

# Virginia Sea Grant

Virginia Sea Grant has set an ambitious course, and by all accounts, the program is on the move! In September 2013, a national review committee “unanimously and enthusiastically” recommended Virginia Sea Grant (VASG) for College Status, the highest level of accreditation in the National Sea Grant Program.



## A Reinvigorated Program on the Right Course

The award of College Status was the positive result of a process of redesign and reconstruction following a 2006 decertification. During the 2010–14 review period, Virginia Sea Grant (VASG) entered a revitalization phase in which the program formalized a newly designed organizational structure, developed new programs such as the Graduate Research Fellowship, and created new institutional partnerships. We built on historic strengths in education, seafood, fisheries, and aquaculture, while initiating new, innovative programs in coastal community development, and hazard resilience. The designation of College Status acknowledged VASG’s success. Today, VASG’s momentum propels us forward as a reinvigorated, high-achieving program.

## Capacity in the Commonwealth

Virginia is home to impressive academic capacity in its public and private colleges and universities. Its academic community offers almost unlimited opportunities to work with top-notch researchers, extension staff, and educators who specialize in fields as diverse as oceanography, marine ecology, public policy, business, and communications. Our academic breadth includes VASG’s six institutional partners: William & Mary – Virginia Institute of Marine Science (VIMS), Virginia Tech (VT), University of Virginia (UVA), Old Dominion University (ODU), Virginia Commonwealth University (VCU), and George Mason University (Mason). All six have capacity in Sea Grant’s functional areas of research, extension, education, and communication. By 2016, all will have research facilities on the water.

## In This Booklet

This booklet is a guide for the 2010–14 PRP. Each chapter will:

- Provide context for the issues that influence our work
- Highlight the broad themes that define our investments
- Identify VASG’s roles within the state
- Tell additional success stories about our program

“Through innovative and creative programs, Virginia Sea Grant has garnered respect from partners and stakeholders throughout Virginia and has become a leader in the Sea Grant System.”  
— NOAA Vice Admiral Michael Devany, Dec. 2014 designation ceremony

### 2007 - 2009

Established at VIMS, Director joins, strategic planning kick-off, Communication Center created

### Reconstruction

### 2010

Asst. Dir. for Research joins, 2010-2014 Strategic Plan released, redesigned RFP, NOAA site review, network design created

### 2011

VCU, GMU join VASG

### 2012

Applied for College Status, Fiscal Officer position created, Charter & Bylaws negotiated

### Launching

### 2013

MOU with ODU, new resiliency extension position created, approved for College Status

### 2014

Meeting Planner position created, MOUs with W&M and VIMS

### 2015

Charter signed

# Safe & Sustainable Seafood Supply

Throughout the 2010–14 reporting period, Virginia Sea Grant (VASG) made tremendous progress toward our goals in the area of Safe and Sustainable Seafood Supply. VASG invested strategically to address needs faced by established and emerging industries, contribute to scientific understanding, inform stakeholders, and benefit society.



## SUMMARIZING OUR IMPACT

### Advancements in Science

VASG investments in Safe and Sustainable Seafood Supply have resulted in:

- **New products** including new seafood products, new value-added marketing strategies, technical advancements in aquaculture and fisheries, and improved selective breeding.
- **New understandings** that supports ecosystem-based fisheries management approaches and improves quality of seafood.
- **New tools** to improve selectivity of gear and reduce bycatch in fisheries.

### Benefits to Stakeholders and Society

VASG's work has led to better informed stakeholders and supported behavioral changes, economic benefits, and improvements in management.

- **Finfish aquaculture businesses** benefited from technical expertise that has resulted in new species to raise, improved ability to install and manage tank equipment, reduced energy costs through solar energy, and better understanding of best aquaculture practices, resulting in 9 new species available for aquaculture and supporting millions in emerging business.
- **Shellfish aquaculture businesses** collaborated with VASG to research water quality at hatcheries and oyster traits that improve profitability, coordinate on common concerns, and improve marketing of market half-shell oysters, supporting a \$55.9M industry.
- **Commercial fishermen** collaborated with VASG to investigate gear modifications and new gear options, including turtle excluder devices for shrimp trawls, electrofishing for blue catfish, net modifications for reducing bycatch when fishing for striped bass, and others.
- **Seafood processing businesses** received training to produce safe products and jobs.
- **Health officials** received information about human health risks and quality in seafood.
- **Land-use managers** received information on disconnects between land and fisheries management and strategies to improve communication and integrated management in the future.
- **Fisheries managers** received information on ecosystem-based fisheries management approaches, including stock assessment data, improved coordination between fisheries surveys, disease ecology information, and data on new gear and gear modifications.
- **US Congress** received new information about how federal efforts to rebuild fish populations have worked and integrated findings into proposed legislation.
- **Seafood consumers** experienced improvements in seafood safety; there have been no FDA citations against Virginia seafood processors that participated in VASG trainings in 12 years.
- **Students** received training and experience in aquaculture production and outreach that support workforce development, particularly among minority students and communities.

## THE VIRGINIA CONTEXT

Virginia leads the East Coast in seafood production and is home to a diverse and highly competitive seafood industry. In 2012, Virginia landed 461.9 million pounds, ranked third of all states by volume, which added over \$673 million in value to the state. Approximately 6,000 Virginians work on the water, including 2,826 licensed watermen and their crew. These watermen harvest 50 commercially valuable species from some 620,000 acres of water.

The economic downturn hit the Virginia seafood industry hard, but the continued growth of the shellfish and finfish aquaculture industries in Virginia added significant value to the state's seafood marketplace and helped to aid in the economic recovery. Virginia's watermen-farmers are providing consumers with a growing quantity of hard clams and oysters that represents \$55.9 million dockside value.

## OUR INVESTMENT

During the 2010–14 reporting period, VASG continued providing science-to-industry and science-to-management support that has been a historical strength for our program. Our impacts and accomplishments demonstrate strength in research and outreach in all sectors of the seafood industry. These efforts have led to changes on the local, state, national, and international level, and many of the impacts of our work are continuing to emerge as management uses VASG expertise to make decisions that affect resources.

### **OUR ROLE: Advancing Safe and Sustainable Seafood**

Virginia's seafood industry is very competitive, so getting different interests to collaborate on larger issues poses a challenge. Our selected impacts and accomplishments show, however, that the seafood industry places strong trust in VASG extension and research, and looks to VASG for leadership in coordinating solutions.

During the 2010–14 reporting period, VASG extension continued supporting the technical needs of Virginia's diverse seafood industry. VASG extension provided hazard analysis critical control points (HACCP) training in English and Spanish and expanded training to include best management practices for sanitation and support for training in safe handling for shippers. VASG extension also continues to develop relationships that help bring industry members together to solve common scientific problems. Seafood industry members attend extension-led events, come together under extension-chaired committees, participate in economic surveys about their industry, and seek extension technical assistance in adopting new technology, training employees in safe seafood, and developing and marketing seafood products.

Several of our selected impacts and accomplishments illustrate the trust that industry places in VASG. These impacts and accomplishments demonstrate the broad expertise of VASG:

- **Finfish aquaculture, aquaponics:** Extension provides technical expertise in setting up and maintaining finfish aquaculture and aquaponics facilities, helping support a newly developing industry. Extension has developed aquaculture protocols for more than a half-dozen popular seafood species, provided training for more than 100 participants in best management practices for aquaculture, and developed an “aquaculture ambassador” program to perform public outreach for aquaculture and sustainable seafood, training minority student ambassadors and targeting outreach to lower-income, minority communities.

- **Shellfish aquaculture:** Research and extension have been involved in the development of triploid oysters which make up 90% of Virginia’s oyster aquaculture industry, and VASG continues to fund breeding efforts to improve survival of oysters and profitability for growers.
- **Human health:** Research and extension investigate cooking, packaging, post-harvest processing, and other methods to reduce risk of illness from seafood.
- **Seafood marketing and product development:** Extension collaborates with industry to develop new ways to market products, including marketing half-shell oysters by their growing region and providing technical expertise to develop new scallop products for market.
- **Efficient green industries:** Extension provided technical expertise to reduce the power bill of a start-up finfish aquaculture facility by advising on implementation of solar energy.

### **Tying It Together: Shellfish Industry Trusts VASG Extension and Research**

“Just having all of us together in the same room is something,” says Ann Arseniu Gallivan of Shooting Point Oyster Company. Gallivan represents one of the Virginian hatcheries that approached Extension with concerns about reduced success at the hatcheries in 2011.

VASG extension responded by providing educational opportunities for hatcheries to learn more about potential water quality issues in that year and in 2013 established the Ocean Acidification Network of Virginia as a working group to discuss and address concerns. Today the network collaborates with VASG researchers to actively research and monitor water quality conditions in hatcheries. The research will provide network members with the knowledge and tools they’ll need to decide when or whether to carry out hatchery processes.

### **OUR ROLE: Advancing Science-to-Management**

Historically, fisheries management has taken a single-species approach. Today, managers would prefer a broad approach that takes all elements of the ecosystem into account, but they don’t always have access to data and tools for achieving ecosystem-based fisheries management.

VASG has been making progress in developing the science to support this management style. Selected impacts and accomplishments demonstrate examples of our success in supporting science-to-management. NMFS-Sea Grant Population Dynamics Fellows conducted and transferred research to management, incorporating disease ecology in managing striped bass and American lobster. Researchers are also learning how to bridge regulatory networks to improve collaboration across jurisdictions.

In addition to providing fisheries science, VASG has been active in injecting big-picture thinking into fisheries management by providing new understandings about the role humans play in fisheries management success and developing coupled human-natural indicators for ecosystem-based fisheries management.

### **Another Success: Research Shows Disconnect Between Fisheries and Land-Use Managers**

“Just getting fisheries and land-use managers to understand each other is a challenge. We’re still at a very fundamental level of mutual understanding,” says VASG Director Troy Hartley.

Working with William & Mary law school students, Hartley compared the terms used in fisheries management plans with those used in local land-use plans at seven different localities. The team found the potential for serious breakdowns in effective communication. In their small sample,

about 80 percent of land-use-relevant shad and river herring management interests did not appear in land-use planning documents and ordinances.

While two separate fields, land-use and fisheries managers' work impacts each another. For instance, shad and river herring swim upstream to spawn but run into dams, turbines, power plants, and other obstacles along the way. These land-based decisions change the options the fish have and constrain the options fisheries managers have for managing fish.

Since completing the 2014 research, Hartley has reached out to localities through numerous fisheries and land-use meetings to encourage dialogue between fisheries and land-use managers to increase mutual understanding and familiarity with each other's professional terminology.

### **OUR ROLE: Developing Gear Collaboratively with Industry**

Reducing the catch of unwanted fish is considered an important step in sustainable fisheries, and for years, it's been known that imposing new gear to reduce bycatch through regulations doesn't necessarily lead to effective adoption.

VASG has a long history of conducting collaborative gear research with fishermen that leads to increased adoption of the gear and effective reduction in bycatch. In our selected impacts and accomplishments, there are several examples of how collaborative research has led to building trust between researchers and industry and the adoption of new and improved gear in the black sea bass, shrimp, and whelk fisheries. In some of these fisheries, the positive benefits of improved gear are already evident. VASG continues supporting gear research activities that will likely lead to more impacts in the future.

### **Another Success: Providing Research on Electrofishing of Blue Catfish**

Since being introduced to Virginia in the late 1970s, blue catfish have expanded to nearly every major tributary in the Chesapeake Bay and are considered an invasive species. In 2014, VASG extension and Virginia watermen partnered to test the effectiveness of electrofishing blue catfish for commercial harvest. Initial tests proved to be successful at catching blue catfish, and VASG is continuing the evaluation to determine whether the method is commercially viable.

### **Another Success: Investigating Gear to Avoid Endangered Sturgeon**

When Atlantic sturgeon made the endangered species list in April 2014, those fishing for striped bass had more questions than answers. George Trice III has been a commercial fisherman targeting striped bass for more than 20 years.

"I don't know how it will affect the fishery," Trice says. "I hope it doesn't." But Trice has been doing more than hoping. He's continuing trials on a new net that leaves a 3-foot gap between the river floor and the net. Trice designed the net with support from VASG and several partners. When tested in 2013, the net reduced accidental catch of sturgeon by about 80 percent.

Now Trice and his partners are continuing to test and verify the design. As one of his project partners says, "It's all about repeatability... if [fishermen are] going to use this net, we have to show that it works."

