

The following national Sea Grant aquaculture extension and technology transfer projects were awarded in 2012 (final year of three-year projects from a 2010 competition):

Sea Grant College Program	Sea Grant Director	Institutional Affiliation	Project Title	FY12 Federal Share*
Connecticut Sea Grant	Sylvain De Guise	University of Connecticut	Community Supported Aquaculture & Education Program	\$89,654
Florida Sea Grant	Karl Havens	University of Florida	Implementation of an Extension Program to Develop the Marine Baitfish Aquaculture Industry in Florida	\$99,913
Georgia Sea Grant	Hopkinson	University of Georgia	Oyster Culture: Diversifying Clam Aquaculture in Coastal Georgia	\$97,366
Illinois-Indiana Sea Grant	Miller	University of Illinois	Outreach and Education Programming Aquaculture and Seafood Products in the Great Lakes Region	\$84,970
Maine Sea Grant	Anderson	University of Maine	Building Extension Capacity towards Sustainable Aquaculture in Maine	\$100,000
Maryland Sea Grant	Moser	University System of Maryland	Evaluation of Innovative Practices for Aquaculture Development	\$97,962
Mississippi-Alabama Sea Grant/Louisiana Sea Grant	Swann/Twilley	University of Southern Mississippi	Farming the Fertile Crescent: Intensification of Oyster Culture in the Northern Gulf of Mexico	\$132,317
New Hampshire Sea Grant	Pennock	University System of New Hampshire	NH Aquaculture Extension Enhancement in Marine Finfish and Molluscan Shellfish Aquaculture	\$93,353
New Jersey Sea Grant	Antonucci	New Jersey Marine Sciences Consortium	Delaware Bay and Southern New Jersey-PI Rowe and Kraeuter	\$100,000
North Carolina Sea Grant	White	North Carolina State University	Developing Tools for the Growth of North Carolina Shellfish Industry: Site Condition Assessment and Economic Impacts	\$95,830
Oregon Sea Grant	Brandt	Oregon State University	2010 Oregon Sea Grant Aquaculture Extension and Technology Transfer	\$99,906
Puerto Rico Sea Grant	Chaparro	University of Puerto Rico	Outreach Mariculture Project as a Fisheries Alternative for Puerto Rico; Growout of Yellowtail and Lane Snappers (<i>Ocyurus chrysurus</i> , <i>Lutjanus synagris</i>)	\$98,951
South Carolina Sea Grant	DeVoe	South Carolina Sea Grant Consortium	Development and delivery of technical training, outreach and demonstration research projects focused on shellfish aquaculture	\$80,715
Virginia Sea Grant	Hartley	Virginia Institute of Marine Science	Virginia Shellfish Aquaculture Extension - Linking Research and Industry for Sustainable Development	\$97,920
Washington Sea Grant	Dalton	University of Washington	Enhancing aquaculture extension and technology transfer in Washington and the Pacific Northwest	\$100,000
Wisconsin Sea Grant	Hurley	University of Wisconsin System	Urban Aquaculture, A Game Changer	\$99,999

*Amount shown is FY 2012 federal funding only (excludes matching funds). More information about NOAA's Sea Grant Program and Aquaculture Program can be found at <http://seagrant.noaa.gov> and <http://aquaculture.noaa.gov>.

The following national Sea Grant aquaculture research projects were awarded in 2012

