Sea Grant
Delaware

Delaware Sea Grant: Strategic Plan (2014–2017)

Science Serving the Delaware Coast

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Our **Goal**

is to ensure that
society benefits from
the sea—today
and in the future.

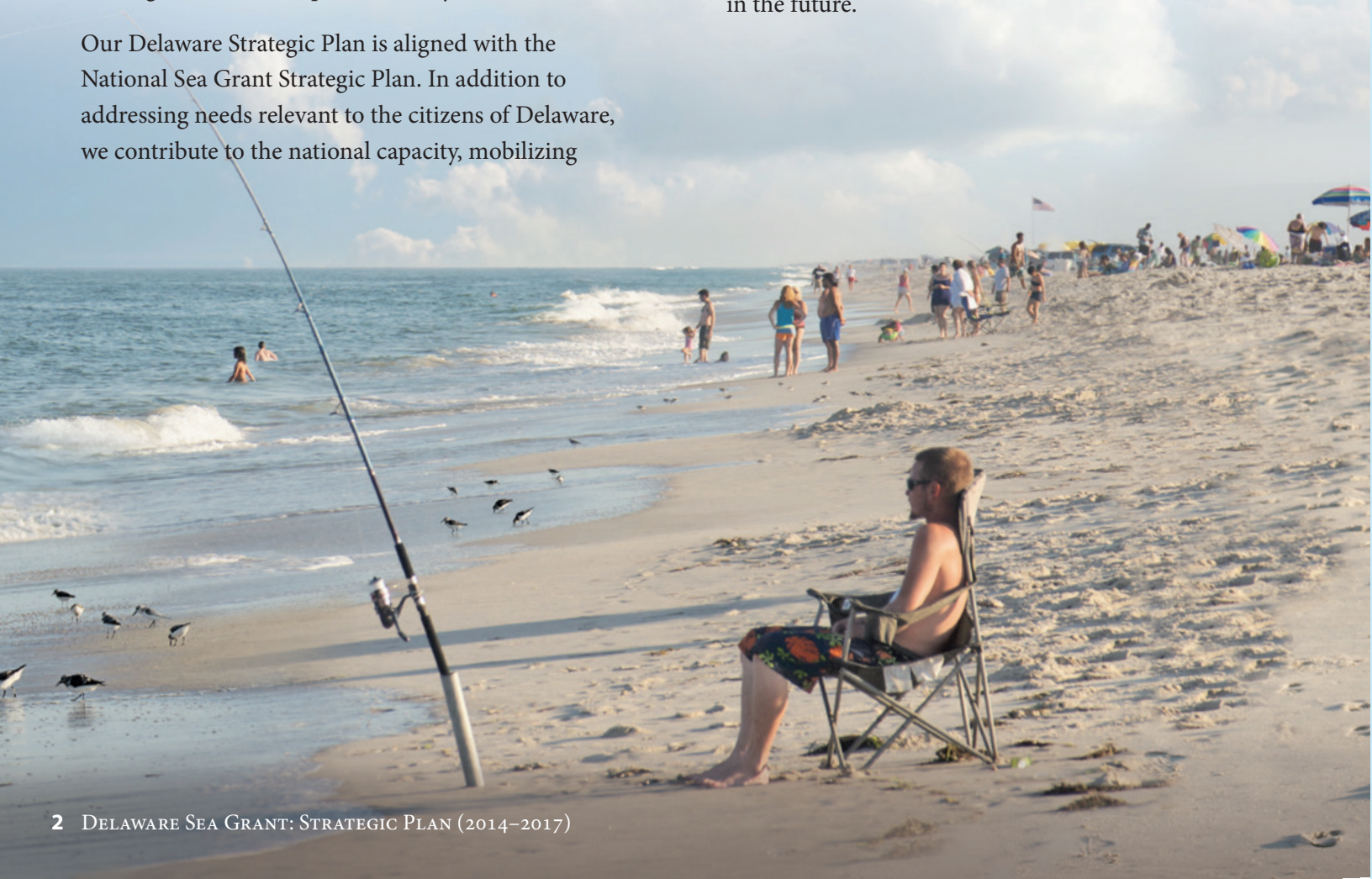
Preamble

Those of us who live along the coast look to it for sustenance, economic value, and recreation. It is important for us to recognize that these uses are not mutually exclusive; the environment and the economy are linked. Maintaining and supporting healthy coastal ecosystems and the ecological services they provide ultimately results in greater economic benefit for our communities. Ensuring that coastal development proceeds in a sustainable way reduces the impact of coastal hazards and means that we benefit now and in the future from that growth.

In this strategic plan, the Delaware Sea Grant College Program renews its commitment to providing sound scientific information and policy analysis on issues related to our coast and our coastal economies. We work to translate our science into applications that have positive impacts for our fellow citizens. The information we provide about our coastal environment helps people make or save money, protects lives, assists with decision making, and enhances public literacy.

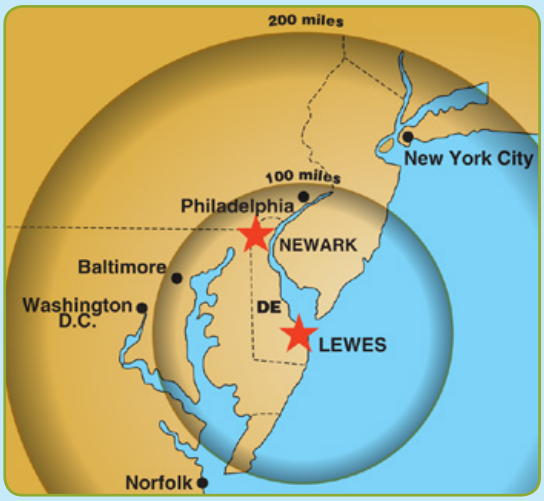
Our Delaware Strategic Plan is aligned with the National Sea Grant Strategic Plan. In addition to addressing needs relevant to the citizens of Delaware, we contribute to the national capacity, mobilizing our efforts in concert with those of others along our country's coasts to help achieve goals that are important not only to Delaware, but also to the nation. This plan takes note of the multiple challenges that face the coastal environment, including population growth, climate change, development, balancing access to multi-use resources, and hazard resilience.

Delaware Sea Grant works with partners in the state, region, and nation to adapt to and mitigate the effects of these challenges by developing the next generation of technologies that allow us to better monitor our waterways, understand vital habitats for valuable aquatic species, keep our communities safe from coastal hazards, and ensure that vital ecosystem services are preserved. We are also helping to lead our nation toward carbon-free energy independence through innovative work with marine renewable energy resources. We are doing this in cooperation with government leaders, businesses, educators, environmental organizations, and concerned citizens on a state, regional, and national scale. Our goal is to ensure that society benefits from the sea—today and in the future.



Delaware and Its Marine Environment

Overview and Context



Delaware is strategically located on the East Coast, halfway between New York City and Washington, D.C. Approximately 15 percent of the nation's population lives within a 200-mile radius of Delaware's world-class Atlantic coast beaches. With only three counties and a land area of 1,982 square miles, Delaware is the second smallest state in the nation, yet only seven U.S. states are more densely populated. The state's current population density is 461 people per square mile (based on 2010 census estimates), and like many other coastal states, Delaware continues to experience growing population pressure. The state anticipates continued growth of 22 percent over the next 30 years.

Delaware is a marine-oriented state, with no part more than eight miles from tidal waters. It has a rich coastal environment with 381 miles of tidal shoreline, including 24 miles of ocean coastline and about 90,000 acres of tidal wetlands. Two major estuaries—the Delaware Estuary and the Inland Bays—have been designated National Estuary Programs. The Chesapeake and Delaware Canal, which connects Chesapeake Bay with Delaware Bay, is an important asset to the nation's commerce, carrying not only recreational boaters, but also commercial vessels navigating between the busy ports of Baltimore, Philadelphia, and Wilmington, Del.

Extending 134 miles from its mouth to the falls at Trenton, N.J., the Delaware Estuary is one of the largest estuaries on the Atlantic coast. Its drainage basin includes portions of Pennsylvania, New York, New Jersey, and Delaware and measures 13,500 square miles. The watershed contains the population centers of Philadelphia, Trenton and Camden, N.J., and Wilmington, Del. In total, it includes 22 counties, 500 municipalities, and an estimated 8.2 million people. The Delaware Estuary receives heavy inputs of nutrients, and while trends in water quality indicate improving conditions, many species of fish continue to exceed contaminant thresholds for consumption. The waters flowing between Burlington, N.J., and Wilmington, Del., have the highest concentrations of nitrogen of any major estuary in the United States. Approximately 50 percent of the inorganic nitrogen and 80 percent of the phosphate entering the estuary result from human activity.

More than 200 species of fish have been identified in the estuary, including 31 commercial species. The American oyster and the blue crab historically have been among the estuary's most commercially valuable species. While the oyster population has seen sharp declines, recent efforts to restore and build the Delaware Bay oyster populations are showing promise. Blue crab populations have remained viable. Recreational fishing in the estuary is popular and has a higher economic impact in the region than the commercial fishing industry.

The Delaware Estuary also harbors the world's largest population of horseshoe crabs. The animal's blood is used by the pharmaceutical industry to test drugs and prosthetic devices for bacteria associated with human diseases such as spinal meningitis. The annual spring spawning of the horseshoe crab is a spectacle for bird watchers who travel to the bay shore to see hundreds of thousands of red knots, ruddy turnstones, semipalmated sandpipers, and other migratory birds feasting on horseshoe crab eggs. The Delaware Estuary is internationally recognized for its importance as a stopover for migrating shorebirds.