# PIER PRP Program Focus Area Report

## Virginia Sea Grant

### Safe and Sustainable Seafood Supply

**Program Focus Area:** Safe and Sustainable Seafood

#### Program Goals

1. Advance scientific understanding of sustainable fisheries and aquaculture and support sustainable fisheries and aquaculture businesses in coastal Virginia.
2. Provide stakeholders with the best available science, facilitate stakeholder engagement in decision making, and advance science-to-management and technology adoption.
3. Provide technical support and guidance to industry to increase food safety and quality of their products.
4. Increase understanding and application of best practices in seafood safety, product and market development, and seafood-processing efficiencies.

#### JUMP TO REPORT SECTION

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[Program Performance Measures](#)

[Objectives](#)

#### Impacts and Accomplishments toward Program Goals

1. **Program Goal: Advance scientific understanding of sustainable fisheries and aquaculture and support sustainable fisheries and aquaculture businesses in coastal Virginia.**

##### Impact(s)

- o [21641](#) - Sea Grant Patent Contributes to \$28.5M Company That Produces Omega-3 Oils from Fungi
- o [21639](#) - Sea Grant Spadefish Aquaculture Research Paves Way for Other Species, More than \$1M Annual Seafood in Virginia
- o [21619](#) - Researchers Collaborate with Industry to Identify the Best Oyster Traits for Profitability, Select Oysters for Future Breeding
- o [21613](#) - Sea Grant Fellow Enables Connections Between Two Fisheries Monitoring Efforts on Atlantic Coast
- o [21605](#) - Sea Grant Researchers Evaluate Factors Affecting Carbonate Chemistry in Chesapeake Bay
- o [21546](#) - Brought Back From the Brink: Black Sea Bass Stock Recovers with Help from VIMS Advisory Services affiliated with Virginia Sea Grant
- o [21545](#) - Millions of Horseshoe Crab Conserved Due to Management Actions, Including a Recommendation Based on Gear Study
- o [19684](#) - Sea Grant Inspires Virginia Shellfish Industry to Put Competition Aside, Address Changing Water Quality
- o [19664](#) - Sea Grant Funding of Oyster Breeding Leads to More than \$80 Million in Annual Economic Impact, Growing
- o [19663](#) - Sea Grant Research Reveals New Directions to Improve Survival of Aquaculture Oysters in Chesapeake Bay
- o [19658](#) - Sea Grant Tests New Conservation Gear, Fishermen Voluntarily Adopt
- o [19619](#) - Sea Grant Aquaculture Specialists Enable \$340,000+ in Seafood Production in 2013
- o [17816](#) - Sea Grant has Virginia's tasting oysters and talking about 'growing regions'
- o [15918](#) - Sea Grant helps fish farm use solar energy as main source for heating water

##### Accomplishment(s)

- o [21621](#) - Sea Grant Funding Establishes Collaboration between Virginian and Australian Shellfish Aquaculture Researchers
- o [21612](#) - Aquaculture Ambassadors Fill Needed Roll in Educating Public about Sustainable Seafood
- o [21611](#) - 100+ Community Members Participate in Aquaponics Training
- o [21604](#) - Sea Grant Researchers Test Novel Equipment to Monitor Water Quality and Improve Oyster Hatchery Success
- o [19603](#) - Sea Grant Extension Partners Sponsor Events for Children to Experience Recreational Fishing
- o [19601](#) - Sea Grant Extension Fish Tagging Program Breaks Record with 31,000+ Fish Tagged in 2012
- o [19600](#) - Sea Grant Extension Partner Engages Veterans in Rehabilitative Fly-Fishing

2. **Program Goal: Provide stakeholders with the best available science, facilitate stakeholder engagement in decision making, and advance science-to-management and technology adoption.**

## Impact(s)

- o [21622](#) - Sea Grant-Funded Researchers Provide Data on Oyster Human Health Concern to Virginia's Department of Health
- o [21605](#) - Sea Grant Researchers Evaluate Factors Affecting Carbonate Chemistry in Chesapeake Bay
- o [21600](#) - Sea Grant Leads Productive Conversation on Gear, Fostering Support to Change Regulation
- o [21548](#) - FDA Reexamines Regulatory Limits for Sea Scallop Moisture Content as a Result of Sea Grant Research
- o [21547](#) - Extension Recommends an Automated Method for Determining Moisture in Scallops Utilized Throughout Industry
- o [21546](#) - Brought Back From the Brink: Black Sea Bass Stock Recovers with Help from VIMS Advisory Services affiliated with Virginia Sea Grant
- o [21545](#) - Millions of Horseshoe Crab Conserved Due to Management Actions, Including a Recommendation Based on Gear Study
- o [19772](#) - Sea Grant Research Leads to Changes in Model Used to Manage Chesapeake Bay Striped Bass
- o [19658](#) - Sea Grant Tests New Conservation Gear, Fishermen Voluntarily Adopt
- o [17799](#) - Virginia Sea Grant leads in compliance training for new seafood safety regulations
- o [17794](#) - Sea Grant research informs management strategies for striped bass and American lobster populations
- o [15925](#) - Sea Grant empowers competing shellfish hatcheries to work together to address water quality

## Accomplishment(s)

- o [21617](#) - Estimating a Current Tag Reporting Rate for Striped Bass
- o [21615](#) - Sea Grant Research about American Lobster Natural Mortality Rate Presented to Management
- o [19618](#) - Sea Grant Develops the Future Aquaculture Workforce
- o [19601](#) - Sea Grant Extension Fish Tagging Program Breaks Record with 31,000+ Fish Tagged in 2012
- o [17812](#) - Virginia Sea Grant graduate research fellowships help students connect research to management
- o [15912](#) - Sea Grant researchers study the effects of low-oxygen on healthy striped bass and those with bacterial infection
- o [15888](#) - Partnership Between Sea Grant Extension and NOAA Fellow Enables More Complete Study of Summer Flounder

### 3. Program Goal: Provide technical support and guidance to industry to increase food safety and quality of their products.

## Impact(s)

- o [21547](#) - Extension Recommends an Automated Method for Determining Moisture in Scallops Utilized Throughout Industry
- o [19614](#) - Proactive Seafood Companies Seek Virginia Sea Grant Analysis to Keep Product Safe
- o [19613](#) - Sea Grant Technical Assistance Enables Virginia Seafood Companies to Meet FDA Requirements

## Accomplishment(s)

- o [19612](#) - Sea Grant Leads Locally, Nationally, and Internationally in Seafood Safety
- o [19611](#) - Sea Grant Provides Safety Training to 243 Mid-Atlantic Seafood Processors in 2013

### 4. Program Goal: Increase understanding and application of best practices in seafood safety, product and market development, and seafood-processing efficiencies.

## Impact(s)

- o [21622](#) - Sea Grant-Funded Researchers Provide Data on Oyster Human Health Concern to Virginia's Department of Health
- o [21550](#) - Scallop Medallions Developed by Sea Grant Exceed \$100 Millions Over Product Lifetime
- o [21549](#) - Sea Grant Demonstrates to FDA Benefits of Phosphate Use in Processing Sea Scallops in the Mid-Atlantic Region
- o [19769](#) - Sea Grant Workshop Enables Virginia Processors to Develop Value-Added Seafood Products
- o [19610](#) - Sea Grant Provides Technical and Marketing Assistance to Help Virginia Aquaculture Get onto Grocery Store Shelves
- o [17799](#) - Virginia Sea Grant leads in compliance training for new seafood safety regulations

## Accomplishment(s)

- o [21610](#) - Sea Grant Extension Trains 100+ in Best Management for Aquaculture
- o [15889](#) - Sea Grant Develops New Seafood Products, Markets for Sustainable Aquaculture

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## Full Text of Impacts and Accomplishments

### **21641 - Sea Grant Patent Contributes to \$28.5M Company That Produces Omega-3 Oils from Fungi**

#### RELEVANCE

Omega-3 fatty acids are an essential nutrient in aquaculture. Traditionally, these have come from fish oil; however, wild fish are not believed to be a sustainable supply for growing demand.

#### RESPONSE

Virginia Sea Grant-funded researchers produced eicosapentaenoic acid (EPA)-rich fungal biomass for use as fish oil replacement in aquaculture. EPA is a type of omega-3 fatty acid. The study resulted in a 2012 patent: "Producing Eicosapentaenoic Acid (EPA) from Biodiesel-derived Crude Glycerol."

#### RESULTS

The patent is one of several currently licensed by Algisys, a supplement manufacturer valued at \$28.5 million in 2012. In 2015, the company announced it developed technology for commercial production. Omega-3 supplements have been derived from fish oils and are the third fastest growing supplement, according to Nutraceuticals World 2013.

**RECAP:** Patent is one piece of technology held by a commercial supplement company. [Back to Goals](#)

### **21639 - Sea Grant Spadefish Aquaculture Research Paves Way for Other Species, More than \$1M Annual Seafood in Virginia**

#### RELEVANCE

Rearing fish for aquaculture requires vast technical knowledge, including details about how to spawn captured fish and proper feeding requirements (nutrition and timing) to rear resulting larvae.

#### RESPONSE

In 2009, Virginia Sea Grant-funded researchers at Virginia Tech and Virginia Institute of Marine Science began to develop aquaculture protocols for Atlantic spadefish, a species of interest for industry and the Virginia Marine Resources Commission. The protocols that resulted cover all aspects of larviculture, including spawning adults and feeding requirements for spadefish from the larval stage to the fingerling stage.

#### RESULTS

This research was essential to develop the expertise at these institutions for developing larviculture protocols for other species. Since then, researchers have developed six different species for aquaculture production, including cobia, Florida pompano, hybrid striped bass, and marine ornamental finfish. This program works toward Virginia Sea Grant's goal of advancing scientific understanding of sustainable fisheries and aquaculture and support sustainable fisheries and aquaculture businesses in coastal Virginia.

**RECAP:** Although spadefish are not aquacultured commercially, the expertise developed by researchers has been instrumental in developing protocols for other aquacultured species. [Back to Goals](#)

### **21622 - Sea Grant-Funded Researchers Provide Data on Oyster Human Health Concern to Virginia's Department of Health**

#### RELEVANCE

In 2009, the United States Food and Drug Administration (FDA) sought to implement guidance to mandate post-harvest processing to eliminate the bacteria *Vibrio vulnificus* from all raw shellfish harvested from Gulf of Mexico waters and sold during the months of April-October. Although directed primarily toward raw product from the Gulf of Mexico, it is thought this mandate will eventually affect other oyster-producing regions such as the mid-Atlantic with potentially significant economic consequences to Virginia's \$16.1-million industry.

#### RESPONSE

Virginia Sea Grant-funded researchers at the Virginia Institute of Marine Science tested oyster relay as a method for reducing bacteria in shellfish while retaining the quality of oyster meat for the raw market and evaluated the costs of implementing this method. Researchers conducted three high salinity relay experiments in which oysters in low salinity environments were transferred to higher salinity waters, known to be less favorable for survival of *Vibrio vulnificus*.

#### RESULTS

The researchers found that high salinity relay could effectively reduce bacteria levels as required by FDA guidance; however additional research would need to be conducted to validate the method as a post-harvest process. Economic analysis estimated that the cost for implementing high salinity relay would be about 7.5-cents per oyster. Data has been shared with Virginia Department of Health, Division of Shellfish Sanitation as they make decisions regarding shellfish regulations in the state. In addition, US Food and Drug Administration is examining the data to evaluate the regulations at the federal level, including the Interstate Shellfish Sanitation Conference. The relay data will be used to determine whether high salinity relay can be validated as a post-harvest process. This research works towards Virginia Sea Grant's goal of providing technical support and guidance to industry to increase food safety and product quality.

**RECAP:** Virginia Institute of Marine Science researchers find that high salinity oyster relay could reduce bacteria in oysters to FDA acceptable levels. [Back to Goals](#)

### **21621 - Sea Grant Funding Establishes Collaboration between Virginian and Australian**

### Shellfish Aquaculture Researchers

As a result of Sea Grant funding the Virginia oyster industry will now have access to the Australian oyster aquaculture industry. Following the completion of the Virginia Sea Grant-funded project researchers at the Virginia Institute of Marine Science (VIMS) have developed a long-term partnership with world-renowned researchers at Commonwealth Scientific and Industrial Research Organization (CSIRO) and the Australian oyster aquaculture industry. This relationship will broaden the scope of work possible for VIMS Aquaculture Genetics and Breeding Technology Center (ABC) and give Virginia growers access to the progressive Australian industry. This partnership works towards Virginia Sea Grant's goal of advancing scientific understanding of sustainable fisheries and aquaculture and support sustainable fisheries and aquaculture businesses in coastal Virginia.