Sea Grant College Program	Investigator	Investigator Affiliation	Project Title	Federal Share
California Sea Grant	Lester	University of California Santa Barbara	Maximizing the value of offshore aquaculture development in the context of multiple ocean uses	\$129,133
California Sea Grant	Glazier	Impact Assessment, Inc.	Social Constraints and Solutions for Progressive Development of the Nation's Offshore Aquaculture Industry	\$169,776
Florida Sea Grant	Benetti	University of Miami	Monitoring, predicting, and managing the environmental impacts of offshore aquaculture in the United States	\$140,146
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 Impediments	\$291,045
Louisiana 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 Model	\$80,998
Maine Sea Grant	Bricknell	University of Maine - ARS	The role of wild and farmed fish in modulating the infectious pressure of the sea louse (<i>Lepeophtheirus salmonis</i> Kroyer 1837)	\$247,603
Maine Sea Grant	Brown	University of Maine - CCAR	From capture to culture: Adding value to the sea urchin fishery with aquaculture	\$94,469
Maine Sea Grant	Johnson	University of Maine	Aquaculture in Shared Waters	\$107,202
Maryland Sea Grant	Li	University of Maryland	Development and evaluation of eco-engineered macroalgae and shellfish multi-trophic aquaculture systems in the Chesapeake Bay	\$114,471
Mississippi-Alabama Sea Grant	Kim	Mississippi State University	Innovative Application of Classic Microbiology for Detecting <i>Vibrio vulnificus</i> in Raw and Post-Harvest Processed Oysters	\$43,531
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	\$112,224
Mississippi-Alabama Sea Grant	Walton	Auburn University	Quantifying the Economic Value of Ecosystem Services of Oyster Farming as Offsets to Regulatory Fees	\$191,720
New Hampshire Sea Grant	Jones	University of New Hampshire	Reducing the Extent of Permanently Closed Shellfish Growing Areas through Regulatory Modernization	\$183,421
South Carolina Sea Grant	Norman	Clemson University	Perceptions of Marine Aquaculture in Tourist Destinations on the Southeastern United States Coast	\$60,948
Texas Sea Grant	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	\$111,685

Virginia Sea Grant	Berman	Virginia Institute of Marine Science	Planning Tools for Aquaculture Expansion and Management within the Chesapeake Bay	\$164,472
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	\$166,428
Washington Sea Grant	Rasmussen	Pacific Shellfish Institute	Identifying Current Activities, Public Perceptions, Conflicts, and Compatibilities for West Coast Shellfish Aquaculture	\$96,442
Washington Sea Grant	Rensel	System Science Applications, Inc.	Fish Aquaculture Simulation Model and GIS: Validation and Adaptation for Government Management Use	\$85,838
Washington Sea Grant	Roberts	University of Washington	Sea Grant Aquaculture Research Program 2012: Alleviating Regulatory Impediments to Native Shellfish Aquaculture	\$199,853

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National Sea Grant Aquaculture extension and technology transfer projects awarded in 2012 (final year of three-year projects):

Increasing Economic and Educational Opportunities in Shellfish Aquaculture: A Community Supported Aquaculture and Education Project

University of Connecticut

This project will increase economic and educational opportunities for shellfish aquaculture in Connecticut and beyond, in part by hiring new Sea Grant extension staff. The primary responsibility of the new staff member will be to develop (in collaboration with an industry partner) the state's first Community Supported Aquaculture (CSA) project. CSAs act as a mechanism for community members to invest in a farm prior to the production season, assume a shared risk with the farmer, and receive a return on their investment during the farming season or upon harvest. The extension staff will work with the industry partner to develop a business plan and implement the CSA in the local community of Groton, Connecticut. Additionally, the new staff would work to create a series of courses in shellfish aquaculture techniques; this training would prepare students for a career in aquaculture as well as provide local resource managers with knowledge essential for the culture and management of molluscan shellfish.

Implementation of an Extension Program to Develop the Marine Baitfish Aquaculture Industry in Florida

University of Florida

This project aims to develop a marine baitfish aquaculture industry, diversify the aquaculture industries of Florida and the southeastern United States, provide a sustainable alternative to wild caught baitfish for Florida's recreational fishery, and create business and employment opportunities in coastal communities. This project will engage in three years of concerted extension activities to educate current and potential aquaculture producers, wholesale and retail distributors, and increase the number of extension personnel trained to serve the marine bait industry. The project will partner with the University of Florida and Florida Sea Grant and will use the Aquaculture Research and Demonstration Facility at the University of Florida Indian River Research and Education Center.