Two recent studies shed light on the contribution of coastal systems to the economy of Delaware and the region. A report completed in 2011 for the Partnership for the Delaware Estuary reviewed the economic contributions of the Delaware Estuary as a whole to the region. More recently, Delaware Sea Grant funded a

study, published in 2012, that determined the economic contributions of the coastal ocean economy to the state of Delaware. When the two studies are reviewed collectively, a picture of the importance of our ocean and bay economies emerges, and the importance of maintaining the integrity of our natural assets becomes clear. In Delaware alone, the coastal systems contribute more than 100,000 jobs and generate 3 and 4 percent, respectively, of the federal and state taxes collected. In addition, the Delaware Estuary contributes an additional $2.5 billion in annual ecosystem services to the state, including water quality maintenance, health benefits, and carbon storage. Delaware's Atlantic coast contributes $6.9 billion in total industry production from direct, indirect, and induced economic activity related to the shore.

The Delaware Estuary is also a major transportation corridor and home of the world's largest freshwater port complex. Currently, ports along the Delaware River and its tributaries handle in excess of 120 million tons of imports and 75 million tons of exports with a total combined value of $41 billion annually. Economic contribution to the region is estimated at $2.4 billion, and oil tankers account for approximately 65 percent of the imports to the upper Delaware River. The Delaware River ports are critically important in the forest product sector and the largest site of cocoa bean imports to the United States. Deepening of the channel serving Philadelphia and New Jersey is underway, and completion is anticipated to coincide with the completed deepening of the Panama Canal in 2015. Ports on the channel expect to see increased large ("New Panamax") vessel traffic, including ships from Asia that previously served only the U.S. West Coast. Delaware's Port of Wilmington is ranked first in North America for imports of fresh fruit, bananas, and juice concentrate and has the largest dockside cold storage facility in the nation. It is a full-service, deep-water port and marine terminal handling more than 400 vessels per year with an annual import/export cargo tonnage of 5 million tons.

Delaware's Inland Bays include three interconnected water bodies—Indian River Bay, Rehoboth Bay, and Little Assawoman Bay—that were awarded National Estuary status by the Environmental Protection Agency (EPA) in 1995. These are "crown jewels" of a beach recreation industry valued at more than $665 million per year. The bays have a drainage area of about 300 square miles; Sussex County encompasses the watershed and reports an average population density of 210 people per square mile. The Inland Bays are suffering from nutrient overload (eutrophication) that causes unwanted phytoplankton blooms and a resultant decline in oxygen and light penetration. Major sources of nutrients include land runoff from intensive agribusiness operations, intrusion of nutrient-contaminated groundwater from agricultural and domestic sources, sewage treatment effluents, and intense residential and commercial development. Changes in environmental quality have led to the eradication of submerged aquatic vegetation (sea grasses) and declines in desirable finfish and shellfish. Major harmful algal bloom-forming species have been identified in the bays. Coordinated efforts to restore the ecosystem have begun to reverse the trends in ecosystem impairment, including across-the-board reductions of nutrients entering the bays from all sources.

The Issues

Population Growth

The state of Delaware continues in a period of unprecedented population growth and development, especially along its coastal zone and associated watersheds. Population growth in the already saturated coastal area grew by more than 50 percent between 1990 and 2000 and the rates of growth are still high. While the Delaware Estuary watershed population increased by 5.1 percent between 2000 and 2010, in two of Delaware's three counties population increased by 24 percent—the highest rates in the watershed. Because of its proximity to four major metropolitan areas (Washington, D.C., Baltimore, Philadelphia, and New York City), eastern Sussex County, which borders on the Delaware Bay, Atlantic Ocean, and Inland Bays, has transitioned into a major Mid-Atlantic tourism and retirement destination.

Hazard Resilience

The rapid development and urbanization of the coastal zone has resulted in an explosion in the number of residents, visitors, homes, and infrastructure exposed to coastal processes, beach erosion, and storm hazards. Delaware coastal communities are at risk from a variety of natural hazards such as winds, waves, and floods generated by coastal storms. Additional threats to coastal development result from the dynamic nature of the land/sea interface—the constant impact of waves, longshore currents, and sea-level rise on sediment transport resulting in short- and long-term shoreline change. Climate change will further exacerbate these impacts on coastal communities.

Delaware, like many other coastal states, must deal with the problem of eroding beaches. As the need for beach nourishment increases each year and the cost of keeping sand in front of coastal communities rises, the ability to build beaches to last as long as possible and best serve those who pay for it becomes increasingly imperative.

Sustainable Development

In addition to physical changes along the shoreline and increased potential for storm hazards, a growing population has caused congested highways and greater impacts on the state's natural resources. Coastal communities need sustainable development policies. Insightful planning requires awareness of a community's natural capital and a commitment to sustainability. Many small towns and communities throughout Sussex County, in particular, do not have professional, experienced land-use planners on their staffs to meet the challenges presented to them as the county experiences severe growing pains. Although state law requires local communities and the county to develop comprehensive land-use plans that address sprawl, balance growth, and protect the environment, results have been slow to materialize.

Preserving open space and conserving agricultural land is also becoming a major concern. Places we assumed were open space—working farms, coastal areas with panoramic vistas of our bays and coastline, quiet country roads—are being converted to residential developments, retail outlets, schools, and workplaces. As growth continues, protecting water quality and preserving natural resources in the coastal region has become increasingly difficult.

Healthy Coastal Ecosystems

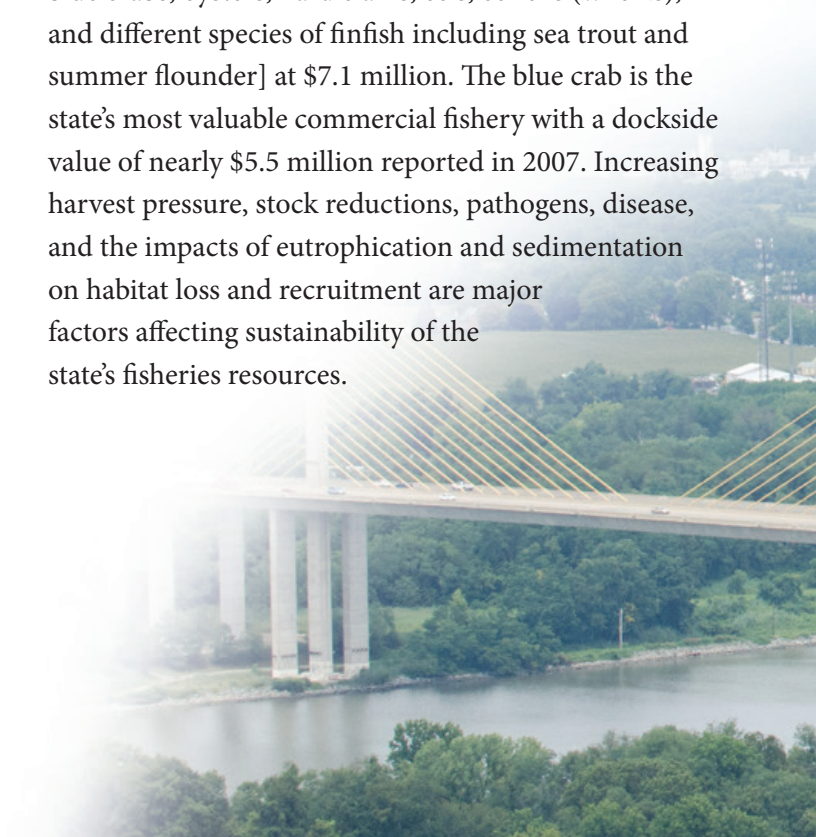
State resource managers are faced with an array of environmental problems and issues related to point and nonpoint source pollution from municipal, industrial, and agricultural sources. Current issues of concern include rising sea level, reduced water quality, anoxia and hypoxia, macroalgal and toxic microalgal blooms, declining fishery stocks, habitat loss, reduced biodiversity, and non-native species introductions. These environmental problems and trends pose a serious long-term threat to Delaware's coastal ecosystems and, if left unchecked, will impact public health, economic stability, and overall quality of life in Delaware's coastal communities.

Balancing Public Access to Multi-Use Resources

Like many coastal communities across the nation, Delaware resource managers seek to balance stakeholder access to multi-use resources. This means managing conflicting goals to ensure sustainable environmental and economic benefit. Coastal tourism is an economic force in the state; approximately 5.6 million people visit Delaware for recreation and vacation, contributing $2.1 billion to the state's economy. The majority of this tourism occurs in Sussex County, but significant activity occurs in smaller communities adjacent to Delaware Bay, which supports thousands of full-time and seasonal jobs. Across Delaware, nearly 58,000 boats were registered in 2011. The $269 million annual contribution to the Delaware economy from recreation such as birding, hunting, and fishing in the estuary is directly dependent upon ecosystem health.

Ports and harbors infrastructure and their operation are also critical to the vitality of our region and to our quality of life. More than 3,500 commercial vessels transit the state's waters annually, most of them en route to the nearby Pennsylvania/New Jersey petroleum refineries. With deepening of the river channel to accommodate Panamax ships, commercial traffic—along with vessel size—is expected to increase.

Delaware's coastal waters are rich in fish and shellfish harvested for their recreational and commercial value, although the commercial fishing sector in Delaware is relatively small by comparison to other neighboring states in the Mid-Atlantic region. For example, across Delaware Bay, Cape May, N.J., is the second-largest commercial fishing port on the East Coast. The National Marine Fisheries Service reports total Delaware commercial landings for 2011 [including blue crabs, oysters, hard clams, eels, conchs (whelks), and different species of finfish including sea trout and summer flounder] at $7.1 million. The blue crab is the state's most valuable commercial fishery with a dockside value of nearly $5.5 million reported in 2007. Increasing harvest pressure, stock reductions, pathogens, disease, and the impacts of eutrophication and sedimentation on habitat loss and recruitment are major factors affecting sustainability of the state's fisheries resources.