#### RECAP:

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### 21619 - Researchers Collaborate with Industry to Identify the Best Oyster Traits for Profitability, Select Oysters for Future Breeding

#### RELEVANCE

The oyster aquaculture industry contributes \$35+ million to the state of Virginia, and 90% of oysters grown are triploid. All of these triploid oysters originate from four-gene parents produced at the Virginia Institute of Marine Science (VIMS) Aquaculture Breeding and Technology Center. To continue supporting the growing aquaculture industry, VIMS researchers intended to develop a breeding plan that would allow them to select the traits in oysters that would be most profitable for growers.

#### RESPONSE

With funding from Virginia Sea Grant, VIMS researchers joined with experts at Australia's Commonwealth Scientific and Industrial Research Organization (CSIRO) to study how different oyster traits could affect profitability for the Virginia oyster industry. Researchers surveyed the aquaculture industry members and conducted economic analysis on traits identified by growers.

#### RESULTS

Researcher found that growth rate, survival, shape, uniformity, and acceptability all impacted profitability, and calculated how enhancing these traits would affect profitability for growers. Utilizing the data from this study, researchers selected families of oysters that produce traits ideal for meeting grower needs. This research works towards Virginia Sea Grant's goal of advancing scientific understanding of sustainable fisheries and aquaculture and supporting sustainable fisheries and aquaculture businesses in coastal Virginia.

**RECAP:** Virginia Institute of Marine Science surveyed industry to identify most important traits for oysters and selected oyster families that will form the basis of Virginia's breeding program.

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### 21617 - Estimating a Current Tag Reporting Rate for Striped Bass

Sea Grant Population Dynamics Fellow at the Virginia Institute of Marine Science evaluated how well tagging studies of striped bass estimated mortality. One method to estimate fish populations is through tagging fish and gathering data on recapture of that fish. For striped bass, a current estimate of tag recaptures and reporting rate was needed to fully determine the extent to which disease, specifically mycobacteriosis, increased natural mortality rate. A high-reward tagging study was done in 2007 and 2008, and the data obtained from this study have been incorporated into the striped bass stock assessment.

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### 21615 - Sea Grant Research about American Lobster Natural Mortality Rate Presented to Management

Sea Grant Population Dynamics Fellow at the Virginia Institute of Marine Science conducted research that led to the estimation of increased mortality associated with the outbreak of epizootic shell disease in Southern New England American lobsters. Data demonstrated that natural mortality rate for the population of lobsters inhabiting eastern Long Island Sound has likely increased by 80% since the onset of disease. This information was presented to the Atlantic States Marine Fisheries Commission lobster technical committee and was used to guide management decisions for the afflicted stock. Future lobster stock assessments will likely incorporate some sort of disease parameters for which information gathered during this study could be used.

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### 21613 - Sea Grant Fellow Enables Connections Between Two Fisheries Monitoring Efforts on Atlantic Coast

#### RELEVANCE

The Northeast Area Monitoring and Assessment Program (NEAMAP) and Southeast Area Monitoring and Assessment Program (SEAMAP) are operated by the Virginia Institute of Marine Science (VIMS) and the South Carolina Department of Natural Resources (SCDNR), respectively. Despite the shared scientific objectives and close sampling proximity of the surveys, the only previous substantive connection between these two groups was that both provided data to the Fisheries Science Coordinator with the Atlantic States Marine Fisheries Commission for use in stock assessments. Never before had the chief scientists of the two surveys collaborated directly regarding scientific and technical issues and goals shared by both surveys.

#### RESPONSE

As a by-product of working towards this scientific goal, Sea Grant Population Dynamics Fellow has initiated connections between VIMS and SCDNR scientists who operate each program.

#### RESULTS

While specific collaborations were not spearheaded by the Fellow, informal discussions between the Fellow and the chief scientists of each survey have led to direct communication and collaboration between chief scientists of the two survey groups. Collaborations include (1) the implementation of new SEAMAP electronic fish measuring system modeled after the current NEAMAP system designed by Chris Bonzek, and (2) a technical considerations workshop initiated by NEAMAP chief scientists James Gartland and Chris Bonzek, hosted by the SCDNR in January 2015, and attended by scientists from multiple other fishery-independent survey groups that operate in U.S. Atlantic and Gulf of Mexico waters. Future collaborations could include side-by-side trawl sampling by NEAMAP and SEAMAP with the goal of quantifying gear selectivity coefficients for individual species of economical importance that could be used to standardize indices of abundance required for stock assessments. An additional collaboration that formed between Kristene Parsons, a PhD student at the VIMS, and the SCDNR. During the Fellow's field work aboard 2013 SEAMAP cruises, he collected butterfly ray specimens (121 total, covered under SEAMAP scientific permits) for Ms. Parsons that SEAMAP personnel otherwise would not have had the time resources to collect. With the goal of collecting additional specimens, she now has plans to participate in summer 2015 cruises with the SCDNR In-Water Sea Turtle Research program. These activities work towards Virginia Sea Grant's goal of advancing scientific understanding of sustainable fisheries and aquaculture and support sustainable fisheries and aquaculture businesses in coastal Virginia.

**RECAP:** Ultimately these collaborations should lead to technical improvements in the surveys and increased comparability of data sets that are frequently leveraged in fishery stock assessments.

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#### **21612 - Aquaculture Ambassadors Fill Needed Roll in Educating Public about Sustainable Seafood**

Hundreds of members of the public received information about aquaculture and sustainable seafood through a Virginia Sea Grant-funded project. Leaders at Virginia Tech and Hampton University developed a Sustainable Fisheries and Aquaculture Ambassadors (SFAAs) program to allow university students to learn about and deliver outreach and education on fisheries and bay health issues to underrepresented groups. The SFAAs interacted with hundreds of clientele at outreach venues, teaching them about bay education, health, and the role both capture and culture fisheries play towards sustainable seafood supplies. The program was so successful, the Virginia Aquarium has requested the SFAAs assistance in 2015 with implementation of a new outreach aquaponics system and conducting subsequent outreach activities. This program works towards Virginia Sea Grant's goal of increasing awareness and understanding of health, safety, and sustainability issues among the culinary community and consumers to enable them to make informed seafood choices.

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#### **21611 - 100+ Community Members Participate in Aquaponics Training**

Virginia Sea Grant extension at Virginia Tech assisted the Greater Southeast Development Corporation to develop an aquaponics system to address a food-desert in Newport News, Virginia. Through a series of workshops, over 100 local individuals from the surrounding area attended aquaponics workshops and learned all about aquaponic systems as well as plant and fish culture. This included PowerPoint presentations of seeding and growing plants, the care of fish, maintaining an aquaponic system and the actual building of two small scale barrel aquaponic systems. This project was designed to provide the public with a healthy and sustainable means to access nutritional food and relieve pressure due to living in a designated food desert.

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#### **21610 - Sea Grant Extension Trains 100+ in Best Management for Aquaculture**

123 individuals from the mid-Atlantic region attended aquaculture best management practices (BMP) training workshops. Attendees included aquaculturists, regulators, and educators. Take home materials were published for all attendees. Two additional workshops have been requested, one by the FDA at their main facilities in College Park, Maryland, and another by North Carolina Sea Grant. Upon completion of these extra workshops, interest was expressed by attending USDA representatives to roll this into a national program. Discussions in regards are ongoing. This research works towards Virginia Sea Grant's goal of increasing understanding and application of best practices in seafood safety, product and market development, and seafood-processing efficiencies.

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#### **21605 - Sea Grant Researchers Evaluate Factors Affecting Carbonate Chemistry in Chesapeake Bay**

##### RELEVANCE

Production of clams and oyster larvae in Virginia has recently been significantly lower than previously reported due to a changing coastal environment. Because shellfish larvae require favorable water conditions to settle and develop a shell, industry and researchers suspected changes in water conditions could be to blame.

##### RESPONSE

A water quality monitoring program was implemented between six Virginia shellfish hatcheries and

researchers at Virginia Tech and the Virginia Institute of Marine Science. This program provided training and resources for each hatchery to discretely monitor numerous water quality parameters. Initially hatcheries monitored alkalinity, ammonia-N, calcium, dissolved oxygen, nitrate-N, nitrite-N, pH, phosphate, and silica. Later the program was expanded to include continuous monitoring of carbonate chemistry to accurately characterize diurnal and seasonal changes. Researchers synchronized data among the industry participants, resulting in a unique temporal and spatial data set for Chesapeake Bay.

#### RESULTS

During the 2014 hatchery season, researchers found that the monitoring parameters would successfully calculate the carbonate mineral saturation state for aragonite, an important mineral for development of shell. Calculations were also successful at a low salinity site, which are more difficult to predict. Researchers found that aragonite values fluctuate diurnally and seasonally and are influenced by factors other than ocean acidification, such as algae activity, weather events, and likely sediment interactions. This program works towards Virginia Sea Grant's goal of providing stakeholders with the best available science, facilitating stakeholder engagement in decision making, and advancing science-to-management and technology adoption.

**RECAP:** Collaboration between Virginia's shellfish industry and researchers has determined new methods for monitoring water quality conditions at hatcheries and has found that many factors affect carbonate chemistry in Chesapeake Bay. [Back to Goals](#)

#### **21604 - Sea Grant Researchers Test Novel Equipment to Monitor Water Quality and Improve Oyster Hatchery Success**

Virginia Sea Grant-funded researchers at Virginia Tech are working with the state's shellfish hatcheries to monitor water quality that could affect success of oyster larvae. From February to July 2014, one hatchery pilot tested novel equipment to continuously monitor pCO<sub>2</sub>, temperature, salinity, and dissolved oxygen. Researchers found that data collected by the equipment was an excellent predictor of when conditions were favorable for oyster spawning and larval rearing. During late summer, July and late August, researchers found the equipment was still helpful but was not as consistent in its usefulness as a tool. Researchers intend to evaluate the equipment over the next season, with some minor modifications to evaluate the usefulness of this equipment as a tool in late summer. This research works toward Virginia Sea Grant's goal of advancing scientific understanding of socially, economically, and ecologically sustainable fisheries and aquaculture, and supporting sustainable fisheries and aquaculture businesses in coastal Virginia.

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#### **21600 - Sea Grant Leads Productive Conversation on Gear, Fostering Support to Change Regulation**

##### RELEVANCE

US law requires use of turtle-excluder devices (TEDs) on shrimp boats, but a 1987 Louisiana law prohibited local enforcement of the federal law. A TED is a grate that helps keep sea turtles out of a towed net, like those used by some shrimp boats. Regulators and scientists believed that industry would not support repealing the Louisiana law.

##### RESPONSE

At a Virginia Sea Grant-organized panel at the 2014 International Sea Turtle Society Symposium shrimpers said they routinely used TEDs. One captain added, "If the regulations weren't there, I'd still use it." The panel enabled constructive discussions between Louisiana shrimp fishermen, including leadership of the Louisiana Shrimp Task Force, researchers, and regulators and sparked continued deliberations after the event.

##### RESULTS

On April 1, the Louisiana Shrimp Task Force voted unanimously to support the repeal of the legislation that halted enforcement of TEDs. This event works towards Virginia Sea Grant's goal of providing stakeholders with the best available science, facilitate stakeholder engagement in decision making, and advance science-to-management and technology adoption.

**RECAP:** Louisiana Shrimp Task Force votes to repeal a 1987 law and require gear that reduces accidental catch of sea turtles. [Back to Goals](#)

#### **21550 - Scallop Medallions Developed by Sea Grant Exceed \$100 Millions Over Product Lifetime**

##### RELEVANCE

Small scallops are less marketable than larger ones, and companies landing small Argentina scallops were looking for a way to increase their marketability. In 1996, two scallop processors--Neptune Fisheries and Wanchese Fish Company--contacted Virginia Sea Grant extension for assistance.

##### RESPONSE

Robert Fisher, Virginia Sea Grant extension at the Virginia Institute of Marine Science (VIMS), explored proteins and other binders that could be used to form a larger high-quality scallop that could be distributed within current fresh, frozen, and breaded scallop markets. The final product, the scallop medallion, was a low-cost, consistent product for these markets.