Oyster Culture: Diversifying Clam Aquaculture in Coastal Georgia

University of Georgia

This project will provide support for a full time Aquaculture Specialist to promote the expansion of the shellfish aquaculture industry for coastal Georgia, thus providing an alternative or supplementary source of income to rural Georgia fishing communities. The goal will be to diversify clam aquaculture farms into producing oysters in a sustainable manner. It will accomplish this by transferring current research knowledge directly to industry, starting with Sapelo Sea Farms, our industry partner. Georgia Sea Grant, The University of Georgia Marine Extension Service, Georgia Department of Natural Resources and local industry will partner to make oyster farming a sustainable aquaculture industry for Georgia.

Outreach and Education Programming Aquaculture and Seafood Products in the Great Lakes Region

University of Illinois

The need exists to educate potential and existing aquaculture farmers on fish handling and production management techniques in the Great Lakes region. This project will organize regional workshops to focus on production practices in aquaculture, indoor recirculating systems, cage production, pond production, and aquaponics. An extension assistance program on waste utilization and waste management will be conducted in conjunction with the workshops to teach potential applications for handling waste by-products. In addition, select topics from the workshop will be converted into webinars that can be broadcast to a national audience. Deliverables from the project will include video materials on the “how-to” on types of fish culture systems and educational materials to increase awareness in waste managing practices. Finally, the project will develop an educational program promoting the benefits of eating locally-raised aquacultured fish.

Building Extension Capacity towards Sustainable Aquaculture in Maine

University of Maine

The goal of this project is to promote the development of a sustainable aquaculture model through the implementation of Integrated Multi-trophic Aquaculture and other innovative farm management and husbandry practices. The project will create a new position for an Extension Associate focused on facilitating the transformation of Maine’s aquaculture industry to one that uses a sustainable farm model. The agent will help existing and future commercial aquaculturists integrate new concepts and technology into their business plans to maximize the economic opportunity of fish farming while ensuring ecological sustainability. The new Associate will join the existing ten-member University of Maine Marine Extension Team (MET) and will bring intellectual resources from Cooperation Extension and the new Aquaculture Research institute (ARI) at the University of Maine to industry through workshops, printed and online materials, and direct interaction.

Evaluation of Innovative Practices for Aquaculture Development

University of Maryland

This project provides complimentary support to an existing team of aquaculture specialists and extension agents in Maryland working to support the development of shellfish aquaculture on a broad scale. An aquaculture specialist will be employed for a three-year period to develop and evaluate innovative business practices and policies that can accelerate the development of Maryland's industry, but also be adopted in other regions. The project seeks to accomplish the following objectives: 1) evaluate the concept of Aquaculture Enterprise Zones being adopted in Maryland; 2) work with the Oyster Recovery Partnership, Maryland Department of Natural Resources and groups of Maryland watermen to develop and test the concept of Industry Reserve Production Cooperatives; 3) provide information to policymakers on the role of aquaculture in

potential ecosystem services markets; and 4) conduct an analysis that incorporates emerging ecosystem service markets into shellfish and plant aquaculture business models.

Farming the Fertile Crescent: Intensification of Oyster Culture in the Northern Gulf of Mexico

University of Southern Mississippi

The primary goal of this project is to build intensive oyster hatchery and nursery capacity by coastal citizens within the northern Gulf of Mexico, thereby creating jobs and providing a safe, sustainable domestic supply. This will be achieved by (1) addressing marine spatial planning & site selection; (2) creation of aquaculture training areas; (3) oyster aquaculture training; (4) adding shellfish hatchery and nursery capacity to support industry development; (5) promotion of food safety; (6) assistance with promotion and marketing of cultured oysters; and (7) response to the Deepwater Horizon incident. The project will educate and assist state permitting and management agencies; local, county, and state governments; and the existing oyster industry and coastal communities. The project will develop training manuals, workshops, and business tools for project participants.

