**The following National Sea Grant aquaculture research projects were awarded in FY2010-2011:**

| Sea Grant College Program | Investigator | Investigator Affiliation | Project Title | FY 10-11 Federal Share* |
|---|---|---|---|---|
| Alaska Sea Grant | Eckert | University of Alaska Fairbanks | Red King Crab Aquaculture in Alaska - Release Strategies and Critical Ecosystem Interactions | $303,359 |
| California Sea Grant | Hedgecock | University of Southern California | Genomically Enabled Crossbreeding to Improve Yields of Farmed Pacific Oysters | $393,862 |
| Florida Sea Grant | Baker | University of Florida | Preparing for Climate Change: Increasing Hard Clam Production in the Southeastern Eastern U.S. | $343,633 |
| Florida Sea Grant | Main | Mote Marine Laboratory | Evaluating performance of pilot and commercial wastewater systems associated with inland production of high-value marine fish | $400,000 |
| Hawaii Sea Grant | Haws | University of Hawaii Hilo | Laying the Foundation for Integrated, Multi-trophic Coastal Aquaculture in Hawaii | $282,222 |
| Louisiana Sea Grant | LaPeyre | Louisiana State University | Evaluation of oyster stocks and grow-out methodologies for commercial production of eastern oysters in Gulf of Mexico estuaries | $296,720 |
| Maryland Sea Grant | Newell | University of Maryland, Center for Environmental Science | Predicting spatial impacts of bivalve aquaculture on nutrient cycling and benthic habitat quality | $398,325 |
| Maryland Sea Grant | Zohar | University of Maryland Baltimore County | Developing sustainable year-round captive spawning technologies for a new aquaculture species, *Seriola dumerili* | $399,967 |
| Maine Sea Grant | Bricknell | University of Maine | The Aquatic Animal Health Ecology of an Industry-Deployed Integrated Multi-Trophic Aquaculture System | $399,544 |
| Mississippi-Alabama Sea Grant | Blaylock | University of Southern Mississippi | An Engineered Multi-Trophic Approach to Minimizing Effluent Impacts from Marine Recirculating Aquaculture Systems | $399,496 |
| Mississippi-Alabama Sea Grant | Arias | Auburn University | Eliminating human-pathogenic *Vibrio vulnificus* from Gulf Coast Oysters with high salinity depuration | $122,275 |
| New Hampshire Sea Grant | Fairchild | University of New Hampshire | Winter flounder enhancement program | $308,285 |
| Texas Sea Grant | Gatlin | Texas A&M University | Advancing fishmeal replacement in diets of marine fish for enhanced production efficiency, health and product quality | $294,836 |
| Virginia Sea Grant | Allen | Virginia Institute of Marine Science | Improvements in triploid C. *virginica* production: Phase I -- characterizing the diploid parent | $340,608 |

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|---|---|---|---|---|
| Virginia Sea Grant | Reece | Virginia Institute of Marine Science | Evaluation of molecular techniques for sensitive detection of pathenogenic human norovirus in bivalve shellfish | $367,188 |
| Washington Sea Grant | VanBlaricom | University of Washington | Community and multi-trophic implications of structure additions associated with intertidal geoduck aquaculture | $397,672 |
| Washington Sea Grant | Cheney | Pacific Shellfish Institute | West Coast Shellfish Aquaculture-Economic Impacts, Barriers to Entry, and Opportunities for Expanded Production | $100,997 |
| Wisconsin Sea Grant | Hartleb | University of Wisconsin Stevens Point | GIS-Based Analysis of Sustainable Domestic Aquaculture Development in Wisconsin | $200,031 |

*Amount shown is FY 2010-11 federal funding only (excludes matching funds)