##### RESULTS

In the first year, the two original firms compiled sales in excess of \$10 million for the plain scallop medallion and another \$1 million in value-added medallions. Additionally, medallion production increased employment in the processing plants by 35-40 people. "Our scallop medallion sales have continued to increase from our initial roll out," says Skip Redfern, former Product Manager at Neptune Fisheries, Inc. "We developed a number of value-added products that have been accepted in the market." In 1998, Neptune Fisheries had made a profit of \$6,506,366 from raw medallions and \$1,019,205 from value added medallions. "For Neptune Fisheries, it became a significant sell for our company and one of the highest margin items that our company had. For years to follow it was just terrific." Today, President of Wanchese Fish Company Sam Daniels says, "We sell over 2 million pounds of scallop medallions a year and it's been very helpful for our company... I am very appreciative to VIMS and Robert Fisher for his help." This project helps advance Virginia Sea Grant's goal to increase understanding and application of best practices in seafood safety, product and market development, and seafood-processing efficiencies.

**RECAP:** Since the product was developed in 1998, the scallop medallion has been a profitable product for seafood processors in Virginia. [Back to Goals](#)

### **21549 - Sea Grant Demonstrates to FDA Benefits of Phosphate Use in Processing Sea Scallops in the Mid-Atlantic Region**

#### RELEVANCE

The benefits of using sodium tripolyphosphate (STP) on sea scallop meats include the reduction of drip loss in both fresh and frozen meats and maintenance of meat texture and color. However, STP could be used to increase scallop capability for taking up and retaining added water, thereby increasing the weight and profitability of the scallop. The absence of a standard application of STP by industry caused considerable variation in product quality.

#### RESPONSE

In 1993, Robert Fisher, Virginia Institute of Marine Science extension affiliated with Virginia Sea Grant determined how to use STP in order for industry to maintain profit margin without compromising quality or nutritional value. Virginia Sea Grant extension evaluated processing aids to see what would best suit the seafood industry to retain natural moisture and soluble proteins. Virginia Sea Grant extension demonstrated benefits and drawbacks in the hope of developing standard procedures within current industry practices to provide for a more consistent high-quality product.

#### RESULTS

In 1993, the American Scallop Association (ASA) and the International Food Additives Council (IFAC) jointly submitted to the US Food and Drug Administration the final report of the 1993 study, according to a 2002 joint report by the Food and Agriculture Organization of the United Nations and the World Health Organization. The study demonstrated that treatment of sea scallop meats with STP can effectively minimize drip loss and minimize the resulting loss of water soluble nutrients. Before STP, the only way to extend shelf life was to freeze the scallops. Processing scallop meats with STP eliminated this need, and according to the industry, the use of STP allowed for nationwide distribution. The study found that treating scallop meats with a 2.5% STP and 1% sodium chloride water solution resulted in the lowest amount of drip loss during iced storage, the lowest mean weight loss during cooking and freezing/thawing, and the highest retention of water-soluble nutrients. With Mid-Atlantic scallop resources spawning twice a year, versus New England scallop resources only spawning once per year, quality of processed Virginia scallops was inconsistent due to scallop integrity loss during spawning, thus creating market preference for more northern scallops. The use of this recommended processing protocol allowed the Virginia scallop industry to produce a more uniform product throughout the year and become more competitive in the market. This project helped advance Virginia Sea Grant's goal to increase understanding and application of best practices in seafood safety, product and market development, and seafood-processing efficiencies.

**RECAP:** A 1993 Virginia Institute of Marine Science report, jointly submitted to the US FDA by the ASA and IFAC, advised the US FDA to treat sea scallop meats with STP to effectively minimize drip loss and minimize the resulting loss of water soluble nutrients during iced storage and cooking and after freezing and thawing. [Back to Goals](#)

### **21548 - FDA Reexamines Regulatory Limits for Sea Scallop Moisture Content as a Result of Sea Grant Research**

#### RELEVANCE

When scallop meats are exposed to ice melt or fresh water during vessel storage or shore-side processing they take in water and gain weight. In 1992, in an effort to curb fraud and poor handling of scallops, FDA ruled in an interim policy that a "natural" scallop could not have moisture content that exceed 80% by weight. However, data on the natural moisture content of sea scallops in the northwest Atlantic Ocean was limited, and Virginia-landed scallops were thought to be naturally close to the 80% limit.

#### RESPONSE

Virginia Institute of Marine Science (VIMS) affiliated with Virginia Sea Grant conducted a 1996 study to assess natural and ex-vessel moisture content of sea scallop meats harvested from most of the commercially fished areas in the Atlantic Ocean over an extended period of time. The results at off-loading were statistically analyzed to determine what the upper limit for moisture content would have

to be in order for all the samples collected in this study to be in compliance with a hypothetical upper limit for scallop meat moisture.

## RESULTS

A 2002 joint report by the Food and Agriculture Organization of the United Nations and World Health Organization examined the results of a 1995 Canadian study and the 1996 Sea Grant extension study. The studies found that natural moisture content ranged from 73.7% to 78.9% and offloading or ex-vessel values ranged from 74.2% to 82.5%. To achieve a 95% probability of industry compliance, the upper limit would have to be 81.6% and for the probability of compliance to be greater than 95%, the upper limit would have to be 82%. The report concluded that the prior standard for moisture content in sea scallops set by FDA, 80%, should be reexamined. The FDA concluded in 2004 that differences in commercial practices in the US, Canadian, and European scallop industries make different regulatory limits appropriate and decided to further review the moisture limits for US scallop. This project helped to advance Virginia Sea Grant's goal to provide stakeholders with the best available science, facilitate stakeholder engagement in decision-making, and advance science-to-management and technology adaptation.

**RECAP:** In 2004, the FDA moved to reexamine the 1992 interim policy that scallop meat should not exceed moisture content of 80% by weight, based on a 1996 recommendation by Virginia Sea Grant extension at Virginia Institute of Marine Science. [Back to Goals](#)

### **21547 - Extension Recommends an Automated Method for Determining Moisture in Scallops Utilized Throughout Industry**

#### RELEVANCE

In 1992, the FDA had a zero tolerance policy for added water to seafood, considered to be a form of economic fraud. The scallop industry became the initial focal point for policy enforcement due to common industry handling and processing practices, which resulted in scallop moisture uptake. Scallops with moisture levels below 80% were labeled and marketed as scallops, whereas scallops with moisture levels between 80-84% were labeled as "scallop products." To stay in compliance, scallop processors had to monitor moisture content using a private lab, which was costly and untimely.

#### RESPONSE

In 1992, Virginia Institute of Marine Science extension affiliated with Virginia Sea Grant introduced the scallop industry to a tool that monitored scallop moisture levels for in-house quality control checks. The unit, the OHAUS MB 200, used infrared heating to rapidly drive-off moisture, providing moisture results in 15-18 minutes. The unit was not a recognized standard method for moisture determination, although it was being used by National Marine Fisheries Services for policy enforcement. Extension performed the first structured collaborative study to determine if the unit could be considered for acceptance as a standard method. In 1997, it was determined that the unit was an effective, relatively inexpensive tool for industry to use for monitoring moisture, but recommended that it should be backed up by the standard AOAC method for regulatory compliance issues.

#### RESULTS

"I have three moisture analyzers here in our facility, and we pretty much use them day in and day out," says Scott Beagle, Director of Operations for Chesapeake Bay Packing. Beagle believes moisture analyzers are utilized industry-wide. "It helps us determine what products will work best for different market specification purposes, as sometimes during the year moisture levels will be higher due to environmental conditions and harvest area." Beagle's company processes and packs fresh and frozen scallop products for domestic and worldwide distribution. According to NOAA Commercial Fisheries Statistics, in 2012 Virginia's scallop industry landed more than 5 million pounds of sea scallops, worth more than \$54 million. Since the technology was introduced, Virginia alone has landed more than \$900 million in sea scallops. This project helps advance Virginia Sea Grant's goal to provide stakeholders with the best available science, facilitate stakeholder engagement in decision-making, and advance science-to-management and technology adaptation.

**RECAP:** With help of technical expertise, the sea scallop industry can ensure FDA compliance and more effectively market product--valued at more than \$54 million in 2012 in Virginia alone.

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### **21546 - Brought Back From the Brink: Black Sea Bass Stock Recovers with Help from VIMS Advisory Services affiliated with Virginia Sea Grant**

#### RELEVANCE

The southern stock of black sea bass, which ranges from Cape Hatteras (NC) to the Florida Keys was declared overfished in 2005. At the time, Virginia landings of black sea bass were just under 500,000 lbs, the third lowest landings since 1970, according to NOAA Annual Commercial Landing Statistics.

#### RESPONSE

In 2002, Jim Dawson, Virginia waterman, and Bob Fisher, Virginia Institute of Marine Science extension affiliated with Virginia Sea Grant, tested new black sea bass fishing gear, hoping to improve recruitment of adult black sea bass by reducing catch and mortality of undersized fish. The study found that experimental traps with multiple 2-inch square vents reduced the sub-legal catch by 78%, and the research team recommended that traps have at least two vents instead of one. These findings were presented at the Atlantic States Marine Fisheries Commission "Black Sea Bass & Scup Escape Vent Workshop" on March 22, 2005. The event report sites Fisher and Dawson's work extensively in its final recommendations to increase escape vents from 1.5-inches to 2-inches and to increase the number of vents from one to two. Along with catch limits and other management measures, the recommendations were implemented in the "Summer Flounder, Scup, and Black Sea Bass Fishery

Management Plan (FMP)" in 2006 (final rule 50 CFR Part 648).

#### RESULTS

In May of 2013, NOAA Fisheries Southeast Regional Office declared the southern stock of black sea bass successfully rebuilt. Catch limits increased that fall. In Virginia, landings increased from \$662,972 in 2006 when the FMP was enacted to \$1,710,228 in 2013. This project helps advance Virginia Sea Grant's goal of providing stakeholders with the best available science, facilitate stakeholder engagement in decision-making, and advance science-to-management and technology adoption.

**RECAP:** A new gear design was incorporated into the 2006 fishery management plan and, in 2013, the stock was announced as rebuilt; Virginia landings reached \$1,710,288 that year. [Back to Goals](#)

### **21545 - Millions of Horseshoe Crab Conserved Due to Management Actions, Including a Recommendation Based on Gear Study**

#### RELEVANCE

Horseshoe crabs are an important food source for migrating shorebirds, finfish, and turtles. Commercial fishermen also use horseshoe crab as bait in whelk fisheries. In 1998, "concerns over increased exploitation of horseshoe crabs, particularly in the mid-Atlantic states" prompted the Atlantic States Marine Fisheries Commission (ASMFC) to issue a Fisheries Management Plan for horseshoe crab, and in 2000 ASMFC's Addendum 1 established quotas to reduce horseshoe crab bait landings by 25% from 1997-1998 levels.

#### RESPONSE

In response to industry concerns about reductions in horseshoe crab and need for bait in the whelk fishery, Robert Fisher, Virginia Institute of Marine Science extension affiliated with Virginia Sea Grant, began research on alternative baits and bait reduction devices in the late 1990s. One study found that placing half of the typical amount of horseshoe crab in a rigid, plastic aquaculture mesh bag resulted in no significant loss of whelk catch. The results of the study were shared with ASMFC, and according to ASMFC's "2001 Review of the Fishery Management Plan for Horseshoe Crab (*Limulus polyphemus*)," "free bait bags have been distributed to whelk potters in several mid-Atlantic states." In 2001, ASMFC presented Fisher with an Award of Excellence for his work. Later the ASMFC's "2012 Review of the Fishery Management Plan for Horseshoe Crab (*Limulus polyphemus*)" acknowledged that for states that were under the Addendum 1 "[t]he reductions in reported bait landings in excess of the 25% reductions required under Addendum 1 were largely attributed to the success of this [bait bag distribution] program, with the widespread use of the devices by the commercial fishery."

#### RESULTS

Under Addendum 1, this additional reduction numbered 371,881 horseshoe crabs. Several management actions have been put in place since 2000 and millions of horseshoe crab have been conserved. Bait bags remain part of the management suite in the horseshoe crab fishery management plan and are used in Atlantic states whelk fisheries. Even while reducing bait, Atlantic states whelk fisheries have increased value of landings from \$6 million in 2006 to \$9.2 million in 2013, according to National Marine Fisheries Services commercial fisheries statistics. This project furthers Virginia Sea Grant's goal of providing stakeholders with the best available science, facilitate stakeholder engagement in decision-making, and advance science-to-management and technology adoption.

**RECAP:** Research by Virginia Institute of Marine Science extension affiliated with Virginia Sea Grant demonstrated that bait bags could reduce horseshoe crab bait needed in the whelk fishery.