NH Aquaculture Extension Enhancement in Marine Finfish and Molluscan Shellfish Aquaculture

University of New Hampshire

The goal of this project is to increase the number of aquaculture producers in the region, focusing on NH, ME and MA by 1) routinely increasing awareness of environmentally sustainable and available finfish and shellfish aquaculture technology and 2) transferring existing and emerging technology to displaced or transitioning commercial fishermen as well as interested entrepreneurs. The loss of aquaculture extension capacity at New Hampshire Sea Grant has severely impacted our ability to respond to outreach and technology transfer requests from the region. To that end, the project will hire a full-time Aquaculture Extension position to compliment and support existing efforts within New Hampshire Sea Grant Extension as well as to work collaboratively with the University of New Hampshire Atlantic Marine Aquaculture Center (AMAC) to coordinate technology transfer of inshore, offshore, and land-based marine farming strategies as they emerge.

Delaware Bay and southern New Jersey

New Jersey Marine Sciences Consortium

Aquaculture in Delaware Bay includes an active shelling project to enhance native stocks, intertidal rack and bag production, and a fledgling deepwater tray culture trial. However, these efforts are not currently being served by someone responsible for expanding the information base to a wider audience. This project provides for a New Jersey Sea Grant/Haskin Shellfish Research Laboratory aquaculture Extension Agent that will work with the various Delaware Bay oyster aquaculture efforts to expand the information resulting from ongoing programs. The project will result in materials in a variety of formats (presentations for technical and nontechnical audiences,

information posted on a web page, fact sheets, posters, etc.) for various aspects of rack and bag, cage culture, and shell planting, including comparison of yield for diploid and triploid disease resistant oyster strains and control of *Vibrio*.

Developing tools for the Growth of the North Carolina Shellfish Industry: Site Condition Assessment and Economic Impacts

North Carolina State University

Despite an increase in the demand for safe and sustainable seafood, the North Carolina shellfish aquaculture industry continues to be a niche industry dominated by fishermen from traditional fishing backgrounds. Obstacles to shellfish culture fall into two main categories: 1) lack of knowledge about the industry and 2) lack of information regarding feasible site locations. This project seeks to use a multidisciplinary approach to assess the state of the current shellfish aquaculture industry; develop tools to assist the siting of shellfish operations; develop specific extension efforts needed to identify potential economic constraints; and evaluate the potential economic impact that growth of shellfish aquaculture could have on local communities. This information will be provided to existing and potential growers through coastal workshops and demonstrations.

Creating Capacity in Oregon and the Northwest

Oregon State University

Molluscan aquaculture on the West Coast and in Oregon in particular faces many challenges including poor fresh water quality, seasonal hypoxia, diseases such as *Vibrio tubiashii*, aquatic invasive species, transportation and marketing issues, lack of grower awareness of broodstock genetics, ocean acidification, and a poorly understood commercial environment. As well, Oregonians rarely are exposed to public outreach or information related to aquaculture topics even as demand for fresh, locally-produced seafood increases. As such, this project will hire an Oregon Sea Grant (OSG) Aquaculture Extension Specialist to help address technical, economic, and biological challenges to Oregon's shellfish growers, a globally significant shellfish hatchery, and other potential aquaculture development on the coast. Aquaculture extension will be highly integrated among the strong OSG extension activities including watersheds and water quality, invasive species, working waterfronts, coastal stormwater management, decision-making under climate change, commercial fisheries, marine spatial planning, seafood development and ornamental fish and fish health.

Outreach Mariculture Project as a Fisheries Alternative for Puerto Rico – Growout of Yellowtail and Lane Snappers in Recirculation Systems Managed by a Fishery Association

University of Puerto Rico

Historically in Puerto Rico, fish and shellfish products have been harvested locally. While commercial fishing is part of the cultural heritage of the Puerto Rican people, steadily declining harvests have made it difficult to make a livelihood from fishing. This project seeks to create new opportunities for employment, economic expansion, and cultural adaptation through

adoption of aquaculture as a component of the overall food production industry in Puerto Rico. The project is part of an overall plan to promote the culture of marine fish to ameliorate fishing pressure on fragile tropical marine ecosystems. The first phase of the project will provide the facilities to transfer proven grow-out recirculation technology, in cooperation with organized commercial fishermen, using wild seed obtained from the coastal zone. Species such as the lane and yellowtail snappers (*Lutjanus synagris*, *Ocyurus chrysurus*) will serve as “starters,” with clam and oyster polyculture introduced in successive years. The goal is to maximize fish and shellfish production through recirculating aquaculture systems during the first phase and in nearshore cage systems during a second phase (not part of this initial effort). These systems will be managed by trained traditional commercial fishers.