## The following National Sea Grant aquaculture extension and technology transfer projects were awarded in FY2010-2011:

| Sea Grant College Program | Sea Grant Director | Institutional Affiliation | Project Title | FY10-11 Federal Share* |
|---|---|---|---|---|
| Alaska Sea Grant | Christie | University of Alaska Fairbanks | Expanding community based shellfish aquaculture opportunities in Alaska | $189,637 |
| Connecticut Sea Grant | De Guise | University of Connecticut | Community Supported Aquaculture & Education Program | $179,488 |
| Florida Sea Grant | Havens | University of Florida | Implementation of an Extension Program to Develop the Marine Baitfish Aquaculture Industry in Florida | $195,165 |
| Georgia Sea Grant | Hopkinson | University of Georgia | Oyster Culture: Diversifying Clam Aquaculture in Coastal Georgia | $165,682 |
| Hawaii Sea Grant | Grau | University of Hawaii | Aquaculture Extension Services for New Farmers on the Big Island and Maui | $100,000 |
| Illinois-Indiana Sea Grant | Miller | University of Illinois | Outreach and Education Programming Aquaculture and Seafood Products in the Great Lakes Region | $134,289 |
| Maine Sea Grant | Anderson | University of Maine | Building Extension Capacity towards Sustainable Aquaculture in Maine | $200,000 |
| Maryland Sea Grant | Kramer | University System of Maryland | Evaluation of Innovative Practices for Aquaculture Development | $183,825 |
| Mississippi-Alabama Sea Grant/Louisiana Sea Grant | Swann/Wilson | University of Southern Mississippi | Farming the Fertile Crescent: Intensification of Oyster Culture in the Northern Gulf of Mexico | $267,462 |
| New Hampshire Sea Grant | Pennock | University System of New Hampshire | NH Aquaculture Extension Enhancement in Marine Finfish and Molluscan Shellfish Aquaculture | $193,769 |
| New Jersey Sea Grant | Rowe | New Jersey Marine Sciences Consortium | Delaware Bay and Southern New Jersey-PI Rowe and Kraeuter | $200,000 |

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|---|---|---|---|---|
| North Carolina Sea Grant | Voiland | North Carolina State University | Developing Tools for the Growth of North Carolina Shellfish Industry: Site Condition Assessment and Economic Impacts | $193,142 |
| Oregon Sea Grant | Brandt | Oregon State University | 2010 Oregon Sea Grant Aquaculture Extension and Technology Transfer | $195,805 |
| 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 (*Ocyurus Chrysurus, Lutjanus synagris*) | $172,813 |
| 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 | $161,430 |
| Virginia Sea Grant | Hartley | Virginia Institute of Marine Science | Virginia Shellfish Aquaculture Extension - Linking Research and Industry for Sustainable Development | $195,840 |
| Washington Sea Gant | Dalton | University of Washington | Enhancing aquaculture extension and technology transfer in Washington and the Pacific Northwest | $200,000 |
| Wisconsin Sea Grant | Andren | University of Wisconsin System | Urban Aquaculture, A Game Changer | $199,998 |

* Amount shown is FY 2010-11 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.

# *National Sea Grant Aquaculture Research Projects Awarded FY 2010-11*

## Red King Crab Aquaculture in Alaska – Release Strategies and Critical Ecosystem Interactions

### University of Alaska – Fairbanks

This project supports commercial production/stock enhancement of Alaskan red king crab. The ability to maintain a sustainable crab fishery by augmenting natural stocks will produce a safe and sustainable seafood supply and provide economic benefits to coastal communities in Alaska. The project seeks to research and address the technical aspects of innovative mitigation (or 'smart design') through improved hatchery-rearing to produce competent animals that are able to compete for resources, find shelter, and avoid predation. This project involves multiple partners including industry, academia, communities, Sea Grant, and state and federal agencies. Outreach activities will include a hatchery open house, project flyers, a website, a juvenile red king crab exhibit at the Alaska SeaLife Center in Seward, presentation of results at national scientific conferences, and publication of results in peer-reviewed scientific publications.

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## Genomically-Enabled Crossbreeding to Improve Yields of Farmed Pacific Oysters

### University of Southern California

The goal of this project is to increase the production of shellfish in the U.S. by applying advanced biotechnology to the breeding of high-yielding Pacific oyster hybrids. Use of the most modern genomic (gene-mapping) and transcriptomic (gene-expression profiling) methods will uncover the key genes in the oyster that can serve as novel biomarkers for early detection of superior hybrids. Once identified, these biomarkers will be mapped onto the oyster genome to identify genes controlling high yield. Collaborators include the U.S. west coast aquaculture industry and Sea Grant, which can translate these basic scientific findings into practical advances. This will be achieved by distributing hybrid seed oysters produced in a commercial hatchery to three California farms that are located in different oceanic regimes. Farms will rear hybrid seed alongside industry-standard wild-type seed so that data on commercial yield, production costs, and return on investment can be obtained.