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### **19772 - Sea Grant Research Leads to Changes in Model Used to Manage Chesapeake Bay Striped Bass**

#### RELEVANCE

Chesapeake Bay is the primary spawning and nursery habitat for striped bass on the East Coast. In 2000, striped bass sales were thought to be more than \$97 million in Virginia's commercial and recreational fisheries. In the early 2000s, fisheries managers started seeing contradictory data. Mathematical models that estimated how fishing activity affected the abundance of striped bass indicated that abundance was high and fishing effort could be significantly increased. However, estimates based on observations and sampling found striped bass abundance was either stable or declining. This contradiction implied a need to recalibrate the model so that future management actions would be predicated on accurate estimates of fishing mortality and population abundance. One explanation for the discrepancy was thought to be a change in the natural mortality rate in striped bass.

#### RESPONSE

Virginia Sea Grant and National Marine Fisheries Service Population Dynamics Fellow based at Virginia Institute of Marine Science investigated whether a relatively new disease called mycobacteriosis, which can produce ulcerous lesions on striped bass, could have lead to a change in natural mortality rate. Collaborating with existing striped bass tagging research efforts, the Fellow collected data on disease prevalence, disease progression, and disease associated reductions in survival. For striped bass in the most severe disease state, survival was 54% that of healthy striped bass; however, fish in earlier stages of the disease could live in the same disease state for more than one year on average. The data indicated that the natural mortality rate for striped bass increased by 60% after 1998. The Fellow presented the findings to the Atlantic States Marine Fisheries Commission's Striped Bass Tagging and Stock Assessment Sub-Committees, the striped bass Technical Committee, and the Atlantic Striped Bass Management Board.

#### RESULTS

The Striped Bass Tagging Sub-Committee agreed that a period shift in striped bass natural mortality

rate occurred around 1998, justifying the use of the original mortality rate for fish alive earlier than that year and a new mortality rate for fish alive after. This program works toward Virginia Sea Grant's goal of providing stakeholders with the best available science, facilitating stakeholder engagement in decision-making, and advancing science-to-management and technology adoption.

**RECAP:** Population Dynamics Fellow finds that mortality rate of striped bass increased after 1998, likely due to new disease. [Back to Goals](#)

### **19769 - Sea Grant Workshop Enables Virginia Processors to Develop Value-Added Seafood Products**

#### RELEVANCE

Instead of selling only seafood, companies are starting to develop and sell products that reduce preparation for customers. This adds value to the product and increases sales and revenue for the companies. However, many seafood processors are uncertain how to develop these "value-added" products.

#### RESPONSE

In 2013, Virginia Sea Grant extension at Virginia Tech held a workshop, "Creating and marketing value-added seafood products," to introduce local seafood processors to value-added seafood, including developing and marketing new products. 40 processors and others attended the event. Speakers from large, vertically integrated seafood companies and small aquaculture companies shared how they use value-added and what can be expected when entering the different food marketing channels. Speakers from U.S. Navy Food Supply explained what the Navy value-added needs are and how to go about supplying those needs. A certified retail quality auditor detailed new quality and process certifications that grocery store chains require from value-added processors. Academic speakers gave insight into how food safety tests work, how to calculate break-even quantities for value-added products, and how to use Cooperative and Sea Grant Extension assistance when working with value-added.

#### RESULTS

Following the workshop, 100% of attendees said they were more confident in their ability to develop value-added products, and 94% said they were more likely to develop a value-added product. Less than six months following the workshop, one attendee developed a value-added product and brought it to market. This project works toward Virginia Sea Grant's goal to increase understanding and application of the best practices in seafood safety, product and market development, and seafood-processing efficiencies.

**RECAP:** Virginia Sea Grant convened a workshop that is helping local seafood processors diversify their businesses and enter into value-added seafood markets. [Back to Goals](#)

### **19684 - Sea Grant Inspires Virginia Shellfish Industry to Put Competition Aside, Address Changing Water Quality**

#### RELEVANCE

Virginia's oyster hatcheries support a more than \$5M industry and are notoriously competitive with each other. Yet they face common challenges, including day-to-day changes in water quality that affect oyster seed production.

#### RESPONSE

Virginia Sea Grant Shellfish Aquaculture Specialist Karen Hudson worked with a West Coast organization, Sustainable Fisheries Partnership, to organize an Ocean Acidification Workshop to educate hatcheries on carbonate chemistry issues in water quality. Representatives from all of Virginia's hatcheries attended the October 2011 event and a majority opted to work collaboratively on the issue. Virginia's hatcheries recognized the need to work collaboratively to address this larger issue. They formed the Ocean Acidification Information Network to continue discussion. Hudson and the Network then joined forces with researcher Dave Kuhn of Virginia Tech, who is already working with one hatchery to standardize data collection and has expanded efforts to include six more hatcheries examining a variety of water quality issues.

#### RESULTS

"Just having all of us together in the same room is something," says Ann Arseniu Gallivan, Shooting Point Oyster Company, at a February 2014 meeting of the Ocean Acidification Network of Virginia meeting. Not only were six out of seven Virginia hatcheries sitting around the same table, they were all contributing data to a Virginia Sea Grant-funded study that researchers will use to help hatcheries predict how and why water quality changes will affect oyster seed. This project works toward Virginia Sea Grant's goals of advancing scientific understanding of sustainable aquaculture, supporting sustainable aquaculture businesses in coastal Virginia, developing and providing sound scientific information to support ecosystem-based approaches, and supporting use of integrated, ecosystem-based approaches.

**RECAP:** By bringing together Virginia's shellfish hatchery members to discuss the broader issues of ocean acidification and water quality, Virginia Sea Grant spurred collaboration and open dialogue that will lead to a coordinated statewide effort to address common challenges. [Back to Goals](#)

### **19664 - Sea Grant Funding of Oyster Breeding Leads to More than \$80 Million in Annual Economic Impact, Growing**

#### RELEVANCE

Throughout the 1900s, a series of diseases decimated Chesapeake Bay's wild oyster populations, reducing landings from 100 million pounds per year to less than 5 million.

#### RESPONSE

From 1979 to today, Sea Grant programs on the East and West Coasts funded Stan Allen's efforts to develop disease resistant, sterile triploid oysters and commercialize production. Allen received funding

from Virginia Sea Grant in the early 2000s to investigate the potential of oyster aquaculture in Virginia, introducing triploids to local industry. In 2005, his collaborative research with industry put triploid oysters into the hands of growers for a comparative study. Seeing the success of triploid oysters proved to industry that the native oyster could be grown again in Chesapeake Bay. It marked a turning point for the industry, which increased plantings by more than 150% the next year. In the 8 years since the study, plantings and sales increased more than 10 fold.

#### RESULTS

Today, more than 90% of oysters planted in Virginia are triploids. Industry is growing at a rate of 34% annually, and economic impact to the state was estimated in 2013 to exceed \$80 million. Allen's work will continue to impact the industry across the country. In 2012, Allen was named Laborde Endowed Chair for Sea Grant Research and Technology Transfer by Louisiana Sea Grant and he will help transfer breeding technology to Louisiana. Virginia Sea Grant is continuing to support the development of oyster aquaculture by funding Allen's research to determine other valuable oyster traits for growers. "Sea Grant has supported every aspect of my career, and I think I'm on the same page with Sea Grant because we want the same things: We want products to be useful for the development of the seafood industry," said Allen. This program works toward Virginia Sea Grant's goal of advancing scientific understanding of sustainable fisheries and aquaculture and support sustainable fisheries and aquaculture businesses in coastal Virginia.

**RECAP:** Sea Grant funding is credited as a major contributor in the development and proliferation of the native disease resistant triploid oyster, planted more than 90% of the time in Virginia where annual economic impact of oyster aquaculture exceeds \$15 million.

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### **19663 - Sea Grant Research Reveals New Directions to Improve Survival of Aquaculture Oysters in Chesapeake Bay**

#### RELEVANCE

Throughout the 1900s, a series of diseases decimated Chesapeake Bay's wild oyster populations, reducing landings from 100 million pounds per year to less than 5 million. In the early 2000s, researchers found that they could improve the survival of native *Crassostrea virginica* oysters by breeding triploid oysters, an oyster with three sets of genes produced from a parent with four sets of genes and one with two sets of genes. It marked a turning point for the industry, which increased plantings by more than 150% the next year. In the eight years since the study, plantings and sales increased more than 10 fold. Today, the oyster industry contributes \$35+ million to the state of Virginia and 90% of oysters grown are triploid. All of these triploid oysters originate from four-gene parents produced at Virginia Institute of Marine Science Aquaculture Breeding and Technology Center.

#### RESPONSE

Virginia Sea Grant-funded researchers at Virginia Institute of Marine Science studied whether oyster breeders could improve traits by selectively breeding the two gene, diploid, parents. Researchers mated four gene oysters with either selectively bred diploids or wild oysters. In all, 13 different types of offspring, mostly triploids with some diploid controls, were tested throughout Chesapeake Bay.

#### RESULTS

Researchers found that salinity plays an important role in survival of oysters. In low salinity environments, triploids with a selectively bred diploid parent survived best. In high salinity environments, selectively bred diploids grew about as well as triploids. Researchers also found that selectively bred diploids grew better than wild diploids, with larger shells and meat weight. These results underscore the importance of continuing to optimize diploid oysters. The results also indicate that low salinity environments pose the greatest challenge for survival. Knowing this information, Virginia Institute of Marine Science's Aquaculture Breeding and Technology Center intends to adjust their breeding strategies. This project supports progress towards Virginia Sea Grant's goal of advancing scientific understanding of sustainable fisheries and aquaculture and supporting sustainable fisheries and aquaculture businesses in coastal Virginia.

**RECAP:** Virginia Sea Grant researchers find that oysters with three genes have a survival advantage in low salinity and that selectively bred two gene oyster parents can survive just as well in high salinity environments.

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### **19658 - Sea Grant Tests New Conservation Gear, Fishermen Voluntarily Adopt**

#### RELEVANCE

Shrimp fisheries face challenges with bycatch of turtles, sharks, rays, jellyfish, red snappers, and other non-target species. In addition, a contentious history with Turtle Excluder Device (TED) implementation has contributed to substantial industry resistance to TED adoption.

#### RESPONSE

Virginia Sea Grant conducted Collaborative Fisheries Research to test new TED designs with the goal to meet conservation and fishing objectives and to increase fishermen and scientist capacity in order to participate in collaborative research. As part of the effort, Virginia Sea Grant gave away seven new TEDs, designed with smaller bar spacing.

#### RESULTS

The new TEDs significantly reduced bycatch, including shark species, rays, jellyfish, red snapper (larger than 30cm), red drum, and cobia. This improved conservation benefits and the quality and market value of the catch. One fisherman was so encouraged by the performance of the new TED that he voluntarily purchased additional TEDs for all his trawls, swapped out his old TEDs, and now only fishes with the new TEDs. This multiplies the conservation and economic impact of Virginia Sea Grant's work. This program works toward Virginia Sea Grant's goal of providing stakeholders with the best available science, facilitating stakeholder engagement in decision making, and advance science-to-management and technology adoption. This program works toward Virginia Sea Grant's goalS of advancing scientific

understanding of sustainable fisheries and providing stakeholders with the best available science, facilitating stakeholder engagement in decision making, and advancing science-to-management and technology adoption.

**RECAP:** Virginia Sea Grant's collaborative research with shrimp fishing industry tested a new design for a turtle excluder device (TED), which proved so effective in reducing bycatch and improving quality and value of shrimp that those who participated voluntarily adopted the device. [Back to Goals](#)

### **19619 - Sea Grant Aquaculture Specialists Enable \$340,000+ in Seafood Production in 2013**

#### RELEVANCE

Setting up recirculating tanks necessary for on-shore aquaculture is an important but challenging step in the aquaculture business.

#### RESPONSE

In 2013, Virginia Sea Grant extension at Virginia Tech provided technical assistance to three Virginia companies to research, design, and set-up holding tanks, cages, and recirculating systems.

#### RESULTS

These companies produce hybrid striped bass, catfish, rainbow trout, and shrimp. Two of the companies reported a total of \$344,000 in annual production due to technical assistance and more than 160,000 pounds of seafood. One of the three companies is expecting to expand and begin production to include an additional fish species in the near future. This project works toward Virginia Sea Grant's goal of advancing scientific understanding of sustainable fisheries and aquaculture and supporting sustainable fisheries and aquaculture businesses in coastal Virginia.

