataset will be analyzed to provide a robust assessment of divergence among regions where red snapper differ in phenotype, thereby assisting in the formulation of recommendations regarding the genetic origin of red snapper that should be reared and/or released in each region. The method will also be used to develop a linkage map incorporating SNP and microsatellite loci. The map will be a critical asset for stock enhancement and future development of domestication programs for this species.

Quantifying the Economic Value of Ecosystem Services of Oyster Farming as Offsets to Regulatory Fees

Auburn University

Three significant regulatory hurdles to the establishment of oyster farming in the Gulf of Mexico region have been identified, through direct experience and working with numerous stakeholders. The specific goals of this project are to measurably: 1) clarify and publicize the submerged land leasing fees for off-bottom oyster farming in each Gulf of Mexico state, increasing the transparency of the leasing process and its costs; 2) educate Gulf of Mexico seafood industry members, including current & prospective oyster farmers, and the general public about the potential value of ecosystem services provided by oyster farming; 3) educate Gulf of Mexico state permitting and management agencies & legislators about the potential value of ecosystem services provided by oyster farming; and 4) engage in collaborative learning with the Alabama Department of Conservation and Natural Resources to determine the feasibility of and process for utilizing ecosystem services valuation to offset submerged land leasing fees. The results of this project will be valuable to a wide variety of stakeholders, both regionally and nationally. If these challenges can be addressed, significant investment and subsequent establishment of a substantial oyster farming industry within the region is anticipated.

Reducing the Extent of Permanently Closed Shellfish Growing Areas through Regulatory Modernization

University of New Hampshire

In the Northeastern United States, many acres of productive shellfish growing waters are permanently closed to aquaculture and harvesting activities, due to concerns associated with human fecal pollution from municipal wastewater treatment plant outfalls. The main public health concern is disease occurrence from exposure to enteric viruses, yet the fecal coliform

indicator used to regulate harvesting is a poor indicator of viruses. The overall project goal is to assess currently closed, yet highly productive, shellfish beds for aquaculture and harvest based on solid scientific evidence ensuring shellfish safety. The primary research objective is to determine the efficacy of using male-specific coliphage (MSC) as a model indicator of enteric viral contamination for shellfish. This project will determine the relationships between water temperature-influenced seasonal levels of norovirus (NoV), MSC and fecal coliforms (FC) in Eastern oysters (*Crassostrea virginica*) and hard-shelled clams (*Mercenaria mercenaria*) harvested from a mid/southerly New England estuarine system in Massachusetts. The project will also determine relative NoV, MSC and FC elimination (reduction) kinetics during relay and depuration as they relate to water temperature and season. The project will positively impact aquaculture development, quality assurance processes, and ultimately consumer confidence, and increasing available growing areas in New England and nationally.

Perceptions of marine aquaculture in coastal tourist destinations in the U.S. Southeastern Region

Clemson University

Marine aquaculture and tourism are both important economic diversification strategies in coastal fishing communities facing the decline of wild-capture fisheries. Growth of marine aquaculture has been limited by economic, regulatory, and socio-political barriers, creating unfavorable conditions for investment. Understanding public support is valuable to generating regional policies and strategies that respond to stakeholder concerns about aquaculture. Little work has been done in the U.S. to examine public perceptions of nearshore and shore-based aquaculture. This study will examine perceptions of coastal tourists and residents in a variety of coastal communities where marine aquaculture and tourism are present. The study uses a comparative case-study approach to select coastal communities in Florida and South Carolina as means to assure variability in types of marine aquaculture and levels of tourism. The study uses focus groups and a survey targeting visitors and residents in each community. Results will be disseminated to aquaculture industry associations, coastal tourism development and planning representatives and state and federal marine resource managers who need input for marine spatial planning and/or aquaculture investment strategies.

Next-generation DNA sequencing for use in permitting, spatial planning, and domestic aquaculture of red drum

Texas A&M University – College Station

This project is designed to utilize next-generation DNA sequencing technology to identify geographic stocks of red drum (*Sciaenops ocellatus*) in the Gulf of Mexico (hereafter Gulf). The new technology will be used to generate and then map thousands of single nucleotide polymorphisms (SNPs). Immediate benefits of the research will be unequivocal identification of geographic units based on genetic differences inferred to represent locally adapted populations or stocks. This will establish a cutting-edge, science-based approach to agency permitting and spatial site planning for new or expanded facilities that will mitigate adverse genetic effects to wild populations (stocks) stemming from escapements at commercial facilities and/or from releases in restoration (enhancement) projects where captive individuals (brood stock) are not genetically representative of local stocks. The research also will contribute to commercial and

restoration aquaculture ongoing in the Gulf region and, in addition, provide genetic tools that can be used to develop genetic selection to enhance commercial red drum production.