Safe and Sustainable Seafood

Seafood consumption in the United States declined slightly since 2007 to 15.8 pounds per person per year in 2010. Despite the small drop in consumption, Americans are spending more on seafood, for a total of $80.2 billion in the same year. In Delaware, most seafood products are sold through restaurants and local retail and wholesale outlets. Out-of-state wholesalers buy directly from Delaware anglers. To meet demand, Delaware seafood businesses buy from out-of-state markets, which include products from other countries.

A well-informed public can consider all the pressures our coastal systems are facing.

Public Education

Because of the ever present and increasing challenges described above, a well-informed, engaged public is crucial for ensuring that public policies promote economic growth while protecting environmental resources. Without good, accurate information based on solid scientific theory and reinforced with data, state, local, and federal officials will find it difficult to plan wisely for our future. Communication of our knowledge of, research in, and need for the protection of coastal ecosystems is important. A well-informed public can consider all the pressures our coastal systems are facing.

Delaware Sea Grant Vision, Mission, Goals, and Values

Vision

Delaware Sea Grant, housed within the College of Earth, Ocean, and Environment at the University of Delaware, is uniquely positioned to provide a forum where science-based information about coastal resources and processes can be shared and exchanged with stakeholders to enhance decision making that will help to realize the full economic potential of our coastal resources while sustaining environmental integrity. As a federal, state, and academic partnership that is part of a national network of Sea Grant Colleges, Delaware Sea Grant can leverage the expertise and assets of partners who are focused on the wise use and management of U.S. marine and coastal resources, leading to a sustainable economy and environment.

Mission and Goals

Delaware Sea Grant's mission is to advance the understanding, development, use, and conservation of state and regional marine and coastal resources through an integrated program of excellence in research, education, and outreach built upon active partnerships with state and federal agencies, the private sector, and citizens at large. Our specific goals are to:

- Provide academic and educational leadership to address issues and problems facing coastal communities throughout the state, region, and nation.
- Create strategic partnerships that help build and sustain programmatic initiatives that solve problems and produce lasting impacts.
- Identify and address emerging coastal issues with accurate, timely, and science-based information for industry, government officials, educators, and the public.
- Maintain the highest quality marine research, outreach, and education programs within the state of Delaware to engage and inform coastal constituents.

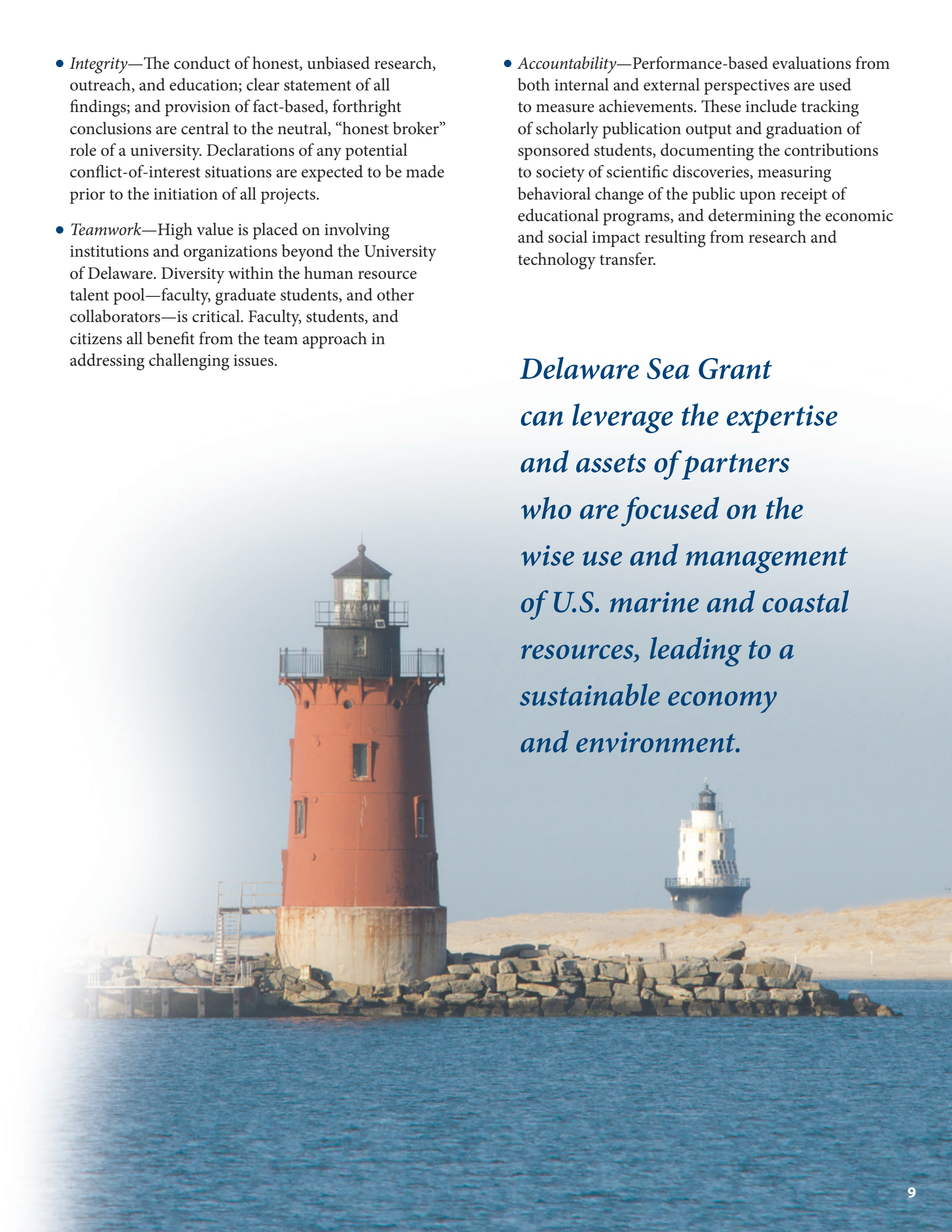
Core Values

Every Delaware Sea Grant activity must satisfy three major criteria: (1) be based on a strong rationale; (2) demonstrate scientific merit as determined by national experts in the field; (3) produce application-oriented results that are clearly useful in industry, management, education, and/or science. Core values underpinning these criteria include:

- *Excellence*—All projects are funded on a competitive basis after undergoing external merit evaluation. Outreach programs are encouraged to connect with ongoing research, and public education efforts must use the most effective technologies to achieve maximum output and distribution of science-based information.
- *Relevance*—A strong, involved advisory process is used to define research priorities, support outreach and education programs, and measure programmatic impact. It also is used to build public and private support for Delaware Sea Grant.

- *Integrity*—The conduct of honest, unbiased research, outreach, and education; clear statement of all findings; and provision of fact-based, forthright conclusions are central to the neutral, "honest broker" role of a university. Declarations of any potential conflict-of-interest situations are expected to be made prior to the initiation of all projects.
- *Teamwork*—High value is placed on involving institutions and organizations beyond the University of Delaware. Diversity within the human resource talent pool—faculty, graduate students, and other collaborators—is critical. Faculty, students, and citizens all benefit from the team approach in addressing challenging issues.
- *Accountability*—Performance-based evaluations from both internal and external perspectives are used to measure achievements. These include tracking of scholarly publication output and graduation of sponsored students, documenting the contributions to society of scientific discoveries, measuring behavioral change of the public upon receipt of educational programs, and determining the economic and social impact resulting from research and technology transfer.

Delaware Sea Grant can leverage the expertise and assets of partners who are focused on the wise use and management of U.S. marine and coastal resources, leading to a sustainable economy and environment.



Delaware Sea Grant Strategic Planning: A Dynamic Process

Involving constituencies—both internal and external to Delaware Sea Grant—has been a longstanding and integral component of developing our strategic plan. Specific objectives are updated and revised with each call for proposals. Thus, strategic planning for Delaware Sea Grant is structured to be a dynamic process.

From the very first Delaware Sea Grant initiatives decades ago, stakeholders from the broad marine community of organizations and individuals in Delaware and the Mid-Atlantic region have been asked for their advice on high-priority ocean and coastal issues that need attention. That practice continues today. Numerous forums contribute to the programmatic definition of Delaware Sea Grant. They include regular meetings with the Delaware Sea Grant Advisory Council (SGAC), communication with the governor and members of the General Assembly, and citizen surveys in our Sea Grant annual report, on our web sites, at workshops and public lectures, and at Coast Day, our annual event that attracts approximately 10,000 visitors to learn about the coastal environment.

For this strategic plan, the first levels of external guidance have come from NOAA and the National Sea Grant College Program through their strategic plans. For regional and state research, education, and outreach priorities, the Delaware Sea Grant Management Team sought information from our recent citizen surveys, from a Mid-Atlantic Regional Ocean Research Plan, and from the SGAC, whose members come from regional and state marine-oriented businesses and industries, resource management and engineering firms, state government agencies, public interest groups, the pre-college educational sector, and the media (Table 1). Working within the context of the national priorities,

Table 1. Delaware Sea Grant Advisory Council (SGAC), January 2013.

Delaware General Assembly

Ruth Briggs-King
House of Representatives

V. George Carey
Former member, House of Representatives

David B. McBride
Senate

Peter C. Schwartzkopf
House of Representatives

F. Gary Simpson
Senate

Business/Industry

Gene R. Bailey
Executive Director
Diamond State Port Corporation

Gerard Esposito
President
Tidewater Utilities Inc.
(Chair, Delaware SGAC)

Jeanie Harper
Treasurer
Dawson's Seafood Inc.