**RECAP:** Virginia Sea Grant extension brings technical expertise in aquaculture system design to industry and enable businesses to get started and expand. [Back to Goals](#)

### **19618 - Sea Grant Develops the Future Aquaculture Workforce**

In 2013, Virginia Sea Grant extension at Virginia Tech lead in workforce development programs in aquaculture, including: (1) establishing a research program with Hampton University (HU), (2) launching a 12-month Aquaculture Ambassadors program, which provides four HU undergraduates with training and internships in aquaculture, (3) providing two high school student interns with training and experience in aquaculture production, and (4) hosting 12 aquaculture graduate student interns, including eight international students and four USA students, to train the next generation of international aquaculture workers. Since 2007, more than 60 graduate-level and undergraduate student interns from more than 12 countries have participated in aquaculture internship programs with Virginia Sea Grant extension at Virginia Tech. These programs work toward Virginia Sea Grant's goal of providing stakeholders with the best available science, facilitating stakeholder engagement in decision-making, and advancing science-to-management and technology adoption.

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### **19614 - Proactive Seafood Companies Seek Virginia Sea Grant Analysis to Keep Product Safe**

#### RELEVANCE

To stay in business, seafood processors must maintain safe products that are free of microbiological contaminants and hold true to the product's advertised shelf life. Many of these tests are above and beyond the regulatory requirements, but Virginia companies seek these analyses to ensure the safety and high quality of their products. However, conducting analyses such as these requires scientific instrumentation and technical expertise which are not always readily available from commercial laboratories.

#### RESPONSE

Virginia Sea Grant extension at Virginia Tech offers confidential microbiological analyses for seafood processors to proactively evaluate their products and processing facilities. Tests evaluate product quality, shelf-life, and safety. Environmental tests look for indicators of contamination in the processing environment. These services are available to all Virginia seafood companies.

#### RESULTS

In 2013, extension conducted 2,235 microbiological analyses for 12 seafood companies. Companies use the results from these tests in developing new products and keeping current products safe, affecting hundreds of thousands of dollars in seafood products in Virginia. This program works toward Virginia Sea Grant's goal of providing technical support and guidance to industry to increase food safety and product quality.

**RECAP:** Since 2009, 12 to 18 companies per year in Virginia seek microbiological analyses to evaluate their product quality, shelf-life, and safety, as well as to evaluate processing facility safety.

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### **19613 - Sea Grant Technical Assistance Enables Virginia Seafood Companies to Meet FDA Requirements**

#### RELEVANCE

US Food and Drug Administration (FDA) requires seafood companies to meet strict temperature limits for transporting, freezing, and pasteurizing seafood products.

#### RESPONSE

Virginia Sea Grant extension at Virginia Tech provides technical assistance to seafood companies. These services include developing temperature profiles for crabs and oysters during transport for eight companies, developing four retort validations, four listericidal process validations, two Salmonella cook validations, and a pasteurization validation. The Virginia Tech facility provides these services to all

Virginia seafood companies,

## RESULTS

In 2013, extension provided technical services to 16 Virginia companies, affecting hundreds of thousands of dollars of seafood produced in the state. This program works toward Virginia Sea Grant's goal of providing technical support and guidance to industry to increase food safety and product quality.

**RECAP:** Since 2009, 64 seafood companies received services and technical assistance to meet FDA requirements, affecting hundreds of thousands of dollars of seafood produced in Virginia. [Back to Goals](#)

### **19612 - Sea Grant Leads Locally, Nationally, and Internationally in Seafood Safety**

Virginia Sea Grant extension at Virginia Tech are sought-after advisors and presenters throughout the world. Individuals conduct trainings and provide technical advice and assistance to individual companies in Virginia, as well as to the Virginia Department of Health, Virginia Seafood Council, State Vibrio Task Force, and state and regional industry events and conferences. Nationally, extension are active participants in organizations that study and advise on food safety, including Global Cold Chain Alliance, National Advisory Committee on Microbiological Criteria and Food Safety, and the Interstate Shellfish Sanitation Conference (ISSC). Extension staff at Virginia Tech also provide training in Hazard Analysis and Critical Control Points (HACCP) and Good Management Practices to countries that export seafood to the U.S. as part of a Food and Drug Administration program. In 2013, extension provided training to 70 international individuals in HACCP through partnering with the US Food and Drug Administration's Joint Institute for Food Safety and Applied Nutrition Train-the-Trainer program. These projects work toward Virginia Sea Grant's goal of providing technical support and guidance to industry to increase food safety and product quality.

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### **19611 - Sea Grant Provides Safety Training to 243 Mid-Atlantic Seafood Processors in 2013**

Virginia Sea Grant extension at Virginia Tech offers Hazard Analysis and Critical Control Point (HACCP) and Good Management Practices (GMP) training for seafood processors. In 2013, 130 members of the seafood processing community received HACCP training. 43 English-speaking and 70 Spanish-speaking received GMP training for a total of 113 people. HACCP training focuses on FDA seafood safety issues, while GMP training focuses on FDA sanitation issues, good hygiene of employees, processing environment conditions, etc. Processors participate to refresh their knowledge, train new employees, or address a citation from an inspector. Those who have attended have said: "Thank you for the trainings; makes our operation staff aware of the importance of GMP's especially in the sanitation areas. Personnel accept these practices more openly when confirmed by an outside source" and "Your services have provided a foundation towards our success." Since 2009, 536 English-speaking and 108 Spanish-speaking individuals received HACCP training. This program works toward Virginia Sea Grant's goal of providing technical support and guidance to industry to increase food safety and product quality.

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### **19610 - Sea Grant Provides Technical and Marketing Assistance to Help Virginia Aquaculture Get onto Grocery Store Shelves**

#### RELEVANCE

Gaining access and introducing new products to retail markets is a challenge for many food producers. Members of the Virginia Aquafarmers Network Cooperative (VAN) have experienced success marketing their products at farmers markets but have been unable to gain entry into more traditional retail market channels. The farmers market channel is very important to VAN, but if Virginia aquaculture production is to increase, the grocery store channel needs to open.

#### RESPONSE

Virginia Sea Grant extension at Virginia Tech provided technical and marketing assistance to VAN to market its shrimp for the first time to a major retail chain. Extension provided training to farmers in pond management and harvest handling. An agreement was reached with a local retailer of a major grocery store chain to conduct a two-day trial sale. Approximately 400 pounds of head-on shrimp were sold or sampled during that time. Those who purchased the product were asked to fill out a questionnaire about their reactions to the shrimp after eating at home. 92 consumers returned the questionnaires with overall positive reactions.

#### RESULTS

Based on the positive reactions from customers, the retailer and VAN are currently making plans to sell the shrimp again at harvest next year. VAN is negotiating to sell other products including catfish, trout, and striped bass. Lynn Blackwood, president of VAN wrote, the project "...was a positive experience from which we learned a great deal. The project opened the door for potential sales to this high-end grocery store. The activity started a dialogue between VAN and the distributor... This will hopefully lead to future sales to [the retailer]. This project has taught VAN how to build another valuable marketing outlet. We truly appreciate this effort towards supporting this young industry in Virginia." This program works toward Virginia Sea Grant's goal of increasing understanding and application of best practices in seafood safety, product and market development, and seafood-processing efficiencies.

**RECAP:** Virginia Sea Grant aquaculture and seafood marketing extension at Virginia Tech helped aquaculture business launch a well-received two-day trial of aquaculture shrimp at a local grocery store. The retailer and producer are negotiating future sales of shrimp and other aquaculture seafood.

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### **19603 - Sea Grant Extension Partners Sponsor Events for Children to Experience**

### **Recreational Fishing**

In 2013, Virginia Sea Grant extension partners collaborated to produce five youth recreational fishing events, reaching 499 children. Events included (1) Chesapeake Bay National Estuarine Research Reserve (CBNERR) Discovery Labs and camps, (2) Kiwanis Fishing Day Clinic, and (3) Charter Boat Association gave 217 Peninsula-area children and chaperones a chance to go fishing aboard some of its members' vessels. Volunteers from the Virginia Game Fish Tagging Program were on hand to help tag and release fish caught by children during the events. These programs work toward Virginia Sea Grant's goals of advancing scientific understanding of sustainable fisheries, supporting sustainable fisheries businesses in coastal Virginia, and elevating awareness and understanding of coastal and ocean science among targeted audiences so they can become more informed decision makers.

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### **19601 - Sea Grant Extension Fish Tagging Program Breaks Record with 31,000+ Fish Tagged in 2012**

In 2013, Sea Grant extension partner and Virginia Institute of Marine Science program, Virginia Game Fish Tagging Program (VGFTP), published its annual report for 2012. In 2012, the program sponsored three fish tagging events and more than 104 trained anglers tagged fish. The program had a 63.2% increase in tagging and a 21.1% increase in recaptures from the previous year. 2012 was a record-breaking year with 31,625 tags. The primary goal of the VGFTP is to train and maintain an experienced group of anglers who are willing to volunteer their time and effort to properly tag and release popular recreational fish species. Direct association of angler taggers with others in the angling community enhances program awareness, reminds anglers and commercial fishers of the importance of reporting tagged fish, and provides the angling community with positive fishery conservation role models. The program documents annual and year-to-year movement and habitat utilization patterns of finfish species in Virginia waters. The number and size distribution of fishes tagged each year compliment other research-based data sets and can help fishery managers gain a more comprehensive picture of sizes of fish released in the state's marine recreational fishery. This program works toward Virginia Sea Grant's goals of advancing scientific understanding of sustainable fisheries, providing stakeholders with the best available science for fisheries management, and developing and providing sound scientific information to support ecosystem-based approaches.

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### **19600 - Sea Grant Extension Partner Engages Veterans in Rehabilitative Fly-Fishing**

In 2013, Sea Grant extension at Virginia Institute of Marine Science sponsored four Project Healing Waters events that hosted 105 veterans for a day of recreational fishing. Project Healing Waters is a cooperative volunteer program that engages disabled active military service personnel and disabled veterans in physical and emotional rehabilitation through fly-fishing and associated activities including education and outings. This program works toward Virginia Sea Grant's goals of elevating awareness and understanding of coastal and ocean science among targeted audiences so they can become more informed decision makers, and supporting sustainable fisheries and aquaculture businesses in coastal Virginia.

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### **17816 - Sea Grant has Virginia's tasting oysters and talking about 'growing regions'**

**RELEVANCE:** The Virginia oyster aquaculture industry has an economic impact that exceeds \$14.3 million and is growing by 34% annually. With increased supply comes a need to increase demand. Continued growth needs to be supported by sound science and marketing education.

**RESPONSE:** Because half-shell oyster flavors vary depending on where they are grown, they can be distinguished from each other; therefore, growers can increase demand for their oysters through marketing strategies. In 2011, Virginia Sea Grant extension established an oyster tasting panel to describe the subtle flavors of oysters grown in local waters. The information allows growers to differentiate their product from others by region. The panel's findings were shared with consumers, via a brochure published by the Virginia Marine Products Board, and growers, via a differentiated half-shell workshop.

**RESULTS:** At least nine online publications ran stories about Virginia's oysters that cited Virginia's "seven oyster growing regions," an idea first proposed in the study's brochure. This coverage generated more than 1.3 million impressions from September 2012 through January 2013. The workshop and brochure have also affected the way growers are marketing products. Literally dozens of articles have been published with growers describing oyster flavors in terms used in the workshop. In an unsolicited email to one of the workshop organizers, grower Chris Ludford wrote: "I am building my business and brand on exclusivity... our oysters will only be enjoyed at certain fine restaurants and small purveyors... The workshop... was a game changer for me, my family, and our business." Ludford is one of more than 10 growers who have been quoted in the press describing oyster flavors using concepts and terminology presented in the workshop.

**RECAP:** As the oyster aquaculture industry grows, Virginia Sea Grant is helping the industry to increase demand through research and outreach on marketing strategies. Virginia Sea Grant is helping to shape the way growers, distributors, restaurants, and consumers think about half-shell oysters, enabling demand for differentiated and branded oysters to increase.

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### **17812 - Virginia Sea Grant graduate research fellowships help students connect research to management**

In addition to supporting relevant and cutting-edge coastal research, one of the major goals of the newly created Virginia Sea Grant graduate research fellowship program is to help fellows develop practical skills in science communication, and in advancing the transfer of science to management. This provides valuable training to the fellows, and also improves integration of Sea Grant research with other functional areas. To this end, each fellow is expected to work with an end-user mentor to ensure that their research is useful and used. VASG grad fellow Mark Stratton, a PhD student at VIMS, is investigating ecological patterns of the fish community inhabiting nearshore U.S. Atlantic waters from Florida to Massachusetts, with the ultimate goal of improving management of these fish communities. His end-user mentor is Genevieve Nesslage, a stock assessment scientist with the Atlantic States Marine Fisheries Commission (ASMFC). In September 2012, Stratton attended an ASMFC meeting, where he observed deliberations among the committee members regarding how to update and modify the existing model that predicts the abundances of and accounts for the trophic interactions between Atlantic menhaden and its major predators (striped bass, bluefish, and weakfish). Learning the specifics about how predator diet information is formatted prior to being input into the model has provided Stratton with important guidance as to the most efficient methods for processing collected fish diet samples; therefore, results from Stratton's diet analysis research will be appropriately formatted for inclusion in the model. Stratton notes that interaction with Nesslage has been highly productive; she has provided key guidance toward shaping his scientific approach so that results will be germane to management considerations, including the generation of appropriate indices of abundances for multiple managed stocks that account for environmental effects, as well as helping to focus the direction of multispecies modelling efforts that could be undertaken in his research. This example shows the success of the VASG graduate research fellow program in providing valuable training for fellows while also ensuring that research results are transferred to end-users.