Development and delivery of technical training, outreach and demonstration research projects focused on shellfish aquaculture

South Carolina Sea Grant Consortium

For the South Carolina aquaculture industry to remain competitive over the next 5 to 10 years, the industry will need resources and technical support in several critical areas to improve productivity and profitability among clam and oyster aquaculture operations. This project seeks to 1) assist clam and oyster growers to improve productivity and profitability; 2) collaborate with aquaculture producers/businesses and state/federal regulatory agencies to streamline permitting; 3) enhance communication and cooperation between the marine aquaculture industry and regulatory agencies towards the development and implementation of regulations; 4) develop and deliver research and technical training programs to the marine aquaculture industry; and 5) assist marine aquaculture producers and businesses in developing effective marketing strategies. This project will be implemented over a three year period to address each of these objectives. The marine aquaculture specialist will implement a coordinated and integrated research, education and outreach program to address the current and future needs of the marine aquaculture industry in South Carolina.

Virginia Shellfish Aquaculture Extension – Linking Research and Industry for Sustainable Development

Virginia Institute of Marine Science

Expansion of shellfish aquaculture in Virginia facing challenges in adopting advanced technology and managing the permitting, land use, and regulatory landscape. This project will support one full-time shellfish aquaculture Extension Specialist who will facilitate a “task force” of integrated university-based experts to support the growing shellfish aquaculture industry. This will be done through the development of an applied Sea Grant research agenda, technology transfer, education, and communications. The goal of the position is to identify and remove impediments to sustainable commercial aquaculture development. Additionally, the specialist will assist in evaluation of culturing additional shellfish species. The specialist will prepare reports and protocols for distribution to the industry developing new information arising from new applied research, gather existing information for shellfish industry needs, transmit information and skills through pamphlets, courses, workshops, lectures and meetings; provide

technical reviews of research and policies; and stimulate new research to meet contemporary and future needs.

Enhancing Aquaculture Extension and Technology Transfer in Washington and the Pacific Northwest

University of Washington

The Washington State aquaculture industry has great potential for growth, but faces a number of challenges associated with culture techniques, disease control, product quality, genetics, and ecological impacts of operations. This array necessitates effective education and outreach efforts. This project will create a new position for a Washington Sea Grant Aquaculture Coordinator to facilitate outreach and research on aquaculture issues and with seafood farmers, state and regional agencies, tribes, stakeholder groups and the public. A systematic needs assessment will be conducted. Outreach products such as publications, a major annual conference, and an aquaculture website will be developed. A consumer survey will be finalized and conducted to assess perceptions by Pacific Northwest consumers regarding aquaculture issues such as sustainability, ecological effects, and health risks and benefits. Results of the survey will be used to further educational work with local seafood consumers.

Urban Aquaculture - A Game Changer

University of Wisconsin

The goal of this project is to create a new “urban aquaculture” industry that produces food from freshwater in a city environment. This initiative presents an opportunity to involve new people and potential investors in urban centers as well as use existing currently underdeveloped property and structures. Public education and awareness that aquaculture produces healthy, safe, and “green” food is necessary to generate interest and growth in the industry. Using a “hands-on” format, this project will coordinate aquaculture demonstrations and provide in-service training for Sea Grant Outreach and Cooperative Extension personnel to focus on developing an urban aquaculture industry. The project also will 1) conduct advisory service/outreach for high production commercial yellow perch recirculating aquaculture systems; 2) conduct outreach education/advisory service for aquaponic and hybrid aquaponic integrated recirculating operations; and 3) continue efforts to develop a commercial aquaculture industry in the Great Lakes region and the United States through development of an investor base.

National Sea Grant aquaculture research projects awarded in 2012

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 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 existing 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.