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## Preparing for Climate Change: Increasing Hard Clam Production and Survival in the Southeastern United States Using Biomarkers of Thermal Tolerance

### University of Florida

Changing environmental conditions indicate that the U.S. clam industry needs a heat-tolerant clam strain to reduce current summer mortalities, adapt to future climate change, and continue to contribute to global food security. The goal of this project is to increase summer survival and productivity of cultured hard clams in the southeastern U.S. This goal will be achieved by identifying biomarkers of heritable thermal tolerance in Florida northern hard clams (*Mercenaria mercenaria*) for use in implementing selective breeding programs. The project expects that one

of more of the identified biomarkers will be significantly associated with hard clam thermotolerance *and* with particular families, indicating heritability. Target families then can be chosen for selective breeding, greatly reducing the time and resource needed for strain development. Development of more robust clam strains would represent an important gain over present reliance on unselected stocks and will have a positive impact on production of cultured clams in the southeastern U.S., improving production and cash-flow for clam farmers and ancillary businesses.

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**Evaluating performance of pilot and commercial wastewater systems associated with inland production of high-value marine fish**

**Mote Marine Laboratory**

The goal of this project is to develop sustainable marine recirculating aquaculture technology to expand land-based marine aquaculture in the United States. Innovative approaches that utilize wastewater resources are needed to advance the development of inland, zero-discharge, marine recirculating aquaculture systems (RAS). This project will evaluate the potential to expand saleable products associated with sustainable marine fish farming (in this case, Florida pompano) to include large-scale land-based production of saltwater plants, while reducing discharges of pollutants to the environment. Plants produced through these efforts will be commercially available for restoration of sensitive coastal habitats and for food inputs for other aquaculture species such as sea urchins and abalone.

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**Laying the foundation for integrated, multi-trophic coastal aquaculture in Hawaii**

**University of Hawai'i**

This project will develop bivalve and macroalgae culture to support development of integrated, multi-trophic aquaculture in Hawaii. The addition of monoculture of either bivalves or macroalgae may create significant economic opportunity for aquaculture in Hawaii and the U.S., as well as for coastal stakeholders such as fishers that need income diversification. Adding bivalves and macroalgae to the slate of species that can be cultured in ancient Hawaiian fishponds also will enhance efforts to restore full productivity to these cultural treasures, which historically produced over two million pounds of fish annually. This work also lays the basis for native species restoration by developing hatchery, propagation, and grow-out methods for rare, native species. Culture of bivalves and macroalgae will help maintain or improve water quality within coastal ponds and other areas where grown. Extension, education, and outreach are important components of this work and will involve training undergraduate and graduate students, a wide range of coastal stakeholders, and new and existing aquaculture farmers.

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**Evaluation of oyster stocks and grow-out methodologies for commercial production of eastern oysters in Gulf of Mexico estuaries**

**Louisiana State University**

This project will compare the performance of oysters previously selected for resistance to dermo to that of wild oysters from Louisiana seed grounds and from other gulf states to determine their

potential for use in intensive aquaculture and to evaluate intensive grow-out systems to produce these oysters. The project will compare survival, growth rates, condition index, and dermo infection intensities. The second part of the project will evaluate the performance of selected oysters in three intensive grow-out systems as well as compare hydrocarbon concentrations in oysters grown off-bottom and on-bottom (in the case that they become exposed). The last part of the study will compare the grow-out of selected oysters to oyster stocks currently being used by the Auburn University Shellfish Laboratory. Project results will be disseminated immediately through collaborative, hands-on training provided at proposed "aquaculture training parks." General public outreach will be conducted through Louisiana Sea Grant information outlets.

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**Predicting spatial impacts of Bivalve Aquaculture on Nutrient Cycling and Benthic Habitat Quality**

**University of Maryland**

A major impediment to the expansion of shellfish culture is the often considerable opposition to the use of public waters due to perceived adverse environmental consequences. The objective of this project is to assess the effects of off-bottom oyster and mussel aquaculture on surrounding sediments and nutrient regeneration processes. The project seeks to generate data and refine models to quantify the effects of bivalve aquaculture on the surrounding ecosystem and to develop design guidelines to help mitigate any possible adverse effects. First-year studies and model development will take place at a shallow oyster aquaculture site in Chesapeake Bay and will be repeated elsewhere to validate the modeling approaches. Results and recommendations will be presented to coastal zone managers to help them learn to use these tools for guidance in locating farms in the coastal zone. Results, recommendations, and tools also will be made available to aquaculturists for optimizing bivalve stocking density, thereby helping minimize some of the adverse effects of over-enrichment of sediments by shellfish fecal waste.