**RECAP:** Fellows conduct research and work with outreach mentors to learn how fisheries managers and others will use data like theirs. [Back to Goals](#)

#### **17799 - Virginia Sea Grant leads in compliance training for new seafood safety regulations**

**RELEVANCE:** In 2011, the FDA passed regulation that mandated states to develop safety certification programs for shellfish shippers and reshippers by 2014. Training the Virginia's 200 shippers with very little budget posed a problem to Julie Henderson, Plant Program Manager at the Virginia Department of Health (Division of Seafood Sanitation). She wanted to have a training video that could be used in an online training and certification program.

**RESPONSE:** With the help of Virginia Sea Grant, Henderson produced a video that will be the main training aid in the state's certification program and could be utilized by other states as well. "We would not have been able to do the video without Sea Grant," Henderson said. "I was sitting in the [Virginia Sea Grant] Symposium... and when I heard about some of the funding opportunities, I thought, maybe Sea Grant might help fund this project?" Henderson approached Karen Hudson, VASG Shellfish Aquaculture Specialist, whom she had worked with in the past, to help. In addition to funding, Hudson also took a lead role in coordinating the video production.

**RESULTS:** The training video developed with Sea Grant support will be the main training aid in Virginia's certification program. This video will be used to educate 200 shellfish dealers in the state in 2014. The video could have national implications as well, said Henderson, "We made it generic enough that any Sea Grant state could use it." Today, Henderson said that Virginia is leading the way in complying with the upcoming regulations: "With the help of Karen, we're far ahead of other states."

**RECAP:** Through collaboration with Virginia Department of Health, Virginia is leading the way in training seafood shippers to meet new national safety regulations. [Back to Goals](#)

#### **17794 - Sea Grant research informs management strategies for striped bass and American lobster populations**

**RELEVANCE:** Disease in striped bass and American lobster leads to high mortality rates. A better understanding of disease on population dynamics can improve management of these species.

**RESPONSE:** Tagging data was utilized to develop new, more accurate models to estimate the impact of disease on population. With improved information, current management strategies were assessed at given disease levels to determine efficacy. New management strategies were recommended as needed.

**RESULTS:** For striped bass, the research has resulted in the tagging model being changed to allow for different natural mortality rates with time, as well as the adoption of a new approach for estimating tag reporting rate. For American lobster, the results have been used to build support for proposing drastic changes to the Southern New England lobster management plan.

**RECAP:** New tagging models and approaches led to better estimations of the effects of disease on striped bass populations and improved management plans for American lobster. [Back to Goals](#)

#### **15925 - Sea Grant empowers competing shellfish hatcheries to work together to address water quality**

**RELEVANCE:** Virginia's \$32.7M shellfish aquaculture industry relies on a consistent supply of oyster and clam larvae and "seed"-baby shellfish-from hatcheries. Production of shellfish larvae and seed is highly susceptible to water quality and, in 2011, unknown water quality complications surprised the hatcheries, resulting in a 60% reduction in seed production. The industry demand for hatchery-produced oyster seed continues to increase and is projected to exceed two billion in 2012 (300 million more than ever before). Therefore, any low seed production due to water quality problems could become a bottleneck for the aquaculture industry in Virginia.

**RESPONSE:** In 2011, Virginia Sea Grant partnered with Sustainable Fisheries Partnership to conduct a

workshop for hatcheries about monitoring and managing around water quality issues associated with ocean acidification. The workshop brought together industry representatives, resource managers, and scientists to discuss this emerging issue.

**RESULTS:** Seven out of the nine hatcheries in Virginia attended. They decided to organize themselves into a Shellfish Hatchery Advisory Panel to coordinate their monitoring efforts, and they are partnering with academic scientists to pursue a sound solution. "The very fact that these individuals are willing to collaborate with their competition shows just how important this subject is," said Virginia Sea Grant Aquaculture Specialist Karen Hudson, who convened the workshop.

**RECAP:** RECAP: By convening an educational workshop, Virginia Sea Grant enabled competing shellfish hatcheries to recognize common water quality challenges and collaborate to solve these problems.

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#### **15918 - Sea Grant helps fish farm use solar energy as main source for heating water**

**RELEVANCE:** Virginia's food producers and processors continue to be impacted by increased energy costs. The average kilowatt-hour cost for electricity on Virginia's Eastern Shore is 150 percent more than the average kilowatt-hour cost for electricity in the rest of the state. In addition, aquaculture companies strive to be environmentally responsible and sustainable, which includes energy conservation.

**RESPONSE:** Extension agent Bob Lane (Virginia Tech) worked with Mid-Atlantic Aquatic Technology (MAAT), a fish farm in Quinby, Virginia, to adapt green technologies to improve the energy efficiency of the facility. Lane conducted an energy audit of their facility and assisted MAAT in an application to the state for a rebate to purchase and install a solar heating system.

**RESULTS:** The farm was approved for the rebate which allowed it to design, purchase, and install a 67-kW solar-panel water heating system that cost about \$67,000. Operational data will be recorded to evaluate performance of the system and will be available for other companies. This is the first successful attempt by an aquaculture facility in Virginia to use this large a solar water heating system.

**RECAP:** RECAP: Technical assistance from a Virginia Sea Grant extension allowed a local fish farm to install a solar-panel water heating system, helping the farm to save money on energy and go green.

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#### **15912 - Sea Grant researchers study the effects of low-oxygen on healthy striped bass and those with bacterial infection**

A Virginia Sea Grant-funded research team based at Virginia Institute of Marine Science conducted laboratory experiments to quantify the interactive influence of mycobacteriosis, hypoxia, and temperature on striped bass metabolism. The objective of this study is to investigate the impact of mycobacteriosis on the metabolism of adult striped bass (*Morone saxatilis*). The group measured standard metabolic rate, maximum metabolic rate, and critical oxygen saturation (dissolved oxygen saturation at which a fish cannot sustain its standard metabolic rate) and calculated the metabolic scope for healthy and diseased fish at normal and elevated temperatures, and under hypoxic conditions. To date, 24 fish have been processed and analyzed.

Preliminary results suggest that regardless of the health status of the fish, an increase in water temperature induced an increase in standard metabolic rate and maximum metabolic rate, consistent with expectations. Also, an increase in water temperature induced an increase in the critical oxygen saturation, suggesting that the ability of striped bass to cope with hypoxia decreases at temperatures above their preferred range. Regardless of temperature, hypoxia induced reductions in maximum metabolic rate and metabolic scope.

Results suggest that the scope for activity of diseased striped bass in warm hypoxic waters is greatly compromised, and thus these fish are likely to experience fatigue more rapidly, be restricted in their ability to elude predators or secure prey, and will most likely exhibit lower growth rates. At completion, this project will provide insights on the effect of habitat change on adult striped bass of the Chesapeake Bay.

Currently, the direct effects of aquatic habitat alterations on fish populations in the Bay are difficult to predict. However, the sustainability of commercial and recreational fisheries will depend on this knowledge; therefore, this research provides sound scientific information to support ecosystem-based approaches to managing the coastal and marine environment and enhancing ecosystem health, services, and resilience.

**RECAP:** Striped bass are an important ecological and economic species in Virginia; knowing how water conditions affect these fish can help fisheries managers plan for sustainable catch.

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#### **15889 - Sea Grant Develops New Seafood Products, Markets for Sustainable Aquaculture**

Virginia Sea Grant extension staff actively collaborates with industry to develop new products and markets to support sustainable aquaculture businesses in coastal Virginia. Virginia Sea Grant extension and researchers at Virginia Tech have helped with the research, development, and marketing of aquacultured saltwater shrimp, which are now being commercially marketed at \$12/pound in regional fish markets. They have performed marketing studies that have identified a large demand for live product, including shrimp and cobia, in New York and Washington, DC, and efforts are underway to further develop these products for live markets. Research and extension services are helping oyster growers improve the marketing of aquacultured oysters with an emphasis on the half shell market. Extension staff developed a manual to help freshwater prawn farmers market their product for seafood boils as civic club fundraisers. Research also focuses on improving the efficiency of aquaculture with respect to energy, feed, husbandry, disease management, and other aspects of operation. These various efforts in research and extension to the aquaculture industry ensure that Virginia aquaculture remains a viable, growing enterprise in the future. This advances Virginia Sea Grant's goal of increasing the understanding and application of best practices in seafood product and market

development.

**RECAP:** Through working with industry, Virginia Sea Grant extension have helped identified market opportunities for Virginia's new aquaculture products. [Back to Goals](#)

### 15888 - Partnership Between Sea Grant Extension and NOAA Fellow Enables More Complete Study of Summer Flounder

By partnering with the Virginia Saltwater Game Fish Tagging Program, Mark Henderson, a National Marine Fisheries Service-Sea Grant Marine Population Dynamics Fellow, gained access to 10 years of summer flounder data-more than 47,500 samples-from throughout coastal Virginia. "The study couldn't have happened on this scale if it wasn't for the Game Fish Tagging Program," reflects Henderson. The tagging program is co-managed by Virginia Marine Resource Commission and Virginia Sea Grant extension at Virginia Institute of Marine Science.

Henderson used this data to develop a model to estimate mortality, a measurement that is of key importance to fisheries managers trying to set size and catch limits. This quantity of samples would have been impossible to obtain without the volunteer-based tagging program. Starting a similar program from scratch, from recruiting and training taggers to setting up a reporting process and distributing recapture awards, would have been too time consuming. A comparable 10-year scientific study would have been more costly. "Just in terms of man hours, it would have been rather expensive," Henderson says. What's more, without the help of the tagging program, the range of the study would have been limited to a few sample sites. With the taggers' help, flounder were captured from Virginia Beach to northern Virginia and throughout tributaries. "Because we have so many sample sites, we can more confidently generalize our results and say our results are broadly applicable to our area," says Henderson. Through collaboration with the tagging program, Henderson improved Virginia's understanding of mortality in summer flounder and developed a model that could improve management of this species. This demonstrates VASG's ability to integrate across extension and research to leverage assets, and supports VASG's goal of providing stakeholders with the best available science for fisheries management.