A. Richard Heffron
Interim President
Delaware State Chamber of Commerce

Ann K. Masse
Manager
DuPont Chamber Works

Gary B. Patterson
Executive Director
Delaware Petroleum Council

Betsy Reamer
Executive Director
Lewes Chamber of Commerce and Visitors Bureau

Paul Sample
Consultant
Samples Inc.

Edward M. Simek
Principal
Environmental Resources Management Inc.

Stuart Widom
Manager of Governmental and Regulatory Affairs
Calpine Corporation

Resource Management Agencies

Sarah Cooksey
Administrator
Delaware Department of Natural Resources and Environmental Control

Thomas J. Fikslin
Manager
Delaware River Basin Commission

Christopher Moore
Executive Director
Mid-Atlantic Fishery Management Council

Dave Saveikis
Director, Division of Fish and Wildlife
Delaware Department of Natural Resources and Environmental Control

John Schneider
Program Manager
Delaware Department of Natural Resources and Environmental Control

Non-Governmental Organizations

Jennifer Adkins
Executive Director
Partnership for the Delaware Estuary

Chris Bason
Executive Director
Delaware Center for the Inland Bays

Lorraine Fleming
Board Member
Delaware Nature Society Inc.

Local, State, and County Government

James L. Ford, III
Mayor
City of Lewes

Academia, Education (Formal and Informal)

Tonyea Mead
Education Associate, Science
Delaware Department of Education

Halsey Spruance
Executive Director
Delaware Museum of Natural History

Katherine Ward
Board Member
Delaware Press Association

Private Citizens

William J. Miller, Jr.
Past Director
Delaware River and Bay Authority
(Chair Emeritus, Delaware SGAC)

the SGAC has helped us to define and update the priority issues of relevance to the state and region. Its members have discussed the current strategic planning effort twice to examine the alignment of Delaware Sea Grant goals with the needs of its stakeholders. In addition, many members of the SGAC attended a roundtable workshop in the spring of 2012 to identify areas of interest common to both the National Sea Grant Office and the Delaware Sea Grant program. The 2009–2013 DESG strategic plan was revisited with data collected from a publicly distributed survey (Figure 1). This plan reflects input gathered through the online survey, discussions at our stakeholder and SGAC workshops, and continued discussions with members of the SGAC.

Involving constituencies has been a longstanding and integral component of developing our strategic plan.

Figure 1. Primary areas of interest identified during Delaware Sea Grant strategic planning workshop (March 14, 2012) and via an online survey for the public, organized by 2009–2013 DESG Focus Areas.

Healthy Coastal Ecosystems

- Water quality monitoring and data analysis to support resource management
- High-quality research and outreach to benefit healthy coastal ecosystems
- Habitat protection—especially coastal marsh and wetland communities

Resilient Communities and Economies

- Balance development and conservation of coastal and marine resources
- Partner with the business community to support innovative/sustainable practices
- Climate change and sea-level rise adaptation
- Resiliency planning with coastal communities
- Renewable energy development and related marine spatial planning efforts

Sustainable Fisheries and Aquaculture

- Sustainable seafood supplies through local aquaculture and commercial harvesting
- Economics of Delaware's seafood industry
- Consumer knowledge and perceptions of fish-based diets
- Research and outreach to support the control of invasive species in Delaware

Environmental Literacy and Workforce Development

- Facilitate public and student understanding of science statewide
- Partner with Delaware Department of Education to support strong K–12 science education
- Improve public recognition and understanding of the interdependence of society and nature
- Serve as advisors for science education, communication, and translation

How Delaware Sea Grant Aligns with the National Plan

Realigning our Delaware Sea Grant Strategic Priorities

The 2009–2013 Delaware Sea Grant strategic plan clustered Delaware's coastal issues into four research priority areas: Healthy Coastal Ecosystems, Sustainable Coastal Development, Hazard Resilience in Coastal Communities, and Safe and Sustainable Seafood Supply. There was also one crosscutting theme: Ocean and Environmental Literacy. For the 2014–2017 strategic plan we still have four focus areas but have modified them by combining sustainable coastal development and hazard resilience, which shared many of the same goals, into a single focus area that aligns with the national theme of Resilient Communities and Economies. Safe and Sustainable Seafood Supply is broadened to encompass the national theme of Sustainable Fisheries and Aquaculture. Ocean and Environmental Literacy is more clearly identified and broadened to highlight its importance as Environmental Literacy and Workforce Development. The revised focus areas meet our Delaware stakeholder needs and fully align to the national plan. They also further emphasize that the issues facing Delaware's coasts today are much the same as they are for the nation's coasts.

Healthy Coastal Ecosystems

Science and policy research and outreach in support of ecosystem sustainability. Emphasis is on ecosystem processes and relationships between coastal stressors and long-term human and ecosystem health and on programs that provide lifelong opportunities to enhance understanding and promote stewardship. Specific areas of interest to Delaware Sea Grant include:

- ***Improving ecosystem services by enhancing health, diversity and abundance of fish, wildlife and plants.***
  - Develop and calibrate new standards, measures, and indicators of ecosystem sustainability including:
    - Regional coastal observation systems that will advance our capability to make predictions about human impacts and environmental changes on coastal resources.
    - New technologies, methods, and policies to address water quality degradation.
  - Identify knowledge gaps that impede progress toward achieving sustainability of ecosystems and the goods and services they provide.

- ***Supporting ecosystem-based approaches to manage land, water and living resources.***
  - Research in support of baseline data to assess health of ecosystems and watersheds.
  - Develop models and training that inform ecosystem-based planning and management approaches.
  - Engage resource managers, policy and decision makers in using standards and indicators to support ecosystem-based management.
  - Outreach efforts that enhance lifelong learning to promote ecosystem stewardship and informed decision making.
- ***Restoring, protecting, and enhancing ecosystems and their habitats.***
  - Develop technologies and approaches to monitor and restore degraded ecosystems.

The broad outcomes of the above efforts will ensure that we maximize the range of ecological, economic, and societal services available to Delaware's citizens and that these services are more resilient to change. To achieve that end, this also requires that resource managers have science-based information available during their decision processes. Ultimately, this leads to greater public stewardship of our multi-use coastal resources.

Resilient Communities and Economies

Research and outreach that provide information and techniques that enhance waterfront-related economic activities. This includes engagement of Delaware's coastal communities in planning processes that support the efforts of community leaders to identify and pursue sustainable economic development and recognition of the need to balance the multiple uses of these resources. In addition, DESG will undertake science and policy research and outreach that provide an informed basis for assessing the risks associated with living and working in coastal communities. This includes the development of strategies to mitigate and adapt to climate change. Specific areas of interest to Delaware Sea Grant include:

- ***Developing vibrant and resilient coastal economies.***
  - Research and outreach activities that provide local communities with information and techniques to enhance waterfront-related economic activities—tourism activities in particular—in a sustainable way.
  - Partnerships with federal, state, and local agencies and others to enhance the development of and support for best practices to foster sustainable economic development in coastal communities.
  - Innovative research (science/engineering/policy) that quantifies and translates opportunities for coastal ocean renewable energy technologies and promotes sustainable land-use practices.
- ***Facilitating community use of comprehensive planning tools to make informed strategic decisions.***
  - Research and outreach activities that help coastal communities address issues related to natural resource planning from a multi-user perspective.
  - Partnerships to develop education and literacy programs focused on the impacts of climate-related changes on coastal communities.
- ***Supporting improvements in coastal water resources that sustain human health and ecosystem services.***
  - Monitoring, research, and outreach activities to support continued management efforts to improve coastal ecosystem health.
- ***Helping to establish resilient coastal communities that can adapt to the impacts of hazards and climate change.***
  - Research aimed at improving the forecasting of coastal hazards (e.g., storm flooding and inundation, sea-level rise) for decision makers and the coastal communities they serve.
  - Programs that help decision makers adopt policies that will reduce risks, manage catastrophic events, and speed recovery.
  - Developing and/or making accessible state/regional databases that support hazard-related planning.

Delaware Sea Grant's efforts will support and encourage vibrant and resilient coastal communities through research, extension, and education efforts that improve coastal community recognition of environmental and economic sustainability.

Sustainable Fisheries and Aquaculture

Research and outreach that catalyze new product innovations to keep the domestic seafood industry financially competitive and environmentally responsible. Development of protocols and training for innovative food safety procedures that reduce risk and enhance consumer knowledge about seafood. Specific areas of interest to Delaware Sea Grant include:

- ***Working to establish a safe, secure, and sustainable supply of seafood to meet public demand.***

- Research, development, and transfer of new technologies to enhance the competitiveness and environmental sustainability of the domestic seafood industry.
- Outreach activities that help develop and support a viable and sustainable domestic aquaculture industry.

- ***Working to inform consumers about the health benefits of seafood consumption and teach them how to evaluate the safety and sustainability of the seafood they buy.***
  - Applied research that facilitates the development of new products and innovative educational approaches to increase seafood availability and consumption by the public.
  - Development of partnerships that enhance training within the industry related to seafood safety best practices.
  - Work with partners to develop educational programs that inform consumers about the benefits of seafood consumption, safe seafood handling practices, and the importance of sustainable harvesting practices to the health of the domestic fisheries.

The broad outcomes of Delaware Sea Grant efforts in this focus area are to ensure contributions to innovative technologies around seafood handling and to enhance consumer knowledge about safe and sustainable seafood.