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**Developing sustainable year-round captive spawning technologies for a new aquaculture species (*Seriola dumerili*)**

**University of Maryland**

Despite its ready adaptation to captivity, greater amberjack (S. *dumerili*) puberty, reproductive maturation, and spawning has proven very unreliable. To develop greater amberjack as a new aquaculture species, research efforts are needed to improve the juvenile supply in captivity. The overall goal of this project is to describe the reproductive cycle and its endocrine dysfunction, from pre-puberty through early gametogenesis and spawning of females held in controlled thermo-photoperiod conditions in a biosecure recirculating aquaculture system. This goal will be achieved through 3 key objectives: (1) study puberty and the reproductive cycle of amberjack held in captivity; (2) develop a GnRH-based technology to induce captive spawning; and (3) study the effect of different environmental regimens on phase-shifting the spawning time. The information derived from these objectives will be used in the subsequent reproductive manipulation of adult amberjack females to produce fertilized eggs and viable larvae on demand, thereby spurring regional economic development through safe and sustainable aquaculture practices.

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**The Aquatic Animal Health Ecology of an Industry Deployed Integrated Multi-trophic Aquaculture System**

**University of Maine**

The project partners with Cooke Aquaculture (a commercial firm) to apply IMTA practices on a marine salmon grow-out site in Maine. The project will compile information on how to successfully integrate mussel culture with a marine fish farm while examining the aquatic animal health ecology of such an integrated system. One of the industry hurdles lies in the receptiveness of existing farms and new entrants to embrace a new approach to aquaculture in this country. With the establishment of a full-scale demonstration IMTA farm, the project's extension and outreach will examine the application learning curve and associated risks involved in establishing productive IMTA culture practices; we then will be able to provide training and problem-solving skills to assist other aquaculture farms in establishing IMTA applications. A training manual and other tools will be developed. The project also will build on current targeted research on the role that mussels may play in perpetuating or limiting the spread of diseases. Salmon will also be monitored from marine grow-out sites in relatively the same geographical area of a non-IMTA site for comparison purposes.

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**An Engineered Multi-Trophic Approach to Minimizing Effluent Impacts from Marine Recirculating Aquaculture Systems**

**University of Southern Mississippi**

The increased carrying capacity in large-scale commercial RAS and the need for high water quality has complicated the issue of effluent waste management, particularly for marine systems whose effluent contains a considerable amount of salt. This project aims to minimize salt loss in RAS and repurpose the effluent discharge from filters for reuse in the system and for cultivation of important salt tolerant plant species that can be used for marsh restoration. Using geotextile bags in conjunction with coagulation and flocculation aids, the project will investigate the use of 1) an engineered treatment system to facilitate the reuse of the liquid fraction of the effluent discharge back into the culture system; 2) aquaponics for nutrient reduction in the liquid fraction of the effluent discharge through cultivation of environmentally and economically valuable salt-tolerant plant species; and 3) solids recovered from effluent for cultivation of commercially important salt marsh species commonly used in marsh restoration.

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**Eliminating human-pathogenic *Vibrio vulnificus* from Gulf Coast Oysters with high salinity depuration**

**Auburn University**

The objective of this project is to test the efficacy of depuration under high salinity conditions to eliminate the human pathogen *Vibrio vulnificus* from oysters. Elimination of V. *vulnificus* will aid the local Mississippi-Alabama oyster industry to produce a safe, naturally processed product. The project will construct a salinity-controlled recirculating aquaculture system (RAS) to test the efficacy of depuration using both hatchery-reared and commercial oysters. Farmed oysters are an essential component of the Gulf of Mexico oyster industry and there is regional interest in

developing intensive oyster aquaculture; this new industry would benefit tremendously from the proposed research. Additionally, this new technology will have a positive impact on the seafood processing industry, restaurants and retailers and the public. It has the potential to decrease the number of fatalities associated to the consumption of Gulf Coast oysters and to improve the image and marketing of oysters grown and harvested in the region.