**RECAP:** Virginia Sea Grant extension offers 10 years of recreational catch data to improve research of fish populations in Chesapeake Bay. [Back to Goals](#)

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### Program Performance Measures (2010 - 2013)

Program Performance Measure	Program Plan Target (2010-2013)	Reported	Program Comments
Number of aquaculture advances adopted (e.g., best management practices, new species for sustainable aquaculture, improved optimal culture conditions, better disease management)	3	7	2010 - In 2010, extension staff at Virginia Tech provided assistance related to husbandry of striped bass as well as improved recirculating aquaculture technology. 2011 - In 2011, VASG extension staff at Virginia Tech continued to provide technical assistance to aquaculture businesses related to shrimp and spadefish aquaculture. 2013 - VASG extension at Virginia Tech provided technical assistance in design and set-up of holding tanks, cages, and recirculating systems for aquaculture.
Number of businesses supplying emerging markets.	3	8	2010 - This performance measure refers to the VASG objective to increase businesses supplying emerging seafood product markets in local farmer markets, community-supported fisheries, or other buy-local or high-value product strategies. In 2010, VASG's Fisheries Resource Grant Program supported the efforts of two local businesses supplying live and value-added products to the market. We continue to develop new projects in this arena and expect to exceed our target by 2012. 2011 - In 2011, VASG extension staff at Virginia Tech continued their collaborative work with businesses to develop new markets and value-added products. In addition, results of a new VASG community-supported fishery study are expected to help additional businesses in 2012. 2012 - VT AREC staff assisted businesses in certifying

			<p>a new value-added product (deviled crab) for market, and in delivering aquaculture black sea bass to live markets</p> <p>2013 - A value-added seafood workshopo has resulted in at least one business bringing a new value-added product to market, with more expected in the future [A/71519E]. Unfortunately, despite evidence of a market for a CSF, there appears to be limited interest from industry to develop a CSF.</p>
Number of bycatch reduction devices and practices adopted by industry	1	1	<p>2010 - Through the Collaborative Fisheries Research Fellowship Program and the Fisheries Resource Grant Program, VASG expects to meet this goal in FY2011/2012.</p> <p>2011 - Through collaborative research, many products have been developed and it is expected that they will be adopted by the industry in the near future. For example, the VIMS Collaborative Fisheries Research Fellow developed a modified trash and turtle excluder devise (TTED) that is being tested for bycatch reduction devise BRD-certification in the summer 2012. Certification would make the TTED pre-approved and more readily adopted by industry.</p> <p>2013 - The TTED developed in R/71515R has been implemented by several of the fishermen involved in the collaborative research.</p>
Number of bycatch reduction devices and practices developed.	1	1	<p>2010 - Through the Collaborative Fisheries Research Fellowship Program and the Fisheries Resource Grant Program, VASG expects to meet this goal in FY2011/2012.</p>
Number of collaborative bycatch reduction devices, conservation engineering and sustainable fishing practices research projects.	2	7	<p>2010 - VASG supports collaborative research between commercial fishermen and academic researchers primarily through two programs: (1) the Collaborative Fisheries Research Fellowship award program supports graduate students in fishing gear technology/conservation engineering and (2) the state-funded Fisheries Resource Grant program that directly funds fishing industry members to test ideas that may enhance or protect fishery resources.</p>
Number of collaborative research projects.	5	6	<p>2010 - This performance measure refers to the VASG objective to support industry-seafood scientist collaborative research with respect to seafood processing. In 2010, VASG supported one project through the Fisheries Resource Grant Program on post-harvest processing of shellfish. VASG expects to continue funding collaborative research in this field, at a minimum through the Fisheries Resource Grant Program and through extension staff activities at Virginia Tech.</p> <p>2011 - In 2011, 3 additional research projects were funded that work collaboratively with industry. We expect to fund an additional 5 collaborative projects in 2012 through a new graduate research fellowship.</p> <p>2012 - VIMS MEP staff worked with industry to improve processing of cownose ray and scallops</p>
Number of created or retained viable aquaculture businesses.	3	8	<p>2010 - In 2010, extension staff at Virginia Tech provided critical technical assistance to two new recirculating aquaculture businesses.</p> <p>2011 - In 2011, VASG supplied critical technical assistance to a new saltwater shrimp aquaculture business.</p> <p>2012 - Two businesses (shrimp farm, hybrid striped bass farm) received significant R&amp;D support from VT AREC to remain viable.</p> <p>2013 - Virginia Sea Grant extension at Virginia Tech provided technical assistance to three Virginia companies to research, design, and set-up holding tanks, cages, and recirculating systems. This technical support in aquaculture system design enabled these businesses to get started and expand. [A/EP-10-01]</p>

Number of educational products.	5	9	<p>2010 - This performance measure refers to the VASG objective to develop region-specific, science-based educational materials for the Virginia and Chesapeake Bay consumers. In 2010, to address extension educator and Food Nutrition Programs (FNP) program assistant food safety educational needs, the Virginia Tech extension program developed seven educational modules related to seafood and other food safety and handling issues.</p> <p>2011 - In 2011, VASG developed a guide to oysters of Virginia, to educate consumers about the different tastes in local oysters and to help local businesses differentiate oysters for the half-shell market.</p> <p>2013 - Trifold educating minority communities about mercury and seafood (R/71516B-SS).</p>
Number of extension services tailored for minority or subsistence fishing communities.	3	1	<p>2010 - This performance measure refers to the VASG objective to advance understanding of minority and subsistence fishing communities, and develop extension services accordingly. In 2010, we funded a research project that examines the mercury exposure of lower Chesapeake Bay fish consumers, including minority communities, and we expect to have extension products from this project by 2012.</p> <p>2011 - Products are in development, but were not completed in this reporting period.</p> <p>2013 - Trifold educating minority communities about mercury and seafood (R/71516B-SS).</p>
Number of research projects that address minority and subsistence fishing communities.	1	3	<p>2010 - This performance measure refers to the VASG objective to advance understanding of minority and subsistence fishing communities, and develop extension services accordingly. In 2010, we funded a research project that examines the mercury exposure of lower Chesapeake Bay fish consumers, including minority communities.</p> <p>2012 - VASG Grad Fellow Xiaoyu Xu studied mercury risk due to fish consumption in minority communities in the lower Chesapeake Bay. An educational product based on this work is expected in 2013.</p> <p>2013 - Virginia Tech project to train Sustainable Fisheries and Aquaculture Ambassadors to do outreach about seafood to local, including minority, communities (A/715175)</p>
Number of seafood processing industry adoptions.	5	18	<p>2010 - This performance measure refers to the VASG objective of advancing implementation of up-to-date post-harvest safety technologies, methods, and best management practices in the seafood processing industry. In 2010, extension staff at Virginia Tech provided technical assistance and recommendations to 14 seafood processors in Virginia on issues such as addressing deficiencies found during inspections, observing and evaluating personnel hygiene practices, reviewing cleaning and sanitation procedures and cross-contamination issues, and sampling of product and environmental surfaces for microbial analysis.</p> <p>2011 - In 2011, VASG provided technical assistance to 3 additional processors.</p> <p>2012 - VIMS MEP staff assisted industry with improving processing of cownose ray to reduce waste</p>
Number of seafood processing industry members trained.	50	1,443	<p>2010 - This performance measure refers to the VASG objective to train and provide technical assistance to increase understanding and compliance of food safety hazards and regulations. In 2010, 141 industry members were HACCP trained. In addition, technical assistance with microbial analyses was provided for an additional 16 businesses.</p> <p>2011 - In 2011, VASG extension staff at Virginia Tech provided training for an additional 463 industry members, in both Spanish and English.</p>

			2013 - Virginia Sea Grant extension at Virginia Tech offered Hazard Analysis and Critical Control Point (HACCP) and Good Management Practices (GMP) training for 243 seafood processors
Number of seafood processing industry technologies and/or management practice adoptions.	5	17	2010 - This performance measure refers to the VASG objective to support adoption of byproduct utilization and improved waste treatment systems by the seafood processing industry. 2011 - In 2011, VASG extension staff helped a local business adopt solar power. 2013 - VASG extension at Virginia Tech developed processes that were adopted by 16 companies, including developing temperature profiles for crabs and oysters during transport, developing retort validations, listericidal process validations, Salmonella cook validations, and pasteurization validation.
Number of warning letters and adverse inspection reports.		0	2010 - This performance measure refers to the VASG objective to increase understanding and compliance of food safety hazards and regulations. Unfortunately, it no longer appears possible to track this performance measure, but we continue to track the objective through our record of training and technical assistance to seafood processors. 2011 - While this metric is difficult to track, of the companies trained on Listeria protocols in 2011, 3 were audited by the FDA and all 3 were found to be clean, after previously being found to have a Listeria contamination concern. In the future, VASG will redesign this measure to be more reasonably tracked.
Number of watermen participating in direct marketing programs.	5	2	2010 - This performance measure refers to the VASG objective to increase businesses supplying emerging seafood product markets in local farmer markets, community-supported fisheries, or other buy-local or high-value product strategies. In 2010, extension staff supported the efforts of a local watermen family that sells products to farmers markets. We are expanding our efforts in areas such as community-supported fisheries and expect to meet or exceed our target by 2012. 2012 - At least one oyster farmer has switched his business model to direct marketing (to high-end restaurants) as a result of training and products developed by VT AREC staff. 2013 - Unfortunately, despite efforts by VASG to support the development of a CSF (including a feasibility study that indicates a viable market in Williamsburg), there remain some impediments and limited interest from industry to start a CSF in this region [R/773801].

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### Program Objectives (2010 - 2013)

Program Objective	Achieved (yes/no)	Program Comments
By 2011, VASG will advance implementation of up-to-date post-harvest safety technologies and methods and best management practices in seafood processing industry.	Yes	2010 - Virginia Sea Grant researchers and extension staff are leaders in the field of post-harvest processing and safety. We continue to assess the needs of the industry, develop new protocols and practices, and transfer this information to regulators and industry members.
By 2011, VASG will develop bycatch reduction devises, conservation engineering and sustainable fishing practices for commercial and recreational fisheries through collaborative research.	Yes	2010 - In 2010, Virginia Sea Grant lost an extension staff member dedicated to bycatch reduction and conservation efforts therefore, we lost the capacity to meet this target by the original 2011 date however, we are moving forward with this goal and should achieve it within the next few years through

		<p>the Collaborative Fisheries Fellowship and Fisheries Resource Grant programs.</p> <p>2011 - VASG is actively supporting several collaborative fisheries research projects dedicated to bycatch reduction devices. Two such devices are currently being tested by industry and it is expected will be fully adopted within the strategic planning period.</p> <p>2012 - While we did not meet this target by 2011, we have all but met this goal and anticipate adoption of bycatch devices by 2013, thus will meet the target by the end of our omnibus.</p>
By 2011, VASG will support adoption of byproduct utilization and improved waste treatment systems by the seafood processing industry.	No	<p>2010 - Virginia Sea Grant extension staff at Virginia Tech have expertise in developing these practices and systems while we may not achieve this goal by the original 2011 deadline, we expect to continue to develop programming in this area to achieve this goal by the end of the current strategic planning period (2010-2014).</p> <p>2012 - While we continue to make progress on this objective, we have not yet met our target of 5 adoptions.</p> <p>2013 - 2013: While we continue to make progress on this objective, we have not yet met our target of 5 adoptions.</p>
By 2011, VASG will support industry-seafood scientist collaborative research	Yes	<p>2010 - Virginia Sea Grant extension staff at Virginia Tech have expertise in working collaboratively with the seafood processing industry on seafood safety and product development while we may not achieve this goal by the original 2011 deadline, we expect to continue to develop programming in this area to achieve this goal by the end of the current strategic planning period (2010-2014).</p>
By 2011, VASG will train and provide technical assistance to increase understanding and compliance of food safety hazards and regulations.	Yes	<p>2010 - Virginia Sea Grant extension staff at Virginia Tech provides regular training and technical assistance to seafood processing industries with respect to food safety hazards and regulations, including regular HACCP training for processors in both Spanish and English.</p>
By 2012, VASG will create or retain competitive, sustainable aquaculture businesses.	Yes	<p>2010 - Virginia Sea Grant extension staff work regularly with developing aquaculture businesses, particularly in recirculating systems but also in shellfish aquaculture, to help these fledgling industries survive and thrive in Virginia through technological advances.</p>
By 2012, VASG will develop region-specific, science-based educational materials for the Virginia and Chesapeake Bay consumers.	Yes	<p>2010 - Virginia Sea Grant extension staff work with food and nutrition extension agents throughout the state to provide information on seafood safety and nutrition. In addition, ongoing research will provide additional information about seafood consumption risks, sustainability, and other topics for local Chesapeake Bay consumers.</p>
By 2012, VASG will increase businesses supplying emerging seafood product markets in local farmer markets, community-supported fisheries, or other buy-local or high-value product strategies.	No	<p>2010 - Virginia Sea Grant has been instrumental in exploring direct marketing, community-supported fisheries, value-added products, and other emerging markets for local businesses. While this work is ongoing, we expect to meet and perhaps exceed our target by 2012.</p> <p>2011 - VASG began a feasibility study in 2011 on community-supported fisheries in conjunction with the College of William and Mary. While the study is still underway, it has generated considerable interest from industry therefore, we expect to meet this target in 2012.</p> <p>2012 - While we did not meet our target by 2012 for watermen doing direct marketing, we anticipate</p>

		<p>meeting this target by 2013.</p> <p>2013 - 2013: While VASG has put significant effort into research and outreach to support this goal, there appear to be many impediments to achieving this goal. While CSFs and local farmers markets are not popular options to local industry, some progress was made on developing new value-added seafood products through hosting a workshop to train and educate industry.</p>
<p>By 2013, VASG will advance understanding of minority and subsistence fishing communities, and develop extension services accordingly.</p>	<p>No</p>	<p>2010 - Virginia Sea Grant is funding ongoing work related to minority and subsistence fishing communities in Virginia.</p> <p>2011 - Products are in development and we expect to meet this target by 2013.</p> <p>2012 - We have supported a research project that has completed its analysis and will producing an extension product by the end of 2013.</p> <p>2013 - 2012: We have supported a research project that has completed its analysis and will producing an extension product by the end of 2013.</p>