Planning Tools for Aquaculture Expansion and Management within the Chesapeake Bay

Virginia Institute of Marine Science

The proposed project addresses several key aquaculture issues challenging managers and policy makers within Virginia and Maryland. The first issue is related to the overall desire to expand the aquaculture industry in both states. In support of this the project will use Geographic Information Systems and techniques common in marine spatial planning to model areas that are suitable for shellfish aquaculture. A web-based educational resource will be developed where this information will be formatted and accessible as a web mapping tool. More specific to the regulation and management of aquaculture in Virginia, the project will develop tools which will improve the state's capacity to monitor and regulate activities that are occurring on state-owned subaqueous bottom. Map services will be developed to provide managers with visual tools to assist in tracking aquaculture activities in leased areas. Finally, the project will engage stakeholders in a survey to better understand the perception of the aquaculture industry from the perspective of the general public, commercial waterman, aquaculturists, and policy makers. This information will reveal both positive and negative perspectives across the diverse stakeholder community and will bolster any future efforts on the part of the Commonwealth to revise policy which affects the industry.

Planning for sustainable shellfish aquaculture in complex multiple use environments: Determining social and ecological carrying capacity for south Puget Sound, Washington

Pacific Shellfish Institute

Shellfish aquaculture is poised to become a dominant player in the U.S. seafood industry, and production on the West Coast has increased steadily over the last 30 years. Using South Puget Sound in Washington State as a case study, this project will define and model factors involved in production and ecological impacts for shellfish aquaculture, along with an approach for generating social carrying capacity data and engaging coastal communities in the modeling process. Farm Aquaculture Resource Management (FARM) and EcoWin2000 models will be used to calculate production and ecological carrying capacities, respectively, at the farm and system scales. Outputs from EcoWin2000, together with water quality and socio-economic data, will be combined using an ASSETS eutrophication assessment model. Ecopath and EcoSim (EwE) will be employed to simulate marine organism interactions and responses to changing anthropogenic and environmental stressors. Within the EwE work, we will engage a stakeholder working group and integrate feedback from a public perceptions survey. We have termed this research a Production, Ecological, and Social Capacity Assessment (PESCA), which combined with the development of relevant guidance documents, will be directed at informing and assisting in coastal and marine spatial planning activities throughout the U.S.

Identifying Current Activities, Public Perceptions, Conflicts, and Compatibilities for West Coast Shellfish Aquaculture

Pacific Shellfish Institute

Increasing coastal populations and complex economic and environmental variables are presenting new challenges for the sustainable management of marine and coastal areas along the West Coast. To manage new and existing coastal development issues, state, regional, and federal agencies and organizations are turning to coastal and marine spatial planning (CMSP) as a tool to support ecosystem-based management and increase public engagement in planning activities. Defining and analyzing exiting conditions, including collecting and mapping information about human activities and identifying current conflicts and compatibilities, are key components of the CMSP process. This proposal aims to support CMSP activities in Washington, Oregon, and California as well as the development of ecologically and socially sustainable shellfish aquaculture in the region by combining geospatial data of commercial shellfish operations and relevant infrastructure and regulations with research and outreach on the social dimensions of shellfish aquaculture. This information will support shellfish aquaculture planning, identify and address current or potential multi-use conflicts or misconceptions, inform and support public outreach and education efforts, and increase awareness of the environmental, economic, and social opportunities shellfish culture provides.

AquaModel Fish Aquaculture Simulation Model and GIS: Validation and Adaptation for Government Management Use

System Science Applications, Inc.

Coastal oceans of the United States are generally well-suited for fish aquaculture, but to date there have been no commercial-scale operations permitted anywhere in the U.S. marine exclusive economic zone. No permitting or management structures for this zone exist and agencies lack necessary quantitative tools to develop management requirements and safeguards. AquaModel (www.AquaModel.org) is a Geographic Information System (GIS) that was developed to simulate the siting, operation and environmental effects of individual or multiple net pen fish farm operations in both coastal and oceanic waters. AquaModel utilizes 3D data from several well-established circulation models and includes fish physiology and benthic effects modules that produce results similar to those observed. This project is focused on formal validation of AquaModel to insure accuracy for use by governments including NOAA staff who have received training to use the system. The attributes of data from candidate validation sites in the U.S. and Canada will be examined to select those that provide the most accurate and comprehensive data that the model requires. Using the best-available data series, we will describe relationships between model input variables of operations and environmental conditions and output variables related to conditions and effects of each fish farm. Validation will involve not just testing, but tuning of model performance to improve accuracy.

Alleviating Regulatory Impediments to Native Shellfish Aquaculture

University of Washington

A significant impediment to sustainable aquaculture is the lack of proper information to predict the impacts of culturing native shellfish species for restoration and commercial production. The overall goals of this project are to increase our knowledge of local adaptation in Olympia oysters to address concerns that interbreeding between potentially maladapted cultured and wild stocks could negatively impact wild populations. Accordingly, in order to attain these goals, the specific objectives of this proposal are to evaluate fitness components and performance of seed from

different origins in a reciprocal transplant experiment and characterize genetic and epigenetic variation associated with oysters from different origins. Based on our results, stakeholders will be able to modify practices to increase aquaculture sustainability and resolve regulatory impediments to the successful expansion of domestic aquaculture. Outreach and education will be carried out via an online portal, citizen science effort, direct connection with the aquaculture community, and a targeted workshop.