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**Working with New England Communities to Restore Winter Flounder Populations - Developing Pilot Scale Stock Enhancement Programs in Massachusetts and New York**

**University of New Hampshire**

Biomass of winter flounder (*Pseudopleuronectes americanus*), a target species of both recreational and commercial fisheries, is at an all-time low. As a result, the largest of the three stocks is closed to all fishing activities in federal waters. The possibility that restocking winter flounder could help the diminished wild stocks has elicited interest from several New England communities. This proposal seeks to initiate a regional winter flounder restocking effort following the "responsible approach" guidelines in two locations (Martha's Vineyard, MA and East Hampton, NY). This project is a regional collaborative effort which includes fishermen, scientists, and managers who will engage in research to find ways to protect and enhance the winter flounder and its fishery. The project consists of training project participants and conducting ecosystem analyses to determine appropriate stocking strategies and conducting pilot-scale releases of winter flounder to evaluate impacts. Final reports, manuscripts, and articles will be published and disseminated to stakeholders. If the strategy is successful, the model may be applicable to other New England fishing communities seeking to recovery winter flounder populations.

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**Advancing Fishmeal Replacement in Diets of Marine Fish for Enhanced Production Efficiency, Health and Product Quality**

**Texas A&M University**

The increased demand for fishmeal by the growth of aquaculture and other sectors has led to an increase in cost, with an approximate tripling of price between 2000 and 2008. In order for aquaculture production to continue to expand, suitable alternatives to fishmeal must be developed. The goal of this project is to affect the increased use of sustainable alternative protein diets for marine carnivorous fish, thereby reducing the costs of production, minimizing environmental impacts, and increasing seafood security. The project will extend the work of an ongoing project to create a completely fishmeal-free diet for the commercial production of red drum. The project also seeks to establish a model approach to the development of alternative-protein diets for various aquacultured marine species that will compare characteristics of fish reared on alternative-protein and traditional diets for product quality, stress tolerance, and disease resistance.

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**Improvements in triploid C. *virginica* production: Phase I – characterizing the diploid parent**

**Virginia Institute of Marine Science**

This proposal aims to contribute to the continued growth of oyster aquaculture in the Chesapeake Bay and the east coast by characterizing the performance of triploids based on their diploid parent. Triploids are a genetic improvement practiced worldwide and are becoming a mainstay of oyster culture in the mid-Atlantic. Thirteen crosses of diploid C. *virginica* and thirteen matching crosses of triploid C. *virginica* will be produced and deployed in three strategically chosen sites in the Chesapeake Bay. They will be evaluated for growth, survival, and reproduction. This research may result in recommendations for the distribution of diploid and tetraploid lines (as they are developed) to hatcheries to optimize triploid performance. The principal form of outreach for this project will be through two annual meetings between the Aquaculture Genetics and Breeding Technology Center (ABC) at the Virginia Institute of Marine Sciences (VIMS) and industry.

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**Evaluation of molecular techniques for sensitive detection of pathogenic human norovirus in bivalve shellfish**

**Virginia Institute of Marine Science**

This proposal seeks to evaluate and compare three different methods for recovery and detection of norovirus in order to improve assay sensitivity and reduce processing time. The project will compare two sample treatment protocols to a current reference method to determine the most sensitive and reproducible assay for the detection of norovirus in homogenates of the Eastern oyster, *Crassostrea virginica,* and the hard clam, M. *mercenaria*. In addition, the three different methods will be tested for sensitivity and reproducibility after the animals have been artificially contaminated in the laboratory and at four different sites in Virginia. The optimized protocol(s) will also be used to analyze commercially-harvested wild oyster and clam samples. On the basis of the results obtained, the method that proves the most sensitive and reliable in both laboratory and field evaluations will be selected to prepare a detailed protocol for use by state and federal shellfish agencies and interested stakeholders.