Environmental Literacy and Workforce Development

The complexity of high-priority marine issues calls for an educated public that can understand the link between science and society and the need for an integrated approach between science and policy. Specific areas of interest to Delaware Sea Grant include:

- ***An environmentally literate public supported and informed by a continuum of lifelong formal and informal engagement opportunities.***
  - Build and sustain outreach capacity to use science-based information in the following areas:
    - Recreation and tourism
    - K–12 education
    - Watershed management and coastal ecosystems health
    - Coastal processes and climate adaptation
    - Safe and sustainable seafood practices
    - Sustainable coastal communities
    - Fisheries and aquaculture
  - Partnerships with federal, state, and industry partners that leverage information and funding.
  - An education and communications component that contributes to a well-informed public. This involves:
    - Partnerships that support programs and training opportunities for educators involved in formal (K–12) and informal (museums, aquaria, nature centers, etc.) education.
    - Development of products/programs that take advantage of current and emerging technologies that can be used by formal and informal educators.
  - Developing a future workforce reflecting the culture of Sea Grant with individuals skilled in science, technology, engineering, mathematics, and active stewardship programs.
    - A robust connection to graduate education/training.

Delaware Sea Grant will continue to support a variety of outreach and education efforts to ensure increased public knowledge of our unique coastal environment, understanding of individuals' roles in its protection, and recognition of the importance of their participation in dialogues to plan for a sustainable future.

Effectively Integrating and Assessing Program Components

This strategic plan includes an implementation plan that is designed to maximize impact. The goal is to formally identify how the components of the Delaware Sea Grant Strategic Plan are to be integrated and executed within the context of the National Sea Grant priorities. The implementation plan articulates expected Delaware Sea Grant outcomes and measurable objectives. Then, the performance measures and targets define how we evaluate and measure program success. Outreach and education are integral components of the implementation plan. The formal and informal reporting of the results to program, state, and national decision makers is key to the process. Assessment criteria include those that are standard for university-based research excellence and—because Sea Grant research is programmatic and application-oriented—it also includes evidence of societal benefits in the form of external collaborations, technology transfer, and other impacts as follows:

Delaware Sea Grant Assessment Standards for Research Excellence

- Quality of research publications as evidenced by the selected journals' impact factor and, over time, by the number of times the article are cited.
- Quantity of research publications in refereed journals and/or patent applications.
- External support from other competitive funding sources for additional research projects related to the Delaware Sea Grant-sponsored research.
- Awards and prizes resulting from Delaware Sea Grant-sponsored research.
- Invited lectures, presentations, and program reviews at other institutions or conferences.
- Involvement of distinguished faculty in Delaware Sea Grant research.
- Timely progress and degree completion by students associated with Delaware Sea Grant research.
- Career placement of Delaware Sea Grant-supported students.

Delaware Sea Grant Assessment Standards for Societal Impact and Benefit

- Interactions and partnerships with appropriate user groups and translation of science findings into practical applications or management strategies.
- Adoption by appropriate end users of predictive modeling tools and new environmental technologies such as sensors and probes.
- Funding of research project scale-up into demonstration or pilot-scale operations.
- Licensing of patents.
- Documentation of generation of economic benefit; that is, new wealth or cost avoidance by end users.
- Legislation, new management strategies, and regulations based on research findings.
- Independent recognition (awards) for effective outreach, education, and communication practices.

Summary

Delaware Sea Grant's 2014–2017 Strategic Plan renews our commitment to providing sound scientific information and policy analysis to address issues related to our coast and coastal economies. Our goals pursue answers to short- and long-term challenges that face the citizens, agencies, and officials of Delaware and the surrounding region, while our Implementation Plan (below) provides detailed outcomes and targets for tracking our progress and measuring results. Delaware Sea Grant is ready to continue our work to provide "science serving the Delaware coast."

Delaware Sea Grant Implementation Plan

Healthy Coastal Ecosystems

National Goals	National Outcomes	DESG Program Goals	DESG Outcomes	DESG Targets	DESG Comments	National Performance Measures
Ecosystem services are improved by enhanced health, diversity and abundance of fish, wildlife and plants.	**Learning Outcomes** 1. Develop and calibrate new standards, measures and indicators of ecosystem sustainability. 2. Identify critical uncertainties that impede progress toward achieving sustainability of ecosystems and the goods and services they provide. **Action Outcomes** 1. Resource managers, policy and decision makers use standards and indicators to support ecosystem-based management. **Consequence Outcomes** 1. Dynamic ecological systems provide a wide range of ecological, economic and societal services and are more resilient to change. 2. Greater public stewardship leads to participatory decision making and collaborative ecosystem based management decisions.	**1.** Understanding of the impact of changing land use on water quality is improved through the use of new tools, technology and information services.	**1.** Community planners benefit from using tools developed by DESG to help manage water quality impacts in local communities. (National Outcomes: Action 1)	**1.** 3 New tools, technologies, information services	**1.** Coastal water quality identified most frequently by strategic planning survey respondents as an issue important to them; adapted from the Mid-Atlantic Regional Ocean Research Plan priority item for water quality/ecosystem research.	(1) Number of Sea Grant tools, technologies and information services that are used by our partners/customers to improve ecosystem-based management. **Total DESG Targets for Performance Measure: 8** (2) Number of ecosystem-based approaches used to manage land, water and living resources in coastal areas as a result of Sea Grant activities. **Total DESG Targets for Performance Measure: 5** (3) Number of acres of coastal habitat protected, enhanced or restored as a result of Sea Grant activities. **Total DESG Targets for Performance Measure: 0**
		2. Regional ecosystem sustainability is improved through data developed by DESG researchers.	**2.** Data obtained through regional ocean observing systems by DESG researchers assist in improving ecosystem sustainability. (National Outcomes: Learning 2)	**2.** 2 ocean observing systems	**2.** Continue DESG leadership in development and application of observing systems to support resource management; research proposals will be solicited in the 2 two-year RFP cycles, reviewed for applicability, and funding will be competitively awarded.	
		3. Innovative technologies lead to improved assessments of sediment transport, long-term coastal morphology, beach nourishment options and sea level rise.	**3.** Data provided by DESG provides resource managers with a better understanding of physical processes relative to sea level rise. (National Outcomes: Learning 2)	**3.** 3 sets of data utilized by resource managers	**3.** Alternatives for coastline management were identified in stakeholder surveys as a primary concern; DESG seeks to provide fundamental research that will inform active efforts by state resource managers to respond to and plan for accelerated sea level rise.	

Healthy Coastal Ecosystems

National Goals	National Outcomes	DESG Program Goals	DESG Outcomes	DESG Targets	DESG Comments	National Performance Measures
Ecosystem-based approaches are used to manage land, water and living resources.	**Learning Outcomes** 1. Stakeholders have access to data, models, policy information and training that support ecosystem based planning, decision-making and management approaches. 2. Baseline data, standards, methodologies and indicators are developed to assess the health of ecosystems and watersheds. 3. Residents, resource managers, businesses and industries understand the effects of human activities and environmental changes on coastal resources. 4. Resource managers have an understanding of the policies that apply to coastal protected species. **Action Outcomes** 1. Methodologies are used to evaluate a range of practical ecosystem-based management approaches for planning and adapt to future management needs. 2. Resource managers apply ecosystem-based management principles when making decisions. 3. Resource managers incorporate laws and policies to facilitate and implement ecosystem-based management. 4. Residents, resource managers and businesses integrate social, natural and physical science when managing resources and work with all sectors in the decision-making process. **Consequence Outcomes** 1. Land, water and living resources are managed using ecosystem-based approaches.	**1.** A network of trained citizen scientists increases the capacity of coastal DE monitoring efforts.	**1a.** Communities are aware of the impact of human activities on water quality/supply. (National Outcomes: Learning 3)	**1a.** Maintain current frequency of ocean bacteria sampling and HAB monitoring (maintain NRDC 5-Star criteria for ocean beaches)	**1a.** Prior DESG support has led to top NRDC rating of two state beaches for two consecutive years.	
			1b. Resource managers use citizen science data to support ecosystem-based management. (National Outcomes: Action 2)	**1b.** Maintain network of 40 citizen scientists and sites in DE coastal watersheds		
			1c. Public health and resource management decision making improves because of DESG collaboration. (National Outcomes: Action 1)	**1c.** 2 meetings with citizen scientists and resource managers for data exchange and discussion		
			1d. Citizen scientists understand the complexities of coastal environments and the interactions between human use and coastal ecosystem health. (National Outcomes: Learning 3)	**1d.** 2 public presentations by citizen scientists		
		2. Development of new research tools and practices to improve water quality monitoring efforts is supported.	**2.** Resource managers benefit from new research tools and practices developed by DESG. (National Outcomes: Learning 2)	**2.** 10 resource managers or volunteers trained with new tools or practices	**2.** Continue to seek proposals to improve the efficiency, effectiveness and availability of water quality monitoring; water quality consistently identified in stakeholder and regional planning efforts as a primary concern.	
		3. Stakeholders are provided with data to support long-term coastline management and sea level rise mitigation efforts.	**3.** Stakeholders use data provided by DESG researchers to understand impacts of sea level rise. (National Outcomes: Learning 1, 3)	**3.** 10 stakeholders	**3.** DESG will extend research (prior and new) to provide data on physical coastal processes in support of community discussions for mitigation and adaptation initiatives.	