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**Community and multi-trophic implications of structure additions associated with intertidal geoduck aquaculture**

**University of Washington**

Expansion of intertidal geoduck aquaculture operations has raised concern among managers, conservation organizations, and the public regarding industry practices that may alter resident ecological communities. This project will investigate the effects of intertidal culture operations for Pacific geoduck clams (*Panopea generosa*) on community dynamics and trophic interactions in South Puget Sound, Washington. The objectives are to (1) characterize changes in benthic communities associated with the planting of geoducks and the placement of aquaculture structures; (2) explore differences in fish abundance and site fidelity among cultured areas and reference beaches; (3) evaluate differences in fish diets in relation to prey abundance and availability using physical and chemical methods; and (4) determine the energetic consequences of diet shifts for growth and survival of fishes. The project also will train undergraduate students in the use of field and laboratory techniques, dietary models based on isotope ratios and lipid biomolecular markers and spectra, and bioenergetics models.

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**West Coast Shellfish Aquaculture – Economic Impacts, Barriers to Entry, and Opportunities for Expanded Production**

**Pacific Shellfish Institute**

The continuation and expansion of shellfish aquaculture is threatened by myriad challenges including permitting issues, use conflicts, litigation, and environmental impacts associated with shifting use patterns and shoreline development. This proposal describes research to support and enhance west coast shellfish aquaculture by examining economic impacts, barriers to entry, and opportunities for expanded production. The project will quantify the economic impacts of commercial shellfish production and investigate and summarize the barriers to entry in the states of Washington, Oregon, and California. The goal is to support coastal communities in planning for sustainable and vibrant coastal economies and communities by filling critical socio-economic information gaps related to the shellfish industry. Research and recommendations will inform policy makers, industry representatives, and other stakeholders interested in economically sustainable shellfish production.

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**GIS-based analysis of sustainable domestic aquaculture development in Wisconsin**

**University of Wisconsin**

GIS-based decision support models can provide information to stakeholders as to where and under what conditions certain aquaculture technologies would be feasible. The hypothesis for this project is to determine if location characteristics of aquaculture operations are significant for determining success or failure of commercialized operations. The project seeks to develop a predictive aquaculture farm model using a multi-criteria evaluation procedure in GIS using parameters such as site suitability, water source, water quality, land ownership, and infrastructure. The project will synthesize existing data about aquaculture farms into the GIS model to further refine a predictive model for particular species selection. The predictive results of the model will then be compared with actual aquaculture farms that exist within the state. The results of this project will generate culture system-specific and species-specific predictive models to help extension personnel, land-use managers, fish culturists, and agriculture & natural resource specialists to evaluate potential fish farm locations in Wisconsin. The project will conduct workshops, presentations, and public education sessions for various groups to explain and demonstrate the model's use to the industry.

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# *National Sea Grant Aquaculture Extension Projects Awarded FY 2010-11*

**Expanding community based shellfish aquaculture opportunities in Alaska through technology transfer, education, and planning outreach to shellfish farmers and coastal communities**

**University of Alaska**

Fostered by broad governmental and private support as an economically viable and environmental sustainable solution to rural economic problems and high unemployment, the Alaskan shellfish farming industry needs significant transformation to improve practices and meet public expectations. This project will implement a technology transfer and training program to increase farming efficiency and expand the industry in southeastern Alaska by implementing community based shellfish aquaculture planning. The project will focus on developing a well-trained workforce of new and existing farmers, identifying suitable aquaculture farm sites, applying business practices, enhancing community support, and increasing farming efficiency and cooperative relationships.

**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.

**Aquaculture Extension Services for New Farmers on the Big Island and Maui**

**University of Hawai'i**

Recent economic events have resulted in the loss of local aquaculture extension service in Hawaii. To meet existing need, this project will hire a University of Hawaii Sea Grant Extension Agent to provide technical assistance to local fish farmers, educational institutions, and governmental and non-governmental agencies. The goals are to promote the advancement of sustainable and profitable aquaculture and increase the production volume and number of individuals participating in aquaculture. Extension strategies will include 1) development of a website for warm-water aquaculture that focuses on the environmental conditions and species found in Hawaii and the Pacific, 2) a series of single-day training workshops and visits to existing fish farms, and 3) professional development of University of Hawaii Sea Grant extension specialists through attendance at annual aquaculture extension meetings and U.S. Aquaculture Society meetings.

**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.

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**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.

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**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.

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**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.

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**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.

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**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*.

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**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.

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**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 underclimate change, commercial fisheries, marine spatial planning, seafood development and ornamental fish and fish health.

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**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.

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**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.

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**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.

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**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.