Delaware Sea Grant Implementation Plan

Healthy Coastal Ecosystems

National Goals	National Outcomes	DESG Program Goals	DESG Outcomes	DESG Targets	DESG Comments	National Performance Measures
Ecosystems and their habitats are protected, enhanced or restored.	**Learning Outcomes** 1. Residents, resource managers and businesses understand the importance of the benefits provided by preserving non-degraded ecosystems. 2. Residents, resource managers and businesses understand the threats to ecosystems and the consequences of degraded ecosystems. 3. Scientists develop technologies and approaches to restore degraded ecosystems. **Action Outcomes** 1. Resource managers set realistic and prioritized goals to protect, enhance and restore habitats by incorporating scientific information and public input. 2. Resource managers, businesses and residents adopt innovative approaches and technologies to maintain or improve the function of ecosystems. **Consequence Outcomes** 1. Habitats are protected, enhanced or restored. 2. Degraded ecosystem function and productivity are restored.	**1.** Improved understanding of ecosystem processes in Delaware and the surrounding region is supported.	**1.** Ecosystem research is communicated to resource managers and improves understanding of ecosystem processes. (National Outcomes: Learning 3; Action 1)	**1.** 5 resource managers	**1.** Adapted from the Mid-Atlantic Regional Ocean Research Plan highest priority research items.	
		2. Low Impact Development (LID) techniques in coastal watersheds are increasingly applied, in collaboration with local partners. (See also in Resilient Communities and Economies)	**2a.** Communities are aware of the impact of human activities on water quality and supply. (National Outcomes: Learning 2) **2b.** Improve ecosystem service functions in coastal watersheds (National Outcomes: Consequence 2)	**2.** 3 LID projects in coastal communities/ year		
		3. Improved knowledge of natural oyster recruitment in Indian River Bay is demonstrated.	**3.** Resource managers and others become aware that oyster stocks are reproducing naturally in Indian River Bay. (National Outcomes: Learning 3, Action 2)	**3.** 3 resource managers	**3.** Successful oyster gardening efforts in bays, led by DESG, have resulted in recruitment of oyster populations in recent years.	
		4. Technical support and guidance improve aquaculture practices and enhance opportunities for new efforts.	**4.** Delaware Center for the Inland Bays oyster gardeners benefit from enhanced guidance and direction from DESG staff. (National Outcomes: Learning 1)	**4.** 40 oyster gardeners		

Resilient Communities and Economies

National Goals	National Outcomes	DESG Program Goals	DESG Outcomes	DESG Targets	DESG Comments	National Performance Measures
Development of vibrant and resilient coastal economies.	**Learning Outcomes** 1. Communities are aware of the interdependence between the health of the economy and the health of natural and cultural systems. 2. Communities have access to information needed to understand the value of waterfront- and tourism-related economic activities. 3. Communities understand the strengths and weaknesses of alternative development scenarios on resource consumption and local economies. 4. Communities are aware of regulatory regimes affecting economic sustainability. 5. Communities are knowledgeable about economic savings from energy planning and conservation. **Action Outcomes** 1. Citizens are actively engaged in management and regulatory decisions.	**1.** Economic growth in coastal communities is stimulated through partnerships with various agencies and organizations.	**1.** Tools and techniques to encourage economic stimulus in DE coastal communities are provided. (National Outcomes: Learning 1, 2, 3, 4)	**1.** 3 communities		(1) Number of communities that implemented sustainable economic and environmental development practices and policies (e.g. land-use planning, working waterfronts, energy efficiency, climate change planning, smart growth measures, green infrastructure) as a result of Sea Grant activities. **Total DESG Targets for Performance Measure: 31** (2) Number of communities that implemented hazards resiliency practices to prepare for, respond to or minimize coastal hazardous events as a result of Sea Grant activities. **Total DESG Targets for Performance Measure: 16**
		2. Leadership is provided regionally and nationally on a sustainable coastal tourism initiative.	**2.** Sea Grant programs nationally create stronger network to address coastal tourism opportunities in coastal communities. (National Outcomes: Learning 2)	**2.** 10 Sea Grant programs	**2.** DESG provided leadership in developing a sustainable coastal tourism policy white paper which outlines a number of future goals and recommendations.	
		3. Development of a "Sustainable Tourism Framework" for coastal Delaware through collaborations with local tourism and business leaders is supported.	**3.** Coastal communities become aware of techniques for developing and promoting sustainable tourism activities. (National Outcomes: Learning 2)	**3.** 3 coastal communities		
		4. Development of marketing/ branding strategies to enhance economic development and employment opportunities in waterfront communities is completed.	**4.** Waterfront communities have strategies and techniques for enhancing economic development efforts. (National Outcomes: Learning 2; Action 2)	**4.** 2 communities	**4.** DESG has initiated a working waterfronts program as part of the Sustainable Coastal Communities Initiative.	
		5. Development of a "coastal economic barometer" to assist community leader and private sector business recognition of the contributions of various sectors to the coastal economy is completed.	**5.** Community leaders and coastal businesses better understand economic trends and contributions of various sectors of local coastal economy to improve decision making. (National Outcomes: Learning 2)	**5.** Create 1 web-based tool	**5.** The economic barometer will be a follow-up tool based on findings reported in a recent DESG report, "The Contribution of the Coastal Economy to the State of Delaware."	
		6. Improved understanding of environmental conditions, environmental data for living resources and physical environments (mapping, extreme events, climate change scenarios) necessary for offshore energy development is supported.	**6.** Research and technical support increase understanding of important environmental parameters necessary for refining siting plans for offshore energy development. (National Outcomes: Learning 1, 2, 3, 5)	**6.** 2 datasets	**6.** Adapted from the Mid-Atlantic Regional Ocean Research Plan's highest priority for offshore energy research.	

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Delaware Sea Grant Implementation Plan

Resilient Communities and Economies

National Goals	National Outcomes	DESG Program Goals	DESG Outcomes	DESG Targets	DESG Comments	National Performance Measures
Continues from previous page. Development of vibrant and resilient coastal economies.	2. Communities engage in economic development initiatives that capitalize on the value of their natural and cultural resources while balancing resource conservation and economic growth. **Consequence Outcomes** 1. Communities have diverse, healthy economies and industries without displacing traditional working waterfronts.	**7.** Improved data on current and future offshore sectoral needs is provided to support marine spatial planning efforts through partnerships with state and regional organizations.	**7.** State and regional organizations are informed by datasets and reports with improved data on competing and anticipated uses of coastal waters. (National Outcomes: Learning 1)	**7.** 3 datasets or reports	**7.** Continue to develop DESG research support of regional spatial planning efforts.	
		8. Understanding of the socioeconomic impacts of offshore energy development (including jobs, energy costs, infrastructure needs/impacts) is improved.	**8.** Communities understand how offshore energy development can affect them at multiple scales—local, regional and national. (National Outcomes: Learning 3, 5, Action 1)	**8.** 3 communities	**8.** Adapted from the Mid-Atlantic Regional Ocean Research Plan's highest priority for offshore energy research.	

National Goals	National Outcomes	DESG Program Goals	DESG Outcomes	DESG Targets	DESG Comments	National Performance Measures
Communities use comprehensive planning to make informed strategic decisions.	**Learning Outcomes** 1. Communities understand the connection between planning and natural resource management issues and make management decisions that minimize conflicts, improve resource conservation efforts and identify potential opportunities. **Action Outcomes** 1. Communities make use of tools and information to explore the different patterns of coastal development, including community visioning exercises, resource inventories and coastal planning. 2. Communities adopt coastal plans. 3. The public, leaders and businesses work together to implement plans for the future and to balance multiple uses of coastal areas. **Consequence Outcomes** 1. Quality of life in communities, as measured by economic and social well-being, improves without adversely affecting the environmental conditions.	**1.** Sustainable development plans with coastal communities increase in recognition and abundance.	**1.** Communities understand the importance of planning for a sustainable future. (National Outcomes: Action 1)	**1.** 5 communities	**1.** DESG has been actively engaging citizens and community leaders in sustainable planning efforts.	
		2. Local officials are better able to support sustainable development practices in coastal communities.	**2.** Tools and techniques developed by DESG assist local officials in community planning exercises. (National Outcomes: Learning 1)	**2.** 3 coastal communities	**2.** DESG and partners have developed a GIS-based land-use model for Sussex County.	

Resilient Communities and Economies

National Goals	National Outcomes	DESG Program Goals	DESG Outcomes	DESG Targets	DESG Comments	National Performance Measures
Improvements in coastal water resources sustain human health and ecosystem services.	**Learning Outcomes** 1. Communities are aware of the impact of human activities on water quality and supply. 2. Communities understand the value of clean water, adequate supplies and healthy watersheds. 3. Communities understand water laws and policies affecting the use and allocation of water resources. **Action Outcomes** 1. Communities engage in planning efforts to protect water supplies and improve water quality. 2. Communities adopt mitigation measures, best management practices and improved site designs in local policies and ordinances to address water supplies and water quality. **Consequence Outcomes** 1. Water supplies are protected. 2. Water quality improves.	**1.** Strategies and techniques for improving water quality in coastal communities are enhanced. (See also in Healthy Coastal Ecosystems)	**1.** Communities adopt low impact development (LID) strategies to improve coastal water quality. (National Outcomes: Learning 1, 2; Action 1, 2)	**1.** 3 communities		
		2. Socioeconomic research explores and improves understanding of the value of ecosystem services, including water quality, habitat, human health and mitigation of the effects of climate change.	**2.** Socioeconomic research results provide information to resource managers to assist in decisions related to climate change impacts. (National Outcomes: Learning 2)	**2.** 4 resource managers	**2.** Adapted from the Mid-Atlantic Regional Ocean Research Plan's highest priority for offshore energy research.	

Delaware Sea Grant Implementation Plan

Resilient Communities and Economies

National Goals	National Outcomes	DESG Program Goals	DESG Outcomes	DESG Targets	DESG Comments	National Performance Measures
Resilient coastal communities adapt to the impacts of hazards and climate change.	**Learning Outcomes** 1. Residents and decision makers are aware of and understand the processes that produce hazards and climate change and the implications of those processes for them and their communities. 2. Decision makers are aware of existing and available hazard- and climate-related data and resources and have access to information and skills to assess local risk vulnerability. 3. Communities have access to data and innovative and adaptive tools and techniques to minimize the potential negative impact from hazards. 4. Decision makers understand the legal and regulatory regimes affecting adaptation to climate change, including coastal and riparian property rights, disaster relief and insurance issues. **Action Outcomes** 1. Communities apply best available hazards and climate change information, tools and technologies in the planning process. 2. Decision makers apply data, guidance, policies and regulations to hazard planning and recovery efforts. 3. Communities develop and adopt comprehensive hazard mitigation and adaptation strategies suited to local needs. 4. Residents take action to reduce the impact of coastal hazards on their life and property. 5. Communities adopt a comprehensive risk communications strategy for hazardous events. **Consequence Outcomes** 1. Communities effectively prepare for hazardous events and climate change. 2. Communities are resilient and experience minimum disruption to life and economy following hazard events.	**1.** Educational programs are developed—targeted to various coastal audiences—to inform about of hazards and risks associated with living along the coast.	**1.** Targeted audiences (homeowners, businesses, etc.) understand the hazards and risks associated with living along the coast. (National Outcomes: Learning 1)	**1.** 15 educational briefings, seminars and workshops		
		2. Coastal communities review comprehensive planning documents and improve hazard mitigation strategies.	**2.** Local officials receive scientific and technical support for the incorporation of hazard mitigation strategies into community comprehensive plans. (National Outcomes: Action 3	**2.** 3 coastal communities	**2.** Approach will be modeled after two successful efforts with coastal communities in DE.	
		3. Science-based data and education/outreach to coastal communities minimizes injury from surf zone hazards, including rip currents and shore break.	**3.** Local beach patrols and community officials use science-based results to minimize surf zone injuries. (National Outcomes: Action 4)	**3.** 5 coastal communities	**3.** Data collection is ongoing with support from local beach patrols and local medical center emergency personnel.	
		4. Local officials' knowledge and awareness of flood hazard BMPs are increased.	**4.** Local officials incorporate BMPs to minimize flood-related impacts and help reduce insurance premiums. (National Outcomes: Learning 4)	**4.** 3 coastal communities		
		5. Improved communication, collaboration and resource-sharing among coastal communities, local decision makers and coastal resource managers improves planning for long-term resilience.	**5.** Community leaders and decision makers benefit from improved communications, collaboration and resource-sharing in planning for long-term resilience within their communities via online networking sites. (National Outcomes: Learning 3; Action 5)	**5.** 10 coastal communities		
		6. Research necessary to aid extension work to improve resiliency in coastal communities is supported.	**6.** Communities gain an understanding of the science and engineering research that supports effective coastal resiliency planning. (National Outcomes: Learning 1)	**6.** 3 communities	**6.** Proposals will be invited through the two 2-year RFPs during this strategic planning period and awarded funding pending review for support of coastal resiliency outreach and technical merit.	

Sustainable Fisheries and Aquaculture

National Goals	National Outcomes	DESG Program Goals	DESG Outcomes	DESG Targets	DESG Comments	National Performance Measures
A safe, secure and sustainable supply of seafood to meet public demand.	**Learning Outcomes** 1. Fishery managers and fishermen understand the dynamics of wild fish populations. 2. The seafood industry is knowledgeable about innovative technologies, approaches and policies. 3. Commercial and recreational fishermen are knowledgeable about efficient and responsible fishing techniques. 4. The commercial fishing industry is aware of innovative marketing strategies to add value to its product. 5. The seafood processing industry learns and understands economically viable techniques and processes to ensure the production and delivery of safe and healthy seafood. **Action Outcomes** 1. Fishermen employ efficient fishing techniques, including bycatch reduction. 2. Fishermen apply techniques to reduce negative impacts on depleted, threatened or endangered species. 3. The seafood industry adopts innovative technologies and approaches to supply safe and sustainable seafood.	**1.** Development of a viable commercial aquaculture industry in DE is supported.	**1a.** State officials and community members receive research results and technical information to enhance their knowledge of the potential impacts of aquaculture development in Delaware. (National Outcomes: Learning 2; Consequence 2)	**1a.** 10 educational briefings, seminars, workshops	**1.** Ongoing efforts by DESG and other organizations are attempting to stimulate aquaculture production in DE waters.	(1) Number of fishermen, seafood processors and aquaculture industry personnel who modify their practices using knowledge gained in fisheries sustainability and seafood safety as a result of Sea Grant activities. **Total DESG Targets for Performance Measure: 210** (2) Number of seafood consumers who modify their purchases using knowledge gained in fisheries sustainability, seafood safety and the health benefits of seafood as a result of Sea Grant activities. **Total DESG Targets for Performance Measure: 350**
			1b. Information about aquaculture in DE and the Mid-Atlantic region will be accessible through the DE Aquaculture Resource Center Website. (National Outcomes: Learning 2; Action 4, 5)	**1b.** 10,000 website visitors/year		
		2. Seafood processors are trained and educated in DE and the region on FDA Seafood HACCP regulations.	**2.** Seafood processors in DE and the region are able to meet requirements of FDA Seafood HACCP regulations. (National Outcomes: Learning 5; Action 3)	**2.** 50 seafood processors		
		3. National Seafood HACCP Alliance Train-the-Trainer materials for the Sanitation Control Procedures (SCP) Course are revised and updated.	**3.** SCP materials are revised and used in course training. (National Outcomes: Learning 2, 5)	**3.** SCP materials are revised and 25 trainers are certified	**3.** DESG is recognized as a national leader in assisting FDA with seafood HACCP training and education.	
		4. Seafood processors are trained on Sanitation Control Procedures (SCP) allowing them to meet the FDA requirements for the 8 key sanitation conditions.	**4.** DE and other U.S. seafood processors are educated on using updated and revised training materials. (National Outcomes: Learning 2,5)	**4.** 20 seafood processors		
		5. Development of a Seafood Marketing Council for seafood harvesters/wholesalers/retailers/restaurants in DE is explored.	**5.** Seafood industry in DE is organized to begin statewide marketing of products. (National Outcomes: Learning 4; Action 4)	**5.** One new council formed to support seafood industry marketing efforts	**5.** Seafood providers in DE have never benefited from have a statewide marketing council. This effort could provide benefits to both suppliers and consumers.	

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Delaware Sea Grant Implementation Plan

Sustainable Fisheries and Aquaculture

National Goals	National Outcomes	DESG Program Goals	DESG Outcomes	DESG Targets	DESG Comments	National Performance Measures
Continues from previous page. A safe, secure and sustainable supply of seafood to meet public demand.	4. The commercial fishing and aquaculture industries adopt innovative marketing strategies to add value to their products. 5. The seafood industry adopts techniques and approaches to minimize the environmental impact of their sectors. 6. Resource managers establish policies and regulations that achieve a better balance between economic benefit and conservation goals. 7. The seafood processing industry implements innovative techniques and processes to create new product forms and ensure the delivery of safe and healthy seafood. **Consequence Outcomes** 1. The U.S. seafood supply is sustainable and safe. 2. There is an expansion of the sustainable domestic fishing and aquaculture industries.	**6.** Spread of aquatic invasive species in DE waters is prevented.	**6.** Anglers, resource managers and bait/tackle shop businesses understand how to reduce threats to ecosystems from aquatic invasive species associated with the live baitworm industry. (National Outcomes: Learning 3; Action 5)	**6.** 2 workshops; engage 20 bait and tackle shop businesses	**6.** This effort builds on a Mid-Atlantic regional research/outreach project to minimize the spread of aquatic invasive species.	
		7. Awareness of methods and gear choices for growout and culture methods is increased among potential shellfish growers.	**7.** Prospective aquaculturists make informed choices about selecting suitable gear and methods for their lease location. (National Outcomes: Action 3)	**7.** 4 workshops and field demonstrations		
		8. Populations of natural oysters and other epifaunal bivalve species are inventoried and cataloged in Delaware's Inland Bays.	**8.** Resource managers improve ability to manage resource with knowledge of spatial distribution of bivalve species. (National Outcomes: Action 6)	**8.** 3 resource managers		

Sustainable Fisheries and Aquaculture

National Goals	National Outcomes	DESG Program Goals	DESG Outcomes	DESG Targets	DESG Comments	National Performance Measures
Informed consumers who understand the health benefits of seafood consumption and how to evaluate the safety and sustainability of the seafood they buy.	**Learning Outcomes** 1. The seafood industry is aware of the standards for safe seafood. 2. The seafood industry is knowledgeable about consumer trends regarding seafood sustainability and safety and how to adjust operations to meet emerging demands. 3. U.S. seafood consumers have the knowledge to evaluate sustainable seafood choices. 4. U.S. seafood consumers have an increased knowledge of the nutritional benefits of seafood products and know how to judge seafood safety and quality. **Action Outcomes** 1. The seafood industry adopts standards for safe seafood. 2. The seafood industry adopts technologies and techniques to ensure seafood safety. 3. U.S. seafood consumers preferentially purchase sustainable seafood products. **Consequence Outcomes** 1. Consumers improve their health through increased consumption of safe and sustainable seafood products. 2. The U.S. seafood industry operates sustainably and is economically viable.	**1.** Seafood consumers in DE are educated on the health benefits of seafood through outreach efforts.	1. Seafood consumers in DE have greater awareness of the health benefits of seafood. (National Outcomes: Learning 4)	**1.** 35 workshops/ seminars	**1.** DESG is the "go-to" organization in DE to provide this type of education for consumers.	
		2. A national survey of seafood consumers in DE and across the country is conducted to re-examine use and consumption trends since original work in 2007.	**2.** Updated information on seafood consumers is revealed and reported. (National Outcomes: Learning 2)	**2.** New Delaware Seafood Council is informed of results along with other seafood marketing groups throughout the U.S.	**2.** Trend data will help the seafood industry determine shifts in consumer attitudes and consumption patterns.	

Delaware Sea Grant Implementation Plan

Environmental Literacy and Workforce Development

National Goals	National Outcomes	DESG Program Goals	DESG Outcomes	DESG Targets	DESG Comments	National Performance Measures
An environmentally literate public supported and informed by a continuum of lifelong formal and informal engagement opportunities.	**Learning Outcomes** 1. Formal and informal educators are knowledgeable of the best available science on the effectiveness of environmental science education. 2. Formal and informal educators understand environmental literacy principles. 3. Lifelong learners are able to engage in informal science education opportunities focused on coastal topics. **Action Outcomes** 1. Engagement professionals use environmental literacy principles in their programs. 2. Engagement programs are developed and refined using the best available research on the effectiveness of environmental and science education. 3. Formal and informal education programs incorporate environmental literacy components. 4. Formal and informal education programs take advantage of the knowledge of Sea Grant-supported scientists and engagement professionals.	**1.** The ability and confidence of formal and informal educators to teach about coastal, ocean and climate change science is improved.	**1a.** Educators are more knowledgeable about coastal and ocean science topics and are able to confidently integrate the information into their curricula. (National Outcomes: Learning 1, 2)	**1a.** 30 educators	**1a.** Recently hired DESG educator is developing classroom lesson plans based on SG supported research.	(1) Number of Sea Grant facilitated curricula adopted by formal and informal educators. **Total DESG Targets for Performance Measure: 100** (2) Number of people engaged in Sea Grant supported informal education programs. **Total DESG Targets for Performance Measure: 30,000** (3) Number of Sea Grant-supported graduates who become employed in a career related to their degree within 2 years of graduation. **Total DESG Targets for Performance Measure: 10**
			1b. Educators receive training and technical support for incorporating climate change science into their classrooms. (National Outcomes: Learning 1, 2; Action 7)	**1b.** 50 educators	**1b.** In partnership with a 5-year NSF-funded climate change science education cooperative agreement for curriculum and professional development of DE and MD educators.	
			1c. High school teachers are trained in using aquaculture in the classroom as a method to augment biology, chemistry and physics curricula. (National Outcomes: Learning 1)	**1c.** 2 workshops annually	**1c.** High schools in DE, especially vocational/ technical high schools offer curricula in aquaculture methods.	
		2. Awareness of and access to marine and environmental information for targeted audiences, including informal student groups, particularly underserved and underrepresented youth, is improved.	**2a.** High school students will participate in Sea Grant TIDE summer program to learn about coastal and marine issues. (National Outcomes: Learning 1, 3; Action 4)	**2a.** 50 students		
			2b. Fulfill requests from educators and informal student group leaders for on-site science content and hands-on activity programs. (National Outcomes: Action 1)	**2b.** 30 programs		
			2c. Students and teachers utilize DESG publications. (National Outcomes: Learning 3)	**2c.** 200 unique publication requests		

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National Goals	National Outcomes	DESG Program Goals	DESG Outcomes	DESG Targets	DESG Comments	National Performance Measures
Continues from previous page. An environmentally literate public supported and informed by a continuum of lifelong formal and informal engagement opportunities.	5. Formal and informal educators, students and/or the public collect and use coastal weather data in inquiry and evidence-based activities. 6. Lifelong learners make choices and decisions based on information they learned through informal science education opportunities. 7. Educators work cooperatively to leverage federal, state and local investments in coastal environmental education. **Consequence Outcomes** 1. Members of the public incorporate broad understandings of their actions on the environment into personal decisions.		**2d.** Individuals download publications and other educational materials from DESG website. (National Outcomes: Action 3)	**2d.** 1,000 downloads		
			2e. Educational displays at UD Sharp Campus are used to inform visiting public and school groups about coastal/marine issues and research. (National Outcomes: Action 4)	**2e.** 5 displays created		
			2f. Educators seek DESG staff to present talks and lectures on coastal/marine topics at K-12 schools throughout the state. (National Outcomes: Action 4)	**2f.** 30 school presentations		
			2g. Schools virtually participate in a research cruise or other coastal/marine research activity via a DESG-developed "online expedition." (National Outcomes: Action 4,6)	**2g.** 1 "online expedition"		
			2h. Submit DESG-related articles for publication by University of Delaware-associated print and electronic publications. (National Outcomes: Action 4)	**2h.** 50 publications		
			2i. Public has opportunity to participate in public lectures developed in partnership by DESG and the University of Delaware, College of Earth, Ocean, and Environment. (National Outcomes: Learning 3; Action 4)	**2i.** 12 lectures	**2i.** Lewes Ocean Currents Lecture Series.	
		3. Increased understanding of role individuals can take to conserve and wisely use coastal, ocean and environmental resources is supported.	**3a.** Interested citizens and targeted audiences become informed on important coastal and environmental issues and actively work to conserve coastal/marine resources. (National Outcomes: Action 6; Consequence 1)	**3a.** 2 "Focus on the DE Coast" workshops/ year	**3a.** "Focus on the DE Coast" workshops are planned for targeted audiences with specific theme topics. Previous workshops have dealt with HABs, coastal groundwater and DE's coastal economy.	
			3b. Visitors have the opportunity to learn about coastal and environmental research at Coast Day. (National Outcomes: Learning 3; Action 4)	**3b.** 25,000 visitors		
			3c. Coast Day visitors completing evaluation surveys report that the event provided useful information. (National Outcomes: Learning 3; Action 4)	**3c.** 50 percent of visitors		
			3d. Public learns about DESG and its research, outreach and education activities through DESG's annual report to the public—*Sea Grant Reporter* (National Outcomes: Action 4)	**3d.** 20,000 issues		

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Delaware Sea Grant Implementation Plan

Environmental Literacy and Workforce Development

National Goals	National Outcomes	DESG Program Goals	DESG Outcomes	DESG Targets	DESG Comments	National Performance Measures
Continues from previous page. An environmentally literate public supported and informed by a continuum of lifelong formal and informal engagement opportunities.			**3e.** *Sea Grant Reporter* reader surveys indicate intent to act upon *Reporter* content. (National Outcomes: Action 4)	**3e.** 50 percent of respondents		
			3f. DESG website and social networking offerings provide useful information for viewers. (National Outcomes: Learning 3; Action 4)	**3f.** Accessed 500,000 times		
			3g. Radio stations download *SeaTalk* radio PSAs for broadcast. (National Outcomes: Learning 3; Action 4)	**3g.** 72 PSAs/ 30 stations		
			3h. Subscribers to DESG *At Sea* newsletter are informed about DESG activities and coastal and environmental issues. (National Outcomes: Action 4)	**3h.** 1000 subscribers/ 20 percent open rate		
			3i. Media covers DESG-related activities. (National Outcomes: Learning 3; Action 4)	**3i.** 150 news releases, video stories, information graphics; 300 media hits		
			3j. Communications industry recognizes the quality of DESG communications products. (National Outcomes: Learning 3; Action 4)	**3j.** 10 communication industry awards		
			3k. Community and public events throughout the state and region feature DESG outreach programming (non-Coast Day). (National Outcomes: Learning 3; Action 4)	**3k.** 10 events		
			3l. Installation of interpretive display describes/informs visiting public of Delaware Bay water quality monitoring efforts. (National Outcomes: Learning 3; Action 4)	**3l.** 1 display	**3l.** In collaboration with PI (J. Sharp) of research project R/HCE-7 currently being funded by DESG.	

Environmental Literacy and Workforce Development

National Goals	National Outcomes	DESG Program Goals	DESG Outcomes	DESG Targets	DESG Comments	National Performance Measures
A future workforce reflecting the diversity of Sea Grant programs, skilled in science, technology, engineering, mathematics and other disciplines critical to local, regional and national needs.	**Learning Outcomes** 1. Students and teachers are aware of opportunities to participate in science, technology, engineering, mathematics and active stewardship programs. **Action Outcomes** 1. A diverse and qualified pool of applicants pursues professional opportunities for career development in natural, physical and social sciences and engineering. 2. Graduate students are trained in research and engagement methodologies. 3. Research projects support undergraduate and graduate training in fields related to understanding and managing our coastal resources. **Consequence Outcomes** 1. A diverse workforce trained in science, technology, engineering, mathematics, law, policy or other job related fields is employed and have high job satisfaction.	**1.** Sea Grant funded graduate students are engaged in opportunities to become more knowledgeable and understanding of Sea Grant outreach and extension mission.	**1.** SG-funded students will participate in outreach and extension activities that supplement their research while building their practical experience and diversifying their suite of accomplishments. (National Outcomes: Learning 1; Action 2)	**1.** 30 students	**1.** Recommendation from Site Review Team (SRT) report was to provide additional opportunities to DESG-funded students to become more engaged with SG outreach and extension personnel.	
		2. Grade 6-16 students and teachers are provided with information on marine careers, with an emphasis on science, technology, engineering and math.	**2a.** Students and teachers are better informed about career opportunities in science, technology, engineering and math and how to pursue career paths through face-to-face presentations. (National Outcomes: Learning 1)	**2a.** 100 teachers/ students		
			2b. A dynamic website will deliver content-rich information on marine careers, including career profiles and an interactive decision tree. (National Outcomes: Action 3)	**2b.** 250 unique visitors		
		3. Opportunities are provided for Delaware students to learn about the coastal and marine environment and demonstrate their knowledge, while supporting teachers' need to meet state standards.	**3a.** Fifth-grade students demonstrate coastal and marine science content knowledge through the annual Coast Day essay contest, which meets state science and English/language arts standards. (National Outcomes: Learning 1)	**3a.** 150 students/ year		
			3b. Secondary students demonstrate coastal and marine science content knowledge through the Coast Day video contest, which allows students to explore new technologies. (National Outcomes: Learning 1)	**3b.** 50 students		
		4. Coursework and training is developed to support a food safety program at local community college.	**4.** Course training supported by DESG will help train future food industry workers. (National Outcomes: Action 1; Consequence 1)	**4.** 50 students		

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